



*Your Dreams Our Goal*  
**POORNIMA**  
**UNIVERSITY**

Member of Association of Indian Universities & Approved by UGC (Govt. of India) under 2(f) & 12(B)



# **FACULTY OF COMPUTER SCIENCE & ENGINEERING**

**B.Tech (Computer Science & Engineering)**

**SCHEME- SYLLABUS BOOKLET**

**BATCH 2025-2029**



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**FACULTY OF COMPUTER SCIENCE &  
ENGINEERING**  
**PROGRAM: B.Tech.(CSE)**

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**Disclaimer:** The scheme, syllabus and other materials published in this booklet may be changed or modified as per the requirement after approval of competent authority. The decision taken by the management of Poornima University will be final and abiding to all.



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## **Vision**

Our vision is to create knowledge based society with scientific temper, team spirit and dignity of labour to face global competitive challenges.

## **Mission**

Our mission is to evolve and develop skill based systems for effective delivery of knowledge so as to equip young professionals with dedication and commitment to excellence in all spheres of life.

## **Quality Policy**

To provide quality education through faculty development, updating of facilities and continual improvement for meeting norms laid down by the government, keeping the stakeholders satisfied. Poornima University has forged industrial alliances with Top MNC's worldwide which assures high educational standards, up to- date and forward-thinking curricula, and professional relevance. At Poornima University you will have a distinct advantage through exposure to the corporate standard environment through industry sponsored infrastructure and expert faculty. The University involves global industry leaders in many ways.



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## Knowledge Wheel

At Poornima, the academic atmosphere is a rare blend of modern technical as well as soft skills and traditional systems of learning processes.





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## **About Program and Program Outcomes (PO):**

**Title of the Programme:** Bachelor of Technology (B. Tech.)

**Nature of the Programme:** B. Tech. is four years full-time programme.

## **Program Outcomes (PO):**

**Engineering Graduates will be able to:**

**PO1: Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

**PO2: Problem analysis:** Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

**PO3: Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

**PO4: Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

**PO5: Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools prediction and modelling to complex engineering activities with an understanding of the limitations.

**PO6: The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

**PO7: Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable development.

**PO8: Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

**PO9: Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**PO10: Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and receive clear instructions.

**PO11: Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in team, to manage projects and in multidisciplinary environments.

**PO12: Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.



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## Program Specific Outcome (PSOs):

**PSO1:** The graduates are proficient in fundamental principles and methods of Computer Science, Mathematical and Scientific reasoning and are able to:

- a) Apply fundamental concepts of integration, differentiation, vector calculus, probability & statistics, and discrete mathematics.
- b) Design, create & evaluate algorithms and data structures appropriate to specific problems.

**PSO2:** The graduates possess in-depth knowledge of various components of hardware and system software. The students have thorough understanding:

- a) Architecture of computer system and functionality of various units.
- b) Role of operating system in managing the hardware units.
- c) Computer networks and security related issues.

**PSO3:** The graduates are competent in object oriented programming languages and possess basic knowledge of several other programming languages.

**PSO-4** - Ability to apply their skills in the field of database design and web & mobile application development.



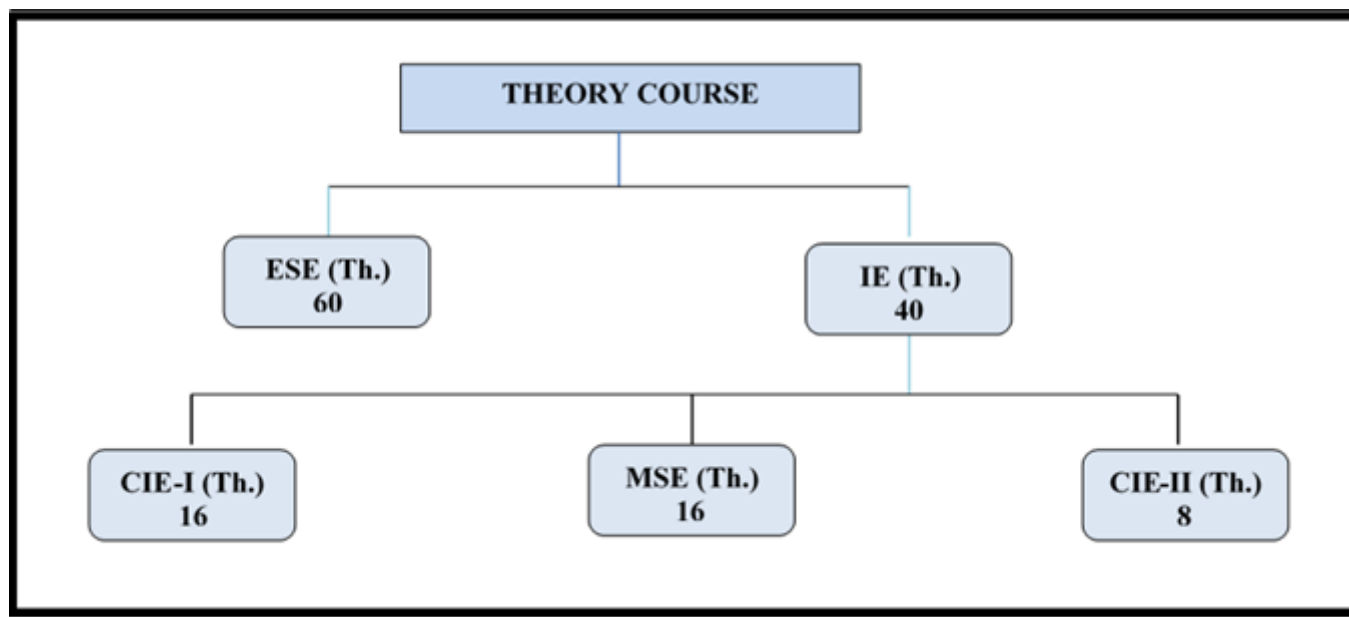
# POORNIMA UNIVERSITY

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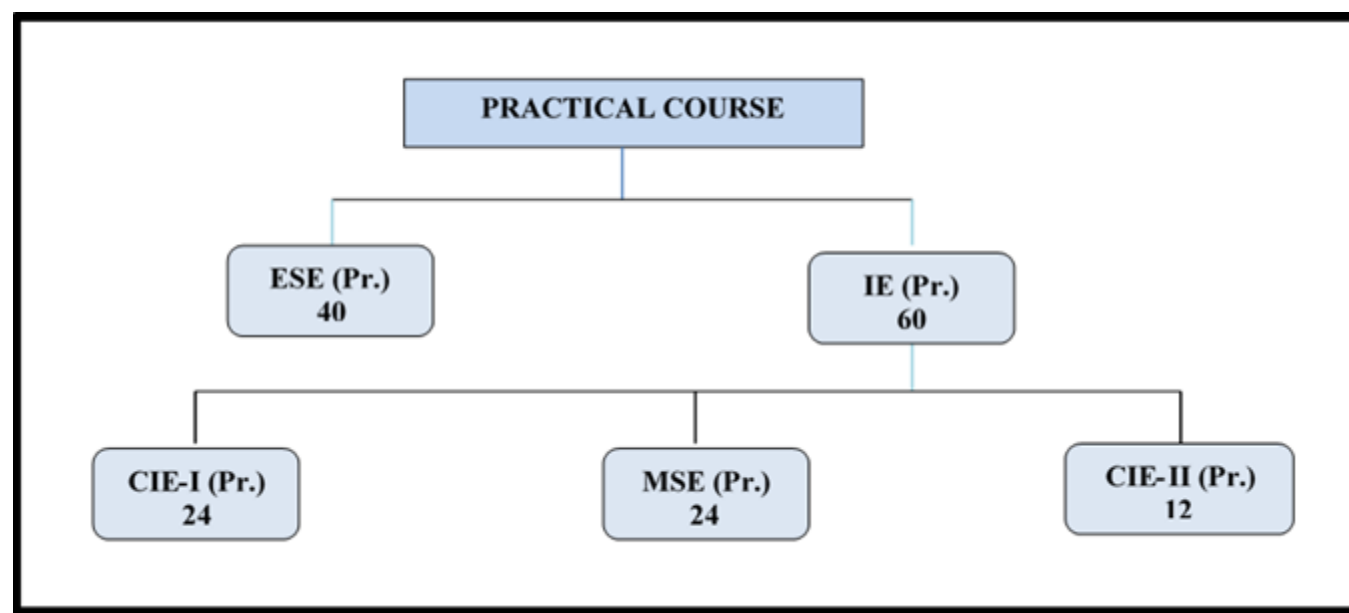
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## Examination System:

### A. Marks Distribution of Theory Course:



### B. Marks Distribution of Practical Course:



**Th.:** Theory, **Pr.:** Practical, **ESE:** End Semester Examination, **MSE:** Mid Semester Examination, **CIE:** Continuous Internal Evaluation.



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### CO Wise Marks Distribution:

<u>Exam Entity</u>	Theory Subject		Practical/ Studio Subject	
	Maximum Marks	CO to be Covered	CO to be Covered	Maximum Marks
<b>CIE-I</b>	16 ( 8 + 8)	1 & 2	1 & 2	24 (12 + 12)
<b>MSE</b>	16 ( 8 + 8)	3 & 4	3 & 4	24 (12 + 12)
<b>CIE-II (Activity/ Assignment )</b>	8 (8)	5	5	12 (12)
<b>ESE</b>	60	-	-	40
<b>TOTAL</b>	100	-	-	100

### Minimum Passing Percentage in All Exams:

S. No.	Program Name	Minimum Passing Percentage in		
		IE Component	ESE Component	Total Component
1	Course Work for PhD Registration	-	-	50%
2	B. Arch., FIRE Dept. ( BBA, B. Com., MBA)	-	45%	50%
3	MBA, MCA, M.Des., M.Tech., M.Plan, MHA, MPH	-	40%	40%
4	B. Tech., B. Des., BVA, BCA, B.Sc., BBA, B.Com., B.A. & any other program	-	35%	35%



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## SGPA Calculation

$$SGPA = \frac{C_1G_1 + C_2G_2 + \dots + C_nG_n}{C_1 + C_2 + \dots + C_n}$$

$$SGPA = \frac{\sum_i C_i \times G_i}{\sum_i C_i}$$

where (as per teaching scheme & syllabus):

$C_i$  is the number of credits of subject  $i$ ,

$G_i$  is the Grade Point for the subject  $i$  and  $i = 1$  to  $n$ ,

$n$  = number of subjects in a course in the semester

## CGPA Calculation

$$CGPA = \frac{C_1G_1 + C_2G_2 + \dots + C_nG_n}{C_1 + C_2 + \dots + C_n}$$

$$CGPA = \frac{\sum_i C_i \times G_i}{\sum_i C_i}$$

where (as per teaching scheme & syllabus):

$C_i$  is the number of credits of subject  $i$ ,

$G_i$  is the Grade Point for the subject  $i$  and  $i = 1$  to  $n$ ,

$n$  = number of subjects in a course of all the semesters up to which CGPA is computed



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**Grading Table:**

<b>Table-A</b> Applicable for B.Arch., FIRE Courses (BBA, B.Com, MBA), & Ph.D. Course Work
--

<b>Table-B</b> Applicable for All Courses except Table-A
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**\* Not applicable for master programs**

Academic Performance	Grade	Grade Point	Marks Range (in %)
Outstanding	O	10	$90 \leq x \leq 100$
Excellent	A+	9	$80 \leq x < 90$
Very Good	A	8	$70 \leq x < 80$
Good	B+	7	$60 \leq x < 70$
Above Average	B	6	$50 \leq x < 60$
Fail	F	0	$x < 50$
Absent	Ab	0	Absent

Academic Performance	Grade	Grade Point	Marks Range (in %)
Outstanding	O	10	$90 \leq x \leq 100$
Excellent	A+	9	$80 \leq x < 90$
Very Good	A	8	$70 \leq x < 80$
Good	B+	7	$60 \leq x < 70$
Above Average	B	6	$50 \leq x < 60$
Average	C	5	$40 \leq x < 50$
Pass*	P	4	$35 \leq x < 40$
Fail	F	0	$x < 35$
Absent	Ab	0	Absent

**CGPA to percentage conversion rule:**

**Equivalent % of Marks in the Program = CGPA \*10**

**Award of Class**

CGPA	Percentage	Equivalent Division
$7.50 \leq CGPA$	75% or more	First Division with Distinction
$6.00 \leq CGPA < 7.50$	$60\% \leq x < 75\%$	First Division
$5.00 \leq CGPA < 6.00$	$50\% \leq x < 60\%$	Second Division
$4.00 \leq CGPA < 5.00$	$40\% \leq x < 50\%$	Pass Class



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## **Guidelines for Massive Open Online Courses (MOOCs)**

**(Batch: 2025-29)**

Poornima University, in its never ending endeavor to equip students with best-of-class learning and knowledge, has undertaken to include MOOC courses as part of its credit scheme from session 2023-24 onwards. The objective behind this is to enable students to study courses designed by the best teachers in the country and to scale their knowledge base with the rest of learners from the nation. The MOOCs which are included under this scheme is can be chosen from SWAYAM-NPTEL.

### **1. Introduction of MOOCs: SWAYAM-NPTEL**

#### **About SWAYAM-NPTEL**

NPTEL (National Programme on Technology Enhanced Learning), is a joint venture of the IITs and IISc, funded by the Ministry of Education (MoE) Government of India, and was launched in 2003. Initially started as a project to take quality education to all corners of the country, NPTEL now offers close to 600+ courses for certification every semester in about 22 disciplines.

#### **Some highlights:**

- Largest online repository in the world of courses in engineering, basic sciences and selected humanities and management subjects
- YouTube channel for NPTEL – most subscribed educational channel, 1.3 billion views and 40+ lakhs subscribers
- More than 56000 hours of video content, transcribed and subtitled
- Most accessed library of peer-reviewed educational content in the world
- Translation of more than 12000 hrs of English transcripts in regional Indian languages

#### **NPTEL Online Certification:**

The objective of enabling students obtain certificates for courses is to make students employable in the industry or pursue a suitable higher education programme. Through an online portal, 4, 8, or 12-week online courses, typically on topics relevant to students in all years of higher education along with basic core courses in sciences and humanities with exposure to relevant tools and technologies, are being offered. Enrolment to and learning from these courses is free. Following these online courses, an in-person, proctored certification exam is conducted and a certificate is provided through the participating institutions and industry, as applicable.

Some statistics regarding the open online courses since March 2014 till Dec 2021

Completed courses: 3496;

Enrollments across courses: 1.58 CRORE +

Number of exam registrations: 15.1 LAKH +

All the statistics pertaining to completed courses are available at <https://beta.nptel.ac.in/courses>.

All courses are completely free to enroll and learn from. The certification exam is optional and comes at a fee of Rs 1000/course exam.

## **2. MOOCs at Poornima University:**

MOOCs envelops best in class teaching - learning processes along with meeting the requirements of various courses in terms of quality of teaching and evaluation system. To promote the MOOCs among students of Poornima University, it is decided to consider the credits earned through MOOCs.

### **(a) MOOCs as Credit Courses**

**(For this document, only those MOOCs will be considered which are available only on NPTEL platforms)**

- Credit and Non-credit SWAYAM-NPTEL MOOCs can be opted by anyone, anytime, anywhere and in any language. However, prior-permission of the University Authorities is mandatory if the credits are to be transferred to regular degree.
- As Open Elective (for batches entered till 2022) / Multidisciplinary Courses (for batches admitted from 2023-24 onwards): Open Elective (for batches entered till 2022) courses were available at University level in offline mode till 2022-23 for which relevant booklets were published. From session 2023-24, Multidisciplinary Courses are introduced in lieu of open elective courses as per NEP 2020. These courses carry 02 credits. These category/type of courses (similar/different) are available as MOOC courses on SWAYAM-NPTEL platform which are being introduced from session 2023-24 onwards for all the students. The respective Deans / HODs shall provide all the information to all the students pertaining to MOOCs as per details given below:
  1. Deans / HODs shall prepare a list of up to 10 appropriate MOOC courses (From NPTEL Only) of Minimum 02/03 credits each, well in advance (at-least 15 days prior to commencement of semester) and take approval from the Office of Dean, Academics / Pro-President, PU.
  2. After approval, the respective Deans / HODs shall circulate a notice to all their respective students so that they can select any one course from the list, the credits (only 02) of which will be counted against Open Elective/ Multidisciplinary courses pertaining to that particular semester.
  3. The tutor of the class shall monitor the progress (assignments, feedback, any problem etc.) on weekly basis and report to Head/Dean and provide the academic support to students as per requirement.

### **(b) Important points related to MOOCs at Poornima University**

- Only one MOOC shall be allowed in a particular semester for the purpose of credit transfer in the beginning.
- No attendance will be taken for MOOC courses.
- The method of assessments of MOOC such as assignments and examination are completely associated with that particular MOOC and no internal exam (IE component) will be conducted by the department as well as by the Examination Cell.
- The respective Dean / HOD must submit the detail of course i.e., code, name and credit of MOOC opted against that particular course in particular semester attached with highlighting in the related examination scheme of syllabus of that semester signed by BOS Convener / HoD and Dean of Faculty to the office of Pro-President before commencement of the classes.
- The center of examination for MOOCs will be finalized by SWAYAM-NPTEL. All the responsibility related to registration for MOOCs, timely submission of assignments, examinations etc. will be borne by the students only.
- NPTEL will award a certificate to all the students passing the examination.
- The list of registered students in MOOC along with name of course will be submitted to the Examination Cell by the Deans / HoDs before commencement of the classes.
- An ESE Exam of each said MOOC course will also be conducted by the University as per University norms.
- The award of marks/grading will be computed as given below:

Award of Marks/Grading	Remarks
1. 20% weightage taken from MOOC Certificate + 80% weightage taken from ESE Exam of Poornima University <b>OR</b> 2. 100% of weightage taken from MOOC Certificate  <b>Note:</b> The Higher Marks/Grades of the above two will be considered.	The Certificate of MOOC to be Submitted as per date notified by COE, Poornima University

- Any student who would not be able to clear/pass the said course, will be required to appear as a back exam candidate of the University as per PU norms. Students who have not passed the MOOC exam are required to register and participate in the next semester for either the same subject or a similar subject (Ensuring at least 60% of the syllabus matches with the back subject and also approved by respective Dean) offered through NPTEL.
- The scorecard and related certificate of MOOC along with a consolidated list of students with marks of assignment and final exam will be submitted to the examination cell by the concerned Dean / HOD for further process. It is also recommended that alteration/changes/scaling in marks obtained by the students in any MOOC will not be considered.
- The exam registration fee of MOOC up to Max. INR 1000/- will be reimbursed to the student only after successful completion of the course in first attempt and submission of the fee receipt, score-card and certificate of the MOOC to the concerned department within stipulated time after declaration of the results.
- There will be no provision of re-evaluation of MOOC.

**NOTE: This is to be noted that the procedure for getting approval from BOS, Faculty Board, Academic Council and BoM is to be followed as per regular process.**

**Attached Items:**

Ability Enhancement Courses	Annexure-1
Value Added Course Booklet	Annexure-2

**POORNIMA UNIVERSITY, JAIPUR**  
**Faculty of Computer Science and Engineering**  
**Faculty of Engineering and Technology**

**Name of Program: B.Tech. CSE**

**Duration: 4 Years**

**Total Credits: 173**

**Teaching Scheme for Batch 2025-29**

**Semester-I**

Course Code	Name of Course	Teaching Scheme			Marks Distribution			Credits
		Lecture (L)	Tutorial (T)	Practical (P)	IE	ESE	Total	
<b>A.</b>		<b>Major (Core Courses)</b>						
<b>A.1</b>	<b>Theory</b>							
BTXCSA1101/ BTXCSA1102	Engineering Physics / Engineering Chemistry	3	-	-	40	60	100	3
BTXCCE1103	Programming in C	3	-	-	40	60	100	3
BTXCCV1104 / BTXCEE1105	Basics of Civil Engineering / Basics of Electrical and Electronics Engineering	3	-	-	40	60	100	3
BTXCSA1106 / BTXCME1107	Engineering Mathematics / Basic of Mechanical Engineering	3	-	-	40	60	100	3
BTXCSA1108	Environmental Studies	2	-	-	40	60	100	2
<b>A.2</b>		<b>Practical</b>						
BTXCSA1201 / BTXCSA1202	Engineering Physics Lab / Engineering Chemistry lab	-	-	2	60	40	100	1
BTXCCE1203	Programming in C Lab	-	-	2	60	40	100	1
BTXCCV1204 / BTXCEE1205	Computer Aided Design (CADD) / Basics of Electrical and Electronics Engineering Lab	-	1	2	60	40	100	1
BTXCME1206 / BTXCME1207	Workshop Practice / Engineering Graphics	-	1	2	60	40	100	1
<b>B.</b>		<b>Minor Stream Courses/ Department Electives</b>						
<b>B.1</b>	<b>Theory</b>	-	-	-	-	-	-	-
<b>B.2</b>	<b>Practical</b>	-	-	-	-	-	-	-
<b>C</b>		<b>Multidisciplinary Courses</b>						
	-	-	-	-				
<b>D</b>		<b>Ability Enhancement Courses (AEC)</b>						
BEACHM1205	Applied English Communication Skills-I	-	-	2	60	40	100	1
<b>E</b>		<b>Skill Enhancement Courses (SEC)</b>						
BELCSE1201	Skill Enhancement Course-I	-	-	2	60	40	100	1
<b>F</b>		<b>Value Added Courses (VAC)</b>						
BUVCVD1202 <b>OR</b> BUVCVH1201/ BUVCVA1201/ BUVCVD1201	Exploratory Project <b>OR</b> Universal Human Values and Professional Ethics Lab / Performing Arts / Entrepreneurship	-	-	2	60	40	100	1
<b>G</b>		<b>Summer Internship / Research Project / Dissertation</b>						
<b>Total</b>		14	2	14				<b>21</b>
<b>Total Teaching Hours</b>		<b>30</b>						

**POORNIMA UNIVERSITY, JAIPUR**  
**Faculty of Computer Science and Engineering**

**Name of Program: B.Tech. CSE**

**Duration: 4 Years**

**Total Credits: 173**

**Teaching Scheme for Batch 2025-29**

**Semester-II**

Course Code	Name of Course	Teaching Scheme			Marks Distribution			Credits
		Lecture (L)	Tutorial (T)	Practical (P)	IE	ESE	Total	
<b>A.</b>	<b>Major (Core Courses)</b>							
<b>A.1</b>	<b>Theory</b>							
BTXCSEA2101 / BTXCSEA2102	Engineering Physics / Engineering Chemistry	3	-	-	40	60	100	3
BTXCCE2103	Introduction to Web Technology	3	-	-	40	60	100	3
BTXCCEV2105 / BTXCCEE2106	Basic of Civil Engineering / Basics of Electrical and Electronics Engineering	3	-	-	40	60	100	3
BTXCSEA2107 / BTXCME2108	Engineering Mathematics / Basic of Mechanical Engineering	3	-	-	40	60	100	3
<b>A.2</b>	<b>Practical</b>							
BTXCSEA2201 / BTXCSEA2202	Engineering Physics lab / Engineering Chemistry lab	-	-	2	60	40	100	1
BTXCCE2203	Introduction to Web Technology Lab	-	-	2	60	40	100	1
BTXCCEV2205 / BTXCCEE2206	Computer Aided Design (CADD)/ Basics of Electrical and Electronics Engineering Lab	-	-	2	60	40	100	1
BTXCME2207 / BTXCME2208	Workshop Practice / Engineering Graphics	-	-	2	60	40	100	1
<b>B.</b>	<b>Minor Stream Courses/ Department Electives</b>							
<b>B.1</b>	<b>Theory</b>							
	Professional Elective - I	2	-	-	40	60	100	2
<b>B.2</b>	<b>Practical</b>							
	Nil	-	-	-	-	-	-	-
<b>C</b>	<b>Multidisciplinary Courses</b>							
	MOOC Course-I	2	-	-	40	60	100	2
<b>D</b>	<b>Ability Enhancement Courses (AEC)</b>							
BEACHM2213	Quantitative & Verbal Aptitude Training-I	0	0	2	60	40	100	1
<b>E</b>	<b>Skill Enhancement Courses (SEC)</b>							
BELCSE2201	Skill Enhancement Course-II	-	-	2	60	40	100	1
<b>F</b>	<b>Value Added Courses (VAC)</b>							
BUVCVD2202 OR BUVCVH2201/ BUVCVA2201/ BUVCVD2201	Exploratory Project OR Universal Human Values and Professional Ethics Lab/ Performing Arts/ Entrepreneurship	-	-	2	60	40	100	1
<b>G</b>	<b>Summer Internship / Research Project / Dissertation</b>							
		-	-	-				
<b>Total</b>		16	0	14				<b>23</b>
<b>Total Teaching Hours</b>		<b>30</b>						

**POORNIMA UNIVERSITY, JAIPUR**  
**Faculty of Computer Science and Engineering**

**Name of Program: B.Tech. CSE**

**Duration: 4 Years**

**Total Credits: 173**

**Teaching Scheme for Batch 2025-29**

**Semester-III**

Course Code	Name of Course	Teaching Scheme			Marks Distribution			Credits
		Lecture (L)	Tutorial (T)	Practical (P)	IE	ESE	Total	
<b>A.</b>		<b>Major (Core Courses)</b>						
<b>A.1</b>	<b>Theory</b>							
BCECCE3101	Programming in Python	3	-	-	40	60	100	3
BCECCE3102	Data Structures and Algorithms	3	-	-	40	60	100	3
BCECCE3103	Operating System	3	-	-	40	60	100	3
BCECCE3104	Relational Database Management System	3	-	-	40	60	100	3
<b>A.2</b>	<b>Practical</b>							
BCECCE3201	Programming in Python Lab	-	-	2	60	40	100	1
BCECCE3202	Data Structure and Algorithms Lab	-	-	2	60	40	100	1
BCECCE3203	Operating System Lab	-	-	2	60	40	100	1
BCECCE3204	Relational Database Management System Lab	-	-	2	60	40	100	1
<b>B.</b>		<b>Minor Stream Courses/ Department Electives</b>						
<b>B.1</b>	<b>Theory</b>							
	Professional Elective – II	3	-	-	40	60	100	3
<b>B.2</b>	<b>Practical</b>							
	-							
<b>C</b>		<b>Multidisciplinary Courses</b>						
	MOOC Course-II	1	-	-	40	60	100	2
<b>D</b>		<b>Ability Enhancement Courses (AEC)</b>						
BEACHM3221	Quantitative And Verbal Aptitude Training-II	-	-	2	60	40	100	1
<b>E</b>		<b>Skill Enhancement Courses (SEC)</b>						
BELCSE3201	Skill Enhancement Course-III	-	-	2	60	40	100	1
<b>F</b>		<b>Value Added Courses (VAC)</b>						
BUVCVA3106	Introduction to Indian Knowledge System	2	-	-	40	60	100	2
<b>G</b>		<b>Summer Internship / Research Project / Dissertation</b>						
	-	-	-				-	
<b>Total</b>		18		12				<b>25</b>
<b>Total Teaching Hours</b>		<b>30</b>						

**POORNIMA UNIVERSITY, JAIPUR**  
Faculty of Computer Science and Engineering

Name of Program: B.Tech. CSE

Duration: 4 Years

Total Credits: 173

**Teaching Scheme for Batch 2025-29**

**Semester-IV**

Course Code	Name of Course	Teaching Scheme			Marks Distribution			Credits	
		Lecture (L)	Tutorial (T)	Practical (P)	IE	ESE	Total		
<b>A.</b>	<b>Major (Core Courses)</b>								
<b>A.1</b>	<b>Theory</b>								
BCECCE4101	Advance Data Structure	3	-	-	40	60	100	3	
BCECCE4102	OOPS With Java	3	-	-	40	60	100	3	
BCECCE4103	Discrete Mathematics Structure	3	-	-	40	60	100	3	
BCECCE4104	Computer Networks	3	-	-	40	60	100	3	
<b>A.2</b>	<b>Practical</b>								
BCECCE4201	Advance Data Structure Lab	-	-	2	60	40	100	1	
BCECCE4202	OOPS With Java Lab	-	-	2	60	40	100	1	
BCECCE4203	Data Visualization Lab	-	-	2	60	40	100	1	
<b>B.</b>	<b>Minor Stream Courses/ Department Electives</b>								
<b>B.1</b>	<b>Theory</b>								
	Professional Elective - III	3	-	-	40	60	100	3	
<b>B.2</b>	<b>Practical</b>								
	Professional Elective Lab - I	-	-	2	60	40	100	1	
<b>C</b>	<b>Multidisciplinary Courses</b>								
	MOOC Course-III	1	-	-	40	60	100	2	
<b>D</b>	<b>Ability Enhancement Courses (AEC)</b>								
<b>E</b>	<b>Skill Enhancement Courses (SEC)</b>								
BELCSE4201	Skill Enhancement Course-IV	-	-	4	60	40	100	2	
<b>F</b>	<b>Value Added Courses (VAC)</b>								
BUVCVD4102	Business Intelligence	2	-	-	40	60	100	2	
<b>G</b>	<b>Summer Internship / Research Project / Dissertation</b>								
	-	-	-				-		
<b>Total</b>		18	-	12				<b>25</b>	
<b>Total Teaching Hours</b>		<b>30</b>							

**POORNIMA UNIVERSITY, JAIPUR**  
Faculty of Computer Science and Engineering

Name of Program: B.Tech. CSE

Duration: 4 Years

Total Credits: 173

**Teaching Scheme for Batch 2025-29**

**Semester-V**

Course Code	Name of Course	Teaching Scheme			Marks Distribution			Credits
		Lecture (L)	Tutorial (T)	Practical (P)	IE	ESE	Total	
<b>A.</b>		<b>Major (Core Courses)</b>						
<b>A.1</b>	<b>Theory</b>							
BCECCE5101	Design & Analysis of Algorithms	3	-	-	40	60	100	3
BCECCE5102	Web Application Development with Spring Boot	3	-	-	40	60	100	3
BCECCE5103	Python Framework	3	-	-	40	60	100	3
<b>A.2</b>	<b>Practical</b>							
BCECCE5201	Design Analysis & Algorithms Lab using Java	-	-	2	60	40	100	1
BCECCE5202	Web Application Development with Spring Boot Lab	-	-	2	60	40	100	1
BCECCE5203	Python Framework Lab	-	-	2	60	40	100	1
<b>B.</b>		<b>Minor Stream Courses/ Department Electives</b>						
<b>B.1</b>	<b>Theory</b>							
	Professional Elective - IV	3	-	-	40	60	100	3
	Professional Elective - V	3	-	-	40	60	100	3
<b>B.2</b>	<b>Practical</b>							
	Professional Elective Lab - II	-	-	2	60	40	100	1
	Professional Elective Lab - III	-	-	2	60	40	100	1
<b>C</b>		<b>Multidisciplinary Courses</b>						
	MOOC Course-IV	1	-	-	40	60	100	2
<b>D</b>		<b>Ability Enhancement Courses (AEC)</b>						
<b>E</b>		<b>Skill Enhancement Courses (SEC)</b>						
BELCSE5201	Skill Enhancement Course - V	-	-	4	60	40	100	2
<b>F</b>		<b>Value Added Courses (VAC)</b>						
	-	-	-	-				
<b>G</b>		<b>Summer Internship / Research Project / Dissertation</b>						
	-	-	-	-				
<b>Total</b>		16	-	14				24
<b>Total Teaching Hours</b>		<b>30</b>						

**POORNIMA UNIVERSITY, JAIPUR**  
**Faculty of Computer Science and Engineering**

**Name of Program: B.Tech. CSE**

**Duration: 4 Years**

**Total Credits: 173**

**Teaching Scheme for Batch 2025-29**

**Semester-VI**

Course Code	Name of Course	Teaching Scheme			Marks Distribution			Credits	
		Lecture (L)	Tutorial (T)	Practical (P)	IE	ESE	Total		
<b>A.</b>	<b>Major (Core Courses)</b>								
<b>A.1</b>	<b>Theory</b>								
BCECCE6101	Information System Security	3	-	-	40	60	100	3	
BCECCE6102	Software Engineering	3	-	-	40	60	100	3	
BCECCE6103	NoSQL using Mongo DB	3	-	-	40	60	100	3	
<b>A.2</b>	<b>Practical</b>								
BCECCE6201	Software Engineering Lab	-	-	2	60	40	100	1	
BCECCE6202	No SQL using Mongo DB Lab	-	-	2	60	40	100	1	
<b>B.</b>	<b>Minor Stream Courses/ Department Electives</b>								
<b>B.1</b>	<b>Theory</b>								
	Professional Elective - VI	3	-	-	40	60	100	3	
	Professional Elective - VII	3	-	-	40	60	100	3	
<b>B.2</b>	<b>Practical</b>								
	Professional Elective Lab - IV	-	-	2	60	40	100	1	
	Professional Elective Lab - V	-	-	2	60	40	100	1	
<b>C</b>	<b>Multidisciplinary Courses</b>								
	MOOC Course-V	1	-	-	40	60	100	2	
<b>D</b>	<b>Ability Enhancement Courses (AEC)</b>								
BELCSE6201	Skill Enhancement Course-VI	-	-	4	60	40	100	2	
<b>F</b>	<b>Value Added Courses (VAC)</b>								
	-	-	-	-					
<b>G</b>	<b>Summer Internship / Research Project / Dissertation</b>								
BCECCE6401	Industrial Training Seminar-I	-	-	2	60	40	100	1	
<b>Total</b>		16	-	14				<b>24</b>	
<b>Total Teaching Hours</b>		<b>30</b>							

**POORNIMA UNIVERSITY, JAIPUR**  
Faculty of Computer Science and Engineering

Name of Program: B.Tech. CSE

Duration: 4 Years

Total Credits: 173

**Teaching Scheme for Batch 2025-29**

**Semester-VII**

Course Code	Name of Course	Teaching Scheme			Marks Distribution			Credits
		Lecture (L)	Tutorial (T)	Practical (P)	IE	ESE	Total	
<b>A.</b>		<b>Major (Core Courses)</b>						
<b>A.1</b>	<b>Theory</b>							
BCECCE7101	Big Data Analytics	3	-	-	40	60	100	3
BCECCE7102	Machine Learning for Image Classification	3			40	60	100	3
<b>A.2</b>	<b>Practical</b>							
BCECCE7201	Big Data Analytics Lab	-	-	2	60	40	100	1
BCECCE7202	UI/UX Lab	-	-	2	60	40	100	1
BCECCE7203	Competitive Programming	-	-	2	60	40	100	1
<b>B.</b>		<b>Minor Stream Courses/ Department Electives</b>						
<b>B.1</b>	<b>Theory</b>							
	Professional Elective - VIII	3	-	-	40	60	100	3
	Professional Elective - IX	3	-	-	40	60	100	3
<b>B.2</b>	<b>Practical</b>							
	Professional Elective Lab - VI	-	-	2	60	40	100	1
	Professional Elective Lab - VII	-	-	2	60	40	100	1
<b>C</b>		<b>Multidisciplinary Courses</b>						
	NIL							
<b>D</b>		<b>Ability Enhancement Courses (AEC)</b>						
BUACHM7239	Employability Skills	-	-	2	60	40	100	1
<b>E</b>		<b>Skill Enhancement Courses (SEC)</b>						
<b>F</b>		<b>Value Added Courses (VAC)</b>						
	-	-	-	-				
<b>G</b>		<b>Summer Internship / Research Project / Dissertation</b>						
BCECCE7301	Minor Project	-	-	4	60	40	100	2
BCECCE7401	Industrial Training Seminar-II			2	60	40	100	1
<b>Total</b>		12	-	18				<b>21</b>
<b>Total Teaching Hours</b>		<b>30</b>						

**POORNIMA UNIVERSITY, JAIPUR**  
Faculty of Computer Science and Engineering

Name of Program: B.Tech. CSE

Duration: 4 Years

Total Credits: 173

**Teaching Scheme for Batch 2025-29**

**Semester-VIII**

Course Code	Name of Course	Teaching Scheme			Marks Distribution			Credits
		Lecture (L)	Tutorial (T)	Practical (P)	IE	ESE	Total	
<b>A.</b>	<b>Major (Core Courses)</b>							
<b>A.1</b>	<b>Theory</b>							
	NIL							
<b>A.2</b>	<b>Practical</b>							
	NIL	-	-	-	-	-	-	-
<b>B.</b>	<b>Minor Stream Courses/ Department Electives</b>							
<b>B.1</b>	<b>Theory</b>							
	NIL	-	-	-	-	-	-	-
<b>B.2</b>	<b>Practical</b>							
	NIL	-	-	-	-	-	-	-
<b>C</b>	<b>Multidisciplinary Courses</b>							
	NIL	-	-	-	-	-	-	-
<b>D</b>	<b>Ability Enhancement Courses (AEC)</b>							
	NIL	-	-	-				
<b>E</b>	<b>Skill Enhancement Courses (SEC)</b>							
	NIL	-	-	-	-	-	-	-
<b>F</b>	<b>Value Added Courses (VAC)</b>							
	NIL	-	-	-	-	-	-	-
<b>G</b>	<b>Summer Internship / Research Project / Dissertation</b>							
BCECCE8301	Major Project			20	60	40	100	10
<b>Total</b>			-	20				<b>10</b>
<b>Total Teaching Hours</b>		<b>20</b>						

## PROFESSIONAL ELECTIVE THEORY COURSES (Batch: 2025-29)

	Professional Elective-I	Professional Elective-II	Professional Elective-III	Professional Elective-IV	Professional Elective-V	Professional Elective-VI	Professional Elective-VII	Professional Elective-VIII	Professional Elective-IX
<b>Computer Science &amp; Engineering</b>	BTXECE2111	BCEECE3111	BCEECE4111	BCEECE5111	BCEECE5112	BCEECE6111	BCEECE6112	BCEECE7111	BCEECE7112
	Introduction to Emerging Technology	Theory of Computation	Fundamentals of Machine Learning	Fundamental of Blockchain Technology	Mobile Application Development	IoT	Software Testing	ASP.Net	Cloud Computing
<b>Artificial Intelligence &amp; Data Science</b>	BTXECE2112	BADECE3111	BADECE4111	BADECE5111	BADECE5112	BADECE6111	BADECE6112	BADECE7111	BADECE7112
	Introduction of AI & Data Science	Mathematics for Machine Learning	Introduction to Machine Learning	Fundamentals of Deep Learning	Computer Vision	Deep Learning for NLP and Textual Gen AI	Deep Learning for Computer Vision and Visual Gen AI	Data Analytics	Machine Learning Operations
<b>Cyber Security</b>	BTXECE2113	BCSECE3111	BCSECE4111	BCSECE5111	BCSECE5112	BCSECE6111	BCSECE6112	BCSECE7111	BCSECE7112
	Introduction to Cyber Security	Cyber Crime Law & IPR	Ethical Hacking	Database Security and Access Control	Security Audit and risk Management	Vulnerability Analysis and Penetration Testing	Cyber Forensics	Malware Analysis & Wireless Security	Security Automation & DevSecOps
<b>Artificial Intelligence &amp; Machine Learning (SAS)</b>	BTXECE2114	BAMECE3111	BAMECE4111	BAMECE5111	BAMECE5112	BAMECE6111	BAMECE6112	BAMECE7111	BAMECE7112
	Base SAS Programming	SAS Programming in Viya	Statistics you need to know for Machine Learning	SAS® Visual Text Analytics in SAS® Viya®	Data Analytics using R Programming	Deep Learning Using SAS® Software	Reinforcement Learning	Optimization Concepts for Data Science and Artificial Intelligence	Speech & Video Processing
<b>Cloud and DevOps</b>	BTXECE2115	BCDECE3111	BCDECE4111	BCDECE5111	BCDECE5112	BCDECE6111	BCDECE6112	BCDECE7111	BCDECE7112
	Introduction to Cloud Technology	Introduction to DevOps	Virtualization in Cloud Computing	Cloud Containerization	Cloud Web Services	DevOps Tools And Technology	Configuration Management and Automation	DevOps Security and Compliance	Linux Server Operating System
<b>Full Stack Development &amp; Mobile Application</b>	BTXECE2116	BSMECE3111	BSMECE4111	BSMECE5111	BSMECE5112	BSMECE6111	BSMECE6112	BSMECE7111	BSMECE7112
	Front End Development	Fundamental of DevOps & Deployment Tools	Android Application Development	Java Script Frameworks-I	PHP Framework	Cross-Platform App Development with Flutter	Java Script Framework-II	Backend Technologies	Android Security & Mobile App Testing

## PROFESSIONAL ELECTIVE LABs (Batch: 2025-29)

	Professional Elective Lab -I	Professional Elective Lab -II	Professional Elective Lab- III	Professional Elective Lab -IV	Professional Elective Lab -V	Professional Elective Lab- VI	Professional Elective Lab- VII
<b>Computer Science &amp; Engineering</b>	BCEECE4211	BCEECE5211	BCEECE5212	BCEECE6211	BCEECE6212	BCEECE7211	BCEECE7212
	Fundamentals of Machine Learning Lab	Fundamental of Blockchain Technology Lab	Mobile Application Development Lab	Rasberry implementation Lab	Software Testing Lab	ASP.Net Lab	Cloud Computing Lab
<b>Artificial Intelligence &amp; Data Science</b>	BADECE4211	BADECE5211	BADECE5212	BADECE6211	BADECE6212	BADECE7211	BADECE7212
	Machine Learning Lab	Deep Learning Lab	Computer Vision Lab	Deep Learning for NLP and Textual Gen AI Lab	Deep Learning for Computer Vision and Visual Gen AI Lab	Data Analytics Lab	Machine Learning Operations Lab
<b>Cyber Security</b>	BCSECE4211	BCSECE5211	BCSECE5212	BCSECE6211	BCSECE6212	BCSECE7211	BCSECE7212
	Ethical Hacking Lab	Database Security and Access Control Lab	Cryptography and Data Security Lab	Vulnerability Analysis and Penetration Testing Lab	Cyber Forensics Lab	Malware Analysis & Wireless Security	Security Automation & DevSecOps Lab
<b>Artificial Intelligence &amp; Machine Learning (SAS)</b>	BAMECE4211	BAMECE5211	BAMECE5212	BAMECE6211	BAMECE6212	BAMECE7211	BAMECE7212
	Application of Machine Learning Using SAS(R) Viya®	Neural network: Essentials (SAS)	Data Analytics using R Programming Lab	Forecasting Using Model Studio in SAS® Viya®	Reinforcement Learning Lab	Data Exploration & Visualization Lab	Time Series Data Analysis Lab
<b>Cloud and DevOps</b>	BCDECE4211	BCDECE5211	BCDECE5212	BCDECE6211	BCDECE6212	BCDECE7211	BCDECE7212
	Virtualization in Cloud Computing Lab	Cloud Containerization Lab	Cloud Web Services Lab	DevOps Tools And Technology Lab	Configuration Management and Automation Lab	DevOps Security and Compliance Lab	Linux Server Operating System Lab
<b>Full Stack Development &amp; Mobile Application</b>	BSMECE4211	BSMECE5211	BSMECE5212	BSMECE6211	BSMECE6212	BSMECE7211	BSMECE7212
	Android Application Development Lab	Java Script Frameworks I Lab	PHP Framework Lab	Flutter Application Development Lab	Java Script Framework II Lab	Full Stack Integration & API Development Lab	Android Security & Mobile App Testing Lab

## Comparison according to NEP Guidelines

### \*TEP 8 Credit

	Broad Category of Course	Minimum Credit Requirement	
		NEP	PU-CSE
1	Major (Core)	80	97
2	Minor Stream	32	33
3	Multidisciplinary	09	10
4	Ability Enhancement Courses (AEC)	08	4
5	Skill Enhancement Courses (SEC)	09	9
6	Value Added Courses common for all UG	06 – 08	6
7	Summer Internship	02 – 04	2
8	Research Project / Dissertation	12	12

### Summary Year wise credit distribution: -

		Major	Minor	MD	AEC	SEC	VAC	SI	Project	TEP	
I	Credit	18			1	1	1				21
II	Credit	16	2	2	1	1	1				23
III	Credit	16	3	2	1	1	2				25
IV	Credit	15	4	2		2	2				25
V	Credit	12	8	2		2					24
VI	Credit	11	8	2		2		1			24
VII	Credit	9	8		1			1	2		21
VIII	Credit								10		10
		97	33	10	4	9	6	2	12	0	173

**B.Tech- I<sup>st</sup> & II<sup>nd</sup> Semester**  
**Batch: 2025-29**

**A. COURSE OUTCOMES AND THEIR RESPECTIVE MAPPING**

Course Outcomes (CO):	At the end of this course, learners will be able to:	Bloom Level	PO Mapping
CO1	Differentiate between Diamagnetism, Para magnetism and ferromagnetism	L1	PO1, PO2, PO3, PO4, PO6, PO7
CO2	Understand the principle behind Newton's rings interference pattern, its construction using a plano-convex lens and a flat glass plate	L1	PO1, PO2, PO3, PO4, PO6, PO7
CO3	Explain the concept of matter waves and describe their wave-particle duality using the de Broglie wavelength equation.	L1	PO1, PO2, PO3, PO4, PO6, PO7
CO4	Provide a solid foundation for understanding the principles behind many electronic devices and applications like Hall effect, PN Junction	L3	PO1, PO2, PO3, PO4, PO5, PO6, PO7
CO5	Comprehensive foundation in the principles and applications of light amplification, He-Ne laser, and holography	L3	PO1, PO2, PO3, PO4, PO6, PO7

**B. MAPPING MATRIX OF CO, PO, & PSO**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO3	2	2	2	-	-	-	-	-	-	-	-	-	3	-	-
CO4	2	2	3	-	-	-	-	-	-	-	-	-	2	-	-
CO5	3	2	2	-	-	-	-	-	-	-	-	-	1	-	-
WT. AVG	2.6	2.4	2.2	-	-	-	-	-	-	-	-	-	2.4	-	-

**C. Mapping matrix of CO & PSO**

	PSO1	PSO2	PSO 3	PSO4	PSO5
CO1	-	-	-	-	1
CO2	-	-	-	-	1
CO3	-	-	-	-	1
CO4	-	-	-	-	1
CO5	-	-	-	-	1
Wt. AVG	-	-	-	-	1

## D. OUTLINE OF THE COURSE

Unit No.	Title of the Unit	Time required for the Unit (Hours)
1.	Material Science	07
2.	Wave optics	07
3.	Quantum Mechanics	08
4.	Semiconductor Physics	08
5.	Laser and Holography	06

## E. DETAILED SYLLABUS

Unit	Unit Details
<b>1.</b>	<b>Material Science</b>
	<ul style="list-style-type: none"><li>• Introduction of Unit</li><li>• Fundamentals of Crystal structure,</li><li>• Para-magnetism, Diamagnetism, Ferromagnetism, Ferrimagnetism, Antiferromagnetic, Magnetic Permeability, Magnetization, Paramagnetic Susceptibility of Solid Substances, and Explanation of Hysteresis.</li><li>• Conclusion of Unit</li></ul>
<b>2.</b>	<b>Wave optics</b>
	<ul style="list-style-type: none"><li>• Introduction of Unit</li><li>• Interference of light, Types of Interference, coherent source, methods to produce coherent sources with examples.</li><li>• Newton's rings: Principle, Construction, working and Applications, Anti Reflection Coating.</li><li>• Fundamental idea about optical fiber, types of fiber, acceptance angle, numerical aperture.</li><li>• Conclusion of Unit</li></ul>
<b>3.</b>	<b>Quantum Mechanics</b>
	<ul style="list-style-type: none"><li>• Introduction of Unit</li><li>• Matter waves and properties. Group and Particle velocities &amp; their relationship.</li><li>• Compton scattering, wave function and its properties.</li><li>• Heisenberg Uncertainty principle.</li><li>• Time dependent and time independent Schrodinger wave equation.</li><li>• Conclusion of Unit</li></ul>
<b>4.</b>	<b>Semiconductor Physics</b>
	<ul style="list-style-type: none"><li>• Introduction of Unit</li><li>• Energy bands in semiconductors,</li><li>• Types of semiconductors, Charge carriers,</li><li>• Intrinsic and extrinsic materials, Carrier Concentration, Conductivity and Mobility,</li><li>• Hall effect,</li><li>• PN Junction diode, Zener diode, Solar Cell</li><li>• Conclusion of Unit</li></ul>
<b>5.</b>	<b>Laser and Holography</b>
	<ul style="list-style-type: none"><li>• Introduction of Unit</li><li>• Introduction of LASER, Conditions for the Light Amplification,</li><li>• Population Inversion and metastable state, pumping.</li><li>• Types of lasers: He-Ne laser and diode laser and their working principle and Holography</li><li>• Conclusion of Unit</li></ul>

## F. RECOMMENDED STUDY MATERIAL

Sr.No	Reference Book	Author	Edition	Publication
1	Materials Science and Engineering	by Raghavan V	Latest	PHI
2	Fundamentals Of Engineering Physics	SS Rawat	Latest	CBH Publications
3	Solid State Physics	By S. O. Pillai	Latest	NEW AGE
4	Concepts of modern physics	Beiser, Arthur	Latest	Mc Graw Hill
5	Introduction to Quantum Mechanics	David J. Griffiths and Darrell F. Schroeter	Latest	Cambridge University Press
Important Web Links				
1	<a href="https://jiet.claybits.com/">https://jiet.claybits.com/</a>			
2	<a href="https://jiet.claybits.com/physics/1-5">https://jiet.claybits.com/physics/1-5</a>			
3	<a href="https://jiet.claybits.com/physics/3-1">https://jiet.claybits.com/physics/3-1</a>			

## A. COURSE OUTCOMES AND THEIR RESPECTIVE MAPPING

Course Outcomes (COs)	At the end of this course, learners will able to:	Bloom level	PO Mapping
CO1	Enumerate the importance, synthesis and applications of polymers.	L2	PO1, PO2, PO3, PO4, PO6, PO7
CO2	Illustrate the fundamental principles of water chemistry, applications of volumetric and analytical instrumentation	L1	PO1, PO2, PO3, PO4, PO6, PO7
CO3	Explain the fundamental concepts of corrosion, its control and surface modification methods namely electroplating and electroless plating	L2	PO1, PO2, PO3, PO4, PO6, PO7
CO4	Impart the basic knowledge of chemistry and its principals involved in electrochemistry, energy storage devices and its commercial applications	L3	PO1, PO2, PO3, PO4, PO5 PO6, PO7
CO5	Learn about the manufacturing of cement and the chemistry involved in setting and hardening of it and also learn about the suitable use of lubricants	L2	PO1, PO2, PO3, PO4, PO6, PO7

## B. Mapping matrix of CO &amp; PO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	-	1	1	-	-	-	-	-
CO2	2	1	2	1	-	2	2	-	-	-	-	-
CO3	3	2	2	1	-	2	2	-	-	-	-	-
CO4	3	1	2	1	1	2	2	-	-	-	-	-
CO5	2	1	1	1	-	2	2	-	-	-	-	-
Wt. AVG	2.6	1.2	1.6	1	1	1.8	1.8					

## C. Mapping matrix of CO &amp; PSO

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	-	-	-	-	1
CO2	-	-	-	-	1
CO3	-	-	-	-	1
CO4	-	-	-	-	1
CO5	-	-	-	-	1
Wt. AVG	-	-	-	-	1

## D. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Polymer Basics and Applications	7
2.	Water Chemistry and methods of analysis	8
3.	Corrosion and Metal finishing	7
4.	Electrochemistry and energy storage systems	7
5.	Engineering Materials	7

## E. DETAILED SYLLABUS

Unit	Unit Details
<b>1.</b>	<b>Polymer Basics and Applications</b>
	<ul style="list-style-type: none"><li>• Introduction of Unit</li><li>• Introduction to Polymer chemistry:</li><li>• Classification of Polymers and Types of polymerization</li><li>• Plastics: Thermosets and Thermoplastics, Preparation, Properties and Uses of Polyethylene, Bakelite, Teflon, and Nylon</li><li>• Flexible materials: Natural rubber, Vulcanization, Synthetic rubber- Preparation, Properties and Applications of SBR, Buna-N and flexible materials.</li><li>• Conclusion of Unit</li></ul>
<b>2.</b>	<b>Water Chemistry and Methods of Analysis</b>
	<ul style="list-style-type: none"><li>• Introduction of Unit Water</li><li>• Sources of water, Impurities in water and effect of impurities</li><li>• Municipal water supply: Requisites of drinking water, Alkaline Water: Benefits, Side Effects and Dangers</li><li>• Steps involved in purification of water, Sedimentation, Coagulation, Filtration and Disinfection, Break Point Chlorination</li><li>• Water Analysis: Hardness of water; Type of hardness, Degree of hardness, Units of hardness, Disadvantages of hard water, Determination of hardness by Complexometric (EDTA) method, Numerical based on hardness by EDTA method</li><li>• Treatment of hard water: Lime-soda method, Permutit (zeolite) method, RO water treatment and Deionization or Demineralization method</li><li>• Conclusion of Unit</li></ul>
<b>3.</b>	<b>Corrosion and Metal Finishing</b>
	<ul style="list-style-type: none"><li>• Introduction of the Unit</li><li>• Definition of corrosion and its Significance</li><li>• Mechanisms of Corrosion: Chemical (Dry) corrosion and Electrochemical (Wet) corrosion</li><li>• Types of corrosion: Galvanic corrosion, Concentration cell corrosion, Stress corrosion, Pitting corrosion</li><li>• Methods of protection against corrosion: Galvanization, Sacrificial coatings etc.</li><li>• Metal finishing: Technological importance, Electroplating and Electroless plating</li><li>• Conclusion of Unit</li></ul>
<b>4.</b>	<b>Electrochemistry and Energy Storage Systems</b>
	<ul style="list-style-type: none"><li>• Introduction of the Unit</li><li>• EMF of cell, Free Energy, Single electrode potential, Nernst equation, Numerical problems based on Nernst Equation.</li><li>• Electrodes: Calomel electrode and Glass electrode</li><li>• Energy storage Systems: Introduction, Classification of batteries. Construction, working and applications of Li-ion batteries.</li><li>• An electrochemical energy system for electric vehicles. Recycling of Lithium-ion batteries by direct cycling Method.</li><li>• Conclusion &amp; Real life applications.</li></ul>
<b>5.</b>	<b>Engineering Materials</b>
	<ul style="list-style-type: none"><li>• Introduction of the Unit</li><li>• Portland Cement; Definition, Manufacturing by Rotary kiln. Chemistry of setting and hardening of cement. Role of Gypsum.</li><li>• Lubricants: Classification, Mechanism, Properties; Viscosity and viscosity index, flash and fire point, cloud and pour point. Emulsification and steam emulsion number.</li><li>• Conclusion &amp; Real life applications</li></ul>

### RECOMMENDED STUDY MATERIAL:

S. No	Reference Book	Author	Publication
1	Engineering chemistry: A Text book	S.K. Jain & K.D. Gupta	Jaipur Publishing House
2	Engineering chemistry: A Text book	S.S. Dara	S. Chand & Co
3	Engineering chemistry: A Text book	P.C. Jain	Dhanpat Rai & Sons.

## A. COURSE OUTCOMES AND THEIR RESPECTIVE MAPPING

Course Outcomes (COs)	At the end of this course, learners will able to:	Bloom level	PO Mapping
CO1	Learn data types, loops, functions, array, pointers, string, structures and files	L2	PO1, PO2, PO3, PO4, PO6, PO7
CO2	Develop conditional and iterative statements to write C programs	L1	PO1, PO2, PO3, PO4, PO6, PO7
CO3	Implement concept of string using array.	L2	PO1, PO2, PO3, PO4, PO6, PO7
CO4	Allocate memory dynamically using pointers	L3	PO1, PO2, PO3, PO4, PO5, PO6, PO7
CO5	Application of file handling and dynamic memory allocation	L2	PO1, PO2, PO3, PO4, PO6, PO7

## B. Mapping matrix of CO &amp; PO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	-	1	-	-	-	-	-
CO2	3	2	3	3	-	-	2	-	-	-	-	-
CO3	2	2	1	1	-	-	2	-	-	-	-	-
CO4	3	1	2	1	-	-	2	-	-	-	-	-
CO5	2	2	1	1	-	-	2	-	-	-	-	-
Wt. AVG	2.6	2	1.8	1.8			1.8					

## C. Mapping matrix of CO &amp; PSO

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	-	-		
CO2	2	-	-		
CO3	2	-	-		
CO4	3	-	-		
CO5	2	-	-		
Wt. AVG	2.4				

## D. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to C Programming	7
2.	Decision Making & Looping	7
3.	Array and string	7
4.	Advance programming in C	8
5.	File handling & Additional features	7

## E. DETAILED SYLLABUS

Unit	Unit Details
1.	<b>Introduction to C Programming</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Introduction to computer-based problem solving, Program design and implementation issues- Flowcharts &amp; Algorithms.</li> <li>• Types of Languages – Machine language, assembly language, high level languages, Assemblers, Compilers, Interpreters.</li> <li>• Overview of C, Data Types, Constants &amp; Variables, Literals, Operators &amp; Expressions</li> <li>• Conclusion &amp; Real Life Application</li> </ul>
2.	<ul style="list-style-type: none"> <li>• <b>Decision Making &amp; Looping</b></li> </ul>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Decision making in C- if statement, if-else statement, Nested if statement, if else if Ladder, Switch case, Ternary Operator</li> <li>• Loop control in C – for loop, while loop, do-while loop</li> <li>• Control flow in C- break, continue and goto statement.</li> <li>• Conclusion &amp; Real Life Application</li> </ul>
3	<ul style="list-style-type: none"> <li>• <b>Array and string</b></li> </ul>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Types of arrays: One-dimensional, Two-dimensional.</li> <li>• Array memory representation</li> <li>• Array indexing and traversal</li> <li>• Operations on Arrays: Reading, Inserting, Deleting, searching</li> <li>• Advantages and limitations</li> <li>• Functions: Definition and need for functions, Advantages of using functions</li> <li>• Function declaration, definition, and call : Syntax and structure in C</li> <li>• Types of Functions: Built-in Functions, User-defined Functions</li> <li>• Function Parameters: Call by Value, Call by Reference</li> <li>• Recursion: Concept of recursion, Base case and recursive case</li> <li>• Scope rules- Local &amp; global variables.</li> <li>• String : Definition of strings and memory representation</li> <li>• String declaration and initialization</li> <li>• Standard library functions (e.g., strlen, strcpy, strcmp, strcat in C)</li> <li>• Conclusion of the Unit</li> </ul>
4.	<ul style="list-style-type: none"> <li>• <b>Advance programming in C</b></li> </ul>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Pointers- The &amp; and * operator, pointer expression, assignments, arithmetic, comparison, arrays of pointers, pointers to pointers, initializing pointers, pointers to functions, function returning pointers.</li> <li>• Advance features- storage classes and dynamic memory allocation(</li> <li>• Structures- Basics, declaring, referencing structure elements, array of structures, passing structures to functions, structure pointers, arrays and structures within structures, typedef.</li> <li>• Unions – Declaration, uses</li> <li>• Enumerated data-types</li> <li>• Conclusion of the Unit</li> </ul>
5.	<ul style="list-style-type: none"> <li>• <b>File handling &amp; Additional features</b></li> </ul>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• File Handling – The file pointer, file accessing functions-fopen, fclose, putc, getc, fprintf, reading and writing into a file</li> <li>• C Preprocessor- #define, #include, #undef, Conditional compilation directives.</li> <li>• C standard library and header files: Header files, string functions, mathematical functions, Date and Time functions.</li> <li>• Conclusion of the Unit</li> </ul>

**F. RECOMMENDED STUDY MATERIAL:**

<b>S. No</b>	<b>Reference Book</b>	<b>Author</b>	<b>Publication</b>
1.	Letus C, 6 <sup>th</sup> Edition	Yashwant Kanitkar	PBP Publication
2.	The C programming Language	Richie and Kenninghan	BPB Publication, 2004
3.	Programming in ANSI C 3 <sup>rd</sup> Edition, 2005	E. Balagurusamy	Tata McGraw Hill
<b>Reference Book</b>			
1	The C programming Language Richie and Kenninghan PBP Publication, 2004		
2	Programming in ANSI C 3 <sup>rd</sup> Edition, 2005 Balaguruswamy Tata McGraw Hill		
<b>Online resources</b>			
1	<a href="https://www.programiz.com/c-programming/examples">https://www.programiz.com/c-programming/examples</a>		
2	<a href="https://www.w3resource.com/c-programming-exercises">https://www.w3resource.com/c-programming-exercises</a>		

**A. COURSE OUTCOMES AND THEIR RESPECTIVE MAPPING**

Course (CO):	Outcomes	At the end of this course, learners will be able to:	Bloom Level
CO1		<b>Understand</b> the various aspect of civil engineering, its novel areas and Career Prospects in Civil Engineering.	L1
CO2		<b>Demonstrate</b> the characteristics of different Construction Materials and construction techniques in Civil Engineering.	L1
CO3		<b>Identify</b> the various building components, and <b>analyze</b> the construction methods and basic principles.	L4
CO4		<b>Understand</b> different types of surveying works required in construction and compare different surveying instruments.	L1
CO5		<b>Understand</b> about the recent advancements in Civil Engineering.	L1

**B. MAPPING MATRIX OF CO,PO, & PSO**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	-	-	-	-	-	-	-	-	1	-	3
CO2	2	3	1	2	-	-	-	-	-	-	-	-	2	-	3
CO3	3	2	2	2	-	-	-	-	-	-	-	-	1	-	3
CO4	3	3	1	2	-	-	-	-	-	-	-	-	1	-	3
CO5	3	3	2	2	-	-	-	-	-	-	-	-	2	-	3
WT. AVG	2.8	2.6	1.6	1.8									1.6		3

**C. Mapping matrix of CO & PSO**

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	-	-		
CO2	2	-	-		
CO3	2	-	-		
CO4	3	-	-		
CO5	2	-	-		
Wt. AVG	2.4				

**D. OUTLINE OF THE COURSE**

Unit No.	Title of the Unit	Time required for the Unit (Hours)
1.	Introduction to Civil Engineering	08
2.	Construction Materials and techniques	08
3.	Building Construction	08
4.	Basic Surveying	08
5.	Advancements in Civil Engineering	08

**E. DETAILED SYLLABUS**

Unit	Unit Details
•	<b>Introduction to Civil Engineering</b>
	<ul style="list-style-type: none"> <li>Introduction</li> <li>Different disciplines of Civil Engineering, Scope and prospects</li> <li>Role of a Civil Engineer, Units of measurement, Unit conversion (Length, Area, Volume)</li> <li>Infrastructure Engineering, Sustainability</li> <li>Automation and Robotics in Construction</li> <li>Novel areas in Construction industry</li> </ul>

	<ul style="list-style-type: none"> <li>• Career Prospects in Civil Engineering</li> </ul>
•	<b>Construction Materials and techniques</b>
	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Cement – Types, properties, grades, Concrete– PCC and RCC, Cement mortar</li> <li>• Stone, Requirements of good building stone, General types of stone used in Construction.</li> <li>• Bricks, Modular and Standard bricks, Characteristics of good brick, Special bricks –fly ash bricks.</li> <li>• Timber, Structure of timber, General properties and uses of good timber, Use of bamboo in construction</li> <li>• Asphalt, bitumen and tar used in construction, their properties and uses</li> <li>• Types of Stone Masonry (Rubble masonry, Ashlar Masonry) and Brick Masonry (English bond and Flemish bond).</li> </ul>
•	<b>Building Construction</b>
	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Classification of Buildings as per National Building Code Group A to I</li> <li>• Types of Constructions- Load Bearing Structure, Framed Structure, Composite Structure</li> <li>• Building Components - Functions of Building Components, Substructure-Foundation, Plinth &amp; Superstructure., Selection of site for different types of Buildings</li> <li>• Basic principles of building planning.</li> <li>• Pre-engineered steel building, Pre-fabricated buildings</li> </ul>
•	<b>Basic Surveying</b>
	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Survey – Principles, purpose and use</li> <li>• Types &amp; Classification of surveying</li> <li>• Instruments used in chain survey: Chains, Tapes, Arrow, Ranging rod, Line ranger, Offset rod, Open cross staff, Optical square</li> <li>• Ranging: Direct and Indirect Ranging, Methods of chaining, obstacles in chaining.</li> <li>• Errors in chain and tape, Numerical based on errors in length due to incorrect length of chain &amp; tape., Modern surveying instruments– EDM, Total station, GPS</li> </ul>
•	<b>Advancements in Civil Engineering</b>
	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Smart city and it's features, Plastic Roads</li> <li>• Mass Transportation systems-BRTS, Metro</li> <li>• Green building, Rain water harvesting systems</li> <li>• Affordable housing &amp; their features</li> <li>• Building Information Modeling (BIM), 3D Printing Technology for Construction, Advanced Civil Engineering Materials</li> </ul>

## F. RECOMMENDED STUDY MATERIAL

Sr.No	Reference Book	Author	Edition	Publication
•	Basics of Civil Engineering	S.S. Bhavikatti	Latest	New Age International Publishers
•	Basic Civil Engineering	B C Punmia, Ashok K Jain, Arun K Jain	Latest	Laxmi Publications
•	Basic Civil Engineering	G K Hiraska	Latest	Dhanpat Rai Publication
•	Basic Civil Engineering	Jhonson Victor D and Esther Malini	Latest	Allied Publishers Limited, Madras
•	Basic Civil Engineering	Arunachalam N	Latest	Pratheeba Publishers, Coimbatore
<b>Important Web Links</b>				
1	<a href="https://archive.nptel.ac.in/courses/105/106/105106201/">https://archive.nptel.ac.in/courses/105/106/105106201/</a>			
2	<a href="https://onlinecourses.nptel.ac.in/noc22_ce42/preview">https://onlinecourses.nptel.ac.in/noc22_ce42/preview</a>			

## A. COURSE OUTCOMES AND THEIR RESPECTIVE MAPPING

Course Outcomes (CO):	At the end of this course, learners will be able to:	Bloom Level
CO1	Apply basic electrical concepts, including various circuit analysis techniques and fundamentals of theorem to solve numerical problem related to basic electrical circuit.	L4
CO2	Demonstrate the fundamentals of AC circuits and Electric Installation by calculating voltage, current, impedance, and power factors.	L1
CO3	Compare various electrical machines and the process of energy conversion specifying the type and characteristics of the power source supplying these machines, such as AC or DC, voltage levels, frequency, etc.	L3
CO4	Understand the fundamental principles of semiconductor devices such as diodes and transistors, knowing their roles in switching and amplification.	L1
CO5	Understand the working principles of communication systems, Transducers and fundamentals of IoT.	L1

## B. MAPPING MATRIX OF CO,PO, &amp; PSO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	3	2	1	-	-	-	-	-	-	-	-	-	3	-	-
CO 2	2	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO 3	2	2	-	2	-	-	1	-	-	-	-	-	2	-	-
CO 4	2	3	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 5	2	3	-	-	-	-	-	-	-	-	-	1	2	-	-
WT . AVG	2.2	2.6	1	2			1					1	2.2		

## C. Mapping matrix of CO &amp; PSO

	PSO1	PSO2	PSO 3	PSO4	PSO5
CO1	3	-	-		
CO2	2	-	-		
CO3	2	-	-		
CO4	3	-	-		
CO5	2	-	-		
Wt. AVG	2.4				

## D. OUTLINE OF THE COURSE

Unit No.	Title of the Unit	Time required for the Unit (Hours)
1.	Basic Concepts of Electrical Engineering	08
2.	Alternating Quantities and Electrical Installations	08
3.	Electrical Machines	07
4.	Basic Electronics	08
5.	Communication Systems and IoT	08

## E. DETAILED SYLLABUS

Unit	Unit Details
1.	<b>Basic Concepts of Electrical Engineering</b> <ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Basic circuit elements and sources; Ohms law; Kirchhoff's laws; Series and Parallel connection of circuit elements; Star-delta transformation;</li> <li>• Mesh current analysis; Node voltage analysis;</li> <li>• Theorems: Statement and Numerical Problems of Thevenin's and Norton theorem</li> <li>• Conclusion of Unit</li> </ul>
2.	<b>Alternating Quantities and Electrical Installations</b> <ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Alternating voltages and currents: RMS, average, maximum values, Single Phase RL, RC, RLC series circuits, Power in AC circuits, Power Factor,</li> <li>• Electrical Safety, Fuses and Earthing</li> <li>• Conclusion of Unit</li> </ul>
3.	<b>Electrical Machines</b> <ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Construction, working principle and applications of DC Machines, Single phase Transformers, Three phase Induction motors, Single phase induction motors.</li> <li>• Special machines -Stepper motor, Universal motor and BLDC motor</li> <li>• Conclusion of Unit</li> </ul>
4.	<b>Basic Electronics</b> <ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Characteristics: PN junction diode, Zener diode, Rectifier, Voltage regulator.</li> <li>• Digital Electronics: Boolean algebra, Binary System, Logic Gates and Their Truth Tables.</li> <li>• Conclusion of Unit</li> </ul>
5.	<b>Communication Systems and IoT</b> <ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Basics of Communication: Types of Communication, Amplitude and Frequency Modulation.</li> <li>• Introduction to Transducers, Thermocouple, RTD, Load Cell and Bimetallic Strip.</li> <li>• An overview of Internet of Things-Building blocks of IoT, IoT enabling technologies, Characteristics of IoT systems</li> <li>• Conclusion of Unit</li> </ul>

## F. RECOMMENDED STUDY MATERIAL

S.No	Reference Book	Author	Edition	Publication
1	Electrical and Electronic Technology	Edward Hughes et al,	Latest	Pearson Publication
2	Basic Electrical & Electronics Engineering	V. Jagathesan, K. Vinod Kumar & R. Saravan Kumar	Latest	Wiley India
3	Basic Electrical & Electronics Engineering	Van Valkenburge	Latest	Cengage learning
4	Basic Electrical and Electronics Engineering by,	Muthusubramaniam	Latest	TMH
5	Basic Electrical & Electronics Engineering	Ravish Singh	Latest	TMH
<b>Important Web Links</b>				
1	<a href="https://nptel.ac.in/courses/108108076/">https://nptel.ac.in/courses/108108076/</a>			
2	<a href="https://nptel.ac.in/courses/117103063/">https://nptel.ac.in/courses/117103063/</a>			
3	<a href="https://nptel.ac.in/courses/108/101/108101091/">https://nptel.ac.in/courses/108/101/108101091/</a>			

**A. COURSE OUTCOMES AND THEIR RESPECTIVE MAPPING**

Course Outcomes (COs)	At the end of this course, learners will able to:	Bloom level	PO Mapping
CO1	Calculating eigen values and eigen vector	L4	PO1, PO5, PO6,
CO2	Determining ordinary differential equation and its types.	L3	PO1. PO2, PO3
CO3	Sketching standard curves using curve tracing.	L3	PO1, PO2, PO3, PO4
CO4	Calculating gamma function and double integration.	L4	PO1, PO2, PO3, PO4,
CO5	Associating Gradient, Divergence and Curl, Directional derivatives	L2	PO1, PO2, PO4

**B. Mapping matrix of CO & PO**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	--	1	1	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-
CO3	3	2	3	1	-	-	-	-	-	-	-	-
CO4	3	2	1	1	-	-	-	-	-	-	-	-
CO5	2	1		1	-	-	-	-	-	-	-	-
Wt. AVG	2.8	2	2.3	1	1	1	-	-	-	-	-	-

**C. Mapping matrix of CO & PSO**

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	-	-	-	-
CO2	3	-	-	-	-
CO3	3	-	-	-	-
CO4	3	-	-	-	-
CO5	3	-	-	-	-
Wt. AVG	3	-	-	-	-

**D. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Matrices	7
2.	Ordinary Differential Equations	8
3.	Applications of Differential Calculus	8
4.	Integral Calculus	8
5.	Vector Calculus	8

**E. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Matrices</b>
	1.Introduction of Unit 2.Rank of a Matrix, Normal form of a Matrix 3.Consistency of systems of linear equations 4.Eigen Values and Eigen Vectors 5.Cayley-Hamilton Theorem (without proof)

	1. Conclusion of Unit
2.	<b>Ordinary Differential Equations</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Linear Equation and reducible to linear form, Exact Equation, Reducible to Exact</li> <li>• First order and first-degree differential equations-Separable Variables,</li> <li>• Homogenous and reducible to homogenous equation</li> <li>• Linear Equation and reducible to linear form, Exact Equation</li> <li>• Linear differential equations with constant coefficients</li> <li>• Conclusion of Unit</li> </ul>
3.	<b>Applications of Differential Calculus</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Asymptotes</li> <li>• Multiple points</li> <li>• Curve tracing for standard Curves (Cartesian Curves only)</li> <li>• Conclusion &amp; Real-life applications</li> </ul>
4.	<b>Integral Calculus</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Gamma functions and their properties</li> <li>• Double integrals, Double integral by changing into polar form</li> <li>• Areas by Double Integration</li> <li>• Change of order of integration</li> <li>• Conclusion of Unit</li> </ul>
5.	<b>Vector Calculus</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Scalar and Vector field</li> <li>• Differentiation and Integration of Vector functions</li> <li>• Gradient, Divergence and Curl</li> <li>• Conclusion of Unit</li> </ul>

#### RECOMMENDED STUDY MATERIAL:

Sr.No	Reference Book	Author	Edition	Publication
1.	Higher Engineering Mathematics	B S Grewal	Latest	Khanna Publications, Delhi,
2.	Higher Engineering Mathematics	Ramana, B.V	Latest	Tata McGraw-Hill.
3	Engineering Mathematics: A Tutorial Approach	Ravish R Singh and M Bhatt	Latest	Tata McGraw-Hill
4	Calculus and Analytical Geometry	Thomas and Finney,	Latest	Narosa Publishing, New Delhi
5	Advanced Engineering Mathematics	Erwin Kreyszig	Latest	John Wiley and Sons

#### Important Web Links:

1	<a href="https://nptel.ac.in/courses/111105134/">https://nptel.ac.in/courses/111105134/</a>
2	<a href="https://nptel.ac.in/courses/122/101/122101001/">https://nptel.ac.in/courses/122/101/122101001/</a>
3	<a href="https://www.classcentral.com/course/swayam-engineering-mathematics-i-13000">https://www.classcentral.com/course/swayam-engineering-mathematics-i-13000</a>

**A. COURSE OUTCOMES AND THEIR RESPECTIVE MAPPING**

Course Outcomes (COs)	At the end of this course, learners will able to:	Bloom level	PO Mapping
CO1	Understand the fundamentals of various manufacturing processes, including casting, forming, and additive manufacturing, and identify their real-life industrial applications.	L2	PO1, PO2, PO5
CO2	Demonstrate the knowledge of thermodynamic laws and apply them to refrigeration and air-conditioning systems.	L2	PO1, PO2, PO3, PO5
CO3	Explain the construction of automobiles, working principles, and performance parameters of internal combustion engines.	L3	PO1, PO2, PO3, PO5
CO4	Illustrate the concepts of aerodynamics, electric vehicle architecture, and evaluate the performance of electric vehicles.	L3	PO1, PO2, PO5
CO5	Describe the basic elements of automation and robotics, including control systems.	L2	PO1, PO2, PO5, PO6, PO7, PO8

**B. Mapping matrix of CO & PO**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2
CO 1	3	2	-	-	2	-	-	-	-	-	-	-
CO 2	3	3	-	-	2	-	-	-	-	-	-	-
CO 3	3	3	2	-	2	-	-	-	-	-	-	-
CO 4	3	2	2	-	2	-	-	-	-	-	-	-
CO 5	3	2	-	-	2	1	2	2	-	-	-	-
Wt. AVG	3	2.4	2		2	1	2	2				

**C. Mapping matrix of CO & PSO**

	PSO1	PSO2	PSO3
CO1	-	-	3
CO2	-	-	3
CO3	2	-	3
CO4	-	-	3
CO5	2	-	2
Wt. AVG	2		2.8

**D. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1	Manufacturing Processes	9
2	Thermal Engineering	9
3	Automobile and IC Engines	8
4	Aerodynamics and Electric Vehicles	7
5	Automation and robotics	7

**E. DETAILED SYLLABUS**

## F. RECOMMENDED STUDY MATERIAL:

Unit	Unit Details
<b>1</b>	<b>Manufacturing Processes</b>
	<p>Introduction of Unit</p> <p><b>Metal Casting Process:</b> Introduction to casting process, sand casting, pattern and their types, pattern materials, moulding sand, casting defects.</p> <p><b>Metal Forming Processes:</b> Introduction to metal forming, hot and cold working process, Forging, Rolling, Extrusion, Drawing.</p> <p><b>Additive manufacturing:</b> Introduction, definition of AM by ASTM, types of AM, Fused Deposition Modeling (FDM) and Laser Powder Bed Fusion (LPBF)</p> <p>Conclusion of Unit including Real Life Application</p>
<b>2</b>	<b>Thermal Engineering</b>
	<p>Introduction of Unit</p> <p><b>Thermodynamics:</b> Thermodynamic system, surroundings, boundary, state, characteristics, process, cycle, zeroth law, first law and second law of thermodynamics.</p> <p><b>Refrigeration and air conditioning:</b> classification and types of refrigeration systems, vapour compression system, vapour absorption system, and window air-conditioning system.</p> <p>Conclusion of Unit including Real Life Application</p>
<b>3</b>	<b>Automobile and IC Engines</b>
	<p>Introduction of Unit</p> <p><b>Automobile:</b> historical development of automobiles, automobile components, types of automobiles.</p> <p><b>IC Engine:</b> Heat engine, types of heat engine, component of IC Engine, working principle of SI and CI engine, two stroke and four stroke engines. Theoretical and actual indicator diagrams, performance parameters of IC Engines, calculation of power - efficiency.</p> <p>Conclusion of Unit including Real Life Application</p>
<b>4</b>	<b>Aerodynamics and Electric Vehicles</b>
	<p>Introduction of Unit</p> <p><b>Aerodynamics:</b> introduction, jet engine, types of jet engine, aerodynamic forces, turbojet engine.</p> <p><b>Electric Vehicles:</b> Architecture of an electric vehicle, essentials and performance of electric vehicles – Traction motor characteristics, tractive effort, transmission requirements, vehicle performance, advantage and limitations, battery heat management system.</p> <p>Conclusion of Unit including Real Life Application</p>
<b>5</b>	<b>Automation and robotics</b>
	<p>Introduction of Unit</p> <p><b>Automation:</b> Basic elements, flexible manufacturing system (FMS), level of automation, hardware component of automation, types of automation, control system, open loop and closed loop system, social issues of automation</p> <p><b>Robotics:</b> Definition of robot, history of robot, law of robotics, classification of robot, SCARA robot, advantage, limitations and application, social issues of robotics</p> <p>Conclusion of Unit including Real Life Application</p>

S. No	Reference Book	Author	Edition	Publication
1	Manufacturing technology Volume I	P N Rao	Latest	McGraw Hill Publication
2	Basics of Mechanical Engineering	R.K. Rajput	Latest	Laxmi Publication
3	IC Engines	V. Ganesan	Latest	McGraw Hill Publication
4	Automobile Engineering Vol-1	Dr. Kripal Singh	Latest	Standard Publishers and Distributors Pvt Ltd
5	Engineering Thermodynamics	PK Nag	Latest	McGraw Hill Publication
6	Basics Of Mechanical Engineering	S Ramachandran	Latest	AIR WALK Publication
7	A Text Book of Hybrid Electric Vehicles	Dr. S. Vijaya Kumar	Latest	Iterative International Publishers IIP
8	Automation and Robotics	Dr. Shailendra Singh Chauhan	Latest	Walnut Publication

## A. COURSE OUTCOMES AND THEIR RESPECTIVE MAPPING

Course Outcomes (COs)	At the end of this course, learners will able to:	Bloom level	PO Mapping
CO1	Introduction to scope of environmental studies & concept of ecology, ecosystem and biodiversity.	L2	PO7, PO8, PO12,
CO2	Implement innovative ideas of controlling different categories of Environmental Pollution.	L3	PO7, PO8, PO11, PO12,
CO3	Environmental issues & various Environmental Acts, regulations and International Agreements.	L2	PO7, PO8, PO11, PO12,
CO4	Social issues related to population, resettlement and rehabilitation of project affected persons. Demonstrate disaster management w.r.t floods, earthquakes, cyclones and landslides.	L2	PO7, PO8, PO11, PO12,
CO5	Determination of local environmental assets with simple ecosystems and identify local flora and fauna	L4	PO7, PO8, PO11, PO12,

## B. Mapping matrix of CO &amp; PO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2
CO1	—	—	—	—	—	—	2	2	—	—	—	1
CO2	—	—	—	—	—	—	3	2	—	—	1	1
CO3	—	—	—	—	—	—	2	3	—	—	1	1
CO4	—	—	—	—	—	—	3	2	—	—	1	1
CO5	—	—	—	—	—	—	2	3	—	—	1	1
Wt. AVG							2.4	2.4			1	1

## C. Mapping matrix of CO &amp; PSO

	PSO1	PSO2	PSO 3	PSO4	PSO5
CO1	—	—	1	—	—
CO2	—	1	1	—	—
CO3	—	1	1	—	—
CO4	—	1	1	—	—
CO5	—	1	1	—	—
Wt. AVG		1	1		—

## D. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to Environmental Studies	5
2.	Environmental Pollution and its Control	5
3.	Environmental Policies & Practices	5
4.	Human Communities and the Environment	5

**E. DETAILED SYLLABUS**

Unit	Unit Details
<b>1.</b>	<b>Introduction to Environmental studies</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Multidisciplinary nature of environmental studies Concept of sustainability and sustainable development.</li> <li>• Ecosystem: Structure and function of ecosystem</li> <li>• Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies\</li> <li>• Case studies of the following ecosystems: Forest ecosystem, Grassland ecosystem, Desert ecosystem</li> <li>• Aquatic ecosystems</li> <li>• Biodiversity and Conservation</li> <li>• Conclusion of the Unit</li> </ul>
<b>2.</b>	<b>Environmental Pollution and its Control</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Environmental pollution: types, causes, effects and controls; Air, water, soil and noise pollution</li> <li>• Nuclear hazards and human health risks</li> <li>• Solid waste management: Control measures of urban and industrial waste.</li> <li>• Pollution case studies</li> <li>• Conclusion of the Unit</li> </ul>
<b>3.</b>	<b>Environmental Policies &amp; Practices</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture</li> <li>• Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.</li> <li>• Environment Laws: Environment Protection Act; Air (Prevention &amp; Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act.</li> <li>• International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD)</li> <li>• Conclusion of the Unit</li> </ul>
<b>4.</b>	<b>Human Communities and the Environment</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Human population growth: Impacts on environment, human health and welfare.</li> <li>• Resettlement and rehabilitation of project affected persons; case studies.</li> <li>• Disaster management: floods, earthquake, cyclones and landslides.</li> <li>• Conclusion of the Unit</li> </ul>
<b>5.</b>	<b>Field Work</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc.</li> <li>• Visit to a local polluted site-Urban/Rural/Industrial/Agricultural.</li> <li>• Study of common plants, insects, birds and basic principles of identification.</li> <li>• Study of simple ecosystems-pond, river, Delhi Ridge, etc.</li> <li>• Conclusion of the Unit</li> </ul>

**RECOMMENDED STUDY MATERIAL:**

S. No	Reference Book	Author	Edition	Publication
1	Environmental Studies	Erach Barucha	Latest	UGC
2	Environmental Studies	Benny Joseph	Latest	Tata McgrawHill
3	Environmental Studies	R. Rajagopalan	Latest	Oxford University Press
4	Principles of Environmental Science and Engineering	P. Venugoplan Rao	Latest	Prentice Hall of India.
5	Environmental Science and Engineering	Meenakshi	Latest	Prentice Hall India.

# Ability Enhancement Courses

## Semester I

BEACHM1205

Applied English Communication- I

Credits: 1 (1-0-2)

### COURSE OUTCOMES AND THEIR RESPECTIVE MAPPING

CO No.	Course Outcome	Bloom's Taxonomy Level
CO1	Develop critical and creative thinking by solving hypothetical problems using limited resources.	Create
CO2	Exhibit persuasive communication and reasoning in debates and decision-making tasks.	Evaluate
CO3	Demonstrate collaboration and interpersonal skills through group-based storytelling and enactments.	Apply
CO4	Enhance public speaking confidence through extempore and stage-based activities.	Apply
CO5	Present innovative ideas and concepts effectively in front of an audience.	Create

### OUTLINE OF THE COURSE

Unit No.	Unit Name	Hours
1	Collaborative Thinking and Problem-Solving Skills	3
2	Narration, Dialogue, and Group Presentation Skills	3
3	Formal and Impromptu Public Speaking	3
4	Functional and Contextual English Communication	3
5	Creativity, Ideation, and Visual Interpretation	3

### DETAILED SYLLABUS

Unit	Unit Details
1	<p><b>Collaborative Thinking and Problem-Solving Skills</b></p> <ul style="list-style-type: none"> <li>Introduction to Unit</li> <li>Team vs Wild – Scenario-based survival task emphasizing teamwork and critical thinking.</li> <li>Who Gets the Heart? – Ethical dilemma debate for persuasive speaking and reasoning</li> <li>Conclusion of the Unit</li> </ul>
2	<p><b>Narration, Dialogue, and Group Presentation Skills</b></p> <ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>Debate – Structured argumentative speaking to enhance critical thinking and leadership.</li> <li>Extempore – Impromptu individual speeches to build spontaneity and stage confidence</li> <li>Theatrix – Paired roleplays to practice situational dialogues and collaborative speaking</li> <li>Conclusion of the Unit</li> </ul>
3	<p><b>Formal and Impromptu Public Speaking</b></p> <ul style="list-style-type: none"> <li>Introduction to Unit</li> <li>Story Mason – Group storytelling for stage interaction and creativity.</li> <li>Picture Connector – Visual storytelling by linking images to construct and narrate a cohesive idea</li> <li>Insane Inventor – Solo presentation of imaginative products to foster innovation and clarity</li> <li>Conclusion of the Unit</li> </ul>
4	<p><b>Functional and Contextual English Communication</b></p> <ul style="list-style-type: none"> <li>Introduction to Unit</li> <li>Shopping Roleplay – Day-to-day dialogue practice in a simulated shopping scenario.</li> <li>Tourism Pitch – Team-based promotion of a location to enhance descriptive and persuasive communication.</li> </ul>

	<ul style="list-style-type: none"> <li>● Interpersonal Interaction Practice – Real-life communication drills for fluent and functional English usage</li> <li>● Conclusion of the Unit</li> </ul>
<b>5</b>	<b>Creativity, Ideation, and Visual Interpretation</b>
	<ul style="list-style-type: none"> <li>● Introduction of Unit</li> <li>● Picture connector: To make the students participate in group interactions, create dialogue and present on the stage. Students link various pictures from newspapers to come up with a pictorial representation of a story or idea and narrate/present the same.</li> <li>● Creativity and presentation skills are concentrated. Students also learn to connect various variables and come up with concrete ideas"</li> <li>● Insane Inventor: To make students present a creative idea or a product on stage. This is an individual task-based presentation session. This helps students instigate innovation and creative thinking along with presentation skills.</li> <li>● Body Language and Professionalism Understanding body language helps students communicate more effectively and professionally. This skill enhances their ability to build trust, make positive impressions, and navigate workplace environments with confidence.</li> <li>● Conclusion of the Unit</li> </ul>

# Skill Enhancement Courses

## Semester I

**BELCSE 1201**

**Skill Enhancement Course-I**

**Credits: 1 (1-0-2)**

### Course: Soft Skills 1

#### **COURSE OUTCOMES: On completion of the course a student will be able to:**

- Demonstrate effective communication skills through the use of appropriate body language, email etiquette, and impression management in academic and professional settings.
- Apply goal setting, habit formation, and time management strategies to enhance personal productivity and academic success.
- Collaborate efficiently in teams by understanding team dynamics, sharing responsibilities, and achieving common goals.
- Construct grammatically correct and contextually appropriate sentences using correct tenses, sentence structures, speech forms, and punctuation.
- Enhance language fluency and expression using idioms, phrasal verbs, collocations, gerunds, and infinitives in both written and spoken communication.

S. No.	Topic	Sub-Topics
1	Body Language and Professionalism	Understanding body language helps students communicate more effectively and professionally. This skill enhances their ability to build trust, make positive impressions, and navigate workplace environments with confidence.
2	Habit Formation	By understanding how habits are formed, students can create positive routines that boost productivity and success. This topic empowers them to adopt habits that support their personal and academic growth, while also learning how to break negative habits.
3	Goal Setting	Goal setting helps students stay focused and motivated. By teaching them to set clear, achievable goals, we ensure they have a roadmap for success, whether in their education, career, or personal life.
4	Impression Management	Impression management enables students to present themselves effectively in various social and professional settings. This skill is vital for building strong professional relationships, gaining trust, and achieving career success.
5	Team Building	Team building helps students understand the dynamics of effective collaboration. This topic teaches them how to work together, share responsibilities, and achieve common goals, which are essential skills in almost every workplace.
6	Time Management	Time management skills are essential for students to balance academic workloads, personal life, and professional responsibilities. By teaching them how to prioritize tasks and manage their time effectively, we help them reduce stress and increase productivity.
7	Email Writing	Helps participants write clear and professional emails with the right tone and structure. Covers greetings, body, closings, and common errors to avoid. Includes real-life practice for confident workplace communication.
8	Classification of sentences	Learning different types of sentence and their application help one to choose appropriate sentence for appropriate function.
9	Tenses	Tense is the skeleton of English language and proper usage of tense forms ensures proper meaning conveyed.

10	Forms and Speech and Voice	Use of direct and indirect speech is essential for speaking ability in English. Voices help in writing convincing and diplomatic sentence/paragraphs.
11	Idioms and Phrasal Verbs	Idioms add flavour and richness to the English language. The author/speakers will sound savvy if idioms and phrasal verbs are appropriately used.
12	Collocations, Gerund and Infinitives	Company of words are called collocations and proper use of collocations brings finesse in one's language. Gerund and infinitives usage helps fine-tune one's language.
13	Punctuations	Improper punctuations in written scripts convey meanings different than the intended one. Writing ability is greatly enhanced by proper usage of punctuations.

# Value Added Courses (VAC)

**Code: BUVCVD1202/ 2202**

**Exploratory Project**

**1 Credits [LTP: 0-0-2]**

LAB OUTCOMES: After Successful completion of the lab students will be able to-

- LO1** Predict a problem of current relevance to society
- LO2** Formulate the problem and identify suitable modelling paradigm
- LO3** Categorize the problem and identify the solution methodology
- LO4** Simulate and design systems using various modern tools
- LO5** Validate the results and prepare a project report

Week	Activity
1	<b>Group Formation &amp; Idea Brainstorming</b> – Team Formation (2–4 members) and Allocation of guide – Brainstorm software/hardware-based problems across domains
2	<b>Topic Finalization &amp; Abstract Submission</b> – Blackboard presentation of ideas– Approval by guide based on feasibility– Submission of abstract and synopsis
3	<b>Requirement Gathering</b> – Software: Define tech stack, features– Hardware: Component list, sensors, budget
4	<b>Design Phase</b> – Software: Wireframes, UI/UX screens, flowchart– Hardware: Circuit diagram, CAD sketch, layout
5	<b>Resource Procurement or Setup</b> – Software: Environment setup (IDE, Git, packages)– Hardware: Components/sensors purchased
6	<b>Implementation Phase I</b> – Software: Frontend/backend/module coding Hardware: Mounting components, early testing
7	<b>Implementation Phase II</b> – Software: Functionality testing, module integration– Hardware: Electrical wiring, circuit optimization
8	<b>Testing &amp; Debugging</b> – Software: Unit/functional testing Hardware: Debug faulty connections, stabilize model
9	<b>Final Assembly / Prototype Completion</b> – Ensure functional integration, aesthetics– Prepare video
10	<b>Presentation Preparation &amp; Evaluation 1</b> – Create pitch deck, documentation, demo script
11	<b>Final Evaluation &amp; Viva</b> – Conducted by internal + external panel– Functionality + creativity + feasibility assessed
12	<b>Final Documentation &amp; Research Paper Presentation</b> – Full report submission (synopsis, design, testing, costing, future scope)– Research Paper/poster/presentation submission (optional)

**COURSE OUTCOMES:**

The student would be able to:

CO1: Identify what is valuable to human beings and what are the aspirations of life.

CO2: Apply the understanding of value education in solving various problems.

CO3: Observe and examine the issues related to harmony in self, society, and nature.

CO4: Focus on physical and mental fitness.

CO5: Apply the knowledge to their own self and in day-to-day life.

**LIST OF ACTIVITIES**

1	Introduce yourself in detail. What are the goals in your life? How do you set your goals in your life? How do you differentiate between right and wrong? What have been your salient achievements and shortcomings in your life? Observe and analyze them.
2	Now-a-days, there is a lot of talk about many techno-genic maladies such as energy and material resource depletion, environmental pollution, global warming, ozone depletion, deforestation, soil degradation, etc. - all these seem to be manmade problems, threatening the survival of life Earth - What is the root cause of these maladies & what is the way out in opinion? On the other hand, there is rapidly growing danger because of nuclear proliferation, arms race, terrorism, breakdown of relationships, generation gap, depression & suicidal attempts etc. - what do you think, is the root cause of these threats to human happiness and peace - what could be the way out in your opinion?
3	Observe that each of us has the faculty of „Natural Acceptance“, based on which one can verify what is right or not right for him. (As such we are not properly trained to listen to our „Natural Acceptance“ and may a time it is also clouded by our strong pre-conditioning and sensory attractions). Explore the following: What is Naturally Acceptable“ to you in a relationship the feeling of respect or disrespect for yourself and for others? What is „naturally Acceptable“ to you - to nurture or to exploit others? Is your living in accordance with your natural acceptance or different from it? 2. Out of the three basic requirements for fulfillment of your aspirations - right understanding, relationship and physical facilities - observe how the problems in your family are related to each. Also, observe how much time & effort you devote to each in your daily routine.
4	1. a. Observe that any physical facility you use, follows the given sequence with time: Necessary and tasteful - unnecessary but still tasteful - unnecessary and tasteless - intolerable b. In contrast, observe that any feeling in you is either naturally acceptable or not acceptable at all. If not acceptable, you want it continuously and if not acceptable, you do not want it any moment! 2. List down all your important activities. Observe whether the activity is of „I“ or of Body or with the participation of both or with the participation of both „I“ and Body. Observe the activities within „i“. Identify the object of your attention for different momentss (over a period of say 5 to 10 minutes) and draw a line diagram connecting these points. Try to observe the link between any two nodes.
5	1. Write a narration in the form of a story, poem, skit, or essay to clarify a salient Human Value to the children. 2. Recollect and narrate an incident in your life where you were able to exhibit willful adherence to values in a difficult situation.
6	List down some common units (things) of Nature which you come across in your daily life and classify them in the four orders of Nature. Analysis and explain the aspect of mutual fulfillment of each unit with other orders.
7	Identify any two important problems being faced by the society today and analyze the root cause of these problems. Can these be solved on the basic of natural acceptance of human values? If so, how should one proceed in this direction from the present situation?
8	1. Suggest ways in which you can use your knowledge of Science/Technology/Management etc. for moving towards a universal human order. 2. Propose a broad outline for humanistic Constitution at the level of Nation.
9	<b>Project:</b> Every student required to take-up a social project e.g. educating children in needy/weaker section; services in hospitals, NGO's and other such work i.e. social work at villages adopted by respective institute/ college.

**A. COURSE OUTCOMES AND THEIR RESPECTIVE MAPPING**

Course outcomes	On completion of this course, the students will be able:	Bloom Level
CO-1	To perform experiment and determine the wavelength using newton's ring setup & dispersive power of prism for violet, red & yellow color using spectrometer	L4
CO-2	To perform experiment and determine wavelength of prominent lines of mercury by plane diffraction grating using spectrometer	L3
CO-3	To measure the numerical aperture of an optical fiber and the coherent length and coherent time by using He-Ne Laser.	L3
CO-4	Determine the Band Gap of the semiconductor in the form of reverse biased P-N junction diode and determine forward and reverse bias resistance for semiconductor diode.	L5
CO-5	To determine the height of a given line drawn on wall by sextant, determine time constant (both current and voltage graphs are to be plotted)	L5

**B. MAPPING OF COURSE OUTCOMES WITH PROGRAMME OUTCOMES**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO2	PSO3
CO1	3	2	2	2	-	-	-	-	-	-	2	2	-	-	3
CO2	3	3	2	-	-	-	-	-	-	-	2	3	-	-	3
CO3	2	3	2	-	-	-	-	-	-	-	2	3	-	-	3
CO4	3	3	1	2	-	-	-	-	-	-	1	3	-	-	3
CO5	3	3	1	-	-	-	-	-	-	-	2	3	-	-	3
Average	3	2.8	1.6	2	-	-	-	-	-	-	1.8	2.8	-	-	3

**C. List of Experiment –**

1.	To determine the wavelength of Sodium light by Newton's Ring.
2.	To determine the dispersive power of material of a prism for violet, red & yellow colour of Mercury light with the help of spectrometer.
3.	To determine the wavelength of prominent lines of mercury by plane diffraction grating with the help of spectrometer.
4.	To verify the expression for the Resolving Power of Telescope.
5.	To measure the numerical aperture of an optical fiber by He-Ne Laser.
6.	To determine the coherent length and coherent time by using He-Ne Laser.
7.	To study the variation of a semiconductor resistance with temperature and hence determine the Band Gap of the semiconductor in the form of reverse biased P-N junction diode.
8.	To study the characteristics of semiconductor diode and determine forward and reverse bias resistance.
9.	To determine the height of a given line drawn on wall by sextant.
10.	To study Charging and Discharging of a condenser and determine time constant (both current and voltage graphs are to be plotted)
Add-ons Experiments	
11.	To determine the high resistance by method of leakage, using a Ballistic Galvanometer.
12.	To specify the specific resistance of a material of a given wire by Carey Foster's bridge.

Virtual Lab Link: <https://www.vlab.co.in/>

**A. COURSE OUTCOMES AND THEIR RESPECTIVE MAPPING**

Course Outcomes (COs)	At the end of this course, learners will able to:	Bloom level	PO Mapping
CO1	Analyze the strength of NaOH and Na <sub>2</sub> CO <sub>3</sub> solutions	L2	PO1, PO2, PO3, PO4, PO6, PO7
CO2	Measure hardness and chloride content of water	L1	PO1, PO2, PO3, PO4, PO6, PO7
CO3	Analyze hardness strength of Ferrous Ammonium sulphate solution and CuSO <sub>4</sub> solution	L2	PO1, PO2, PO3, PO4, PO6, PO7
CO4	Determine the different properties of lubricating oil	L3	PO1, PO2, PO3, PO4, PO5, PO6, PO7
CO5	Use different instruments & analytical techniques.	L2	PO1, PO2, PO3, PO4, PO6, PO7

**B. Mapping matrix of CO, PO & PSO**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	-	1	1	-	-	-	-	-
CO2	2	1	2	1	-	2	2	-	-	-	-	-
CO3	3	2	2	1	-	2	2	-	-	-	-	-
CO4	3	1	2	1	1	2	2	-	-	-	-	-
CO5	2	1	1	1	-	2	2	-	-	-	-	-
Wt. AVG	2.6	1.2	1.6	1	1	1.8	1.8					

**C. Mapping matrix of CO & PSO**

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	-	-	-	-	1
CO2	-	-	-	-	1
CO3	-	-	-	-	1
CO4	-	-	-	-	1
CO5	-	-	-	-	1
Wt. AVG	-	-	-	-	1

**D. LIST OF EXPERIMENTS**

1	To determine the strength of NaOH and Na <sub>2</sub> CO <sub>3</sub> in a given alkali mixture.
2	To determine the strength of Ferrous Ammonium sulphate solution with the help of K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> solution using diphenyl amine as internal indicator.
3	To determine the hardness of water by EDTA method.
4	To determine the amount of chloride content in drinking water
5	To determine the strength of CuSO <sub>4</sub> solution with the help of hypo solution.
6	To determine the acid value of a given oil.
7	To determine the viscosity of a given lubricating oil by Redwood viscometer.

<b>8</b>	To determine the flash and fire point of a given lubricating oil.
<b>9</b>	To determine the cloud and pour point of a given oil.
<b>10</b>	Synthesis of Bakelite.
Add-ons Experiments	
<b>11</b>	Determination of pH by pH-metric titration.
<b>12</b>	Estimation of an acid (weak/strong) by Conductometric titration.

**E. RECOMMENDED STUDY MATERIAL:**

S. No	Reference Book	Author	Publication
1	Engineering Chemistry	Dr. Mahima Tulsian	Jhunjhunwala Publication
2	Engineering Chemistry Lab Manual	Dr. N. Rama Jyothi	Shine Book publication
3	Chemistry	Dr. Sanjay Sharma	College Book House

Virtual Lab Link: <https://www.vlab.co.in/>

**COURSE OUTCOMES AND THEIR RESPECTIVE MAPPING**

Course Outcomes (COs)	At the end of this course, learners will able to:	Bloom level	PO Mapping
CO1	Gain concept of functional hierarchical code organization.	L2	PO1, PO2, PO3, PO4, PO6, PO7
CO2	Work with textual information, characters and strings	L1	PO1, PO2, PO3, PO4, PO6, PO7
CO3	Implement file handling concepts	L2	PO1, PO2, PO3, PO4, PO6, PO7
CO4	Implement real time applications using the power of C language features.	L3	PO1, PO2, PO3, PO4, PO5, PO6, PO7
CO5	Overcome and solve possible errors during program execution	L2	PO1, PO2, PO3, PO4, PO6, PO7

**B. Mapping matrix of CO, PO & PSO**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2
CO1	3	2	1	2	-	-	2	-	-	-	-	-
CO2	2	3	3	1	-	-	2	-	-	-	-	-
CO3	3	2	2	3	-	-	2	-	-	-	-	-
CO4	2	1	1	2	-	-	2	-	-	-	-	-
CO5	3	1	2	1	-	-	2	-	-	-	-	-
Wt. AVG	2.6	1.8	1.8	2			2					

**C. Mapping matrix of CO & PSO**

	PSO1	PSO2	PSO 3	PSO4	PSO5
CO1	3	-	-		
CO2	2	-	-		
CO3	3	-	-		
CO4	2	-	-		
CO5	1	-	-		
Wt. AVG	2.2				

**LIST OF EXPERIMENTS**

1	a) Given the values of the variables x, y and z, write a program to rotate their values such that x has the value of y, y has the value of z, and z has the value of x a) Write a program that reads a floating-point number and then displays the right-most digit of the integral part of the number.
2	a) Program to find largest and smallest number from four given numbers Program to find whether a year is leap or not
3	a) Write a C program in which enters any number by the user and perform the operation

	of Sum of digits of entered number. Write a C Program to convert Decimal number to Binary number
4	a) Find the sum of this series upto n terms $1+2+3+4+5+6+\dots$ b) Program to print Armstrong's numbers from 1 to 100 Write a program to convert years into Minute, Hours, Days, Months, Seconds using switch () statements
5	a) Write a C Program to print the reverse of an integer number b) Write a C program to check if the given Number is Prime or Not Write a C program to perform the factorial of given number
6	a) Write a C program to find maximum and minimum element in the Array b) Write a C program to Search the given element is in the Array or not (Linear Search) Write a C program to check if the given array is sorted or not
7	a) write a C program to perform Matrix addition and multiplication operations. Write a C Program to perform Transpose of a Matrix
8	a) Write a C Program to check if the given string is palindrome or not using Function b) Write a C Program to check if the given two strings are Anagram or not using Function Write a program to determine the length of the string and find its equivalent ASCII codes.
9	a) Write a C program to find nth Fibonacci number using Recursion Write a C Program to Find factorial of a number using Recursion
10	a) Write a C program to reverse an array using pointers and using Functions. (Dynamic Memory allocation for array) Write a C program to copy the contents of one array to another using pointers. (Dynamic Memory allocation for array)
Add-ons Experiments	
11	a) Write C Program to create a Book Structure and Pass this Book Structure as Argument to a function and print the total data in that function. a) Write C Program to create a Array of Books Structure and Pass this Book Structure as Argument to a function and return the book which has highest price.
12	a) Write a C program to open a text file and count the total number of lines, words, and characters. a) Write a C program that reads data from source.txt and copies it to destination.txt.

#### E. RECOMMENDED STUDY MATERIAL:

S. No	Reference Book	Author	Publication
1	Let us C	Yashwant Kanetkar	6th Edition
2	The C programming Language	Richie and Kenninghan	2nd Edition 2004
3	Programming in ANSI C	E Balaguruswamy	3rd Edition, 2005

Virtual Lab Link: <https://www.vlab.co.in/>

**COURSE OUTCOMES AND THEIR RESPECTIVE MAPPING**

Course Outcomes (COs)	At the end of this course, learners will able to:	Bloom level	PO Mapping
CO1	Understand basic functions of commands, their techniques and fundamentals used in drafting and drawing.	L2	PO1,PO2
CO2	Demonstrate the fundamentals of commands through line diagram.	L2	PO1,PO2, PO3
CO3	Compare various shortcut keys and their different use case in drafting.	L4	PO1,PO2,PO3,PO 4,PO5,PO6,PO7,P O9
CO4	Understand the fundamental principles of Blocks, Hatching, and texts of drawings.	L2	PO1,PO2,PO3,PO 4,PO5,PO6,PO7,P O8,PO9,PO10,PO 11,PO12
CO5	Creating the layout of 2D plans in the workspace.	L6	PO1,PO2,PO3,PO 4,PO5,PO6,PO7,P O8,PO9,PO10,PO 11,PO12

**B. Mapping matrix of CO, PO & PSO**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2
CO1	3	1	-	-	-	-	-	-	-	-	-	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-
CO3	3	1	1	1	3	1	2	-	1	-	-	-
CO4	3	3	2	3	3	2	2	2	2	1	1	1
CO5	3	3	3	3	3	3	3	3	2	2	2	2
Wt. AVG	3	2	2	2.3	3	2	2.3	2.5	1.6	1.5	1.5	1.5

**C. Mapping matrix of CO & PSO**

	PSO1	PSO2	PSO 3	PSO4	PSO5
CO1	1	-	-	-	-
CO2	1	-	-	-	-
CO3	1	-	-	-	-
CO4	1	-	-	-	-
CO5	1	-	-	-	-
Wt. AVG	1	-	-	-	-

**D. LIST OF EXPERIMENTS**

1	Introduction to AutoCAD and Drawing Tools Draw Different Shapes using Line, Polyline Circle, and Polygon.
2	Draw Different Shapes using Rectangle Use of Dimensions in Circle, rectangles, Line and other shapes.
3	Modify Drawings in AutoCAD using Modification Tools. Offset and Mirror Different Shapes and Lines.

<b>4</b>	Use Trim, Extend & Align, Scale and Stretch Command
<b>5</b>	Use of Text, Line, Block and Conversion Tools.
<b>6</b>	Introduction to Layers, How to add, Modify layers in layer manager.
<b>7</b>	Introduction of Hatch Command in AutoCAD
<b>8</b>	Opening and Modifying properties in AutoCAD
<b>9</b>	2D Plan of 1 BHK Residential Structure
<b>10</b>	2D Pine Flat Dam
	<b>Add-ons Experiments</b>
<b>11</b>	2D Sewerage Treatment Plant of Poornima University
<b>12</b>	Line Diagram of T shaped Building
	<b>Virtual Lab</b>
<b>1</b>	<a href="https://www.autodesk.in/campaigns/autocad-tutorials">https://www.autodesk.in/campaigns/autocad-tutorials</a>
<b>2</b>	<a href="https://web.autocad.com/login">https://web.autocad.com/login</a>

**COURSE OUTCOMES AND THEIR RESPECTIVE MAPPING**

Course Outcomes (COs)	At the end of this course, learners will able to:	Bloom level	PO Mapping
CO1	Assemble and understand the operation of house wiring systems	L1	PO1, PO2,
CO2	Gain the ability to prepare and test connections for single-phase and three-phase induction motors using auto transformers	L2	PO1, PO2, PO3,
CO3	Develop the skills to connect and measure the electrical parameters (voltage, current, and power) of various lighting systems, such as fluorescent lamps, sodium vapor lamps, and halogen lamps.	L3	PO1, PO2, PO3
CO4	Proficient in identifying, testing, and applying various electronic components, such as resistors, conductors, capacitors, diodes , LEDs, LCDs, BJTs,	L2	PO1, PO2, PO3
CO5	Verify the truth tables of basic logic gates (AND, OR, NOT, NOR, NAND) and understand their applications.	L2	PO1, PO2, PO4

**B. Mapping matrix of CO, PO & PSO**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	-								
CO2	3	2	3	-								
CO3	3	2	3	-								
CO4	3	3	2	-								
CO5	3	2	2	2								
Wt. AVG	3	2.4	2.4	2								

**LIST OF EXPERIMENTS**

1	Assemble house wiring including earthing for 1-phase energy meter, MCB, ceiling fan, tube light, three pin socket and a lamp operated from two different positions. Basic functional study of components used in house wiring.
2	Prepare the connection of ceiling fan along with the regulator and vary the speed.
3	Prepare the connection of single phase induction motor through 1-Phase Auto-transformer and vary the speed.
4	Prepare the connection of three phase squirrel cage induction motor through 3-Phase Autotransformer and vary the speed.
5	Prepare the connection of Fluorescent Lamp, Sodium Vapour and Halogen Lamp and measure voltage, current and power in the circuit.
6	Identification, testing and application of Resistors, Inductors, Capacitors, PN-Diode. Zenger Diode, LED, LCD, BJT, Photo Diode, Photo Transistor, Analog/Digital Multi- Metres and Function/Signal Generator.
7	Measure the frequency, voltage, current with the help of CRO.
8	Assemble the single phase half wave and full wave bridge rectifier & the analyse effect of L, C and L-C filters in rectifiers.
9	Verify the truth table of AND, OR, NOT, NOR and NAND gates
10	Introduction to IOT. Printing of a Hello World on LCD Screen using Arduino
	<b>Add-ons Experiments</b>

11	Controlling the Light Emitting Diode (LED) with a push button and Interfacing of the Relay with Arduino.
12	Introduction to Raspberry Pi and Programming of available GPIO pins of the corresponding device using native programming language. Interfacing of I/O devices like LED/Switch etc., and testing the functionality.
	<b>Virtual Lab</b>
<b>1</b>	To perform Ohm's Law <a href="http://vlabs.iitkgp.ernet.in/be/exp4/index.html">http://vlabs.iitkgp.ernet.in/be/exp4/index.html</a>
<b>2</b>	Half Wave Rectification <a href="http://vlabs.iitkgp.ernet.in/be/exp6/index.html">http://vlabs.iitkgp.ernet.in/be/exp6/index.html</a>
<b>3</b>	VI Characteristics of Diode <a href="http://vlabs.iitkgp.ernet.in/be/exp5/index.html">http://vlabs.iitkgp.ernet.in/be/exp5/index.html</a>

**A. COURSE OUTCOMES AND THEIR RESPECTIVE MAPPING**

COURSE OUTCOMES (Cos)	At the end of this course, learner will be able to :	Bloom Level	PO Mapping
CO – 01	Prepare a model of T Lap and T- Briddle Joint through carpentry shop	L3	PO1, PO2, PO3
CO – 02	Understand the making of prototype model through foundry shop	L2	PO1,PO2,PO3
CO – 03	Understand the difference between gas welding and arc welding and their applications.	L2	PO1, PO2, PO3
CO – 04	prepare a model on fitting shop through filling, drilling and tapping operation	L3	PO1, PO2,PO3
CO – 05	Understand the difference between forging, moulding and casting	L2	PO1, PO2, PO3

**B. MAPPING MATRIX OF CO, PO, & PSO**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	1	-	-	-	-	-	-	-	-	-
CO 2	3	1	2	-	-	-	-	-	-	-	-	-
CO 3	3	2	1	-	-	-	-	-	-	-	-	-
CO 4	3	2	1	-	-	-	-	-	-	-	-	-
CO 5	3	2	1	-	-	-	-	-	-	-	-	-
<b>WT. AVG</b>	<b>3</b>	<b>1.8</b>	<b>1.2</b>									

**C. DETAILED SYLLABUS**

1	<b>Carpentry Shop</b> <ul style="list-style-type: none"> <li>Timber, definition, engineering applications, seasoning and preservation</li> <li>Plywood and ply boards</li> </ul>
2	<b>Machine Shop</b> <ul style="list-style-type: none"> <li>Introduction to machine shop tools with emphasis on lathe machine operations.</li> <li>Practical exercises on turning, facing, chamfering, and knurling of cylindrical components.</li> </ul>
3	<b>Welding Shop</b> <ul style="list-style-type: none"> <li>Definition of welding, brazing and soldering processes and their applications</li> <li>Oxyacetylene gas welding process, equipment and techniques, types of flames and their applications</li> <li>Manual metal arc welding technique and equipment, AC and DC welding</li> <li>Electrodes: Constituents and functions of electrode coating, welding positions</li> <li>Types of welded joints, common welding defects such as cracks, undercutting, slag inclusion and boring</li> </ul>
4	<b>Fitting Shop</b> <ul style="list-style-type: none"> <li>Files, materials and classification.</li> </ul>
5	<b>Sheet metal shop</b> <ul style="list-style-type: none"> <li>Introduction to sheet metal tools, operations (cutting, bending, folding), and safety practices.</li> <li>Hands-on fabrication of simple components like trays, boxes, and funnels using sheet metal techniques.</li> </ul>
6	<b>Foundry Shop</b> <ul style="list-style-type: none"> <li>Moulding Sands, constituents and characteristics</li> <li>Pattern, definition, materials types, core prints</li> <li>Role of gate, runner, riser, core and chaplets</li> <li>Causes and remedies of some common casting defects like blow holes, cavities, inclusions</li> </ul>

**A. COURSE OUTCOMES AND THEIR RESPECTIVE MAPPING**

COURSE OUTCOMES (Cos)	At the end of this course, learner will be able to :	Bloom Level	PO Mapping
CO – 01	Understand basic technical drawing concepts, including lines, lettering, dimensions, and scales, through the creation of sketches and drawings.	L2	PO2, PO4, PO5
CO – 02	Construct conic sections (ellipse, parabola, and hyperbola) on drawing sheets, showcasing practical application skills.	L3	PO4, PO5,
CO – 03	Apply knowledge of projection techniques to represent complex objects, such as regular polygons in different positions.	L3	PO1, PO3, PO4, PO5
CO – 04	Differentiate between types of projections, such as orthographic projections with first and third angle conventions. Proficiently project points, straight lines, and planes in different positions	L3	PO1, PO4
CO – 05	Analyze knowledge of sectional views and machine drawing techniques to communicate design and manufacturing details effectively	L3	PO1, PO4

**B. MAPPING MATRIX OF CO, PO, & PSO**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	2	-	2	2	—	—	—	—	—	—	—
CO 2	-	-	-	3	2	—	—	—	—	—	—	—
CO 3	3	-	2	2	2	—	—	—	—	—	—	—
CO 4	3	-	-	2	-	—	—	—	—	—	—	—
CO 5	3	-	-	3	-	—	—	—	—	—	—	—
<b>WT. AVG</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>2.5</b>	<b>2</b>							

**C. List of Experiments**

1.	<ul style="list-style-type: none"> <li>• Lines, Lettering and Dimension (Sketch Book)</li> <li>• Scales: Representative Fraction, plain scales, diagonal scales, (In drawing sheet 1)</li> </ul>
2.	<ul style="list-style-type: none"> <li>• Conic Sections: Construction of ellipse, parabola and hyperbola by different methods( in drawing sheet 2)</li> </ul>
3.	<ul style="list-style-type: none"> <li>• Type of Projection, Orthographic projection: first angle and third angle projection (in drawing sheet)</li> <li>• Projection of Points</li> <li>• Projection of Straight lines</li> <li>• Projection of planes: Different positions of plane lamina like: regular polygon (four problems in drawing sheet 3)</li> </ul>
4.	<ul style="list-style-type: none"> <li>• Orthographic Projections (3 Problems in drawing sheet 4)</li> </ul>
5.	<ul style="list-style-type: none"> <li>• Sectional Views (2 Problems) and Riveted joints, lap joints, butt joints, (drawing sheet 5)</li> </ul>

**D. RECOMMENDED STUDY MATERIAL**

Sr.No	Reference Book	Author	Edition	Publication
1	Engineering Drawing	N. D. Bhatt	Latest	Charotar Publishing House PVT. LTD.
<b>Virtual Lab</b>				
1	<a href="https://kdm-iitkgp.vlabs.ac.in/exp/simple-drawing-board/theory.html">https://kdm-iitkgp.vlabs.ac.in/exp/simple-drawing-board/theory.html</a>			
2	<a href="https://cse18-iiith.vlabs.ac.in/">https://cse18-iiith.vlabs.ac.in/</a>			

**E. RECOMMENDED STUDY MATERIAL**

<b>S. No.</b>	<b>Reference Book</b>	<b>Author</b>	<b>Edition</b>	<b>Publication</b>
1	Engineering Drawing	N. D. Bhatt	Latest	Charotar Publishing House PVT. LTD.
<b>Virtual Lab</b>				
1	<a href="https://kdm-iitkgp.vlabs.ac.in/exp/simple-drawing-board/theory.html">https://kdm-iitkgp.vlabs.ac.in/exp/simple-drawing-board/theory.html</a>			
2	<a href="https://cse18-iiith.vlabs.ac.in/">https://cse18-iiith.vlabs.ac.in/</a>			

## For FCE Students

Code: BTXCCE2103

Introduction to Web Technology

3 Credits [LTP:3-0-0]

### A. Course Outcomes: -

CO	Cognitive Level	Course Outcomes
CO-1	Understand	Understand the fundamentals of internet technologies, protocols, and the client-server architecture to build a foundation for web development.
CO-2	Apply	Apply HTML and CSS concepts to create static web pages with structured layout and styling.
CO-3	Apply	Use JavaScript to implement interactivity and handle events through DOM manipulation and scripting logic.
CO-4	Analyze	Analyze and implement dynamic server-side functionality using PHP, including form handling, sessions, and cookies.
CO-5	Create	Design and deploy functional websites using modern deployment tools and platforms, and demonstrate practical knowledge of website management.

### A. B. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to HTML And Internet	6
2.	HTML& CSS	9
3.	JAVASCRIPT	10
4.	PHP	7
5.	Practical web site development	7

### C. DETAILED SYLLABUS

Unit	Unit Details
1.	<b>Introduction to HTML And Internet</b>
	<ul style="list-style-type: none"> <li>Introduction, History of internet, Internet Design Principles, Internet Protocols - FTP, TCP/IP, SMTP, Telnet, etc., Client Server Communication, Web System architecture</li> <li>Evolution of the Web, Web architectures, Web clients and servers, Static and Dynamic Web Applications, Front end and back end web development.</li> <li>HTML, CSS, JS, XML; HTTP, secure HTTP, etc; URL, Web Services – SOAP, REST</li> <li>Conclusion of the Unit</li> </ul>
2.	<b>HTML&amp; CSS</b>
	<ul style="list-style-type: none"> <li>Introduction to Html, Html Document structure, Html Editors, Html element/tag &amp; attributes, Designing simple page - Html tag, Head tag, Body tag;</li> <li>More HTML Tags - Anchor tag, Image tag, Table tag, List tag, Frame tag, Div tag ; Html forms - Input type, Text area, Select , Button, Images.</li> <li>New features, Local storage, Web Sockets, Server events, Canvas, Audio &amp; Video, Geo location, Micro data, Drag and Drop</li> <li>Introduction to CSS, Syntax, Selectors, Embedding CSS to Html, Formatting fonts, Text &amp; background colour, Inline styles, External and Internal Style Sheets, Borders &amp; boxing.</li> <li>Conclusion of the Unit</li> </ul>
3.	<b>JAVASCRIPT</b>
	<ul style="list-style-type: none"> <li>Introduction of the Unit</li> <li>Features, syntax, and script integration methods (inline, internal, external)</li> <li>Variables (var, let, const), data types, operators, Control structures (if, switch, loops), functions, and scope</li> <li>DOM structure: nodes, elements &amp; attributes, accessing elements: getElementById, querySelector, etc., Modifying content, style, and attributes dynamically</li> <li>Common events (click, mouseover, keydown), Using addEventListener, preventing default actions, Event bubbling and delegation.</li> <li>Conclusion of the Unit</li> </ul>

<b>4.</b>	<b>PHP</b>
	<ul style="list-style-type: none"> <li>• Introduction of the Unit</li> <li>• Role of PHP in server-side web development, Comparison with client-side scripting (JavaScript), Syntax and embedding PHP in HTML</li> <li>• Variables, data types, constants, and operators, Control structures: if, else, switch, loops, Functions and arrays</li> <li>• Overview of PHP superglobals: \$_GET, \$_POST, \$_REQUEST, \$_SERVER\$_SESSION, \$_COOKIE, \$_FILES, \$_ENV, \$_GLOBALS</li> <li>• Dynamic content generation, Including external files (include, require), Using PHP to show form input, session info, etc.</li> <li>• Conclusion of the Unit</li> </ul>
<b>5.</b>	<b>Practical web site development</b>
	<ul style="list-style-type: none"> <li>• Introduction of the Unit</li> <li>• Commonly used Web Servers and browsers, Setting up a server and domain name, website types and structures,</li> <li>• Protocols used for web application deployment :</li> <li>• Deploy web application on : GitHub, Netlify, Vercel, Replit, Firebase etc.</li> <li>• Web authoring tools, Web hosting, website maintenance, generating traffic to your website.</li> <li>• Conclusion of the Unit</li> </ul>

#### D. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Practical Web Design for Absolute Beginners	AdrianW. West	2016	Apress 2016
2.	Introducing Web Development	Jorg Krause	2017	Apress 2017
3.	HTML & CSS: The Complete Reference	Thomas Powell	2010	McGrawHill, Fifth Edition.
<b>Reference Book</b>				
1	HTML and CSS: Design and Build Websites – by Jon Duckett			
2.	Head First HTML and CSS: A Learner’s Guide to Creating Standards-Based Web Pages – by Elisabeth Robson & Eric Freeman Publisher- ORELLY			
<b>Online Resources</b>				
1	<a href="https://www.w3schools.com/html/html_links.asp">https://www.w3schools.com/html/html_links.asp</a>			
2	<a href="https://www.tutorialrepublic.com/html-tutorial/html-links.php">https://www.tutorialrepublic.com/html-tutorial/html-links.php</a>			

#### E. CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	1	-	-	-	-	-	-	-	-	-	1	1	1	-
CO2	2	2	1	-	-	-	-	-	-	-	-	-	2	2	1	-
CO3	3	3	2	1	-	-	-	-	-	-	-	-	3	2	2	-
CO4	3	3	3	2	-	-	-	-	-	-	-	-	3	3	2	-
CO5	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3	-

**A. Course Outcomes: -**

CO	Cognitive Abilities	Course Outcomes
CO – 01	Understand	To understand the core concepts of HTML, CSS, and client-server architecture in building static web pages.
CO – 02	Apply	To apply styling and layout techniques using CSS for designing visually appealing and responsive web pages.
CO – 03	Apply	To implement interactive features using JavaScript and validate user input on web forms.
CO – 04	Analyze	To analyze and develop dynamic web pages using PHP for server-side scripting and file handling.
CO – 05	Evaluate	To evaluate user interaction data and apply session tracking techniques in PHP for personalized web content.

**B. List of Experiments:-**

1	a. Create a web page using basic HTML features like tags, attributes, elements and page title b. How to install and configure a web server
2	a. Create My Profile Page and make it functional by making use of headings, paragraphs, lists, images and links. b. Enhance the above web page using CSS include the following: <ol style="list-style-type: none"> <li>1. Use different font styles.</li> <li>2. Set back ground image for both the page and single elements on the page.</li> <li>3. Control the repetition of image with back ground-repeat property.</li> <li>4. Define style for links as a:link, b:active, c:hover, d:visited.</li> <li>5. Add customized cursors for links.</li> </ol>
3	Design an HTML form titled "Workshop Registration" using <form> tags as below: <div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;"> <p><b>Workshop Registration Form</b></p> <p>Full Name: <input type="text"/></p> <p>Email Address: <input type="text"/></p> <p>Gender: <input type="radio"/> Male <input type="radio"/> Female <input type="radio"/> Other</p> <p>Select Your Skills:</p> <p><input type="checkbox"/> HTML</p> <p><input type="checkbox"/> CSS</p> <p><input type="checkbox"/> JavaScript</p> <p><input type="checkbox"/> PHP</p> <p>Country: <input type="text" value="India"/></p> <p>Comments or Expectations:</p> <p><input type="text"/></p> <p><input type="button" value="Submit"/> <input type="button" value="Reset"/></p> </div>
4	Create the following webpage: <ol style="list-style-type: none"> <li>Show the class time table in a tabular format.</li> <li>Create a web page using HTML to show your geolocation.</li> </ol>
5	Create a webpage using HTML for audio and video player.
6	Create a log in registration form and validate it using JavaScript.
7	a) Create a page with a <p> element and a <button>. When the button is clicked, change the paragraph text to "You clicked the button!". b) Create a button and a <p> element. Every time the button is clicked, increment and display a counter in the <p>. c) Create a page with a <button> labeled "Click Me". When clicked, it should display the current date and time in a <div> using JavaScript and the click event.
8	a) Create an HTML page with an input field. On keydown, display the key pressed in a <span> next to the input field. b) Create a dropdown (<select>) with color options (e.g., red, blue, green). Change the page background to the selected color on change. c) Create an image that changes to another image when hovered over, and reverts back when the mouse leaves.

	d) Create a Full To-Do List with Add, Done, Show Done, and Delete Functionality
9	Create a log in registration form using PHP.
10	Create a dynamic web page by using PHP conditional operators, loops and strings .
	<b>Add-ons Experiments</b>
11	Develop a PHP web application tracks the user as how many times visited and last visited time
12	Develop a static website using HTML, CSS & JavaScript

### C. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1	Practical Web Design for Absolute Beginners	AdrianW. West	2016	Apress 2016
2	Introducing Web Development	Jorg Krause	2017	Apress2017
3	HTML & CSS: The Complete Reference	Thomas Powell	2010, Fifth Edition	McGrawHill,
<b>Reference Book</b>				
1	<u>HTML and CSS: Design and Build Websites – by Jon Duckett</u>			
2.	<u>Head First HTML and CSS: A Learner’s Guide to Creating Standards-Based Web Pages – by Elisabeth Robson &amp; Eric Freeman Publisher- ORELLY</u>			

### D. CO-PO-PSO Mapping

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	3	2	-	-	2	-	-	-	-	2	-	3	2	-	2	3
CO 2	2	-	3	-	2	-	-	-	-	-	-	2	-	-	2	3
CO 3	2	2	3	-	3	-	-	-	-	-	-	2	-	-	3	3
CO 4	2	3	3	2	3	-	-	-	-	-	-	3	-	2	2	3
CO 5	2	3	3	-	3	-	-	-	-	-	-	3	-	-	2	3

# Ability Enhancement Courses

## Semester II

**BEACHM2213**

**QUANTITATIVE AND VERBAL APTITUDE TRAINING-I**

**Credits: 1 (1-0-2)**

### COURSE OUTCOMES AND THEIR RESPECTIVE MAPPING

Course Outcomes	Details of Course Outcomes	Bloom's Taxonomy Level
CO1	Understand concepts of number systems, percentages, and interest to solve quantitative problems.	Understand
CO2	Analyze data from tables, pie charts, and bar graphs to derive conclusions and evaluate the sufficiency of information.	Analyze
CO3	Demonstrate accuracy in solving logical reasoning problems involving arrangements, blood relations, and visual patterns.	Apply
CO4	Apply grammatical rules and sentence structures to identify and correct errors in English usage.	Apply
CO5	Develop effective reading, comprehension, and vocabulary skills to enhance verbal aptitude and communication.	Create

### OUTLINE OF THE COURSE

UNIT NO.	UNIT NAME	HOURS
1	<b>Foundations of Quantitative Reasoning</b>	3
2	<b>Applied Arithmetic and Data Analysis</b>	3
3	<b>Logical and Analytical Reasoning</b>	3
4	<b>Verbal Mastery and Grammar Essentials</b>	3
5	<b>Reading, Vocabulary &amp; Data Interpretation</b>	3

### DETAILED SYLLABUS

Unit	Unit Details
1	<b>Foundations of Quantitative Reasoning</b>
	<ul style="list-style-type: none"> <li>● Introduction to Unit</li> <li>● Number System – I      Number system, Power cycle</li> <li>● Number System – II      Remainder cycle, Factors, Multiples, HCF &amp; LCM</li> <li>● Reading Comprehension: Speed Reading Strategies, RC types, Tackling Strategies</li> <li>● Conclusion of the Unit</li> </ul>
2	<b>Applied Arithmetic and Data Analysis</b>
	<ul style="list-style-type: none"> <li>● Introduction of Unit</li> <li>● Data Arrangement – I      Linear and Circular Arrangements</li> <li>● Data Arrangement – II      Multi-dimensional Arrangement, Blood Relations</li> <li>● Time and Work – I      Work with efficiencies, Pipes and Cisterns</li> <li>● Conclusion of the Unit</li> </ul>
3	<b>Logical and Analytical Reasoning</b>
	<ul style="list-style-type: none"> <li>● Introduction to Unit</li> <li>● Time and Work – II      Work equivalence, Division of wages</li> <li>● Sentence Correction – I      Subject-Verb Agreement, Modifiers, Parallelism</li> <li>● Conclusion of the Unit</li> </ul>
4	<b>Verbal Mastery and Grammar Essentials</b>
	<ul style="list-style-type: none"> <li>● Introduction to Unit</li> <li>● Sentence Correction – II      Pronoun Agreement, Verb Tenses, Comparisons</li> <li>● Sentence Correction – III      Prepositions, Determiners</li> <li>● Conclusion of the Unit</li> </ul>
5	<b>Reading, Vocabulary &amp; Data Interpretation</b>
	<ul style="list-style-type: none"> <li>● Introduction of Unit</li> <li>● Reasoning – I      Coding-Decoding, Series</li> </ul>

- |  |  |
|--|--|
|  | <ul style="list-style-type: none"><li>● Reasoning – II Analogy, Odd Man Out, Visual Reasoning</li><li>● Percentage &amp; Interest – I Percentages, Percentage Change, S.I.</li><li>● Percentage &amp; Interest – II C.I., Relation between S.I. and C.I.</li><li>● Verbal &amp; DI Sentence Completion, Para-jumbles, Vocabulary, DI &amp; DS</li><li>● Conclusion of the Unit</li></ul> |
|--|--|

# Skill Enhancement Courses

## Semester II

**BELCSE 2201**

**Skill Enhancement Course-II**

**Credits: 1 (1-0-2)**

### Course: Fundamental of Programming

#### COURSE OUTCOMES: On completion of the course a student will be able to:

- Demonstrate basic input and output operations using formatted printing and user input methods.
- Apply various operators to perform arithmetic, relational, logical, and bitwise operations in programs.
- Implement conditional logic using if-else, nested conditions, and switch-case constructs.
- Develop iterative solutions using loops such as for, while, and do-while, along with loop control statements.
- Generate mathematical sequences like Fibonacci, arithmetic, and geometric series using programming logic.

S. No.	Topic	Sub-Topics
1	<b>Input &amp; Output</b>	<p><b>System.out.println():</b> Used to display output on the console. Allows formatted output with printf() or format().</p> <p><b>Practical Exercise:</b> Write a program to print a personalized greeting message using System.out.println().</p> <p><b>Scanner class:</b> Reads user input from the console. Supports methods like nextInt(), nextDouble(), nextLine() for different data types.</p> <p><b>Practical Exercise:</b> Write a program to take two numbers as input from the user and display their sum.</p>
2	<b>Operators</b>	<p><b>Arithmetic operators:</b> Perform basic mathematical operations like addition, subtraction, multiplication, division, modulus, exponentiation, and floor division.</p> <p><b>Relational operators:</b> Compare values and return Boolean results like greater than, less than, equal to, or not equal.</p> <p><b>Logical operators:</b> Combine multiple conditions using logical connectors like AND, OR, and NOT.</p> <p><b>Assignment operators:</b> Assign values to variables and combine them with arithmetic or logical operations.</p> <p><b>Bitwise operators:</b> Perform operations at the binary level, manipulating individual bits in integers.</p> <p><b>Practical Exercise:</b> Create a program to find to all the operators</p>
3	<b>Operators</b>	<p><b>Arithmetic operators:</b> Perform basic mathematical operations like addition, subtraction, multiplication, division, modulus, exponentiation, and floor division.</p> <p><b>Relational operators:</b> Compare values and return Boolean results like greater than, less than, equal to, or not equal.</p> <p><b>Logical operators:</b> Combine multiple conditions using logical connectors like AND, OR, and NOT.</p> <p><b>Assignment operators:</b> Assign values to variables and combine them with arithmetic or logical operations.</p> <p><b>Bitwise operators:</b> Perform operations at the binary level, manipulating individual bits in integers.</p> <p><b>Practical Exercise:</b> Create a program to find to all the operators</p>
4	<b>Decision Making</b>	<p><b>if, elif, else statements:</b> Control the program flow based on conditions. Execute specific blocks of code depending on whether conditions are met.</p> <p><b>Practical Exercise:</b> Write a program to determine if a number is positive, negative, or zero.</p> <p><b>Nested conditions:</b> Allow the inclusion of an if statement inside another if to test complex logic.</p> <p><b>Practical Exercise:</b> Create a program to check if a number is divisible by both 2 and 3.</p> <p><b>switch-case:</b> Selects among multiple options based on the value of an expression.</p> <p><b>Practical Exercise:</b> Create a program that accepts a number (1-7) and prints the corresponding day of the week.</p>
5	<b>Decision Making</b>	<p><b>if, elif, else statements:</b> Control the program flow based on conditions. Execute specific blocks of code depending on whether conditions are met.</p> <p><b>Practical Exercise:</b> Write a program to determine if a number is positive, negative, or zero.</p> <p><b>Nested conditions:</b> Allow the inclusion of an if statement inside another if to test complex logic.</p> <p><b>Practical Exercise:</b> Create a program to check if a number is divisible by both 2 and 3.</p> <p><b>switch-case:</b> Selects among multiple options based on the value of an expression.</p> <p><b>Practical Exercise:</b> Create a program that accepts a number (1-7) and prints the corresponding day of the week.</p>

6	<b>Decision Making</b>	<p><b>if, elif, else statements:</b> Control the program flow based on conditions. Execute specific blocks of code depending on whether conditions are met.</p> <p><b>Practical Exercise:</b> Write a program to determine if a number is positive, negative, or zero.</p> <p><b>Nested conditions:</b> Allow the inclusion of an if statement inside another if to test complex logic.</p> <p><b>Practical Exercise:</b> Create a program to check if a number is divisible by both 2 and 3.</p> <p><b>switch-case:</b> Selects among multiple options based on the value of an expression.</p> <p><b>Practical Exercise:</b> Create a program that accepts a number (1-7) and prints the corresponding day of the week.</p>
7	<b>Looping</b>	<p><b>for loop:</b> Used to iterate over sequences like ranges, lists, or strings, executing a block of code for each element.</p> <p><b>Practical Exercise:</b> Write a program to print the squares of numbers from 1 to 10.</p> <p><b>while loop:</b> Executes a block of code as long as the condition is true, often used when the number of iterations is unknown.</p> <p><b>Practical Exercise:</b> Write a program to find the sum of natural numbers up to a given limit using a while loop.</p> <p><b>do-while loop:</b> Similar to while, but guarantees at least one iteration.</p> <p><b>Practical Exercise:</b> Create a program to repeatedly ask the user for input until a valid number is provided.</p> <p><b>Loop control statements:</b> break stops the loop, continue skips the current iteration, and pass is a placeholder for future code without affecting execution.</p> <p><b>Practical Exercise:</b> Demonstrate the use of break to exit a loop when a condition is met.</p>
8	<b>Looping</b>	<p><b>for loop:</b> Used to iterate over sequences like ranges, lists, or strings, executing a block of code for each element.</p> <p><b>Practical Exercise:</b> Write a program to print the squares of numbers from 1 to 10.</p> <p><b>while loop:</b> Executes a block of code as long as the condition is true, often used when the number of iterations is unknown.</p> <p><b>Practical Exercise:</b> Write a program to find the sum of natural numbers up to a given limit using a while loop.</p> <p><b>do-while loop:</b> Similar to while, but guarantees at least one iteration.</p> <p><b>Practical Exercise:</b> Create a program to repeatedly ask the user for input until a valid number is provided.</p> <p><b>Loop control statements:</b> break stops the loop, continue skips the current iteration, and pass is a placeholder for future code without affecting execution.</p> <p><b>Practical Exercise:</b> Demonstrate the use of break to exit a loop when a condition is met.</p>
9	<b>Looping</b>	<p><b>for loop:</b> Used to iterate over sequences like ranges, lists, or strings, executing a block of code for each element.</p> <p><b>Practical Exercise:</b> Write a program to print the squares of numbers from 1 to 10.</p> <p><b>while loop:</b> Executes a block of code as long as the condition is true, often used when the number of iterations is unknown.</p> <p><b>Practical Exercise:</b> Write a program to find the sum of natural numbers up to a given limit using a while loop.</p> <p><b>do-while loop:</b> Similar to while, but guarantees at least one iteration.</p> <p><b>Practical Exercise:</b> Create a program to repeatedly ask the user for input until a valid number is provided.</p> <p><b>Loop control statements:</b> break stops the loop, continue skips the current iteration, and pass is a placeholder for future code without affecting execution.</p> <p><b>Practical Exercise:</b> Demonstrate the use of break to exit a loop when a condition is met.</p>
10	<b>Series Programming</b>	<p><b>Series Programming:</b> It involves generating various types of sequences like arithmetic, geometric, Fibonacci, etc. These series are useful in mathematics and algorithm design.</p> <p><b>Practical Exercise:</b> Write a program to generate the Fibonacci series up to n terms.</p> <p><b>Arithmetic and Geometric Series:</b> The arithmetic series involves generating numbers by adding a constant difference to the previous term. The nth term is given by <math>T_n = a + (n-1) * d</math>. A geometric series is a sequence where each term is found by multiplying the previous term by a constant ratio r. The nth term is <math>T_n = a * r^{(n-1)}</math>, where a is the first term and r is the common ratio. The sum of the first n terms is <math>S = a * (1 - r^n) / (1 - r)</math>. This series often appears in financial calculations such as compound interest.</p> <p><b>Practical Exercise:</b> Write a program to generate the first n terms of an arithmetic and geometric series.</p>
11	<b>Series Programming</b>	<p><b>Series Programming:</b> It involves generating various types of sequences like arithmetic, geometric, Fibonacci, etc. These series are useful in mathematics and algorithm design.</p> <p><b>Practical Exercise:</b> Write a program to generate the Fibonacci series up to n terms.</p> <p><b>Arithmetic and Geometric Series:</b> The arithmetic series involves generating numbers by adding a constant difference to the previous term. The nth term is given by <math>T_n = a + (n-1) * d</math>. A geometric series is a sequence where each term is found by multiplying the previous term by a constant ratio r. The nth term is <math>T_n = a * r^{(n-1)}</math>, where a is the first term and r is the common ratio. The sum of</p>

		<p>the first n terms is <math>S = a * (1 - r^n) / (1 - r)</math>. This series often appears in financial calculations such as compound interest.</p> <p><b>Practical Exercise:</b> Write a program to generate the first n terms of an arithmetic and geometric series.</p>
12	<p><b>Pattern Programming</b></p>	<p><b>Star Pattern:</b> Pattern programming involves printing specific patterns (e.g., stars, numbers) arranged in different shapes like triangles, squares, pyramids, etc. These patterns help practice loops and conditional statements.</p> <p><b>Practical Exercise:</b> Write a program to print the following pyramid of stars:</p> <pre>* *** *****</pre> <p><b>Number and Alphabet Pattern:</b> In number patterns, numbers are arranged in specific sequences, often following simple rules. Examples include printing numbers in ascending or descending order in different shapes.</p> <p><b>Practical Exercise:</b> Write a program to print a number triangle pattern like:</p> <pre>1 1 2 1 2 3</pre>

# Value Added Courses (VAC)

Code: BUVCVD1201/ 2201

Entrepreneurship

1 Credits [LTP: 0-0-2]

## COURSE OUTCOMES

- Understand the role of entrepreneurship and assess entrepreneurial traits for personal development
- Demonstrate teamwork, leadership, creative thinking, and problem-solving skills in entrepreneurial contexts
- Identify and evaluate entrepreneurial opportunities through fieldwork and feasibility analysis.
- Develop and articulate business models, value propositions, and branding strategies for startup ideas.
- Pitch startup concepts confidently and test prototypes through practical simulations and presentations.

## DETAILED SYLLABUS

S. No.	Activity
1	Discovering Entrepreneurship ( <i>Roleplay + Reflection</i> ) - Understand who an entrepreneur is, explore the relevance of entrepreneurship in daily life and India's economy.
2	Entrepreneurial Traits Self-Assessment ( <i>Psychometric test + Peer discussion</i> ) - Reflect on one's own entrepreneurial potential and learn about key traits such as risk-taking, innovation, and leadership.
3	Team Building and Leadership Game ( <i>Marshmallow Challenge / Tower Building</i> )- Experience real-time leadership, communication, and team dynamics.
4	Creative Thinking & Problem Solving ( <i>SCAMPER Technique, Brainwriting</i> ) - Apply creativity tools to real-life problems and generate startup-worthy ideas.
5	Opportunity Hunting on Campus/Community ( <i>Field task + analysis</i> ) - Identify unmet needs around them and frame them as entrepreneurial opportunities.
6	Feasibility Check – Market & Tech ( <i>Customer interviews, internet research</i> ) - Evaluate technical and market feasibility of selected ideas.
7	Value Proposition Canvas ( <i>Hands-on worksheet</i> ) - Learn how to define pain points, gains, and value offering for a chosen idea.
8	Business Model Canvas ( <i>Build BMC for idea in teams</i> ) - Draft one-page startup blueprint covering key segments.
9	Elevator Pitch – 60 Seconds to Win ( <i>Practice in class + peer feedback</i> ) - Develop confidence and clarity in articulating startup ideas.
10	Startup Branding and Naming Workshop ( <i>Design logo/tagline using Canva/Figma</i> ) - Understand basics of startup identity, naming, logo creation, and storytelling.
	<b>Add-ons</b>
11	Mini Campus Startup Fair ( <i>1-day sales/prototype simulation</i> ) - Create and test MVP/prototype through sales or demo booths within campus.
12	Final Pitch + Learning Showcase ( <i>Team presentation + reflection journal</i> ) - Summarize the journey, pitch refined startup idea, and reflect on growth and learning.

**Code: BUVCVA1201/2201****Performing Arts****1 Credits [LTP: 0-0-2]****(Global Moves: A Practice Course in Dance)****COURSE OUTCOMES**

- Gain practical exposure to Indian and international dance styles, fostering cultural appreciation and diversity.
- Develop physical awareness, rhythm, coordination, and stamina through structured training.
- Learn and perform choreographies across diverse genres, enhancing versatility and adaptability.
- Enhance stage presence, group dynamics, and body confidence, crucial for performing arts.
- Create original dance compositions using acquired vocabularies, culminating in a final polished performance and a comprehensive video portfolio.

**DETAILED SYLLABUS**

S.No.	Activity
1	Foundations of Movement <ul style="list-style-type: none"> <li>• Introduction to body alignment, posture, balance, and rhythm</li> <li>• Daily warm-ups, isolations, strength-building, and flexibility training</li> <li>• Introduction to breath and movement synchrony</li> </ul> Music and tempo awareness
2	Indian Folk Dance Practices I (dance styles such as Garba, Ghoomar, Bhangra, Kalbeliya)
3	Indian Folk Dance Practices II (dance styles such as Garba, Ghoomar, Bhangra, Kalbeliya)
4	Classical and Semi-Classical Basics I (Bharatanatyam, Kathak, Odissi)
5	Classical and Semi-Classical Basics II (Bharatanatyam, Kathak, Odissi)
6	International Groove Sessions I (Basics of Ballroom, Latin Dances, such as Salsa and Cumbia, Bacchata, Contemporary dance, Hip-Hop)
7	International Groove Sessions II (Basics of Ballroom, Latin Dances, such as Salsa and Cumbia, Bacchata, Contemporary dance, Hip-Hop)
8	International Groove Sessions III (Basics of Ballroom, Latin Dances, such as Salsa and Cumbia, Bacchata, Contemporary dance, Hip-Hop)
9	Choreography Lab 1 <ul style="list-style-type: none"> <li>• Small group choreographies using Indian and global movement vocabularies</li> <li>• Music selection, improvisation games, transitions</li> </ul> Peer-to-peer feedback and refinement
10	Choreography Lab 2 + Performance Skills <ul style="list-style-type: none"> <li>• Full choreography creation (3–5 min group piece)</li> <li>• Focus on stage presence, projection, entrances/exits</li> </ul> Styling, costumes, and syncing with music
	<b>Add-ons</b>
11	Rehearsals and Filming <ul style="list-style-type: none"> <li>• Rehearsal with stage lighting and mock performance runs</li> </ul> On-camera performance practice and professional video shoot
12	Final Showcase <ul style="list-style-type: none"> <li>• Public showing or campus performance</li> <li>• Reflection circle and feedback</li> </ul> Video portfolio handed over to students

**B.Tech- III<sup>rd</sup> Semester**  
**Batch: 2025-29**

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Course Outcomes
CO1	Remember	To understand core Python concepts including components, versions, type systems, and the differences between interpreters, compilers, and Python versions.
CO2	Understand	To understand advanced functional programming features like first-class functions, immutability, iterators, generators, and the use of strings, tuples, and named tuples.
CO3	Apply	To understand best coding practices, file operations, and gain introductory knowledge of essential Python libraries for real-world applications.
CO4	Apply	To understand data validation techniques, outlier detection and treatment methods for improving data quality.
CO5	Apply	To understand the concept and techniques of curve fitting for modeling relationships between variables.

**B. CO-PO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	-	-	-	-	-	-	-	-	-	3	-	-	-
CO2	2	3	1	-	-	-	-	-	-	-	-	-	2	-	-	-
CO3	2	3	-	-	1	-	-	-	-	-	-	-	1	-	3	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-	-
CO5	3	-	2	-	-	-	-	-	-	-	-	1	2	1	-	-
Wt. AVG	2.3	2.7	1.0	-	1.0	-	-	-	-	-	-	-	2.0	-	3.0	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Setting up the Python Environment	8
2.	Programming with Python-1	8
3.	Programming with Python-2	9
4.	Data Pre-Processing	7
5.	Statistical Modelling	8

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Introduction to Python Programming</b> <ul style="list-style-type: none"> <li>Introduction to Unit</li> <li>What is Python,</li> <li>Uses of Python Programming Language / Python Applications</li> <li>Features of Python Programming Language</li> <li>Python-2 and Python-3 differences</li> <li>Python environment setup — Installation and working of IDE</li> <li>Running Simple Python scripts to display 'welcome' message.</li> <li>Python Data Types: Numbers, String, Tuples, Lists, Dictionary. Python building blocks — Identifiers, Keywords, Indention, Variables, Comments</li> <li>Conclusion of unit</li> </ul>
2.	<b>Python Operators and Control Flow statements</b> <ul style="list-style-type: none"> <li>Introduction to Unit</li> <li>Basic Operators: Arithmetic, Comparison/ Relational, Assignment, Logical, Bitwise, Membership, Identity operators, Python Operator Precedence</li> <li>Control Flow:</li> <li>Conditional Statements (if, if ... else, nested if)</li> </ul>

	<ul style="list-style-type: none"> <li>• Looping in python (while loop, for loop, nested loops)</li> <li>• Conclusion of Unit</li> </ul>
<b>3.</b>	<b>Data Structures, Python Functions and Packages</b>
	<ul style="list-style-type: none"> <li>• Introduction to Unit</li> <li>• Lists, Tuple, Sets</li> <li>• String and Slicing</li> <li>• Use of Python built</li> <li>• User defined functions and its types</li> <li>• Using standard packages (math, scipy, Numpy, pandas)</li> <li>• Conclusion of Unit</li> </ul>
<b>4.</b>	<b>Object Oriented Programming</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Creating Classes and Objects</li> <li>• Inheritance</li> <li>• Method Overloading and Overriding</li> <li>• Data Hiding</li> <li>• Types of Methods: Instance Methods, Static Methods, Class Methods</li> <li>• Conclusion of Unit</li> </ul>
<b>5.</b>	<b>File I/O Handling and Exception Handling</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Types of File</li> <li>• File Objects, File Built-in Function, File Built-in Methods</li> <li>• File Built-in Attributes</li> <li>• Read/write operations Reading Text</li> <li>• Errors in Python: Compile-Time Errors, Runtime Errors , Logical Errors</li> <li>• Regular expressions</li> <li>• Conclusion of Unit</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Python for Beginners,	Harsh Bhasin,	Latest	New Age International
2	Core Python Programming	Chun, JWesley	Pearson,2007	Core Python Programming
<b>Reference Book</b>				
1.	Martin C Brown, The Compleetete Reference- Python, Mc Graw Hill			
2.	Ryan Turner, Python Programming 3 in 1, Kindle			
<b>Online Resources</b>				
1.	<a href="https://www.geeksforgeeks.org/python/python-programming-language-tutorial/">https://www.geeksforgeeks.org/python/python-programming-language-tutorial/</a>			
2.	<a href="http://www.coursera.org">www.coursera.org</a>			

## A. COURSE OUTCOMES: -

CO	Cognitive Abilities	Course Outcomes
CO1	Remember	Define fundamental data structure concepts, including classification, time and space complexity, dynamic memory allocation, and recursion
CO2	Understand	Contrast basic search techniques, such as sequential and binary search, along with sorting algorithms (Bubble sort, Selection sort, Insertion sort, Merge sort, Quicksort).
CO3	Apply	Examine stack and queue concepts, including operations, representation, and types.
CO4	Analyze	Explain linked lists, their components, types, and operations. Estimate advantages, disadvantages, and real-life applications of linked lists.
CO5	Evaluate	Validate tree and graph concepts, including binary trees, search trees and graph applications. Covering tree terminology, array representation, tree traversal, and graph algorithms like Depth First Search and Breadth First Search

## B. CO-PO-PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	1	1	-	-	-	-	-	-	-	-	-	2	-	-
CO2	3	2	1	2	-	-	-	-	-	-	-	-	-	2	-	-
CO3	2	3	2	1	-	-	-	-	-	-	-	-	-	1	-	-
CO4	2	2	2	1	-	-	-	-	-	-	-	-	-	2	-	-
CO5	2	3	1	1	-	-	-	-	-	-	-	-	-	2	-	-
Wt. AVG	2.3	-	1.0	1.0	-	-	-	-	-	-	-	-	-	1.5	-	-

## C. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to Data structures	7
2.	Searching and Sorting	8
3.	Stack and Queue	8
4.	Linked List	8
5.	Tree, Graphs and their Applications	9

## D. DETAILED SYLLABUS

Unit	Unit Details
1.	<b>Introduction to Data structures</b>
	<ul style="list-style-type: none"> <li>Introduction to Unit</li> <li>Definition, Classification of data structures: primitive and non-primitive</li> <li>Elementary data organization</li> <li>Time and space complexity of an algorithm (Examples), String processing.</li> <li>Definition of dynamic memory allocation</li> <li>Accessing the address of a variable, Declaring and initializing pointers -</li> <li>Accessing a variable through its pointer, Meaning of static and dynamic memory allocation, Memory allocation functions: malloc(), calloc(), free() and realloc().</li> <li>Recursion – Definition, advantages, Writing Recursive programs – Binomial coefficient, Fibonacci, GCD.</li> <li>Conclusion and Real-Life Applications of unit</li> </ul>
2.	<b>Searching and Sorting</b>
	<ul style="list-style-type: none"> <li>Introduction to Unit</li> </ul>

	<ul style="list-style-type: none"> <li>• Basic Search Techniques - Sequential search, Iterative and Recursive methods.</li> <li>• Binary search: Iterative and Recursive methods, Comparison between sequential and Binary Search</li> <li>• Discuss about Time and space complexity of Search Algorithms</li> <li>• Sorting: General background and definition- Bubble sort, Selection sort, Insertion sort,</li> <li>• Merge sort (Iterative and recursive), Quick sort</li> <li>• Space and Time Complexity (Best, Average, and Worst Case) for each of the sorting algorithms</li> <li>• Conclusion and Real-Life Applications of unit</li> </ul>
<b>3.</b>	<b>Stack and Queue</b>
	<ul style="list-style-type: none"> <li>• Introduction to Unit</li> <li>• Stack – Definition, Array representation of stack</li> <li>• Operations on stack: Push and Pop</li> <li>• Infix, prefix and postfix notations</li> <li>• Conversion of an arithmetic expression from Infix to postfix, Infix to Prefix</li> <li>• Applications of stacks.</li> <li>• Definition of queue, Array representation of queue</li> <li>• Types of queues: Simple queue, Circular queue, Double ended queue (deque),</li> <li>• Operations on all types of Queues: Enqueue and Dequeue</li> <li>• Conclusion and Real-Life Applications of Unit</li> </ul>
<b>4.</b>	<b>Linked List</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Definition of linked list, Components of linked list</li> <li>• Representation of linked list, Advantages and Disadvantages of linked list</li> <li>• Types of linked list: Singly linked list, doubly linked list, Circular linked list</li> <li>• Operations on Singly linked list: creation, insertion, deletion, search and display</li> <li>• Implement Stack and Queue using Linked List</li> <li>• Operations on Circular linked list: creation, insertion, deletion, search and display</li> <li>• Conclusion and Real-Life Applications of Unit</li> </ul>
<b>5.</b>	<b>Tree, Graphs and their Applications</b>
	<ul style="list-style-type: none"> <li>• Introduction to Unit,</li> <li>• Definition: Tree, Binary tree, Complete binary tree, Binary search tree</li> <li>• Tree Terminology: Root, Node, Degree of a node and tree, Terminal nodes, non-terminal nodes, Siblings, Level, Edge, Path, depth, Parent node, ancestors of a node</li> <li>• Binary tree: Array representation of tree, Creation of binary tree.</li> <li>• Traversal of Binary Tree: Preorder, In order, post order and Level order.</li> <li>• Binary Search Tree: Representation, Operations: Insert, Delete, Traversal and Search</li> <li>• Graphs, Application of Graphs</li> <li>• Representation of Graphs: Adjacency Matrix and Adjacency List</li> <li>• Graph Traversals: Depth First search, Breadth First search.</li> <li>• Conclusion and Real-Life Applications of Unit</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Schaum's outline series Data structures	Lipschutz	Lates T	TMH.
2.	Data Structures and program designing using 'C	Robert Kruse	Lates T	Pearson Education
<b>Reference Book</b>				
1.	Introduction to Data Structures in C by- Kamthane Pearson Education 2005			
2.	Data Structures Using C by- Bandyo Padhyay Pearson Education			
<b>Online Resources</b>				
1.	<a href="https://www.gatevidyalay.com/data-structures/">https://www.gatevidyalay.com/data-structures/</a>			
2.	<a href="https://www.youtube.com/watch?v=QBrDsG3MTkw">https://www.youtube.com/watch?v=QBrDsG3MTkw</a>			
3.	<a href="https://www.tutorialspoint.com/data_structures_algorithms/index.htm">https://www.tutorialspoint.com/data_structures_algorithms/index.htm</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Course Outcomes
CO1	Remember	Comprehend fundamental concepts of Operating Systems and learn the evolution and structures of Operating Systems.
CO2	Understand	Apprehend the concepts of Process and Inter Process Communication and understand the need of semaphores and mutual exclusion.
CO3	Apply	Determining the deadlock and its characteristics and applying the techniques of deadlock prevention, avoidance and recovery.
CO4	Analyze	Analyze system performance using the paging, segmentation, paging with segmentation and cache allocation techniques.
CO5	Evaluate	Evaluating file system fundamentals in terms of primary and secondary file management and device management.

**B. CO-PO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	1	1	1	1	1	-	-	-	-	2	1	3	-	-
CO2	2	2	2	2	1	1	1	-	-	-	1	2	1	3	-	-
CO3	2	2	2	2	1	1	1	-	-	-	1	2	1	3	-	-
CO4	2	2	2	2	1	1	1	-	-	-	1	2	1	3	-	-
CO5	2	2	2	2	1	1	1	-	-	-	1	2	1	3	-	-
Wt. AVG	1.7	1.7	2.0	1.7	1.0	-	1.0	-	-	-	1.0	-	1.0	3.0	-	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Overview of Operating System	8
2.	Process Management	10
3.	Deadlocks	6
4.	Memory Management	9
5.	File and Device Management	7

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Overview of Operating System</b> <ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>Definition of Operating Systems, Goals and objectives of OS</li> <li>OS as a Resource Manager</li> <li>Evolution of operating systems</li> <li>OS structures</li> <li>Kernel and Shell in an OS</li> <li>System calls: Definition, types and examples</li> <li>Conclusion of Unit</li> </ul>
2.	<b>Process Management</b> <ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>Process v/s Program</li> <li>Process Model, Process States, Process Control Block</li> <li>Threads, Thread v/s Process, User and Kernel Space Threads, Threading models</li> <li>Inter Process Communication: Need of addressing IPC, Race Condition, Critical Section</li> <li>Classical IPC Problems: Producer Consumer, Sleeping Barber, Dining Philosopher Problem</li> <li>Mutual Exclusion, Semaphores and Monitors</li> </ul>

	<ul style="list-style-type: none"> <li>• Software and Hardware approaches to mutual Exclusion: Mutual Exclusion with Busy Waiting Interrupts, Lock Variables, Strict Alternation, Peterson’s Solution, Test and Set Lock. Sleep and Wake-up</li> <li>• Process Scheduling: Basic concepts, Batch System Scheduling (First-Come First-Served, Shortest Job First, Shortest Remaining Time Next), Interactive System Scheduling (Round-Robin Scheduling, Priority Scheduling, Multiple Queues)</li> <li>• Overview of Real Time Systems and Scheduling</li> <li>• Conclusion of Unit</li> </ul>
<b>3.</b>	<b>Deadlocks</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Conditions of Deadlock</li> <li>• Deadlock prevention</li> <li>• Deadlock Avoidance Techniques – Resource Allocation Graph(RAG), Deadlock Detection (For Single and Multiple Resource Instances)</li> <li>• Deadlock Recovery Techniques: Ostrich Algorithm, Preemption and Rollback</li> <li>• Conclusion of Unit</li> </ul>
<b>4.</b>	<b>Memory Management</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Need of Memory Management: Relocation and Protection</li> <li>• Multiprogramming with fixed and variable partitions</li> <li>• Memory Allocation Strategies: First Fit, Best Fit and Next Fit</li> <li>• Virtual memory: Paging, Segmentation, Paging with Segmentation</li> <li>• Page Tables and TLBs</li> <li>• Page Replacement Algorithms: FIFO, Second Chance, LRU, Optimal, Clock, WS- Clock,</li> <li>• Concept of Locality of Reference and Belady’s Anomaly</li> <li>• Cache and Cache allocation Techniques: Direct, Associative and Set Associative</li> <li>• Conclusion of Unit</li> </ul>
<b>5.</b>	<b>File Management and Device Management</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• File Overview: File Naming, File Structure, File Types, File Access, File Attributes, File Operations</li> <li>• Directory: Single Level, Two Level and Hierarchical Directory Systems, Directory Attributes and Directory Operations, Absolute Vs Relative Path</li> <li>• File Allocation Techniques: Contiguous allocation, Linked List Allocation, Linked List Allocation using Table in Memory, Inodes.</li> <li>• Free Space Management: Bitmaps, Linked List</li> <li>• Conclusion of Unit</li> </ul>

## E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Operating systems	Silberschatz, Galvin, Gagne	8th edition	John Wiley and Sons
2.	Modern Operating Systems	A.S.Tanenbaum	2nd Edition	Pearson
<b>Reference Book</b>				
1.	Operating Systems: A Concept-Based Approach, # edition, 2022, McGraw-Hill Education			
<b>Online Resources</b>				
1.	<a href="https://en.wikipedia.org/wiki/Operating_system">https://en.wikipedia.org/wiki/Operating_system</a>			
2.	<a href="https://www.geeksforgeeks.org/what-is-an-operating-system/">https://www.geeksforgeeks.org/what-is-an-operating-system/</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Course Outcomes
CO1	Understand	To understand the characteristics of DBMS, schemas, and ER Models.
CO2	Apply	To apply relational database principles including relational algebra and normalization for database design.
CO3	Apply	To apply SQL commands for data definition, manipulation, control, and transaction handling.
CO4	Analyze	To analyze and develop PL/SQL programs including procedures, functions, and cursors.
CO5	Evaluate	To evaluate Oracle DBMS architecture, backup/recovery strategies, and DBA roles for secure and efficient database management.

**B. CO-PO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	-	-	-	-	-	-	2	3	-	-	2
CO2	3	3	2	-	-	-	-	-	-	-	-	2	3	-	-	3
CO3	3	3	2	-	2	-	-	-	-	2	-	2	-	-	3	3
CO4	3	3	3	2	3	-	-	-	-	3	-	2	-	-	3	3
CO5	3	3	3	2	3	2	2	2	2	3	2	2	-	3	-	3
Wt. AVG	3.0	2.7	2.0	-	2.0	-	-	-	-	2.0	-	2.0	3.0	-	3.0	2.7

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to Database Management System	7
2.	RDBMS	7
3.	SQL	8
4.	PL/SQL	8
5.	Oracle, Trigger and wrapping	6

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Introduction to Database Management System</b> <ul style="list-style-type: none"> <li>Introduction to Database Management System</li> <li>Characteristics of database approach, Advantages of DBMS</li> <li>Schemas: Three schema architecture - The external level, the conceptual level and the internal level.</li> <li>Data Independence, Database languages and Interfaces</li> <li>Introduction to Data Models (Hierarchical, Network and Relation)</li> <li>Entity type, Entity sets, Attributes and keys.</li> <li>Relationship and Relationship Sets, Participation Constraints, Weak Entities,</li> <li>The ER Model: ER Diagram &amp; Database design with the ER Model</li> <li>Generalization and Aggregation</li> <li>Conclusion of the Unit</li> </ul>
2.	<b>RDBMS</b> <ul style="list-style-type: none"> <li>Introduction to Distributed Database</li> <li>Classification of DBMS</li> <li>Introduction to RDBMS</li> <li>Relational Data Model Concepts, Integrity Constraints, Entity Integrity, Referential Integrity, Keys</li> </ul>

	<p>Constraints, Domain Constraints</p> <ul style="list-style-type: none"> <li>• Relational Algebra: Relational operators (Insert, delete, update, select, project, rename, union, intersection, minus, Join, division), Relational Calculus</li> <li>• Transactions and ER mapping Examples</li> <li>• ACID Property of Transaction, 12 Golden rules of dr. E.F.Codd</li> <li>• Normalization of RDBMS (1NF, 2NF, 3NF and 4NF) and inference rules.</li> <li>• Conclusion of the Unit</li> </ul>
<b>3.</b>	<b>SQL</b>
	<ul style="list-style-type: none"> <li>• Introduction to Unit</li> <li>• DBMS v/s RDBMS</li> <li>• Introduction to SQL: Data types, Constraints -Integrity Constraints, Entity Integrity, Keys Constraints, Domain Constraints, Referential Integrity (ON UPDATE/ DELETE/ UPDATE CASCADE)</li> <li>• Features of SQL, Parts of SQL: DDL, DML, DCL, TCL and DQL</li> <li>• DDL Commands: Create table, Drop Table, Truncate table and Alter table.</li> <li>• DML commands: Insert, delete and update</li> <li>• DCL, TCL &amp; DQL commands</li> <li>• Manipulation of data, Tables in SQL, Aggregate functions</li> <li>• Joins in SQL (Cross Join, Inner join, outer join, Natural Join, Equi Join)</li> <li>• Subqueries and Nested Queries, Views and Indexes</li> <li>• Conclusion of the Unit</li> </ul>
<b>4.</b>	<b>PL/SQL</b>
	<ul style="list-style-type: none"> <li>• Introduction to PL/SQL</li> <li>• Approaches to database programming: with function calls</li> <li>• Dynamic SQL, SQL commands in Java, retrieving multiple triples using Iterators</li> <li>• Advantages of PL/SQL,</li> <li>• Features of PL/SQL: Block structure, Error handling, Input and output designing, variables and constant, data abstraction, control structures and subprogram</li> <li>• Fundamentals of PL/SQL: character sets, lexical, delimiters, identifiers, declarations, scope and visibility,</li> <li>• Embedded SQL using CURSORS, Stored procedures &amp; functions</li> <li>• Exception Handling, Static and dynamic and static SQL, Implicit and explicit locking</li> <li>• Conclusion of the Unit</li> </ul>
<b>5.</b>	<b>Oracle, Trigger and wrapping</b>
	<ul style="list-style-type: none"> <li>• Introduction to Oracle, Trigger and wrapping</li> <li>• Functions/responsibilities of DBA</li> <li>• Oracle product details, Oracle files, System and User process, Oracle Memory</li> <li>• Protecting data: Oracle backup &amp; recovery</li> <li>• Triggers - types, uses, data access for triggers</li> <li>• PL/SQL Packages and Wrapping</li> <li>• Conclusion of the Unit</li> </ul>

## E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	System Concepts SQL, PL/SQL	S. Sudarshan, Henry F. Korth, Avi Silberschatz	7th Edition	McGraw Hill Bpb
2.	SQL, PL/SQL: The Programming Language of Oracle	Ivan Bayross	4 <sup>th</sup> edition	Bpb
3.	System Concepts SQL, PL/SQL	Kevin Loney		McGraw Hill Bpb
<b>Reference Book</b>				
1.	PL/SQL, best practices, Bpb Publications, Steven Feuerstein			
2.	The Oracle Cook Book, Bpb Publications, Liebschuty			
3.	Oracle A Beginners Guide, TMH Publication, Michael Abbey, Michael J.Corey			
<b>Online Resources</b>				
1.	<a href="https://www.tutorialspoint.com/sql/sql-rdbms-concepts.htm">https://www.tutorialspoint.com/sql/sql-rdbms-concepts.htm</a>			
2.	<a href="https://nptel.ac.in/courses/106106093">https://nptel.ac.in/courses/106106093</a>			
3.	<a href="https://www.coursera.org/learn/introduction-to-relational-databases">https://www.coursera.org/learn/introduction-to-relational-databases</a>			

**A. COURSE OUTCOMES: -**


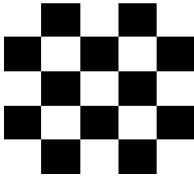
CO	Cognitive Abilities	Course Outcomes
CO1	Understand	Understand why Python is a useful scripting language for developers.
CO2	Apply	Develop problem solving and critical thinking skills in fundamental enable techniques like conditionals and loops.
CO3	Apply	Execute python program with concept of functions, List, Dictionary, structure, class & object.
CO4	Analyze	Integrate the key issues in Python code, develop and experiment with python programming.
CO5	Evaluate	Linking read and write data from/to files in Python and Develop Python programs step-wise by defining functions with turtle.

**B. CO-PO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	-	-	-	-	-	-	-	-	-	3	-	-	-
CO2	2	3	1	-	-	-	-	-	-	-	-	-	2	-	-	-
CO3	2	3	-	1	-	-	-	-	-	-	-	-	2	-	3	-
CO4	3	2	-	-	1	-	-	-	-	-	-	-	2	-	-	-
CO5	3	-	2	-	1	-	-	-	-	-	-	-	1	-	-	-
Wt. AVG	2.3	2.7	1.0	1.0	-	-	-	-	-	-	-	-	2.3	-	3.0	-

**C. LIST OF EXPERIMENT**

S.No	Experiment
1	a) Write a python program to check if the number is prime or not. b) Write a python program to find greatest of four numbers entered by user.
2	Write and run a Python program that asks the user for a temperature in Celsius and converts and output the temperature in Fahrenheit.
3	Write python program to perform following operations on Lists: a) Create list b) Access list c) Update list (Add item, Remove item) d) Delete list
4	Here is an algorithm to print out n! (n factorial) from 0! to 19!: 1. Set f = 1 2. Set n = 0 3. Repeat the following 20 times: a. Output n, "!" = ", f b. Add 1 to n c. Multiply f by n Using a for loop, write and run a Python program for this algorithm.
5	Modify the program above using a while loop so it prints out all of the factorial values that are less than 1 billion.
6	Write a python program to find the minimum in the array and find its index in the array.
7	Write a python program to implement bubble sort using function.
8	Write a python program to read 3 subject marks and display pass or failed using class and object.
9	Draw the Target symbol (a set of concentric Squares, alternating red and white) in a graphics window that is 200 pixels wide by 200 pixels high. Hint: Draw the largest circle first in red, then draw the next smaller circle in white, then draw the next smaller circle in red. Graphical objects drawn later appear "on top of" graphical objects drawn earlier.

	
10	<p>Create a 5 X 5 rectangle whose top left corner is at (row*5, col*5). (Where is the bottom right corner?)          If the sum of the row and col numbers is even, set the fill color of the rectangle to white, otherwise set it to black. Then draw the rectangle.</p> <div style="text-align: center;"></div>
<b>Value Added</b>	
1	Simulate python program to analyze the concept of Constructor and Inheritance.
2	Simulate python program using Math, datetime, random and operator Module.

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Python for Beginners,	Harsh Bhasin,	Latest	New Age International
2	Core Python Programming	Chun, JWesley	Pearson,2007	Core Python Programming
<b>Reference Book</b>				
1.	Martin C Brown, The Compleetete Reference- Python, Mc Graw Hill			
2.	Ryan Turner, Python Programming 3 in 1, Kindle			
<b>Online Resources</b>				
1.	<a href="https://www.geeksforgeeks.org/python/python-programming-language-tutorial/">https://www.geeksforgeeks.org/python/python-programming-language-tutorial/</a>			
2.	<a href="http://www.coursera.org">www.coursera.org</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Course Outcomes
CO – 01	Remember	Introduction to Data Structures, Recall fundamental data structures such as arrays, linked lists, stacks, and queues.
CO – 02	Understand	Understand various algorithm design techniques, including greedy algorithms, dynamic programming, and divide and conquer.
CO – 03	Apply	Apply data structure implementation techniques in programming assignments to solve problems efficiently.
CO – 04	Analyze	Analyze the time and space complexity of algorithms using Big O notation to evaluate their efficiency.
CO – 05	Evaluate	Evaluate algorithm performance through empirical analysis and optimize algorithms for better efficiency.

**B. CO-PO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	-	2	1	-	-	-	-	-	-	-	2	-	-	-
CO2	1	2	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO3	1	3	3	1	-	-	-	-	-	-	-	-	2	-	-	-
CO4	2	-	1	1	-	-	-	-	-	-	-	-	2	-	-	-
CO5	1	1	2	-	-	-	-	-	-	-	-	-	1	-	-	-
Wt. AVG	1.3	2.0	3.0	1.7	1.0	-	-	-	-	-	-	-	1.7	-	-	-

**C. LIST OF EXPERIMENT**

S.No	Experiment
1	Function and Recursion: a) GCD of two numbers. b) Use a recursive function to find the Fibonacci series. c) Factorial d) Binomial Coefficient
2	Basic Array Problems: a) Insert an integer into a given position in an array. b) Deleting an integer from an array.
3	Searching: a) Write a program for linear search b) Write a program for Binary search c) Write a program to sort N numbers using bubble sort.
4	Basic Sorting Techniques: a) Write a program to sort N numbers using insertion sort. b) Write a program to sort N numbers using selection sort. c) Write a program to sort N numbers using bubble sort.
5	Advanced sorting techniques: a) Write a program to sort N numbers using quick sort. b) Write a program to sort N numbers using merge sort.
6	Stack Programs: a) Write a C program to create Stack using array and implement operations- Push, Pop, Display. b) Write a C Program to Convert Infix notation to Postfix Notation c) Write a C Program to Convert Infix notation to Prefix Notation
7	Queue Programs: a) Write a C Program to Implement Queue and perform the operations – Enqueue, Dequeue and Display b) Write a C Program to Implement Circular Queue and perform the operations – Enqueue, Dequeue and Display c) Write a C Program to Implement Double ended Queue and perform the operations – Enqueue, Dequeue and Display
8	Linked List Programs part -1: a) Write a C program to implement Single Linked list and perform all the operations b) Write a C program to implement Stack using Single Linked List

	c) Write a C program to implement Queue using Single Linked List
9	Linked List Programs part -2 a) Write a C program to implement Circular Linked list and perform all the operations b) Write a C program to implement Double Linked list and perform all the operations
10	Binary Tree a) Write a C program to Implement Binary Tree and Traverse using all 4 Techniques (Inorder, Preorder, PostOrder, Level Order) b) Write a C Program to Implement Binary Search Tree and perform all the operations- Insert, Delete, Search and Traverse
<b>Value Added</b>	
1	Graphs part-1 a) Write a C program to Implement Graph using Adjacency Matrix representation b) Write a C program to Implement Graph using Adjacency List representation
2	Graphs part-2 a) Write a C program to Traverse the Graph Using BFS b) Write a C program to Traverse the Graph Using DFS

#### D. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Data Structures and Algorithm Analysis in C	Weiss	2021	Pearson Education
2.	Schaum's outline series Data structures	Lipschutz	2018	Tata McGraw-Hill
3.	Data Structures Using C	Bandyopadhyay	2008	Pearson Education
<b>Reference Book</b>				
1.	Data Structures Using C, Pearson Education, Tenenbaum.			
2.	Introduction to Data Structures in C, Pearson Education 2005, Kamthane			
3.	Data Structures using C and C++, Pearson Education, Langsam, Ausenstein Maoshe & M. Tanenbaum.			
<b>Online Resources</b>				
1.	<a href="https://www.programiz.com/dsa">https://www.programiz.com/dsa</a>			
2.	<a href="https://www.geeksforgeeks.org/data-structures/">https://www.geeksforgeeks.org/data-structures/</a>			
3.	<a href="https://www.codechef.com/certification/data-structures-and-algorithms/prepare">https://www.codechef.com/certification/data-structures-and-algorithms/prepare</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Course Outcomes
CO1	Remember	To set up the environment of the Linux using ISO or dual boot Operating System
CO2	Understand	To understand the file system of Linux and the GRUB.
CO3	Apply	To apply basic system commands and get help in Linux.
CO4	Analyze	To analyze the file types and compressions, file and directory permissions.
CO5	Evaluate	To evaluate the shadow file, passwd and group information in Linux in user management

**B. CO-PO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2	2	-	-	2	1	1	2	2	-	3	2	-
CO2	2	2	2	2	2	-	-	2	1	1	2	2	-	3	2	-
CO3	2	2	2	2	2-	-	-	2	1	1	2	2	-	3	2	-
CO4	2	2	2	2	2	-	-	2	1	1	2	2	-	3	2	-
CO5	2	2	2	2	2	-	-	3	1	1	2	2	-	3	2	-
Wt. AVG	2.0	2.0	2.0	2.0	2.0	-	-	2.0	1.0	1.0	2.0	2.0	-	3.0	2.0	-

**C. LIST OF EXPERIMENTS**

S.No	Experiment
1	To understand Operating System and it's architecture.
2	To set up Linux Environment using ISO installation.
3	To set up Linux Environment using dual boot and setting up Grub.
4	To set up and understand File system structure in Linux and perform operations like creating file, listing, displaying, copy, move, rename, delete a file and a directory.
5	a) Write a shell script that accept a file name starting and ending line numbers as arguments and display all the lines between given line no. b) Write a shell script that delete all lines containing a specified word.
6	a) Write a shell script to find the factorial of given integer. b) Write a shell script to design basic calculator in Linux
7	a) Demonstrate all I/O output redirection operators b) Use filtering commands like grep, head, tail, sort, uniq, wc, sed, tac, nl, cut, paste.
8	Demonstrate use of df, du, ls -al, stat and fdisk.
9	Demonstrate how to add a user using terminal or GUI.
10	Understand shadow, passwd and group files.
<b>Value Added</b>	
11	To delete a user and understand corresponding changes in shadow, passwd and group files
12	Self study on awk toolkit commands.

**D. RECOMMENDED STUDY MATERIAL**

S. No	Text Books:	Author	Edition	Publication
1.	The Linux Command Line: A Complete Introduction	William E. Shotts Jr.	2009	No starch Press
2.	Linux Administration Handbook	Trent Hein, Evi Nemeth Garth Synder	II Edition,2002	Pearson Education
<b>Online Resources</b>				
1.	<a href="https://www.simplilearn.com/linux-programming-for-beginners-article">https://www.simplilearn.com/linux-programming-for-beginners-article</a>			
2.	<a href="https://www.geeksforgeeks.org/linux-tutorial/">https://www.geeksforgeeks.org/linux-tutorial/</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Course Outcomes
CO1	Apply	Design and manage database schemas using Oracle DDL commands, constraints, and normalization techniques to ensure data integrity and efficient design
CO 2	Apply	Perform data manipulation and transaction control using DML, TCL, and MERGE operations for reliable data handling in Oracle.
CO3	Analyze	Construct and execute advanced SQL queries using joins, subqueries, and set operations for meaningful data analysis.
CO4	Create	Develop robust PL/SQL programs with control structures, procedures, cursors, and packages to implement business logic and automate database tasks.
CO5	Evaluate	Apply database security and performance techniques including user roles, triggers, indexing, and materialized views for enterprise-level DBMS solutions.

**B. CO-PO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	-	3	-	-	-	-	-	-	-	3	3	-	-
CO2	3	2	-	-	3	-	-	-	-	-	-	-	2	-	-	-
CO3	3	3	-	2	3	-	-	-	-	-	-	-	3	2	-	-
CO4	3	2	3	-	3	-	-	-	-	-	-	-	-	3	3	3
CO5	3	2	3	-	3	-	-	2	2	2	2	2	2	3	-	2
Wt. AVG	3.0	2.3	3.0	2.0	3.0	-	-	-	-	-	-	-	2.7	2.5	-	-

**C. LIST OF EXPERIMENTS**

S.No	Experiment
1	<b>User Access and Security</b> <ul style="list-style-type: none"> <li>Creating and managing users, roles, and privileges</li> <li>Granting/revoking permissions</li> <li>Using <b>DATA CONTROL LANGUAGE (DCL)</b> commands</li> </ul>
2	<b>Database Setup and Schema Design</b> <ol style="list-style-type: none"> <li>Creating, modifying, and removing database schemas using DDL commands (CREATE, ALTER, DROP, RENAME, TRUNCATE)</li> <li>Best practices for naming conventions, data typing, normalization, and constraints (NOT NULL, CHECK, DEFAULT, UNIQUE, PRIMARY KEY, FOREIGN KEY)</li> </ol>
3	<ol style="list-style-type: none"> <li>Implement parent-child relationships using foreign keys.</li> <li>Demonstrate cascading update and delete actions.</li> <li>Show effect of violating referential integrity.</li> </ol>
4	<b>Data Manipulation and Transaction Control</b> <ul style="list-style-type: none"> <li>Using DML commands: INSERT, UPDATE, DELETE</li> <li>Transaction handling using TCL commands: COMMIT, ROLLBACK, SAVEPOINT</li> <li>Bulk insert and update strategies</li> <li>Use of MERGE (UPSERT) in Oracle</li> </ul>
5	<ul style="list-style-type: none"> <li>Simple queries: selection, projection, sorting, Distinct output values</li> <li>Renaming attributes Computed attributes Simple-complex conditions (AND, OR, NOT)</li> <li>Partial Matching operators (LIKE, %, _, *, ?) ASC-DESC ordering combinations</li> <li>Checking for Nulls</li> </ul>
6	<b>Advanced Data Retrieval and Querying</b> <ul style="list-style-type: none"> <li>Complex queries using SELECT, WHERE, ORDER BY, GROUP BY, HAVING</li> </ul>

	<ul style="list-style-type: none"> <li>Joins: INNER, LEFT, RIGHT, FULL OUTER, SELF JOIN, CROSS JOIN</li> </ul>
7	<b>Advanced Data Retrieval and Querying</b> <ul style="list-style-type: none"> <li>Subqueries: IN, ANY, ALL, EXISTS, NOT EXISTS</li> <li>Set operations: UNION, INTERSECT, MINUS</li> </ul>
8	<b>Functions and Operators</b> <ul style="list-style-type: none"> <li><b>String functions:</b> CONCAT, SUBSTR, INSTR, LPAD, RPAD, TRIM, REPLACE, etc.</li> <li><b>Date functions:</b> SYSDATE, SYSTIMESTAMP, ADD_MONTHS, MONTHS_BETWEEN, LAST_DAY</li> <li><b>Number functions:</b> ROUND, TRUNC, CEIL, FLOOR, MOD, ABS, POWER</li> <li><b>Conversion functions:</b> TO_CHAR, TO_DATE, TO_NUMBER</li> </ul>
9	<b>Views, Indexes, and Sequences</b> <ul style="list-style-type: none"> <li>Creating and managing <b>Views</b></li> <li>Use of <b>Materialized Views</b> for reporting (industry use case)</li> <li>Creating and using <b>Indexes</b></li> <li><b>Sequences</b> for auto-incrementing values</li> </ul>
10	<b>PL/SQL Programming (Highly Relevant for Placements)</b> <ul style="list-style-type: none"> <li><b>Anonymous blocks</b> and <b>named blocks</b></li> <li><b>Control structures:</b> IF, CASE, LOOP, WHILE, FOR</li> </ul>
<b>Value Added</b>	
11	<b>PL/SQL Programming (Highly Relevant for Placements)</b> <ul style="list-style-type: none"> <li>Oracle-specific features like %TYPE, %ROWTYPE</li> <li><b>Cursors:</b> Implicit, Explicit, Cursor FOR loops</li> <li><b>Exception Handling</b></li> <li><b>Stored Procedures, Functions, and Packages</b></li> </ul>
12	<b>Database Triggers and Auditing</b> <ul style="list-style-type: none"> <li>Row-level and statement-level triggers</li> <li>BEFORE, AFTER, and INSTEAD OF triggers</li> <li>Trigger use cases: auditing, logging, enforcing business rules</li> </ul>

#### D. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Database System Concepts	S.Sudarshan, Henry F. Korth, Avi Silberschatz	6th Edition	McGraw Hill
2.	SQL, PL/SQL	Ivan Bayross		Bpb
<b>Reference Book</b>				
1.	PL/SQL, best practices, Bpb Publications, Steven Feuerstein			
2.	The Oracle Cook Book, Bpb Publications, Liebschuty			
<b>Online Resources</b>				
1.	<a href="https://www.tutorialspoint.com/sql/sql-rdbms-concepts.htm">https://www.tutorialspoint.com/sql/sql-rdbms-concepts.htm</a>			
2.	<a href="https://nptel.ac.in/courses/106106093">https://nptel.ac.in/courses/106106093</a>			

# Ability Enhancement Courses

Code: BEACHM3221

Quantitative & Verbal Aptitude Training-II

1 Credits

[LTP:0-0-2]

## A. COURSE OUTCOMES: -

CO	Cognitive Abilities	Course Outcomes
CO1	Understand	Understand principles of profit and loss, averages, ratios, and equations to solve quantitative problems
CO 2	Apply	Apply concepts of speed, time, distance, probability, and permutations to real-life and theoretical problems
CO3	Analyze	Analyze logical reasoning problems using connectives, syllogisms, and Venn diagrams.
CO4	Apply	Demonstrate proficiency in grammar, sentence construction, and transformation through speech and voice.
CO5	Create	Create solutions using image-based interpretation and attention to detail to enhance analytical thinking.

## B. LIST OF EXPERIMENTS

S.No	Experiment
1	<b>Profit, Loss &amp; Partnerships</b> <i>Basic terminologies, Partnership, Averages</i>
2	<b>Mixtures and Alligations</b> <i>Weighted Average, Mixtures and Alligations</i>
3	<b>Ratio, Proportion and Ages</b> <i>Ratio, Proportion, Variation, Simple equations, Ages</i>
4	<b>Permutations &amp; Combinations – I</b> <i>Fundamental Counting, Permutation, Circular Computation of Combination, Probability</i>
5	<b>Speed-Time-Distance</b> <i>Basics, Relative Speed, Boats, Trains, Races. Clocks, Calendars &amp; Cubes Time Reasoning, Direction Sense, Cubes</i>
6	<b>Articles &amp; Prepositions</b> <i>Definite/Indefinite Articles, Omission, Compound Prepositions</i>
7	<b>Interrogatives &amp; Sentence Framing</b> <i>Prepositional Phrases, Interrogative Structures, Speech and Voice Transformation Active-Passive Voice, Direct-Indirect Speech</i>
8	<b>Logical Connectives &amp; Syllogisms</b> <i>Logical Connectives, Syllogistic Analysis. VennDiagrams Interpretation and Problem Solving with Venn Diagrams</i>
9	<b>Progressions &amp; Logarithms</b> <i>Arithmetic, Geometric Progressions, Logarithms. Geometry &amp; Quadratics Geometry, Mensuration, Quadratic Equations</i>
10	<b>Image Interpretation &amp; Detail Analysis</b> <i>Rebus, Forming Words, String Matching, Text/Image Comprehension</i>

# Skill Enhancement Courses

Code: BELCSE3201

Skill Enhancement Course-III

1 Credits [LTP:0-0-2]

## A. FACE Domain: Advanced Fundamental of Programming

### Course: Structured Programming Techniques

Applicable for BTech, BCA, MCA (Batch 2029, 2028, 2027)

## B. COURSE OUTCOMES: On completion of the course a student will be able to:

- Develop pattern-based programs using loops and conditional statements to generate star, number, and alphabet patterns.
- Implement one-dimensional arrays to store, access, and manipulate data using iteration and indexing.
- Construct and traverse two-dimensional arrays for matrix operations and tabular data processing.
- Apply string operations using built-in methods and manipulate strings efficiently with StringBuilder.
- Design modular programs using user-defined functions with parameters and return values.

## D. DETAILED SYLLABUS

S. No.	Topic	Sub-Topics
1	Pattern Programming	<p><b>Star Pattern:</b> Pattern programming involves printing specific patterns (e.g., stars, numbers) arranged in different shapes like triangles, squares, pyramids, etc. These patterns help practice loops and conditional statements.</p> <p><b>Practical Exercise:</b> Write a program to print the following pyramid of stars:</p> <pre>* *** *****</pre> <p><b>Number and Alphabet Pattern:</b> In number patterns, numbers are arranged in specific sequences, often following simple rules. Examples include printing numbers in ascending or descending order in different shapes.</p> <p><b>Practical Exercise:</b> Write a program to print a number triangle pattern like:</p> <pre>1 1 2 1 2 3</pre>
2	Arrays (1D)	<p><b>Definition and declaration:</b> Arrays are fixed-size collections of elements of the same type, indexed starting from 0.</p> <p><b>Practical Exercise:</b> Create an array of 5 integers, initialize it, and display its elements using a loop.</p> <p><b>Common operations:</b> Includes accessing elements using indices, iterating, and modifying values.</p> <p><b>Practical Exercise:</b> Write a program to find the largest and smallest elements in an array.</p>
3	Arrays (1D)	<p><b>Definition and declaration:</b> Arrays are fixed-size collections of elements of the same type, indexed starting from 0.</p> <p><b>Practical Exercise:</b> Create an array of 5 integers, initialize it, and display its elements using a loop.</p> <p><b>Common operations:</b> Includes accessing elements using indices, iterating, and modifying values.</p> <p><b>Practical Exercise:</b> Write a program to find the largest and smallest elements in an array.</p>
4	Arrays (2D)	<p><b>Definition and declaration:</b> 2D arrays are collections of arrays, often used to represent grids or matrices.</p> <p><b>Practical Exercise:</b> Create a 2D array to store a 3x3 matrix and display its elements row by row.</p> <p><b>Initialization:</b> Elements can be initialized during declaration or dynamically in a loop.</p> <p><b>Practical Exercise:</b> Write a program to create a 2D array representing a multiplication table.</p> <p><b>Traversal:</b> Access elements using nested loops, row-wise or column-wise.</p> <p><b>Practical Exercise:</b> Write a program to calculate the sum of all elements in a 2D array.</p>
5	Arrays (2D)	<p><b>Definition and declaration:</b> 2D arrays are collections of arrays, often used to represent grids or matrices.</p> <p><b>Practical Exercise:</b> Create a 2D array to store a 3x3 matrix and display its elements row by row.</p> <p><b>Initialization:</b> Elements can be initialized during declaration or dynamically in a loop.</p> <p><b>Practical Exercise:</b> Write a program to create a 2D array representing a multiplication table.</p> <p><b>Traversal:</b> Access elements using nested loops, row-wise or column-wise.</p> <p><b>Practical Exercise:</b> Write a program to calculate the sum of all elements in a 2D array.</p>

6	<b>Strings</b>	<p><b>Definition and immutability:</b> Strings are sequences of characters and immutable. Modifications create new objects.</p> <p><b>Practical Exercise:</b> Write a program to input a string and count the number of vowels in it.</p> <p><b>Common methods:</b> Includes charAt(), length(), toLowerCase(), toUpperCase(), replace(), and substring().</p> <p><b>Practical Exercise:</b> Write a program to find and replace all occurrences of a word in a sentence using replace().</p> <p><b>StringBuilder:</b> A mutable alternative to strings, used for efficient modifications.</p> <p><b>Practical Exercise:</b> Create a program to reverse a string using StringBuilder.</p>
7	<b>Strings</b>	<p><b>Definition and immutability:</b> Strings are sequences of characters and immutable. Modifications create new objects.</p> <p><b>Practical Exercise:</b> Write a program to input a string and count the number of vowels in it.</p> <p><b>Common methods:</b> Includes charAt(), length(), toLowerCase(), toUpperCase(), replace(), and substring().</p> <p><b>Practical Exercise:</b> Write a program to find and replace all occurrences of a word in a sentence using replace().</p> <p><b>StringBuilder:</b> A mutable alternative to strings, used for efficient modifications.</p> <p><b>Practical Exercise:</b> Create a program to reverse a string using StringBuilder.</p>
8	<b>Strings</b>	<p><b>Definition and immutability:</b> Strings are sequences of characters and immutable. Modifications create new objects.</p> <p><b>Practical Exercise:</b> Write a program to input a string and count the number of vowels in it.</p> <p><b>Common methods:</b> Includes charAt(), length(), toLowerCase(), toUpperCase(), replace(), and substring().</p> <p><b>Practical Exercise:</b> Write a program to find and replace all occurrences of a word in a sentence using replace().</p> <p><b>StringBuilder:</b> A mutable alternative to strings, used for efficient modifications.</p> <p><b>Practical Exercise:</b> Create a program to reverse a string using StringBuilder.</p>
9	<b>Functions</b>	<p><b>Defining methods:</b> Use the public, static, void keywords to define reusable blocks of code.</p> <p><b>Practical Exercise:</b> Create a method to calculate the area of a circle, and call it from the main() method.</p> <p><b>Parameters and return values:</b> Pass values to methods and retrieve results.</p> <p><b>Practical Exercise:</b> Write a method to find the maximum of three numbers, and test it with user input.</p>
10	<b>Functions</b>	<p><b>Defining methods:</b> Use the public, static, void keywords to define reusable blocks of code.</p> <p><b>Practical Exercise:</b> Create a method to calculate the area of a circle, and call it from the main() method.</p> <p><b>Parameters and return values:</b> Pass values to methods and retrieve results.</p> <p><b>Practical Exercise:</b> Write a method to find the maximum of three numbers, and test it with user input.</p>
11	<b>Recursion</b>	<p><b>Definition:</b> A method calls itself to solve a problem, often breaking it into smaller subproblems.</p> <p><b>Practical Exercise:</b> Write a recursive function to calculate the factorial of a number.</p> <p><b>Base case and recursive case:</b> Every recursion needs a base case to terminate.</p> <p><b>Practical Exercise:</b> Create a recursive function to find the nth Fibonacci number.</p>
12	<b>Recursion</b>	<p><b>Definition:</b> A method calls itself to solve a problem, often breaking it into smaller subproblems.</p> <p><b>Practical Exercise:</b> Write a recursive function to calculate the factorial of a number.</p> <p><b>Base case and recursive case:</b> Every recursion needs a base case to terminate.</p> <p><b>Practical Exercise:</b> Create a recursive function to find the nth Fibonacci number.</p>

# Value Added Courses (VAC)

Code: BUVCVA3106

Introduction to IKS (As a part of IKS)

2 Credits [LTP:2-0-0]

## A. COURSE OUTCOMES: -

CO	Cognitive Abilities	Course Outcomes
CO-1	Understand	Understand the basic concepts, scope, and significance of Indian Knowledge Systems.
CO-2	Understand	Identify major components and classifications within the Indian Knowledge tradition.
CO-3	Analyze	Explain the historical development and evolution of IKS across different disciplines.
CO-4	Analyze	Analyze the relationship between IKS and contemporary knowledge frameworks.
CO-5	Analyze	Demonstrate the ability to apply introductory IKS principles to solve practical and theoretical problems.

## B. CO-PO-PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	1	-	3	-	-	-	-	2	-	-	-
CO2	3	3	-	-	-	2	-	2	-	-	-	-	2	1	-	-
CO3	3	3	2	1	-	3	-	2	-	-	-	-	3	2	-	-
CO4	3	2	2	2	-	3	2	3	-	-	-	-	3	2	2	-
CO5	3	3	3	2	2	3	2	3	2	2	-	-	3	3	2	1
Wt. AVG	3	2.6	2.3	1.7	0.4	2.4	0.8	2.6	0.4	0.4	0	0	2.6	1.6	0.8	0.2

## C. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Essence of Indian Knowledge	6
2.	Components of Knowledge Traditions	6
3.	Evolution of Indian Thought	6
4.	IKS in Contemporary Contexts	6
5.	Applying IKS in Research	6

## D. DETAILED SYLLABUS

Unit	Unit Details
1.	<b>Essence of Indian Knowledge</b>
	<ul style="list-style-type: none"> <li>Introduction of the Unit</li> <li>Define Indian Knowledge Systems (IKS) and its philosophical foundation.</li> <li>Explore the historical context and cultural importance of IKS.</li> <li>Discuss the scope and diversity within IKS across disciplines.</li> <li>Highlight the role of IKS in shaping Indian civilization and identity.</li> <li>Examine the relevance of IKS in contemporary education and knowledge discourse.</li> <li>Conclusion of the unit</li> </ul>
2.	<b>Components of Knowledge Traditions</b>

	<ul style="list-style-type: none"> <li>• Introduction of the Unit</li> <li>• Introduce key classifications: <i>Shruti, Smriti, Darshanas, Shastras</i>.</li> <li>• Explore different domains: philosophy, science, arts, medicine, and language.</li> <li>• Study the categorization of knowledge in ancient texts (e.g., <i>Vedas, Upanishads</i>).</li> <li>• Discuss the distinction between revealed and derived knowledge.</li> <li>• Highlight interdisciplinary links within IKS components.</li> <li>• Conclusion of the unit</li> </ul>
<b>3.</b>	<b>Evolution of Indian Thought</b>
	<ul style="list-style-type: none"> <li>• Introduction of the Unit</li> <li>• Trace the origins of IKS from Vedic to classical periods.</li> <li>• Examine the evolution of philosophical schools and scientific thought.</li> <li>• Analyze the impact of historical events on the transmission of IKS.</li> <li>• Study key contributors and scholars in various fields of IKS.</li> <li>• Understand the continuity and transformations in IKS traditions.</li> <li>• Conclusion of the unit</li> </ul>
<b>4.</b>	<b>IKS in Contemporary Contexts</b>
	<ul style="list-style-type: none"> <li>• Introduction of the Unit</li> <li>• Compare IKS with Western and other global knowledge systems.</li> <li>• Explore complementarities and conflicts between IKS and modern science.</li> <li>• Discuss efforts to integrate IKS in contemporary education and research.</li> <li>• Examine case studies where IKS informs sustainable practices and innovation.</li> <li>• Reflect on the challenges and opportunities in validating IKS today.</li> <li>• Conclusion of the unit</li> </ul>
<b>5.</b>	<b>Applying IKS in Research</b>
	<ul style="list-style-type: none"> <li>• Introduction of the Unit</li> <li>• Apply IKS concepts to ethical and philosophical dilemmas.</li> <li>• Use traditional frameworks to approach health and wellness questions.</li> <li>• Explore IKS-based methods in environmental conservation and sustainability.</li> <li>• Develop basic research questions integrating IKS perspectives.</li> <li>• Present examples of problem-solving inspired by IKS in various domains.</li> <li>• Conclusion of the unit</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	The Foundations of Indian Culture	S. Radhakrishnan	Edition, 2016	Oxford University Press
2.	Indian Philosophy: Volume 1	S. Radhakrishnan	2nd Edition, 2014	George Allen & Unwin Ltd.
3.	Knowledge Systems of India: Volumes 1 & 2	Vishwa Bandhu Gupta	1st Edition, 2018	Indira Gandhi National Centre for the Arts (IGNCA)
4.	Science in India: A Historical Perspective	B. V. Subbarayappa	1st Edition, 2008	National Book Trust, India

**B.Tech- IVth Semester**  
**Batch: 2025-29**

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Course Outcomes
CO1	Remember	Understand the concept of hashing and hash functions. Apply collision resolution techniques to efficiently store and retrieve data.
CO2	Understand	Explain the working of priority queues and heap structures. Implement min-heap and max-heap to solve scheduling and optimization problems.
CO3	Apply	Analyze advanced tree structures like AVL, B-Trees, and Binary Search Trees. Apply these trees for efficient searching, insertion, and deletion operations.
CO4	Analyze	Understand graph representations and traversal techniques. Implement shortest path, spanning tree, and topological sort algorithms.
CO5	Evaluate	Apply union-find algorithms to solve connectivity problems. Implement efficient string-matching techniques like KMP and Rabin-Karp.

**B. CO-PO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	1	1	-	-	-	-	-	-	-	-	2	-	-	-
CO2	3	2	1	2	-	-	-	-	-	-	-	-	2	-	-	-
CO3	2	3	2	1	-	-	-	-	-	-	-	-	1	-	-	-
CO4	2	2	2	1	-	-	-	-	-	-	-	-	2	-	-	-
CO5	2	3	1	1	-	-	-	-	-	-	-	-	2	-	-	-
Wt. AVG	2.3	-	1.0	1.0	-	-	-	-	-	-	-	-	1.7	-	-	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Hashing	7
2.	Priority Queues (Heaps)	7
3.	Advanced Tree Data Structure	8
4.	Graph Algorithms	7
5.	Disjoint Sets and String Matching	7

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Hashing</b>
	<ul style="list-style-type: none"> <li>Introduction to Hashing</li> <li>Hash Function, collision</li> <li>Collision Resolution Techniques: <ul style="list-style-type: none"> <li>Separate Chaining</li> <li>Open Addressing: Linear Probing, Quadratic Probing, Double Hashing, Rehashing.</li> </ul> </li> <li>Hash Tables in the Standard Library</li> <li>Universal Hashing, Extendible Hashing.</li> <li>Conclusion of Unit</li> </ul>
2.	<b>Priority Queues (Heaps)</b>
	<ul style="list-style-type: none"> <li>Introduction to Priority Queues (Heaps) Model</li> <li>Binary Heap: Min Heap and Max Heap Structure Property, Heap Order Property</li> <li>Basic Heap Operations: insert, delete, Percolate down, Other Heap Operations</li> <li>Introduction to Binomial Queues (Binomial Heap)</li> <li>Binomial Queue Structure, Binomial Tree</li> </ul>

	<ul style="list-style-type: none"> <li>• Binomial Queue Operations: Insert, Delete, Merge</li> <li>• Implementation of Binomial Queue</li> <li>• Priority Queues in the Standard Library.</li> <li>• Conclusion of Unit</li> </ul>
<b>3.</b>	<b>Advanced Tree Data Structure</b>
	<ul style="list-style-type: none"> <li>• Introduction to Trees, AVL: Single Rotation, Double Rotation, Insertion, Deletion.</li> <li>• Red-Black Trees: Properties of red-black trees: Rotations, Insertion, Deletion., B-Trees</li> <li>• Multi-way Search Trees – 2-3 Trees</li> <li>• Searching for an Element in a 2-3 Tree</li> <li>• Inserting a New Element in a 2-3 Tree</li> <li>• Deleting an Element from a 2-3 Tree</li> <li>• Conclusion of Unit</li> </ul>
<b>4.</b>	<b>Graph Algorithms</b>
	<ul style="list-style-type: none"> <li>• Introduction to Graphs Algorithms</li> <li>• Graph Representation and Traversal techniques</li> <li>• Topological sort, Graph Coloring</li> <li>• Single Source Shortest Path Algorithms: Dijkstra's, Bellman-Ford Algorithms</li> <li>• All-Pairs Shortest Paths: Floyd- Warshall's Algorithm</li> <li>• Conclusion of Unit</li> </ul>
<b>5.</b>	<b>Disjoint Sets and String Matching</b>
	<ul style="list-style-type: none"> <li>• Introduction to Disjoint Sets</li> <li>• Equivalence relation</li> <li>• Simple Union and Find algorithms, Smart Union and Path compression algorithm.</li> <li>• Introduction to String Matching, The naive string-matching algorithm</li> <li>• The Rabin-Karp algorithm</li> <li>• The Knuth-Morris-Pratt algorithm.</li> <li>• Conclusion of Unit</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Data Structures and Algorithm Analysis in C++	Mark Allen Weiss	4 th Edition	Pearson
2.	Introduction to Algorithms	Thomas H Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein	3 rd Edition	The MIT Press.
<b>Reference Book</b>				
1.	Fundamentals of Computer Algorithms, 2nd Edition, 2009, University Press Pvt. Ltd, Ellis Horowitz, Satraj Sahani and Raja sekharam.			
2.	Advanced Data Structures, Oxford University Press, 2018, ReemaThareja, S. Rama Sree.			
<b>Online Resources</b>				
1.	<a href="https://nptel.ac.in/courses/106106133">https://nptel.ac.in/courses/106106133</a>			
2.	<a href="https://www.geeksforgeeks.org/advanced-data-structures/">https://www.geeksforgeeks.org/advanced-data-structures/</a>			
3.	<a href="https://youtube.com/playlist?list=PLdo5W4Nhv31bbKJzrsKfMpo_grxuL18LU&amp;si=Itm-EWhejxkigRng">https://youtube.com/playlist?list=PLdo5W4Nhv31bbKJzrsKfMpo_grxuL18LU&amp;si=Itm-EWhejxkigRng</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Course Outcomes
CO-01	Understand	Recall the concepts and features of java or Java Buzzwords with Java Tokens.
CO-02	Applying	Demonstrate an understanding of object oriented programming concepts and interface using Java.
CO-03	Applying	Apply the concept of package, stings and collections framework to develop the application in Java.
CO-04	Applying	Apply the concept of exception handling and multithreading to develop the application in Java.
CO-05	Applying	Apply the concept of AWT and JDBC to develop the java application.

**B. CO-PO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	1	-	1	-	-	-	-	-	-	2	-	1	-
CO2	1	2	3	2	-	2	-	-	-	-	-	-	2	-	3	-
CO3	2	2	2	-	-	1	-	-	-	-	-	-	2	-	1	-
CO4	2	2	3	-	-	1	-	-	-	-	-	-	2	-	1	-
CO5	2	2	2	1	-	1	-	-	-	-	-	-	2	-	2	-
Wt. AVG	1.7	1.7	2.0	1.5	-	1.3	-	-	-	-	-	-	2.0	-	1.7	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to Java	08
2.	Object Oriented Programming (OOP)	08
3.	Packages, Strings & Collections Framework	07
4.	Exception Handling & Multithreaded Programming	09
5.	Abstract Window Toolkit (AWT) & Java Database Connectivity (JDBC)	08

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<p><b>Introduction to Java</b></p> <ul style="list-style-type: none"> <li>Introduction to Unit</li> <li>History and Overview of Java (JDK, JRE &amp; JVM)</li> <li>Java Buzzwords</li> <li>Structure of a Java Program</li> <li>Constants &amp; Variables, Declaration of Variables, Types of Variables, Scope of Variables, Data Types in Java, Type conversion and casting</li> <li>Operators, Control Statements</li> <li>Arrays: Creating One, Two &amp; Multi-Dimensional Arrays, Jagged Array</li> <li>Conclusion of unit</li> </ul>

<b>2.</b>	<b>Object Oriented Programming (OOP) &amp; Interface</b>
	<ul style="list-style-type: none"> <li>• Introduction to Unit</li> <li>• Basic concepts of OOPS: OOPS terminology, Classes, Methods, Creating Instance &amp; Class Variables, Accessing Class Members, Constructors, this &amp; super keyword, Method Overloading, Inheritance and its Types in Java, Method Overriding, Final Variables, Methods and Classes, finalize method, Abstract Methods &amp; Abstract Classes</li> <li>• Interfaces: Defining Interfaces, Implementing and Inheriting Interfaces, Functional Interface, Comparison Class, Abstract Class &amp; Interface.</li> <li>• Conclusion of Unit</li> </ul>
<b>3.</b>	<b>Packages, Strings &amp; Collections Framework</b>
	<ul style="list-style-type: none"> <li>• Introduction to Unit</li> <li>• Concept of Package: Using In-Built Packages, Creating User Defined Packages, Accessing a User-Defined Package, Visibility Control in Java</li> <li>• Working with Strings: String, String Buffer and String Builder.</li> <li>• Collections Framework: Set, List, Queue, Maps, Iterators.</li> <li>• Conclusion of Unit</li> </ul>
<b>4.</b>	<b>Exception Handling &amp; Multithreaded Programming</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Exception Handling: Exception &amp; Their Use, Types of Exceptions</li> <li>• Try, Catch, Finally Blocks, Throw and Throws Clauses</li> <li>• Custom Exceptions</li> <li>• Multithreading: Introduction to Threads, Life Cycle of a Thread</li> <li>• Creating Threads: Extending Thread Class and Implementing Runnable Interface</li> <li>• Synchronization in Java, Inter-thread Communication and methods</li> <li>• Conclusion of the Unit</li> </ul>
<b>5.</b>	<b>Abstract Window Toolkit (AWT) &amp; Java Database Connectivity (JDBC)</b>
	<ul style="list-style-type: none"> <li>• Introduction to Unit</li> <li>• AWT API: Basic GUI Components of AWT</li> <li>• AWT: Event Handling</li> <li>• Database connectivity – JDBC architecture and Types of Drivers.</li> <li>• JDBC API - loading a driver, connecting to a database, creating and executing JDBC statements</li> <li>• Handling SQL exceptions.</li> <li>• Accessing result sets: types and methods.</li> <li>• Conclusion of Unit</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	The complete reference Java –2	Herbert Schildt	V Edition,	TMH.
2.	SAMS teach yourself Java – 2	Rogers Cedenhead and Leura Lemay	3rd Edition	Pearson Education
3.	Programming With Java	Balaguruswamy	3 <sup>rd</sup> Edition	TMH
<b>Reference Book</b>				
1.	Object Oriented Programming with Java PUBLISHER PHI by M.T. Somashekara (Author), D.S. Guru (Author), K.S. Manjunatha (Author)			
2.	“Head First Javal by Kathy Sierra			
<b>Online Resources</b>				
1.	<a href="https://www.programiz.com/java-programming/online-compiler/">https://www.programiz.com/java-programming/online-compiler/</a>			
2.	<a href="https://www.tutorialspoint.com/compile_java_online.php">https://www.tutorialspoint.com/compile_java_online.php</a>			
3.	<a href="https://onecompiler.com/java">https://onecompiler.com/java</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Course Outcomes
CO1	Remember	Recall fundamental definitions, concepts, and theorems in discrete mathematics. Examples: define propositions, connectives, sets, functions, graphs.
CO2	Understand	Explain the principles of logic, set theory, relations, functions, and elementary number theory. Examples: explain how truth tables work or describe properties of relations.
CO3	Apply	Use propositional and predicate logic to verify arguments and solve problems. Apply counting techniques to solve problems. Use recurrence relations to solve problems.
CO4	Analyze	Analyze and construct mathematical proofs using various techniques (e.g., direct, indirect, induction). Compare different types of graphs and trees and their properties.
CO5	Evaluate	Assess the validity of logical arguments and mathematical statements. Evaluate the efficiency of different algorithms using discrete structures.

**B. CO-PO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	1	-	-	-	-	-	-	2	2	1	-	-
CO2	2	3	1	-	-	-	-	-	-	-	-	2	2	2	-	-
CO3	3	3	2	1	2	-	-	-	1	-	-	2	3	3	-	-
CO4	2	3	2	3	1	-	-	-	1	1	-	2	3	2	-	-
CO5	2	2	2	2	2	-	-	-	1	1	-	2	2	3	-	-
Wt. AVG	2.7	2.7	1.5	1.0	1.5	-	-	-	1.0	-	-	2.0	2.3	2.0	-	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Fundamentals of logic	08
2.	Properties of the integers	08
3.	Relations and functions	08
4.	The principle of inclusion and exclusion and recurrence relations	06
5.	Introduction to graph theory	08

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Fundamentals of logic</b> <ul style="list-style-type: none"> <li>Basic Connectives and Truth Tables: Understanding logical operators like AND, OR, NOT, XOR, and their truth table representations.</li> <li>Logic Equivalence: Learning the laws of logic (e.g., commutative, associative, distributive laws) and their application in simplifying and verifying logical statements.</li> <li>Logical Implication and Rules of Inference: Exploring how to derive new conclusions from existing premises using various rules of inference like modus ponens and modus tollens.</li> <li>Quantifiers: Understanding the use of universal and existential quantifiers in expressing statements about collections of objects.</li> <li>Definitions and Proofs of Theorems: Learning how to construct formal proofs for mathematical statements using various proof techniques.</li> </ul>
2.	

	<ul style="list-style-type: none"> <li>• Mathematical Induction: Mastering this powerful proof technique for proving statements about integers.</li> <li>• Well-Ordering Principle: Understanding the concept of well-ordered sets and its application in proofs.</li> <li>• Fundamental Principles of Counting: Applying the rules of sum and product for counting the number of ways to perform tasks.</li> <li>• Permutations and Combinations: Learning about arrangements and selections of objects, with and without repetition.</li> <li>• Binomial Theorem: Understanding its application in expanding binomial expressions.</li> </ul>
<b>3.</b>	
	<ul style="list-style-type: none"> <li>• Cartesian Products and Relations: Defining relations between sets and their representation using Cartesian products.</li> <li>• Functions: Studying properties of functions like injectivity, surjectivity, bijectivity, and inverses.</li> <li>• Pigeonhole Principle: Applying this principle for solving counting problems involving distribution.</li> <li>• Function Composition and Inverse Functions: Understanding how to combine and reverse functions.</li> <li>• Properties of Relations: Analyzing different types of relations like reflexive, symmetric, transitive, and their properties.</li> <li>• Computer Recognition – Zero-One Matrices and Directed Graphs: Representing relations using matrices and directed graphs.</li> <li>• Partial Orders – Hasse Diagrams: Visualizing partially ordered sets using Hasse diagrams.</li> <li>• Equivalence Relations and Partitions: Understanding the connection between equivalence relations and partitioning sets.</li> </ul>
<b>4.</b>	
	<ul style="list-style-type: none"> <li>• Principle of Inclusion and Exclusion: Using this principle to count elements in the union of sets.</li> <li>• Generalizations of the Principle: Expanding the application of the principle to more complex scenarios.</li> <li>• Derangements and Rook Polynomials: Solving advanced counting problems.</li> <li>• Recurrence Relations: Studying methods for solving linear recurrence relations with constant coefficients.</li> </ul>
<b>5.</b>	
	<ul style="list-style-type: none"> <li>• Definitions and Examples of Graphs: Understanding basic graph terminology like vertices, edges, and different types of graphs.</li> <li>• Subgraphs, Complements, and Graph Isomorphism: Analyzing relationships between graphs and identifying isomorphic graphs.</li> <li>• Trees: Learning about different types of trees, including rooted trees, spanning trees, and their properties.</li> <li>• Trees and Sorting: Understanding the application of trees in sorting algorithms.</li> <li>• Weighted Trees and Prefix Codes: Studying weighted trees and their use in prefix codes like Huffman codes.</li> <li>• Vertex Degree, Euler Trails and Circuits: Exploring properties of vertices and identifying Euler trails and circuits in graphs.</li> </ul>

## E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Discrete and Combinatorial Mathematics	Ralph P. Grimaldi	5th Edition	Pearson Education
2.	Discrete Mathematics and its Applications	Kenneth H. Rosen	6th or later editions	McGraw Hill
Reference Book				
S. No	Reference Book			
1.	Discrete Mathematics – A Concept based approach			
2.	Discrete Mathematical Structures with Applications to Computer Science			
Online Resources				
1.	NPTEL Course on Discrete Mathematics			
2.	MIT OpenCourseWare - Mathematics for Computer Science			

## A. COURSE OUTCOMES: -

CO	Cognitive Abilities	Course Outcomes
CO 1	Knowledge	<b>Describe</b> the fundamentals of computer networks including types, topologies, and networking devices, and <b>compare</b> OSI and TCP/IP models.
CO 2	Analyze	<b>Explain</b> various transmission media, cabling standards, and connectors; <b>analyze</b> data link layer functionalities including error control, flow control, and MAC protocols.
CO 3	Apply	<b>Apply</b> IP addressing techniques including subnetting and address classification; <b>demonstrate</b> understanding of routing and switching concepts.
CO 4	Analyze	<b>Differentiate</b> between TCP and UDP protocols, <b>explain</b> port numbers and socket concepts, and <b>describe</b> the role of the Presentation Layer including SSL/TLS.
CO 5	Evaluate	<b>Identify and explain</b> the functionality of key application layer protocols; <b>describe</b> the types of wireless networks and <b>evaluate</b> wireless security mechanisms and VPN/VLAN usage.

## C. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Networking Fundamentals & Internet	08
2.	Basics of Physical and Data Link Layer	10
3.	Basics of Network Layer layer	09
4.	Basics of Transport & Presentation Layer	08
5.	Basics of Application Layer & Wireless Networking	08

## B. CO-PO-PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO2	1	3	-	1	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	2	3	-	3	-	-	-	-	-	-	-	-	-	2	-	-
CO5	-	2	3	2	-	-	-	-	-	-	-	-	-	-	-	-
Wt. AVG	3	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-

## D. DETAILED SYLLABUS

Unit	Unit Details
1.	<b>Networking Fundamentals</b>
	<ul style="list-style-type: none"> <li><b>Basics of Network &amp; Networking:</b> Types of Networks (LAN, MAN, WAN), Peer-to- Peer &amp; Client/Server, Workgroup vs. Domain, Network Devices (NIC, Hub, Switch, Bridge, Router, Gateways, Firewall, Repeater, CSU/DSU, and modem), Network Topologies, Introduction of OSI model and TCP/IP Model, Comparison between OSI model &amp; TCP/IP mode.</li> <li>Conclusion &amp; Real Life Application</li> </ul>
2.	<b>Basics of Physical and Data Link Layer</b>
	<ul style="list-style-type: none"> <li><b>Physical Layer:</b> Types of Transmission Media, Communication Modes, Wiring Standards and Cabling (straight through cable, crossover cable, and rollover cable), Media connectors (Fibre optic, Coaxial, and TP etc.).</li> <li>Data Link Layer Services, Sublayers of Data link, Framing, Error detection and correction, Flow</li> </ul>

	Control: Stop and Wait protocol, Sliding Window protocols Go-Back-N Protocol, Channel allocation problem, Multiple access protocols: ALOHA, CSMA/CA, CSMA/CD. <ul style="list-style-type: none"> <li>• Conclusion &amp; Real Life Application</li> </ul>
<b>3.</b>	<b>Basics of Network Layer layer</b>
	<ul style="list-style-type: none"> <li>• <b>Network Layer:</b> Internet Protocol (IP), IP standards, versions, functions, IPv4 addressing: IPv4 address Classes, IPv4 address types, Default Gateway, Public &amp; Private IP Address, methods of assigning IP address, Subnet Mask, Concept of subnetting, unicast, multicast, broadcast, IPv4 Datagram Format, IPv6 address, Data encapsulation, Introduction to Routing and Switching concepts.</li> <li>• Conclusion &amp; Real Life Application</li> </ul>
<b>4.</b>	<b>Basics of Transport &amp; Presentation Layer</b>
	<ul style="list-style-type: none"> <li>• <b>Transport Layer:</b> Overview, Port Numbers &amp; Sockets, Transport Layer Protocol: Reliability-Delay tradeoff, User Datagram Protocol (UDP), Transmission Control Protocol (TCP).</li> <li>• <b>Presentation Layer:</b> Function, Presentation Layer Protocols: TLS, SSL, Working of SSL.</li> <li>• Conclusion &amp; Real Life Application</li> </ul>
<b>5.</b>	<b>Basics of Application Layer &amp; Wireless Networking</b>
	<ul style="list-style-type: none"> <li>• <b>Application Layer:</b> Functions and support, Application Layer Protocols: DHCP, DNS, HTTP/HTTPS, FTP, TFTP, SFTP, Telnet, Email: SMTP, POP3/IMAP.</li> <li>• WAN, VLAN, VPN, Wireless Networking, Types of Wireless Networks: Ad-hoc mode, Infrastructure mode, wireless LAN standards: IEEE 802.11a, IEEE 802.11b, IEEE 802.11g, wireless security Protocols: WEP, WPA, 802.1X, Cellular Technologies Conclusion &amp; Real Life Application</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Computer Network	Andrew S. Tanenbaum	2013	Pearson
2.	Computer Networking: Top Down Approach	Kurose. Ross	2017	Pearson
<b>Reference Book</b>				
1.	Networking All in One – Doug Lowe 7th edition Publisher- Wiley			
<b>Online Resources</b>				
1.	Networking All in One – Doug Lowe 7th edition Publisher- Wiley			
2.	Networking All in One – Doug Lowe 7th edition Publisher- Wiley			

## A. COURSE OUTCOMES: -

CO	Cognitive Abilities	Course Outcomes
CO1	Remember	Understand the concept of hashing and hash functions. Apply collision resolution techniques to efficiently store and retrieve data.
CO2	Understand	Explain the working of priority queues and heap structures. Implement min-heap and max-heap to solve scheduling and optimization problems.
CO3	Apply	Analyze advanced tree structures like AVL, B-Trees, and Binary Search Trees. Apply these trees for efficient searching, insertion, and deletion operations.
CO4	Analyze	Understand graph representations and traversal techniques. Implement shortest path, spanning tree, and topological sort algorithms.
CO5	Evaluate	Apply union-find algorithms to solve connectivity problems. Implement efficient string-matching techniques like KMP and Rabin-Karp.

## B. CO-PO-PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	2	-	-	-	-	2	-	2	2	3	-	-
CO2	3	3	-	2	3	-	-	-	-	2	-	2	2	3	-	-
CO3	3	3	-	2	3	-	-	-	-	2	-	2	2	3	-	-
CO4	3	3	-	1	3	-	-	-	-	2	-	2	1	2	-	-
CO5	3	3	2	1	3	2	2	-	2	2	2	3	2	3	-	1
Wt. AVG	3.0	2.7	-	2.0	2.7	-	-	-	-	2.0	-	2.0	2.0	3.0	-	-

## C. LIST OF EXPERIMENTS

1	<b>Collision Resolution Techniques-1:</b> a) Write a program to implement a hash table using <b>linear probing</b> for collision resolution b) Write a program to implement a hash table using <b>Quadratic Probing</b> for collision resolution
2	<b>Collision Resolution Techniques-2:</b> a) Write a program to implement a hash table using <b>Double Hashing</b> for collision resolution b) Write a program to implement a hash table using <b>Separate Chaining</b> for collision resolution
3	<b>Heaps-1:</b> a) Write a program to implement Min Heap and perform the operations like insert and delete b) Write a program to implement Max Heap and perform the operations like insert and delete
4	<b>Heaps-2:</b> a) Write a program to implement Binomial Heap and perform the operations like insert and delete
5	<b>Trees-1:</b> a) Write a program to Construct AVL Tree and Perform the operations like Insert, delete and Traversal b) Write a program to Construct Red-black Tree and Perform the operations like Insert, delete and Traversal
6	<b>Tree-2:</b> a) Write a program to construct 2-3 Tree and Perform the operations like Insert, delete and Traversal
7	<b>Graphs-1:</b> a) Write a program to perform <b>Topological Sorting</b> of a <b>Directed Acyclic Graph (DAG)</b> b) Write a program to color a graph using at most M colors.

8	<b>Graphs-2:</b> a) Write a program to implement Dijkstra's Algorithm to find single source shortest path b) Write a program to implement Bellman-Ford Algorithm to find single source shortest path c) Write a program to implement Floyd- Warshall's Algorithm to find all pairs shortest path
9	<b>Disjoint Sets:</b> a) Write a program to Implement Disjoint Set Operations with Path Compression and Union by Rank
10	<b>String Matching:</b> a) Write a program to Implement the Naive and Rabin-Karp String Matching Algorithms b) Write a program to Implement the Knuth-Morris-Pratt (KMP) Algorithm

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	C++	Mark Allen Weiss	4 th Edition	Pearson
2.	Introduction to Algorithms	Thomas H Cormen, Charles E. Leiserson,	3 rd Edition	The MIT Press.
<b>Reference Book</b>				
1.	Fundamentals of Computer Algorithms, 2nd Edition, 2009, University Press Pvt. Ltd, Ellis Horowitz, Satraj Sahani and Raja sekharam.			
2.	Advanced Data Structures, Oxford University Press, 2018, ReemaThareja, S. Rama Sree.			
<b>Online Resources</b>				
1.	<a href="https://nptel.ac.in/courses/106106133">https://nptel.ac.in/courses/106106133</a>			
2.	<a href="https://www.geeksforgeeks.org/advanced-data-structures/">https://www.geeksforgeeks.org/advanced-data-structures/</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Course Outcomes
CO1	Demonstrate & Develop & Evaluate	Demonstrate and Creating Java Program Using Java Tokens and Arrays.
CO2	Develop & Evaluate	Apply and Creating Java Program Using Object Oriented Programming & Interface.
CO3	Develop & Evaluate	Apply the concept of package, stings and collections framework to develop the application in Java.
CO4	Develop & Evaluate	Apply the concept of exception handling and multithreading to develop the application in Java.
CO5	Develop & Evaluate	Apply the concept of AWT and JDBC to develop the java application.

**B. CO-PO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	1	-	-	-	-	-	1	2	-	-	1	2	1	1
CO2	1	1	1	-	-	-	-	-	1	2	-	-	1	2	1	1
CO3	2	2	2	2	-	-	-	-	1	2	-	-	2	2	2	2
CO4	2	2	3	3	-	-	-	-	1	3	2	-	2	2	2	2
CO5	3	3	3	3	3	-	-	-	1	3	3	3	3	3	3	3
Wt. AVG	1.3	1.3	1.3	2.0	-	-	-	-	1.0	2.0	-	-	1.3	2.0	1.3	1.3

**C. LIST OF EXPERIMENTS**

Ex-No	List of Programs
1	a) Write a Java program to print "Hello World" Using Command Line argument. b) Write a Java program to calculate sum of n numbers and average using command line argument. c) Write a Java program to calculate prime factor of a given number. d) Write a Java program to calculate following pattern * * * * * *
2	a) Write a Java program to calculate Fibonacci series up to nth term. b) Write a Java program to perform linear search using array. c) Write a Java Program to calculate sum of two matrixes. d) Write a Java Program to demonstrate jagged array.
3	a) Write a Java program to demonstrate static and instance variables and methods. b) Write a program to calculate sum of two objects. c) Write a Java program to demonstrate this and super keywords. d) Write a Java program to demonstrate method overloading.
4	a) Write a Java program to demonstrate abstract class. b) Write a Java program to demonstrate multiple inheritance using interfaces. c) Write a Java program to demonstrate dynamic methods invocation using interface.
5	a) Write a Java program to demonstrate any three pre-define methods of two predefined packages. b) Write a Java program to demonstrate user-define package. c) Write a Java program to demonstrate any three pre-define methods of String, String-Buffer and String-Builder classes.
6	a) Write a Java program to count each letter in a string like "hello", h=1, e=1, l=2, o=1.

	b) Write a Java program to demonstrate set and list collections. c) Write a Java program to demonstrate queue and maps collections.
7	a) Write a Java program to demonstrate any two checked and any two unchecked exceptions. b) Write a Java program to demonstrate try, catch, throw, throws and finally block. c) Write a Java program to demonstrate custom exception.
8	a) Write a Java program to demonstrate any three pre-define methods of thread class. b) Write a Java program to create multi-thread using runnable interface. c) Write a Java program to demonstrate synchronization in inter-thread communication.
9	Write a Java program to create a login form and check user authentication.
10	Write a Java program to establish database connection and fetch the tuples from database

#### D. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1	The complete reference Java –2	Herbert Schildt	5th Edition,	TMH.
2	SAMS teach yourself Java – 2	Rogers Cedenhead and Leura Lemay	3rd Edition,	Pearson Education
3	Programming With Java	Balaguruswamy	3 <sup>rd</sup> Edition	TMH
<b>Reference Book</b>				
1.	The complete reference Java –2			
2.	SAMS teach yourself Java – 2			
<b>Online Resources</b>				
1.	<a href="https://www.programiz.com/java-programming/online-compiler/">https://www.programiz.com/java-programming/online-compiler/</a>			
2.	<a href="https://www.tutorialspoint.com/compile_java_online.php">https://www.tutorialspoint.com/compile_java_online.php</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Course Outcomes
CO1	Remember	Recall key Tableau components and basic data visualization concepts in BI
CO2	Understand	Understand data preparation, apply functions, and create various visualizations in Tableau.
CO3	Apply	Apply Power BI interface, data modeling, and foundational DAX for effective analysis.
CO4	Analyze	Analyze business data using advanced DAX, secure data models, and publish interactive reports.
CO5	Evaluate	Create advanced dashboards and narratives; evaluate performance through capstone projects.

**B. CO-PO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1		-	2	-	-	-	-	1	-	-	1		-	-
CO2	2	2	1	-	-	-	-	-	-	1	-	-	-	-	-	-
CO3	3	3	2	2	1	-	-	1	-	-	2	1	-	-	-	-
CO4	3	3	3	1	-	-	-	-	-	-	-	1	-		-	-
CO5	3	3	3	2	2	-	1	-	-	-	-	1	1	-	-	-
Wt. AVG	2.3	2.0	1.5	2.0	1.5	-	-	1.0	-	1.0	2.0	1.0	1.0	-	-	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Tableau – Introduction, Installation & Basics	8
2.	Tableau – Data Handling, Functions & Visualizations	8
3.	Power BI – Setup, Data Modelling & DAX Foundations	9
4.	Power BI – Visualization, Advanced DAX, Security & Publishing	9
5.	Advanced Visualization, Storytelling & Project in Power BI & Tableau	7

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Tableau – Introduction, Installation &amp; Basics</b>
	<ul style="list-style-type: none"> <li>• <b>Module 1: Introduction to Data Visualization</b> <ul style="list-style-type: none"> <li>○ What is Data Visualization? Importance in BI</li> <li>○ Comparison of Tableau vs Power BI</li> </ul> </li> <li>• <b>Module 2: Tableau Installation</b> <ul style="list-style-type: none"> <li>○ Tableau Desktop</li> <li>○ Tableau Server</li> <li>○ Tableau Online</li> </ul> </li> <li>• <b>Module 3: Tableau Basics</b> <ul style="list-style-type: none"> <li>○ Data Interpreter</li> <li>○ Filtering &amp; Aggregates</li> <li>○ Calculations</li> <li>○ Sheets, Dashboards, Stories</li> <li>○ Live vs Extract</li> <li>○ Hierarchies, Measures, Tables</li> <li>○ Grouping &amp; Mapping Features</li> </ul> </li> </ul>
2.	<b>Tableau – Data Handling, Functions &amp; Visualizations</b>

	<ul style="list-style-type: none"> <li>• <b>Module 4: Connectors &amp; Prep</b> <ul style="list-style-type: none"> <li>○ Data Connections: SQL Server, Oracle, CSV/Excel Tableau Prep</li> <li>○ Working with Connectors</li> </ul> </li> <li>• <b>Module 5: Conditions &amp; Functions</b> <ul style="list-style-type: none"> <li>○ If, Not, And, Or Absolute Function Rounding</li> </ul> </li> <li>• <b>Module 6: Text Functions</b> <ul style="list-style-type: none"> <li>○ Left, Right, Mid Find, Trim Concatenate, Replace Upper, Lower</li> </ul> </li> <li>• <b>Module 7: Date Functions &amp; Word Cloud</b> <ul style="list-style-type: none"> <li>○ Year, Month, Day, Today/Now Date Difference</li> <li>○ Customized Date Column Word Cloud</li> </ul> </li> <li>• <b>Module 8: Plots &amp; Customizations</b> <ul style="list-style-type: none"> <li>○ Bar Charts, Pie Charts, Line &amp; Scatter Plots Map Views, Analytics Menu</li> <li>○ Parameters, Annotations</li> </ul> </li> <li>• <b>Module 9: Administration &amp; REST API</b> <ul style="list-style-type: none"> <li>○ Keep Only, Exclude, Exports Scheduling, Sharing, Jobs, Tasks</li> <li>○ Tableau Server Client (Python REST API)</li> </ul> </li> </ul>
<b>3.</b>	<b>Power BI – Setup, Data Modeling &amp; DAX Foundations</b>
	<ul style="list-style-type: none"> <li>• <b>Module 10. Getting Started with Power BI</b> <ul style="list-style-type: none"> <li>○ Installation of Power BI Desktop Overview of the Power BI Interface</li> <li>○ Understanding different views: Report View, Data View, Model View Power BI workflow from data to dashboard</li> </ul> </li> <li>• <b>Module 11. Connecting to Data Sources</b> <ul style="list-style-type: none"> <li>○ Importing from Excel, SQL Server, Web, JSON, and others Differences between Import mode and DirectQuery Scheduling data refresh and understanding refresh behavior Handling large data models and performance considerations</li> </ul> </li> <li>• <b>Module 12. Data Transformation Using Power Query</b> Introduction to Power Query Editor <ul style="list-style-type: none"> <li>○ Cleaning data: removing duplicates, replacing values, filtering Advanced shaping: pivot/unpivot, split column, grouping Merging and appending queries</li> <li>○ Managing query dependencies and applied steps</li> </ul> </li> <li>• <b>Module 13. Building the Data Model</b> <ul style="list-style-type: none"> <li>○ Creating relationships between tables Understanding cardinality and cross-filter direction Handling star and snowflake schemas</li> <li>○ Managing schema views, tables, and metadata Naming conventions and best practices for models</li> </ul> </li> <li>• <b>Module 14. Introduction to DAX (Data Analysis Expressions)</b> <ul style="list-style-type: none"> <li>○ Difference between calculated columns and measures Common DAX functions:</li> <li>○ Aggregations: SUM(), AVERAGE(), COUNT(), DISTINCTCOUNT() Logical: IF(), AND(), OR(), SWITCH()</li> <li>○ Text and date functions</li> <li>○ Basic expressions using RELATED(), CALCULATE() Using quick measures and calculated tables</li> </ul> </li> <li>• <b>Module 15. Basic Interactivity and KPI Implementation</b> <ul style="list-style-type: none"> <li>○ Applying visual and page-level filters Creating slicers and drill-down capabilities Implementing KPIs and using indicators</li> <li>○ Adding hierarchy and conditional formatting in visuals</li> </ul> </li> </ul>
<b>4.</b>	<b>Power BI – Visualization, Advanced DAX, Security &amp; Publishing</b>
	<ul style="list-style-type: none"> <li>• <b>Module 16. Data Visualization and Dashboard Design</b> <ul style="list-style-type: none"> <li>○ Creating and customizing visualizations (bar, pie, line, map, card, treemaps) Working with multiple pages in dashboards</li> <li>○ Using bookmarks and tooltips</li> <li>○ Applying conditional formatting and themes</li> </ul> </li> <li>• <b>Module 17. Advanced DAX for Time Intelligence</b> DAX functions for YTD, MTD, QTD calculations Rolling averages and cumulative totals <ul style="list-style-type: none"> <li>○ Working with custom calendars and time-based filters</li> </ul> </li> <li>• <b>Module 18. Data Security and Governance</b> Implementing Row-Level Security (RLS) <ul style="list-style-type: none"> <li>○ Creating roles and access restrictions</li> <li>○ Understanding data sensitivity and user access controls</li> </ul> </li> <li>• <b>Module 19. Publishing and Sharing Reports</b> Publishing to Power BI Service <ul style="list-style-type: none"> <li>○ Managing datasets, reports, and dashboards in Power BI Pro Mobile view customization and app integration Collaboration through workspaces</li> </ul> </li> <li>• <b>Module 20. Power BI Use Cases in Business Domains</b> <ul style="list-style-type: none"> <li>○ HR: Employee performance dashboards Finance: Budgeting and forecasting reports</li> <li>○ Operations: Inventory and supply chain visualizations</li> </ul> </li> </ul>

	<ul style="list-style-type: none"> <li>○ Interactive storytelling through real-time metrics</li> </ul>
<b>5.</b>	<b>Advanced Visualization, Storytelling &amp; Project in Power BI &amp; Tableau</b>
	<ul style="list-style-type: none"> <li>• <b>Module 21: Advanced Dashboards</b> <ul style="list-style-type: none"> <li>○ Dashboard design principles (layout, colors, interactivity) Tooltips, filters, bookmarks</li> <li>○ KPI cards, trend visuals Case study: Sales dashboard</li> </ul> </li> <li>• <b>Module 22: Data Storytelling</b> <ul style="list-style-type: none"> <li>○ Data storytelling basics</li> <li>○ Narrative with captions and annotations Tableau stories &amp; Power BI report narratives Case study: Revenue decline story</li> </ul> </li> <li>• <b>Module 23: Security &amp; Sharing</b> <ul style="list-style-type: none"> <li>○ Power BI workspaces, apps, Row-Level Security (RLS) Tableau Server roles, scheduling, governance</li> <li>○ Report publishing and collaboration</li> </ul> </li> <li>• <b>Module 24: Capstone Project</b> <ul style="list-style-type: none"> <li>○ End-to-end dashboard creation with real data</li> <li>○ Data cleaning, modeling, DAX/Tableau calculations Publish &amp; present final report</li> </ul> </li> <li>• <b>Project ideas:</b> Retail sales, Healthcare, Finance, Education</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	<i>Effective Data Storytelling: How to Drive Change with Data, Narrative, and Visuals</i>	Brent Dykes	2018	—
2.	<i>Effective Data Visualization: The Right Chart for the Right Data</i>	Stephanie D. H. Evergreen	2021	Evergreen Data & Evaluation, LLC
3.	<i>The Visual Display Of Quantitative Information</i>	Edward R. Tufte	2018	Amazon
<b>Reference Book</b>				
1.	"Information Dashboard Design: Displaying Data for At-a-glance Monitoring" by Stephen Few, O'Reilly			
2.	"The Accidental Analyst: Show Your Data Who's Boss" by Eileen and Stephen McDaniel, O'Reilly			
<b>Online Resources</b>				
1.	<a href="https://towardsdatascience.com/visualize-hierarchical-data-using-plotly-and-datapane-7e5abe2686e1">https://towardsdatascience.com/visualize-hierarchical-data-using-plotly-and-datapane-7e5abe2686e1</a>			
2.	<a href="https://www.idvbook.com/index.html%3Fp=44.html">https://www.idvbook.com/index.html%3Fp=44.html</a>			

# Skill Enhancement Courses

Code: BELCSE4201

Skill Enhancement Course-IV

2 Credits [LTP:0-0-4]

## A. COURSE OUTCOMES: -

### A. FACE Domain: OOPS and Basic DS

#### Course: Advanced Programming with Data Structures

Applicable for BTech (Batch 2029)

### B. COURSE OUTCOMES: On completion of the course a student will be able to:

- Apply object-oriented programming concepts such as classes, objects, encapsulation, inheritance, and polymorphism to develop modular and reusable code in Java.
- Implement abstraction using abstract classes and interfaces to design flexible and maintainable software components.
- Develop robust Java programs by incorporating exception handling and custom exceptions for effective error management.
- Construct and manipulate linear and non-linear data structures like linked lists, stacks, and queues for efficient data storage and retrieval.
- Design and traverse hierarchical data structures such as generic and binary trees using appropriate traversal techniques.

## D. DETAILED SYLLABUS

S. No.	Topic	Sub-Topics
1	Class and Object	<b>Class and Object</b> - Definition and purpose of a class - Syntax of class declaration in Java - Object creation using the new keyword - Instance variables and methods in a class - Initializing objects with constructors - Difference between class and object <b>Practical Exercise</b> Write a program to create a class Car with attributes like make, model, and year. Instantiate an object of Car and display its properties.
		<b>Constructor and Destructor</b> - Types of constructors: default, parameterized - Constructor overloading - Constructor chaining using this() - How constructors are called when objects are created <b>Practical Exercise</b> Create a class Book with a constructor that initializes the book's title, author, and price, and a destructor that prints a message when the object is destroyed.
2	Encapsulation	<b>Encapsulation</b> - Concept of encapsulation in Java - Protecting data using private access modifier - Benefits of encapsulation: data hiding, security, modularity <b>Practical Exercise</b> Write a program to create a class Employee with private data members (name, salary) and provide public getter and setter methods to access them.
		<b>Access Specifiers</b> - Overview of Java access modifiers: public, private, protected, and default - Controlling access to fields and methods - Use of private and public for data security <b>Practical Exercise</b> Modify the Employee class so that the salary is private, but can be accessed and modified through public getter and setter methods.
		<b>Getter and Setter Methods</b> - How to create getter and setter methods

		<ul style="list-style-type: none"> <li>- How they work with private fields</li> <li>- Benefits of getter and setter methods in controlling access to data</li> </ul>
3	<b>Inheritance</b>	<p><b>Inheritance</b></p> <ul style="list-style-type: none"> <li>- Concept of inheritance in OOP</li> </ul> <p><b>Superclass and Subclass</b></p> <ul style="list-style-type: none"> <li>- The relationship between the base and derived classes.</li> <li>- Using the extends keyword for class inheritance</li> </ul> <p><b>Types of inheritance</b></p> <ul style="list-style-type: none"> <li>- single, multilevel, hierarchical</li> <li>- Accessing inherited members in derived classes</li> </ul> <p><b>Practical Exercise</b></p> <p>Create a class Animal with methods eat() and sleep(). Derive a class Dog from Animal that overrides eat() to provide specific implementation.</p>
		<p><b>Super Keyword</b></p> <ul style="list-style-type: none"> <li>- Using super() to call the base class constructor</li> <li>- Accessing base class methods and variables using super</li> <li>- super keyword for method overriding</li> </ul> <p><b>Practical Exercise</b></p> <p>Create a class Vehicle with a method start(). Derive two classes Car and Truck from Vehicle, and implement the start() method in each.</p>
4	<b>Abstraction</b>	<p><b>Abstraction</b></p> <ul style="list-style-type: none"> <li>- What is abstraction and why it is used</li> <li>- Abstract classes and their purpose</li> <li>- Defining abstract methods using the abstract keyword</li> <li>- Abstract classes cannot be instantiated</li> </ul> <p><b>Practical Exercise</b></p> <p>Create an abstract class Shape with a pure virtual function area(). Derive two classes Circle and Rectangle, and implement the area() function in each derived class.</p>
		<p><b>Abstract Classes and Methods</b></p> <ul style="list-style-type: none"> <li>- Creating abstract classes</li> <li>- Implementing abstract methods in subclasses</li> <li>- Importance of abstraction in hiding implementation details</li> <li>- Extending abstract classes in concrete classes</li> </ul> <p><b>Practical Exercise</b></p> <p>Modify the Shape class to include another pure virtual function perimeter(). Implement the perimeter() function in the derived classes Circle and Rectangle.</p>
5	<b>Polymorphism</b>	<p><b>Polymorphism</b></p> <ul style="list-style-type: none"> <li>- Concept of polymorphism: one interface, multiple implementations</li> <li>- Compile-time polymorphism (method overloading)</li> <li>- Runtime polymorphism (method overriding)</li> <li>- Dynamic method dispatch</li> </ul> <p><b>Practical Exercise</b></p> <p>Create a base class Shape with a method draw(). Derive classes Circle and Rectangle from Shape and override the draw() method in both.</p>
		<p><b>Method Overloading</b></p> <ul style="list-style-type: none"> <li>- Overloading methods with different parameter types</li> <li>- Rules for method overloading: same method name, different parameters</li> <li>- Benefits of method overloading</li> </ul>
		<p><b>Method Overriding</b></p> <ul style="list-style-type: none"> <li>- Overriding methods in derived classes</li> <li>- Using the @Override annotation</li> <li>- Rules for method overriding</li> <li>- Achieving runtime polymorphism</li> </ul> <p><b>Practical Exercise</b></p> <p>Implement method overloading in a class Calculator by defining multiple add() methods with different argument types (e.g., int, float).</p>
		<p><b>Virtual Functions</b></p> <ul style="list-style-type: none"> <li>- Polymorphic behavior of overridden methods</li> <li>- Use of super to call base class method in case of method overriding</li> </ul>
6	<b>Interface</b>	<p><b>Interface</b></p> <ul style="list-style-type: none"> <li>- What is an interface and how it differs from abstract classes</li> <li>- Defining methods in an interface</li> <li>- Implementing interfaces using implements keyword</li> <li>- Multiple interfaces implementation</li> </ul> <p><b>Practical Exercise</b></p>

		<p>Create an interface Drawable with a pure virtual method draw(). Implement this interface in two classes, Circle and Rectangle, by providing the draw() function in both classes.</p> <p><b>Abstract Methods in Interface</b></p> <ul style="list-style-type: none"> <li>- Methods in an interface are implicitly abstract</li> <li>- Interfaces cannot have method bodies</li> <li>- Implementing interface methods in the class</li> <li>- Multiple interfaces and method conflict resolution</li> </ul> <p><b>Default Methods</b></p> <ul style="list-style-type: none"> <li>- Using default keyword to define methods with a body in interfaces</li> <li>- Benefits of default methods</li> <li>- Static methods in interfaces and their usage</li> </ul>
7	<b>Exception Handling</b>	<p><b>Exception Handling</b></p> <ul style="list-style-type: none"> <li>- Introduction to exceptions in Java</li> </ul> <p><b>Try-Catch-Finally</b></p> <ul style="list-style-type: none"> <li>- Blocks used for handling exceptions and executing code regardless of whether an exception occurs.</li> <li>- Syntax of try, catch, and finally blocks</li> <li>- Types of exceptions: checked and unchecked</li> <li>- How exceptions are thrown using throw keyword</li> </ul> <p><b>Practical Exercise</b></p> <p>Write a program that divides two numbers, with exception handling to catch a division by zero error.</p> <p><b>Throw and Throws</b></p> <ul style="list-style-type: none"> <li>- Difference between throw and throws</li> <li>- Using throw to explicitly throw exceptions</li> <li>- Declaring exceptions with throws keyword</li> </ul> <p><b>Custom Exceptions</b></p> <ul style="list-style-type: none"> <li>- Creating custom exceptions by extending Exception or RuntimeException</li> <li>- Throwing custom exceptions</li> <li>- Catching custom exceptions in catch blocks</li> </ul> <p><b>Practical Exercise</b></p> <p>Create a custom exception class NegativeNumberException to handle negative number input and throw it when a user enters a negative number.</p>
8	<b>Linked List</b>	<p>Introduction to Linked Lists, Types (Singly, Doubly, Circular), Operations (Insertion, Deletion, Traversal), Implementing Linked Lists in Java, Memory Management Concepts, Use Cases</p> <p><b>Practical Exercises:</b> Programs for Various Linked List Operations (Reverse a List, Detect Loop, Merge Two Sorted Lists)</p>
9	<b>Linked List</b>	<p>Introduction to Linked Lists, Types (Singly, Doubly, Circular), Operations (Insertion, Deletion, Traversal), Implementing Linked Lists in Java, Memory Management Concepts, Use Cases</p> <p><b>Practical Exercises:</b> Programs for Various Linked List Operations (Reverse a List, Detect Loop, Merge Two Sorted Lists)</p>
10	<b>Stack and Queue</b>	<p>Understanding Stacks and Queues, Stack Operations (Push, Pop, Peek), Queue Operations (Enqueue, Dequeue, Front), Implementing Stacks and Queues in Java, Applications of Stack and Queue</p> <p><b>Practical Exercises:</b> Programs Using Stacks and Queues (Expression Evaluation, Balanced Parentheses, Queue Using Two Stacks)</p>
11	<b>Generic Trees</b>	<p>Introduction to Trees, Generic Trees, Tree Terminologies (Node, Leaf, Root, Height, Depth), Tree Traversal Techniques (Preorder, Postorder, Level Order), Implementing Generic Trees</p> <p><b>Practical Exercises:</b> Programs for Tree Traversals, Constructing Trees from Given Data, Counting Nodes, Depth Calculation</p>
12	<b>Binary Tree</b>	<p>Understanding Binary Trees, Properties of Binary Trees, Types (Full, Complete, Perfect, Skewed), Binary Tree Representation in Java, Binary Tree Traversal (Inorder, Preorder, Postorder)</p> <p><b>Practical Exercises:</b> Programs for Various Binary Tree Operations (Height Calculation, Find All Leaves, Count Nodes at Each Level)</p>

# Value Added Courses (VAC)

Code: BUVCVD4102

Business Intelligence

2 Credits [LTP:2-0-0]

## A. COURSE OUTCOMES: -

CO	Cognitive Abilities	Course Outcomes
CO1	Remember	Gain knowledge of Business Intelligence
CO2	Understand	Elements of Business Intelligence Solutions
CO3	Apply	Build business projects
CO4	Analyze	Generate and manage BI reports
CO5	Evaluate	BI Deployment, Administration & Security.

## B. CO-PO-PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1	1	-	-	-	-	-	-	-	1	3	2	-	-
CO2	3	3	1	2	-	-	-	-	-	-	-	1	2	3	-	-
CO3	3	3	1	2	-	-	-	-	-	-	-	1	3	3	-	-
CO4	3	3	2	2	-	-	-	-	-	-	-	1	3	3	-	-
CO5	3	3	2	2	-	-	-	-	-	-	-	1	3	3	-	-
Wt. AVG	3	3	1	1	-	-	-	-	-	-	-	1	3	2	-	-

## C. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to Business Intelligence	6
2.	Elements of Business Intelligence Solutions	6
3.	Building the BI Project	6
4.	Reporting Authoring	6
5.	BI Deployment, Administration & Security	6

## D. DETAILED SYLLABUS

Unit	Unit Details
1.	<b>Introduction to Business Intelligence</b> <ul style="list-style-type: none"> <li>Introduction of the Unit</li> <li>Understanding the scope of today's BI solutions and how they fit into existing infrastructure. Describe BI, its components &amp; architecture.</li> <li>The future of BI, better experience for all business users.</li> <li>The Functional Area of BI Tools, Query Tools and Reporting.</li> <li>OLAP and Advanced Analytic</li> <li>Conclusion of the Unit</li> </ul>
2.	<b>Elements of Business Intelligence Solutions</b> <ul style="list-style-type: none"> <li>Introduction of the Unit</li> <li>Reports &amp; ad hoc queries.</li> <li>Dashboards &amp; Scorecards development.</li> <li>Metadata, Real time monitoring capabilities.</li> </ul>

	<ul style="list-style-type: none"> <li>• BI portals, web applications, Desktop applications.</li> <li>• Conclusion &amp; Real life applications</li> <li>• Conclusion of the Unit</li> </ul>
<b>3.</b>	<b>Building the BI Project</b>
	<ul style="list-style-type: none"> <li>• Introduction of the Unit</li> <li>• Planning the BI project, Project Resources,</li> <li>• Collecting User Requirements,</li> <li>• Validating BI Requirements</li> <li>• BI Design and Development</li> <li>• Conclusion of the Unit</li> </ul>
<b>4.</b>	<b>Introduction to Business Intelligence</b>
	<ul style="list-style-type: none"> <li>• Introduction of the Unit</li> <li>• Building reports with relational vs Multidimensional data models.</li> <li>• Types of Reports – List, Crosstabs, Statistics, Chart, map, financial etc.</li> <li>• Data Grouping &amp; Sorting, Filtering Reports.</li> <li>• Conditional formatting, Adding Summary Lines to Report</li> <li>• Conclusion of the Unit</li> </ul>
<b>5.</b>	<b>BI Deployment, Administration &amp; Security</b>
	<ul style="list-style-type: none"> <li>• Introduction of the Unit</li> <li>• BI Architecture</li> <li>• Expanding BI Authentication Authorization, Access Permissions, Groups and Roles.</li> <li>• Manage Status &amp; Monitoring.</li> <li>• Back Up and Restore</li> <li>• Conclusion of the Unit</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Reference Book	Author	Edition	Publication
1	Business Intelligence	Mark Whitehorn , Mary Whitehorn	Ist	(IBM ICE Publication).
2	Data Strategy: How To Profit From A World Of Big Data, Analytics And The Internet Of Things	Bernard Marr	2nd	Kogan Page
3	The Data Detective: Ten Easy Rules to Make Sense of Statistics	Tim Harford	Latest	Riverhead Books
4	From Big Data to Big Profits: Success with Data and Analytics	Russell Walker	Latest	Oxford University Press

**B.Tech- V<sup>th</sup> Semester**  
**Batch: 2025-29**

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Course Outcomes
CO1	Remember	Recall basic concepts of Algorithms, complexity and methods Like divide and conquer and greedy Algorithms.
CO2	Understand	Demonstrate an understanding of the Dynamic Programming To resolve min and max related Daily life problems.
CO3	Apply	Apply Pattern matching algorithms to find out patterns along With the Assignment Problem.
CO4	Analyze	Examine randomized algorithms to find desired solutions.
CO5	Evaluate	Assess the concept of NP-Hard and NP-Complete Problem for High computational problems.

**B. CO-PO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-	2
CO2	2	2	1	2	-	-	-	-	-	-	-	-	-	-	-	2
CO3	2	3	2	1	-	-	-	-	-	-	-	-	-	-	-	2
CO4	2	2	2	1	-	-	-	-	-	-	-	-	-	-	-	2
CO5	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-	2
Wt. AVG	2.0	2.7	1.3	1.3	-	-	-	-	-	-	-	-	-	-	-	2.0

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction	06
2.	Dynamic Programming, Branch and Bound	06
3.	Pattern Matching and Assignment Problem	08
4.	Randomized Algorithm	08
5.	NP-Hard and NP-Complete Problem	08

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Introduction</b>
	<ul style="list-style-type: none"> <li>Introduction to Unit</li> <li>Algorithm Specification, Algorithm Complexity and Order Notations.</li> <li>Divide and Conquer Method : General Method, Binary Search, Merge Sort, Quick sort and strassen's matrix multiplication algorithm.</li> <li>Greedy Method: General method, Knapsack Problem, Job Sequencing, Optimal Merge Patterns and Minimal Spanning Tree: Prim's, Kruskal's Algorithm</li> <li>Conclusion of Unit</li> </ul>
2.	<b>Dynamic Programming, Branch and Bound</b>
	<ul style="list-style-type: none"> <li>Introduction to Unit</li> <li>Dynamic Programming: Matrix Chain Multiplication, Longest Common</li> <li>Subsequence and 0/1Knapsack Problem, All pairs shortest path, Flow shop scheduling</li> <li>Branch And Bound: Traveling Salesman Problem, Bounding, FIFO Branch and Bound,</li> <li>Backtracking: The8-queensproblem,Hamiltoniancycles Comparison between Dynamic, Backtracking and Branch Bound</li> </ul>

	<ul style="list-style-type: none"> <li>• Conclusion of Unit</li> </ul>
<b>3.</b>	<b>Pattern Matching and</b>
	<ul style="list-style-type: none"> <li>• Introduction to Unit</li> <li>• Pattern Matching Algorithms: Naïve and Rabin Karp string matching algorithms, KMP Matcher and Boyer Moore Algorithms.</li> <li>• Assignment Problems: Formulation of Assignment and Quadratic assignment Problem.</li> <li>• Conclusion of Unit.</li> </ul>
<b>4.</b>	<b>Randomized Algorithm</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit.</li> <li>• Probabilistic Analysis &amp; Randomized Algorithms: Las Vegas algorithm, Monte Carlo algorithms for Min-Cut, randomized algorithm for 2- SAT.</li> <li>• Problem definition of Multi commodity flow, Flow shop scheduling and Network capacity</li> <li>• Assignment problems.</li> <li>• Conclusion of Unit</li> </ul>
<b>5.</b>	<b>NP-Hard and NP-Complete Problem</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit.</li> <li>• Definitions of P, NP-Hard and NP-Complete Problems. Decision Problems. Cook's Theorem. Proving NP- Complete Problems - Satisfiability problem and Vertex Cover Problem.</li> <li>• Approximation Algorithms for Vertex Cover and Set Cover Problem</li> <li>• Conclusion of Unit</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Fundamentals of Computer Algorithms	E.Horowitz & S.Sahani	Latest	Galgotia Publications
2.	Introduction to Algorithms	Corman, Leiserson & Rivest	Latest	MIT Press
<b>Reference Book</b>				
1.	Algorithm Analysis & Design, Goodrich, Tamassia, Wiley			
2.	Computer Algorithms, Introduction to Design and Analysis, SaraBasse, A. V. Geider			
<b>Online Resources</b>				
1.	<a href="https://www.javatpoint.com/daa-tutorial">https://www.javatpoint.com/daa-tutorial</a>			
2.	<a href="https://www.guru99.com/design-analysis-algorithms-tutorial.html">https://www.guru99.com/design-analysis-algorithms-tutorial.html</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Course Outcomes
CO1	Understand, Apply	Understand and apply Spring Core concepts such as IoC, Dependency Injection, AOP, and annotations.
CO2	Apply, Analyze	Develop RESTful web services using Spring Boot, including exception handling, validation, and logging.
CO3	Apply, Analyze	Implement data persistence solutions using Hibernate ORM and Spring Data JPA with proper entity relationships.
CO4	Analyze, Evaluate	Design microservice-based applications using Spring Cloud components like Eureka and API Gateway.
CO5	Analyze, Evaluate	Apply unit, integration, and component testing in Spring Boot applications using appropriate testing tools.

**B. CO-PO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	1	2	-	-	-	-	2	-	-	1	3	2	-
CO2	3	2	3	2	3	-	-	-	1	2	-	-	1	3	3	-
CO3	3	2	3	2	3	-	-	-	1	2	-	-	1	3	2	-
CO4	3	2	3	3	3	-	-	-	2	3	-	-	2	3	3	-
CO5	3	3	2	3	3	-	-	-	1	3	-	-	2	3	2	-
Wt. AVG	3.0	2.0	3.0	1.7	2.7	-	-	-	1.0	2.0	-	-	1.0	3.0	2.3	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Spring Core + Spring Boot Fundamentals	8
2.	REST API development + Boot internals	9
3.	Hibernate + Spring Data JPA	10
4.	Microservices + Advanced Spring MVC	9
5.	Testcases	7

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Spring Core + Spring Boot Fundamentals</b> <ul style="list-style-type: none"> <li>• <b>Spring Core:</b></li> <li>• Introduction to Spring Framework, Inversion of Control (IoC) and Dependency Injection (DI), Spring Bean Life Cycle</li> <li>• Spring Configuration (XML and Java-based), Spring AOP (Aspect-Oriented Programming)</li> <li>• Spring MVC Basics (Model-View-Controller pattern)</li> <li>• Annotations in Spring</li> <li>• Commonly Used Design Patterns in Spring (Singleton, Factory, Proxy, Prototype etc.)</li> <li>• <b>Spring Boot:</b></li> <li>• Introduction to Spring Boot</li> <li>• Spring Boot Starters, Auto Configuration, Spring Boot Annotations</li> <li>• Embedded Server (Tomcat, Jetty), Spring Boot CLI</li> </ul>
2.	<b>REST API development + Boot internals</b> <ul style="list-style-type: none"> <li>• RESTful Web Services with Spring Boot</li> <li>• Creating REST APIs using Spring MVC</li> <li>• Exception Handling in REST APIs</li> </ul>

	<ul style="list-style-type: none"> <li>• Content Negotiation</li> <li>• Spring Boot Actuator (Monitoring and Metrics)</li> <li>• Configuration Properties and Profiles</li> <li>• Logging with Spring Boot</li> <li>• Validation using JSR-303 (Hibernate Validator)</li> </ul>
<b>3.</b>	<b>Hibernate + Spring Data JPA</b>
	<ul style="list-style-type: none"> <li>• <b>Hibernate:</b></li> <li>• Introduction to Hibernate ORM, Hibernate Configuration and Setup</li> <li>• Entity Mapping (OneToOne, OneToMany, ManyToOne, ManyToMany)</li> <li>• CRUD Operations with Hibernate &amp; Using List</li> <li>• Entity Lifecycle in Hibernate</li> <li>• Validation and Constraints</li> <li>• Spring Data JPA:</li> <li>• Introduction to Spring Data</li> <li>• Spring Data JPA Repositories</li> <li>• Custom Query Methods</li> <li>• Pagination and Sorting</li> <li>• JPQL and Native Queries</li> <li>• Entity Relationships and Mappings</li> </ul>
<b>4.</b>	<b>Microservices + Advanced Spring MVC</b>
	<ul style="list-style-type: none"> <li>• <b>Spring MVC (Advanced):</b></li> <li>• Spring MVC Architecture</li> <li>• Components of Spring MVC (DispatcherServlet, Controllers, ViewResolvers, etc.)</li> <li>• Form Handling</li> <li>• File Upload</li> <li>• <b>Microservices:</b></li> <li>• Introduction to Microservices</li> <li>• Building Microservices with Spring Boot</li> <li>• Spring Cloud Overview</li> <li>• Spring Cloud Eureka (Service Discovery)</li> <li>• Spring Cloud Gateway (API Gateway)</li> </ul>
<b>5.</b>	<b>Testcases</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Unit Testing with JUnit and Mockito</li> <li>• @SpringBootTest Annotation</li> <li>• @MockBean Annotation</li> <li>• Testing Repositories with @DataJpaTest</li> <li>• Testing Controllers with MockMvc</li> <li>• Integration Testing in Spring Boot</li> </ul>

## E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Spring Boot in Action	Craig Walls	1st Edition	Manning Publications
2.	Spring Microservices in Action	John Carnell	2nd Edition	Manning Publications
<b>Reference Book</b>				
1.	Pro Spring Boot 2: An Authoritative Guide to Building Microservices, Web and Enterprise Applications – Felipe Gutierrez, Apress, 2019			
2.	Spring Boot: Up and Running: Building Cloud Native Java and Kotlin Applications – Mark Heckler, O'Reilly Media, 2021			
<b>Online Resources</b>				
1.	<a href="https://spring.io/guides">https://spring.io/guides</a>			
2.	<a href="https://www.baeldung.com/">https://www.baeldung.com/</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Course Outcomes
CO1	Remember	Understand the fundamental concepts of web frameworks and the MVC architecture, and distinguish between popular Python-based frameworks.
CO2	Understand	Develop basic web applications using Flask by implementing routing, HTTP methods, and modular application structures.
CO3	Apply	Utilize advanced features of Flask including template rendering, form handling, sessions, and database integration using SQLAlchemy.
CO4	Analyze	Build and manage Django projects with a clear understanding of the MTV architecture, views, templates, forms, and URL configurations.
CO5	Evaluate	Construct RESTful APIs using Django REST Framework and demonstrate the ability to handle JSON data, test endpoints, and apply basic authentication mechanisms.

**B. CO-PO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	-	2	-	-	-	-	-	-	1	3	2	1	-
CO2	3	2	3	2	3	-	-	-	-	1	-	2	3	3	2	1
CO3	3	2	3	2	3	-	-	-	-	1	-	2	3	3	2	1
CO4	3	2	3	2	3	-	-	-	-	1	-	2	3	3	2	1
CO5	3	2	3	3	3	-	-	-	-	1	-	2	3	3	2	2
Wt. AVG	3.0	2.0	2.5	2.0	3.0	-	-	-	-	1.0	-	1.7	3.0	3.0	2.0	1.0

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to Web Frameworks	5
2.	Introduction to Flask	7
3.	Advanced Flask Features	9
4.	Introduction to Django	10
5.	Advanced Django and RESTful APIs	9

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Introduction to Web Frameworks</b>
	<ul style="list-style-type: none"> <li>Introduction of Frameworks</li> <li>Web Application Frameworks and MVC Architectures</li> <li>Overview of Python frameworks and their importance</li> <li>Comparison of popular Python frameworks (e.g., Django, Flask, Pyramid)</li> <li>Introduction to REST architecture and its role in modern web frameworks</li> <li>Conclusion of the Unit</li> </ul>
2.	<b>Introduction to Flask</b>
	<ul style="list-style-type: none"> <li>Overview of Flask and its features</li> <li>Creating and structuring a basic Flask application</li> <li>Understanding URL routing and dynamic URLs</li> <li>Implementing variable rules in Flask</li> <li>Handling HTTP methods like GET, POST, etc.</li> <li>Overview of Flask Blueprints for modular applications</li> </ul>
3.	<b>Advanced Flask Features</b>

	<ul style="list-style-type: none"> <li>• Working with Jinja2 templates for dynamic HTML</li> <li>• Serving and managing static files</li> <li>• Understanding and using the request object</li> <li>• Processing and validating form data</li> <li>• Implementing cookies and managing sessions</li> <li>• Handling redirects, custom error pages, and message flashing</li> <li>• Introduction to Flask extensions, focusing on SQLAlchemy for database integration</li> <li>• Connecting Flask with SQLite/MySQL for CRUD operations</li> <li>• Introduction to Flask-RESTful for building APIs</li> </ul>
<b>4.</b>	<b>Introduction to Django</b>
	<ul style="list-style-type: none"> <li>• Introduction to Django and its role in back-end web development</li> <li>• Understanding the HTTP protocol and its importance in web development</li> <li>• Learning the MVC model and its application in Django (MTV model)</li> <li>• Setting up and using virtual environments for Django projects</li> <li>• Exploring Django project structure and the built-in admin interface</li> <li>• Working with generic views for rapid development</li> <li>• Creating and managing HTML templates</li> <li>• Configuring URL dispatcher and routing in Django</li> <li>• Creating and working with Django apps using startapp</li> <li>• Introduction to Django forms and handling user input</li> </ul>
<b>5.</b>	<b>Advanced Django and RESTful APIs</b>
	<ul style="list-style-type: none"> <li>• Building custom views and handling GET/POST methods</li> <li>• Implementing a URL shortener and managing the user model</li> <li>• Adding logic in templates and querying models</li> <li>• Serving static files and deploying Django applications</li> <li>• Introduction to Django REST framework for building APIs</li> <li>• Handling JSON data and building RESTful APIs</li> <li>• Using Postman for API testing and managing related models</li> </ul>

## E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Django for Beginners: Build websites with Python and Django	William S. Vincent	2023 Edition	Welcome To Code
2.	REST APIs with Django: Build powerful web APIs with Python and Django	William S. Vincent	2023 Edition	Welcome To Code
<b>Reference Book</b>				
1.	Flask By Example – Gareth Dwyer, Packt Publishing			
2.	Two Scoops of Django 3.x – Daniel Roy Greenfeld and Audrey Roy Greenfeld			
<b>Online Resources</b>				
1.	<a href="https://realpython.com">https://realpython.com</a>			
2.	<a href="https://djangorestframework.com">https://djangorestframework.com</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Course Outcomes
CO1	Remember	Recall basic concepts of Algorithms, complexity and methods like divide and conquer and greedy Algorithms.
CO2	Understand	Demonstrate an understanding of the Dynamic Programming to resolve min and max related Daily life problems.
CO3	Apply	Apply Pattern matching algorithms to find out patterns along with the Assignment Problem.
CO4	Analyze	Examine randomized algorithms to find desired solutions.
CO5	Evaluate	Assess the concept of NP-Hard and NP-Complete Problem for high computational problems.

**B. CO-PO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	-	2	1	-	-	-	-	-	-	-	2	-	-	2
CO2	1	2	3	2	-	-	-	-	-	-	-	-	1	-	-	1
CO3	1	3	3	1	-	-	-	-	-	-	-	-	2	-	-	1
CO4	2	-	1	1	-	-	-	-	-	-	-	-	2	-	-	2
CO5	1	1	2	-	-	-	-	-	-	-	-	-	1	-	-	1
Wt. AVG	1.3	2.0	3.0	1.7	1.0	-	-	-	-	-	-	-	1.7	-	-	1.3

**C. LIST OF EXPERIMENTS**

1	<ul style="list-style-type: none"> <li>Write a C program to implement the Stack using arrays. Write Push(), Pop(), and Display() methods to demonstrate its working.</li> <li>Write a C program to implement the Queue using arrays. Write Enqueue(), Dqueue(), Display() &amp; Peak() methods to demonstrate its working.</li> </ul>
2	<ul style="list-style-type: none"> <li>Write a C program to implement a Merge sort algorithm to a list of elements for different values of n and determine the time required to sort the elements.</li> <li>Write a C program to sort a list of elements using the quick sort algorithm. The elements can be read from a file.</li> </ul>
3	<ul style="list-style-type: none"> <li>Write a C program to find the product of two matrix of size (2X2) using Strassen's Matrix multiplication algorithm.</li> <li>Implement 0/1 Knapsack problem using Dynamic Programming in C.</li> </ul>
4	<ul style="list-style-type: none"> <li>WAP to find the Minimum Cost Spanning Tree (MCST) of a given connected undirected graph using Kruskal's Algorithm.</li> <li>WAP in C to find the Minimum Cost Spanning Tree (MCST) of a given connected undirected graph using Prim's algorithms.</li> </ul>
5	<ul style="list-style-type: none"> <li>Write a C program to find the shortest paths between nodes in a undirected graph using Dijkstra's algorithm.</li> <li>Write a C program to find the shortest paths between nodes in a directed graph using BelmanFord algorithm.</li> </ul>
6	<ul style="list-style-type: none"> <li>Write a C program to implement N Queen's problem using Back Tracking.</li> </ul>
7	<ul style="list-style-type: none"> <li>WAP in C to find a subset of a given set <math>S = \{s_1, s_2, \dots, s_n\}</math> of n positive integers whose sum is equal to a given positive integer d.</li> </ul>
8	<ul style="list-style-type: none"> <li>Write a C program to Print all the nodes reachable from a starting node in a digraph using BFS method.</li> </ul>
9	<ul style="list-style-type: none"> <li>Check whether a graph is connected or not using DFS method.</li> </ul>
10	<ul style="list-style-type: none"> <li>Write a C Program to Search a given pattern in a input String.</li> </ul>
11	<ul style="list-style-type: none"> <li>Write a C program to implement all pairs shortest paths problem using Floyd's algorithm.</li> </ul>
12	<ul style="list-style-type: none"> <li>Write a C program to find out the probability of generating any random no using Monte Carlo algorithm.</li> </ul>

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Course Outcomes
CO1	Understand, Apply	Understand and apply Spring Core concepts such as IoC, Dependency Injection, AOP, and auto-configuration.
CO2	Apply, Analyze	Develop RESTful web services using Spring Boot, including exception handling, validation, and logging.
CO3	Apply, Analyze	Implement database interactions using Hibernate ORM and Spring Data JPA with proper entity relationships.
CO4	Analyze, Evaluate	Design microservice-based applications using Spring Cloud components like Eureka and API Gateway.
CO5	Analyze, Evaluate	Apply unit, integration, and component testing in Spring Boot applications using appropriate testing tools.

**B. CO-PO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	-	2	1	-	-	-	-	-	-	-	2	-	-	2
CO2	1	2	3	2	-	-	-	-	-	-	-	-	1	1	-	1
CO3	1	2	3	1	-	-	-	-	-	-	-	-	2	-	-	1
CO4	2	1	2	1	-	-	-	-	-	-	-	-	2	1	-	2
CO5	1	1	2	-	-	-	-	-	-	-	-	-	1	-	-	1
Wt. AVG	1.3	1.7	3.0	1.7	1.0	-	-	-	-	-	-	-	1.7	1.0	-	1.3

**C. LIST OF EXPERIMENTS**

1	Create a simple Spring application using IoC and Dependency Injection (DI)
2	Implement Spring AOP with custom advice and pointcuts
3	Create a Spring Boot application with REST controller and auto-configuration
4	Build a REST API using Array List for CRUD operations
5	Implement Exception Handling in REST APIs
6	Secure a REST API using Spring Security (basic auth)
7	Configure Hibernate with Spring Boot and perform CRUD operations
8	Use Spring Data JPA repositories to interact with a relational database
9	Build two microservices and enable communication via REST
10	Register microservices using Spring Cloud Eureka and use API Gateway
11	Write unit tests using JUnit and Mockito for a service layer
12	Create an REST API and perform following operations. GetByID a. Post b. DeleteById c. Update

**D. RECOMMENDED STUDY MATERIAL**

S. No	Text Books:	Author	Edition	Publication
1.	Spring in Action	Craig Walls	6th Edition	McGraw Hill
2.	Spring Boot in Action	Craig Walls	1st Edition	Bpb
3.	Spring Microservices in Action	John Carnell	2nd Edition	Bpb
Reference Book				
1.	Spring Boot: Up & Running – Building Cloud Native Java and Kotlin Applications			
2.	Spring Boot 2: An Authoritative Guide to Building Microservices, Web and Enterprise applications			
Online Resources				
1.	<a href="https://www.baeldung.com">https://www.baeldung.com</a>			
2.	<a href="https://spring.io/guides">https://spring.io/guides</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Course Outcomes
CO1	Understand, Apply	Understand and apply Flask concepts such as URL routing, Jinja2 templating, form handling, session management, and HTTP method handling.
CO2	Apply, Analyze	Develop RESTful APIs using Flask-RESTful and Django REST Framework, including JSON-based CRUD operations, validations, and API testing using Postman.
CO3	Apply, Analyze	Implement database interactions using Flask-SQLAlchemy and Django ORM for CRUD operations and model management through Django Admin.
CO4	Analyze, Evaluate	Design modular and scalable web applications using Django's MTV architecture with custom views, forms, and templates.
CO5	Analyze, Evaluate	Design and develop a full-stack mini project using Flask or Django integrating all key aspects: routing, templates, forms, database, and RESTful APIs.

**B. CO-PO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	-	-	-	-	-	-	2	-	1	3	2	-	-
CO2	3	2	3	-	-	-	-	-	-	2	-	1	3	2	-	-
CO3	3	3	3	2	-	-	-	-	-	2	-	1	3	3	-	-
CO4	3	3	3	-	-	-	-	-	-	2	-	1	3	2	-	-
CO5	3	3	3	2	-	-	-	-	-	2	-	1	3	3	-	-
Wt. AVG	3.0	2.3	3.0	2.0	-	-	-	-	-	2.0	-	1.0	3.0	2.3	-	-

**C. LIST OF EXPERIMENTS**

S. No	Experiment Description
1	Create a basic Flask application that demonstrates the use of URL routing and dynamic URL handling using variable rules.
2	Build a Flask application that uses Jinja2 templates to render dynamic HTML pages with user-provided input.
3	Develop a form in Flask to accept input, validate it, and display the results. Include usage of GET and POST methods.
4	Implement session management and cookies in a Flask application. Demonstrate login/logout functionality.
5	Integrate Flask-SQLAlchemy with a Flask app to perform CRUD operations on a SQLite/MySQL database.
6	Create a RESTful API using Flask-RESTful, and perform JSON-based GET, POST, PUT, DELETE operations.
7	Set up a Django project with a custom app. Demonstrate URL routing, views, templates, and the MTV architecture.
8	Use Django's admin interface to manage database models. Create a model, register it in the admin, and perform CRUD operations.
9	Build a Django web application with forms to accept user input and store data in the database using Django ORM.
10	Create custom views in Django to handle GET and POST requests, and include logic for displaying database records.
11	Develop a RESTful API using the Django REST Framework (DRF) to expose a model and test endpoints using Postman.

12

Create a full-stack mini project using Django or Flask that includes templates, forms, database integration, and API handling (e.g., To-Do App or Blog App).

#### D. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Django for Beginners: Build websites with Python and Django	William S. Vincent	2023 Edition	Welcome To Code
2.	REST APIs with Django: Build powerful web APIs with Python and Django	William S. Vincent	2023 Edition	Welcome To Code
3.	Django for Beginners: Build websites with Python and Django	William S. Vincent	2023 Edition	Welcome To Code
<b>Reference Book</b>				
1.	Python Web Development with Flask			
2.	Two Scoops of Django: Best Practices for Django Web Applications			
<b>Online Resources</b>				
1.	<a href="https://flask.palletsprojects.com/">https://flask.palletsprojects.com/</a>			
2.	<a href="https://docs.djangoproject.com/">https://docs.djangoproject.com/</a>			

# Skill Enhancement Courses

Code: BELCSE5201

Skill Enhancement Course - V

2 Credits [LTP:0-0-4]

**FACE Domain: Advanced Data Structures and Basic Algorithms**

**Course: Advanced Data Structures and Algorithms**

Applicable for BTech (Batch 2029, 2028)

**A. COURSE OUTCOMES: On completion of the course a student will be able to:**

- Implement advanced tree-based and priority data structures such as Binary Search Trees (BST), Heaps, and Priority Queues to solve complex data organization problems.
- Apply hashing techniques and HashMap operations for efficient data storage, retrieval, and real-world use cases like frequency analysis and caching.
- Design and analyze graph-based algorithms using BFS, DFS, Minimum Spanning Tree (Prim's, Kruskal's), and Shortest Path (Dijkstra's, Floyd-Warshall) for network problem-solving.
- Evaluate algorithm efficiency using time and space complexity concepts and solve mathematical problems using number theory and sieve-based approaches.
- Solve problems using algorithmic strategies such as Two Pointer Technique, Searching & Sorting, and Divide and Conquer for optimized performance and scalability

**B. DETAILED SYLLABUS**

S. No.	Topic	Sub-Topics
1	<b>Binary Search Tree (BST)</b>	Understanding Binary Search Trees, Properties of BST, Operations (Insertion, Deletion, Search, Min/Max), Implementing BST in Java, Self-Balancing Trees (Introduction) <b>Practical Exercises:</b> Programs for BST Operations (Find K-th Smallest/Largest Element, Check if a Given Tree is BST, Convert Sorted Array to BST)
2	<b>Priority Queue</b>	Introduction to Priority Queues, Min-Heap and Max-Heap, Operations on Heaps (Insertion, Deletion, Heapify), Implementing Priority Queue in Java, Applications of Priority Queues <b>Practical Exercises:</b> Programs Using Priority Queues (K-Largest Elements, Merge K Sorted Lists, Find Median in a Data Stream)
3	<b>HashMaps</b>	Introduction to HashMaps, Hashing Techniques, Collision Resolution Strategies, Implementing HashMaps in Java, Use Cases and Applications of HashMaps <b>Practical Exercises:</b> Programs for HashMap Operations (Frequency Count, Anagram Detection, Find Pairs with Given Sum, Caching Mechanism)
4	<b>Graphs</b>	Introduction to Graphs, Representation (Adjacency List, Adjacency Matrix), Types of Graphs (Directed, Undirected, Weighted), Graph Traversal Techniques (BFS, DFS), Implementing Graphs Minimum spanning tree - Prims and Kruskals algorithm, Shortest path algorithm - Dijkstra and Floyd warshall algorithm <b>Practical Exercises:</b> Programs for Graph Operations (Shortest Path Algorithm, Detect Cycle, Graph Coloring, Minimum Spanning Tree)
5	<b>Graphs</b>	Introduction to Graphs, Representation (Adjacency List, Adjacency Matrix), Types of Graphs (Directed, Undirected, Weighted), Graph Traversal Techniques (BFS, DFS), Implementing Graphs Minimum spanning tree - Prims and Kruskals algorithm, Shortest path algorithm - Dijkstra and Floyd warshall algorithm <b>Practical Exercises:</b> Programs for Graph Operations (Shortest Path Algorithm, Detect Cycle, Graph Coloring, Minimum Spanning Tree)

6	<b>Graphs</b>	Introduction to Graphs, Representation (Adjacency List, Adjacency Matrix), Types of Graphs (Directed, Undirected, Weighted), Graph Traversal Techniques (BFS, DFS), Implementing Graphs Minimum spanning tree - Prims and Kruskals algorithm, Shortest path algorithm - Dijkstra and Floyd warshall algorithm <b>Practical Exercises:</b> Programs for Graph Operations (Shortest Path Algorithm, Detect Cycle, Graph Coloring, Minimum Spanning Tree)
7	<b>Time &amp; Space Complexity, Mathematical algorithms</b>	Introduction Time and Space Complexity, Calculating time complexities - Best case, Average case and Worst case scenarios, Asymptotic notations, Divisors of a number, Sieve of eratosthenes, Euclid algorithm, Prime factorization, Set theory, ncr computations <b>Practical Exercises:</b> Sum of prime factors, GCD of n numbers, problems using prime numbers
8	<b>Two Pointer Approach</b>	Introduction to Two Pointer Technique, Applications (Sorting, Searching), Problems (Pair Sum, Subarray Problems), Implementing Two Pointer Approach in Java <b>Practical Exercises:</b> Programs Using Two Pointers (Finding Triplets with Zero Sum, Longest Substring without Repeating Characters, Container with Most Water)
9	<b>Searching &amp; Sorting</b>	Linear & Binary Search, Bubble, Insertion, Selection and problems on searching and sorting <b>Practical Exercises:</b> Programs using binary search and other sorting algorithms
10	<b>Searching &amp; Sorting</b>	Linear & Binary Search, Bubble, Insertion, Selection and problems on searching and sorting <b>Practical Exercises:</b> Programs using binary search and other sorting algorithms
11	<b>Divide and Conquer Techniques</b>	Understanding Divide and Conquer, Recursion Basis, Applications (Merge Sort, Quick Sort, Binary Search), Implementing Divide and Conquer in Java <b>Practical Exercises:</b> Programs for Divide and Conquer Problems (Find the Median, Closest Pair of Points, Large Integer Multiplication)
12	<b>Divide and Conquer Techniques</b>	Understanding Divide and Conquer, Recursion Basis, Applications (Merge Sort, Quick Sort, Binary Search), Implementing Divide and Conquer in Java <b>Practical Exercises:</b> Programs for Divide and Conquer Problems (Find the Median, Closest Pair of Points, Large Integer Multiplication)

**FACE Domain: Front End Development****Course: Front-End Web Development with React**

Applicable for BTech and BCA (Batch 2029, 2028)

**COURSE OUTCOMES: On completion of the course a student will be able to:**

- Build responsive web pages using HTML, CSS, Flexbox, Grid, and media queries that adapt across various screen sizes.
- Implement dynamic and interactive web features using JavaScript fundamentals, DOM manipulation, and event handling.
- Develop modular and reusable user interfaces using modern JavaScript (ES6+) features, functions, and scope management.
- Design single-page applications (SPAs) using React, including component structure, state management, routing, and hooks.
- Integrate APIs and handle asynchronous operations using Fetch API, Promises, and Async/Await to fetch and display dynamic data.

**B. DETAILED SYLLABUS**

S. No.	Topics	Sub-Topics
1	<b>HTML Basics</b>	<p><b>HTML Structure:</b> Understanding the HTML document structure, including &lt;!DOCTYPE&gt;, &lt;html&gt;, &lt;head&gt;, &lt;body&gt;.</p> <p><b>Basic Elements:</b> Familiarizing with headings (&lt;h1&gt; - &lt;h6&gt;), paragraphs (&lt;p&gt;), images (&lt;img&gt;), links (&lt;a&gt;), lists (&lt;ul&gt;, &lt;ol&gt;), and tables (&lt;table&gt;).</p> <p><b>Forms and Inputs:</b> Working with &lt;form&gt;, input types (text, email, password, checkbox, radio), submit buttons, and labels for accessible forms.</p> <p><b>Semantic HTML:</b> Using semantic elements like &lt;header&gt;, &lt;footer&gt;, &lt;section&gt;, &lt;article&gt;, &lt;nav&gt; &lt;main&gt;</p>
	<b>CSS Basics</b>	<p><b>Selectors and Specificity:</b> Understanding CSS selectors (class, ID, element selectors) and specificity hierarchy.</p> <p><b>CSS Properties:</b> Applying styles with properties for color, background, font styling, borders, and padding/margin.</p> <p><b>Box Model:</b> Examining content, padding, border, and margin layers, and understanding how they affect layout.</p> <p><b>Typography:</b> Using font-size, font-family, font-weight, and line-height to create readable text layouts.</p>
	<b>Project</b>	<b>Facebook Login page clone</b>
2	<b>Flexbox &amp; Grid Layouts</b>	<p><b>Flexbox:</b> Creating flexible layouts using properties like flex-direction, justify-content, align-items, and flex-wrap.</p> <p><b>CSS Grid:</b> Designing complex grids using grid-template-columns, grid-template-rows, gap, justify-content, and align-items.</p> <p><b>Layout Techniques:</b> Building responsive layouts by combining Flexbox and CSS Grid for various screen sizes.</p>
	<b>Responsive Design</b>	<p><b>Media Queries:</b> Writing media queries for mobile, tablet, and desktop views to ensure layout adapts to different screen sizes.</p> <p><b>Responsive Units:</b> Utilizing relative units like %, em, rem, vw, vh for scalable layouts.</p> <p><b>Mobile-First Design:</b> Structuring CSS for mobile-first approach, then scaling up for larger screens.</p>
	<b>Project</b>	<b>Chessboard</b>
3	<b>CSS Animations</b>	<p><b>Transitions:</b> Adding smooth transitions to properties like color, opacity, and positioning with transition.</p> <p><b>Keyframes:</b> Creating animations using @keyframes for dynamic effects (e.g., fade-in, bounce).</p> <p><b>Hover and Focus States:</b> Enhancing user interaction with hover effects and focus states for accessibility.</p>
4	<b>Project: Responsive Portfolio Page</b>	<p>Building a responsive personal portfolio page that includes sections for about, projects, and contact.</p> <p>Applying Flexbox and CSS Grid for layout and CSS animations for visual appeal.</p>

5	<b>JavaScript Fundamentals</b>	<p><b>Variables and Data Types:</b> Using var, let, const, and understanding data types (string, number, boolean, object, array).</p> <p><b>Operators and Expressions:</b> Arithmetic, logical, and comparison operators for building expressions.</p> <p><b>Control Flow:</b> Using conditionals (if, else if, else) and loops (for, while, do...while) for program flow.</p>
6	<b>DOM Manipulation</b>	<p><b>Selecting Elements:</b> Using methods like getElementById, querySelector, querySelectorAll.</p> <p><b>Modifying Elements:</b> Changing HTML content, adding/removing classes, and styling elements directly.</p> <p><b>Event Handling:</b> Adding event listeners for user interactions (clicks, key presses) and writing callback functions.</p>
	<b>Functions &amp; Scope</b>	<p><b>Function Declarations and Expressions:</b> Defining reusable code blocks, using arrow functions.</p> <p><b>Scope:</b> Understanding local vs. global scope and closures in JavaScript.</p>
	<b>ES6+ Features</b>	<p><b>Modern Syntax:</b> Using let and const for variables, destructuring objects/arrays, template literals, and arrow functions.</p> <p><b>Spread and Rest Operators:</b> Expanding and combining arrays and objects with ....</p> <p><b>Modules:</b> Import/export syntax for modular code organization.</p>
	<b>Project</b>	<b>Number Guessing game</b>
7	<b>Promises and Async/Await</b>	<p><b>Promises:</b> Understanding asynchronous operations with .then() and .catch().</p> <p><b>Async/Await:</b> Simplifying async code with async functions and await for cleaner syntax.</p>
8	<b>JSON and Fetch API</b>	<p><b>Working with JSON:</b> Parsing JSON data and handling it in JavaScript.</p> <p><b>Fetch API:</b> Making GET/POST requests, handling responses, and managing errors.</p>
9	<b>Project: Dynamic Blog Page</b>	<p>Building a blog section that fetches posts from an API.</p> <p>Displaying posts dynamically on the page and handling errors gracefully.</p>
10	<b>React Basics</b>	<p><b>Introduction to React:</b> Understanding component-based architecture and the virtual DOM.</p> <p><b>Components, Props, and State:</b> Building functional components, passing props, and managing component state.</p> <p><b>JSX Syntax:</b> Writing HTML-like syntax in JavaScript and understanding JSX rules.</p>
11	<b>Event Handling</b>	<p><b>Synthetic Events:</b> Understanding React's synthetic event system and handling events like onClick, onChange.</p> <p><b>Form Handling:</b> Handling form inputs and managing state with controlled components.</p>
	<b>Lists &amp; Keys</b>	<p><b>Rendering Lists:</b> Mapping data arrays to create lists of components.</p> <p><b>Using Keys:</b> Adding unique keys to improve performance and avoid render conflicts.</p>
	<b>React Router &amp; SPAs</b>	<p><b>Setting Up Routes:</b> Installing and configuring react-router-dom for navigation.</p> <p><b>Navigation Links:</b> Using Link and NavLink for navigation without page reloads.</p> <p><b>Nested and Dynamic Routes:</b> Creating nested routes and using parameters in route paths.</p>
	<b>Project: To-Do App</b>	<p>Developing a to-do list app to practice component structure, state management, and routing.</p> <p>Adding CRUD operations with local state to manage the to-do items.</p>
12	<b>React Hooks</b>	<p><b>useState and useEffect:</b> Managing state and side effects in functional components.</p> <p><b>useEffect Dependency Array:</b> Handling dependencies and avoiding unnecessary renders.</p>
	<b>Context API</b>	<b>Global State:</b> Using createContext and useContext to manage shared state across components.
	<b>Advanced Hooks</b>	<p><b>useReducer:</b> Managing complex state logic similar to Redux.</p> <p><b>Custom Hooks:</b> Creating reusable logic in custom hooks.</p>
	<b>Component Styling</b>	<p><b>CSS Modules and Styled-Components:</b> Using scoped styles with CSS Modules and dynamic styling with styled-components.</p> <p><b>Inline Styles:</b> Applying styles directly within component JSX.</p>
	<b>Project: Recipe Management App</b>	<p>Building a recipe management app with pages for adding, viewing, and managing recipes.</p> <p>Using React Router for navigation and Context API for managing shared data like recipe lists.</p>

**FACE Domain: MongoDB Certification****Course: NoSQL Database Systems using MongoDB**

Applicable for BTech and BCA (Batch 2029, 2028)

**COURSE OUTCOMES: On completion of the course a student will be able to:**

- Explain the core features, architecture, and advantages of MongoDB over traditional RDBMS, including sharding and document-based storage.
- Perform CRUD operations using MongoDB shell and Java integration, including querying, updating, deleting, and aggregating documents.
- Implement indexing strategies to optimize query performance, and analyze execution plans to identify and resolve performance issues.
- Configure and manage MongoDB replication for high availability, including primary/secondary roles, elections, read preferences, and write concerns.
- Design and deploy backend applications using MongoDB with integrated CRUD operations, optimized queries, replication, and backup-recovery strategies.

S. No.	Topic	Sub-Topics
1	<b>Philosophy and Features</b>	Characteristics of MongoDB. Differences between MongoDB and RDBMS. Methods to access and administer MongoDB. Function of sharding in MongoDB.
2	<b>MongoDB General Operations - part 1</b>	<b>Inserting Documents:</b> Single and multiple document inserts. <b>Selecting Documents:</b> Filtering, projections. <b>Comparison Query Operators:</b> \$eq, \$gt, \$lt, \$ne, \$gte, \$lte. <b>Logical Query Operators:</b> \$and, \$or, \$not. <b>Element Query Operators:</b> \$exists, \$type. <b>Array Query Operators:</b> \$all, \$size, \$elemMatch. Sorting, Limiting, and Skipping documents.
3	<b>MongoDB General Operations - part 2</b>	<b>Updating Documents:</b> Using \$set, \$inc, \$unset, and replacing documents. <b>Deleting Documents:</b> Single and multiple deletions. <b>Aggregation:</b> Basics, using \$match, \$group, \$project, and \$sort.
4	<b>Java with MongoDB - CRUD</b>	<b>Insert Commands:</b> Properly and improperly formed insertions. <b>Update Scenarios:</b> Using \$set, upserts, and update expressions. <b>Delete Expressions:</b> Matching and removing documents. <b>Query Operations:</b> Equality constraints, comparison operators, \$in, \$elemMatch. <b>Aggregation Scenarios:</b> Using \$match and \$group. Sorting, limiting, and projections.
5	<b>Indexes</b>	<b>Index Creation:</b> Indexes to improve query performance. <b>Index Types:</b> Single field, compound, multi-key indexes. <b>Explain Plan:</b> Identifying performance issues. <b>Hidden Index:</b> Purpose and use. <b>Error Handling:</b> Common issues during index creation. <b>Index Validation:</b> Checking if a query is using an index. Optimizing index order for performance.
6	<b>Replication</b>	Purpose and setup of replication. <b>Primary and Secondary:</b> Roles and purposes. <b>Read Preference:</b> Configurations for read consistency and performance. <b>Write Concern:</b> Ensuring data durability. <b>Elections:</b> Handling primary failure. <b>oplog:</b> Synchronizing replica sets. Analyzing rs.status output for replication health.
7	<b>Replication</b>	Purpose and setup of replication. <b>Primary and Secondary:</b> Roles and purposes. <b>Read Preference:</b> Configurations for read consistency and performance. <b>Write Concern:</b> Ensuring data durability. <b>Elections:</b> Handling primary failure. <b>oplog:</b> Synchronizing replica sets. Analyzing rs.status output for replication health.

8	<b>Replication</b>	<p>Purpose and setup of replication.  <b>Primary and Secondary:</b> Roles and purposes.  <b>Read Preference:</b> Configurations for read consistency and performance.  <b>Write Concern:</b> Ensuring data durability.  <b>Elections:</b> Handling primary failure.  <b>oplog:</b> Synchronizing replica sets.  Analyzing rs.status output for replication health.</p>
9	<b>Backup and Recovery</b>	<p>Creating backups of replica sets.  Restoring data from backups.  Strategies for disaster recovery.</p>
10	<b>Project</b>	<p>Development of a backend application using MongoDB.  Integration of CRUD operations.  Designing queries and indexes for optimal performance.  Implementation of replication and backup strategies.  Deployment and testing of the application.</p>
11	<b>Project</b>	<p>Development of a backend application using MongoDB.  Integration of CRUD operations.  Designing queries and indexes for optimal performance.  Implementation of replication and backup strategies.  Deployment and testing of the application.</p>
12	<b>Project</b>	<p>Development of a backend application using MongoDB.  Integration of CRUD operations.  Designing queries and indexes for optimal performance.  Implementation of replication and backup strategies.  Deployment and testing of the application.</p>

**B.Tech- VI<sup>th</sup> Semester**  
**Batch: 2025-29**

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Course Outcomes
CO1	Remember	Understand the fundamentals of information security, its attributes, and basic cryptographic concepts.
CO2	Apply	Analyze and implement symmetric and asymmetric cryptographic techniques such as DES, AES, RSA, etc.
CO3	Understanding	Evaluate network and internet security threats and propose solutions using SSL, SET, TLS, and WAP.
CO4	Remember	Demonstrate understanding of web and program security techniques like firewalls, PGP, and secure email practices.
CO5	Remember	Examine cyber laws, ethics, and legal provisions under IT Act 2000 and amendments in 2008

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	<b>Introduction to Information Security System</b>	6
2.	<b>Cryptographic Techniques</b>	8
3.	<b>Network and Internet Security</b>	8
4.	<b>Web and Program Security</b>	6
5.	<b>IT Attacks and Cyber Laws</b>	8

**D. DETAILED SYLLABUS**

Unit	Unit Details
<b>1.</b>	<b>Introduction to Information Security System</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Need of Information Security</li> <li>• Attributes: Authentication, Confidentiality, Integrity, Availability, Non-Repudiation</li> <li>• Attacks-Types of Attacks (Active and Passive attacks)</li> <li>• Security Goals</li> <li>• Cryptographic Techniques: Substitution and Transposition Ciphers and their types</li> <li>• Malicious Software: Virus, Trapdoor, Honeypot, Trojan Horse, Logic Bomb, Worms</li> <li>• Conclusion &amp; Real Life Application</li> </ul>
<b>2.</b>	<b>Cryptographic Techniques</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• DES (Data Encryption Standard)</li> <li>• AES (Advanced Encryption Standard)</li> <li>• RSA Algorithm</li> <li>• Cryptosystems: Rabin, ElGamal, IDEA</li> <li>• Modes of Operation (e.g., ECB, CBC, CFB, OFB)</li> <li>• Hash Functions and Message Authentication Code (MAC)</li> <li>• Digital Signatures and Digital Certificates</li> <li>• Conclusion &amp; Real Life Application</li> </ul>
<b>3.</b>	<b>Network and Internet Security</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Network Threats and Wireless Security</li> <li>• SSL (Secure Socket Layer)</li> <li>• SET (Secure Electronic Transaction)</li> <li>• TLS (Transport Layer Security)</li> <li>• WAP (Wireless Application Protocol)</li> <li>• 3D secure, Security in 3G</li> <li>• Conclusion of the Unit</li> </ul>

<b>4.</b>	<b>Web and Program Security</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Buffer Overflow, Intrusion</li> <li>• Time of Check to Time of Use (TOCTOU)</li> <li>• Salami Attack</li> <li>• Man-in-the-Middle Attack</li> <li>• Covert Channel</li> <li>• Firewalls and Their Types</li> <li>• Email Security: PGP, S/MIME</li> <li>• Cookies and Caching</li> <li>• Conclusion of the Unit</li> </ul>
<b>5.</b>	<b>IT Attacks and Cyber Laws</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Computer and Internet Crimes</li> <li>• Hackers and Crackers</li> <li>• Cyber Crime, Fraud, and Abuse</li> <li>• National Security and Cyber Warfare</li> <li>• Privacy, Ethics, Censorship, Harassment</li> <li>• Steganography</li> <li>• IT Act 2000 and Amendments in 2008</li> <li>• Legal Provisions and Resnet Abandonment</li> <li>• Conclusion of the Unit</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Cryptography and Network Security: Principles and Practice	William Stallings	Pearson Education	Pearson Education
2.	Cryptography and Network Security	Behrouz A. Forouzan	McGraw-Hill Education	McGraw-Hill Education
3.	Security in Computing	Charles P. Pfleeger	Pearson Education	Pearson Education
<b>Reference Book</b>				
1.	Applied Cryptography: Protocols, Algorithms, and Source Code in C, Schneier, Bruce 2nd Edition, Wiley.			
2.	Principles of Information Security, Whitman, Michael E., and Mattord, Herbert J, 6th Edition, Cengage Learning, 2017			
<b>Online Resources</b>				
1.	<a href="https://www.geeksforgeeks.org/cryptography-and-network-security/">https://www.geeksforgeeks.org/cryptography-and-network-security/</a>			
2.	<a href="https://nptel.ac.in/courses/106105031">https://nptel.ac.in/courses/106105031</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Course Outcomes
CO1	Remember	Recall basic concepts of software life cycle models to develop realtime projects.
CO2	Understand	Demonstrate an understanding of the procedural design methods to architect software systems.
CO3	Apply	Apply and articulate Software Testing Principles.
CO4	Analyze	Analyze existing Software Quality Management Standards.
CO5	Evaluate	Evaluate cost estimation and risk analysis in project management.

**B. CO-PO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	1	2	1	-	2	-	1	-	2	3	2	3	2
CO2	3	3	2	2	3	-	-	1	-	1	-	2	3	3	3	3
CO3	3	2	2	2	3	1	1	2	1	1	1	2	2	3	3	2
CO4	2	2	2	1	2	1	-	1	-	1	-	2	2	3	2	2
CO5	2	2	1	1	1	3	1	3	1	2	1	2	1	2	2	2
Wt. AVG	3.0	2.3	2.0	1.7	2.7	1.0	1.0	1.7	1.0	1.0	1.0	2.0	2.7	2.7	3.0	2.3

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Software Engineering Fundamentals	07
2.	Software Project Planning	08
3.	Software Design and UML	08
4.	Software Testing	07
5.	AGILE Project Management	07

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Software Engineering Fundamentals</b>
	<ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>Software Engineering - A layered Technology, The importance of software, software myths, software engineering paradigms</li> <li>Software Process Models: Linear Sequential Model, Prototyping Model, RAD Model</li> <li>Evolutionary Software Process Models: Incremental Model, Spiral Model Component Assembly Model, Formal Methods, Fourth-Generation Techniques.</li> <li>Conclusion of Unit</li> </ul>
2.	<b>Software Project Planning</b>
	<ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>Software Project Planning, Size Estimation, Cost Estimation, Models, Static, single variable models, Static, Multivariable Models, COCOMO, The Putnam Resource Allocation Model,</li> <li>Risk Identification and Projection: RMMM, Project scheduling and Tracking.</li> <li>Software Design Process, Design Principles, and Design Concepts: Effective Modular Design, Design Heuristics, Design Documentation,</li> <li>Design Methods: Data Design, Architectural Design, Interface Design, Human Computer Interface Design, Procedural Design. Case Study for Design of any Application Project.</li> <li>Conclusion of Unit</li> </ul>

<b>3.</b>	<b>Software Design and UML</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Unified Modeling Language, Basic structures and modeling classes, common modeling techniques, relationships, common mechanism, class diagrams.</li> <li>• Advanced structured modeling, advanced classes and relationships, interfaces, types and roles, instances and object diagram.</li> <li>• Basic behavioral Modeling: Use cases, use case diagrams, Interaction diagram, Activity diagrams, state chart diagrams, component diagrams, deployment diagrams, patterns and frame works.</li> <li>• Conclusion of Unit</li> </ul>
<b>4.</b>	<b>Software Testing</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• S/W Testing Fundamentals, Unit, integration, system testing, black box and white box testing Incremental testing, formal proof of correctness, software matrix</li> <li>• Automated Testing: Introduction to Automated testing, Software testing with automated tools</li> <li>• Conclusion of Unit</li> </ul>
<b>5.</b>	<b>AGILE Project Management</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Agile Programming- Introduction, Flavors of Agile Development, Agile Manifesto, Refactoring Techniques, Limitations of the Agile Process.</li> <li>• Agile Modeling: Introduction, Agile Modeling – Principles, Comparing Waterfall and Agile Modeling</li> <li>• Scrum Methodology- The roles of Scrum, Project Artifacts, Meetings, Advantages of Scrum.</li> <li>• Conclusion of Unit</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Software Engineering: A Practitioner's Approach	Roger S Pressman, Bruce R Maxim	8 <sup>th</sup> Edition	TMH.
2.	Software engineering	Ian Sommerville	9 <sup>th</sup> Edition	Addison Wesley Longman
<b>Reference Book</b>				
1	Grady Booch, James Rumbaugh, IvarJacobson.,” The Unified Modeling Language User Guide”, 2nd Edition, 2017			
2.	James Rumbaugh. MichealBlaha “Object oriented Modeling and Design with UML”, 2011			
3.	Ali Behforooz, Hudson, “Software Engineering Fundamentals”, Oxford, 2009			
4.	Charles Ritcher, “Designing Flexible Object Oriented systems with UML”, TechMedia , 2008			
<b>Online Resources</b>				
1	<a href="https://nptel.ac.in/courses/106105182">https://nptel.ac.in/courses/106105182</a>			
2	<a href="https://www.w3schools.in/sdlc/software-development-life-cycle-sdlc">https://www.w3schools.in/sdlc/software-development-life-cycle-sdlc</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Course Outcomes
CO1	Remember	Recall the evolution, classification, and fundamental concepts of NoSQL databases and distinguish them from traditional relational databases.
CO2	Understand	Understand and compare different NoSQL data models including key-value, document, column-family, graph, and search-based databases.
CO3	Apply	Apply MongoDB architecture and data modeling concepts to perform CRUD operations and design database schemas.
CO4	Analyze	Analyze MongoDB's query language, indexing, and aggregation features to optimize data access and performance.
CO5	Evaluate	Evaluate MongoDB's scalability, replication, sharding, and deployment strategies for secure and efficient real-world applications.

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Foundations of NoSQL Databases	07
2.	NoSQL Data Models and Storage Paradigms	08
3.	MongoDB Essentials	08
4.	Advanced MongoDB: Querying, Indexing, and Aggregation	07
5.	MongoDB for Scalability and Deployment	07

**B. CO-PO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	0	0	1	0	0	0	0	1	0	2	3	1	1	0
CO2	2	2	1	1	2	0	0	0	0	1	0	2	3	2	1	1
CO3	2	2	3	2	3	0	0	0	1	2	1	2	3	3	3	2
CO4	3	3	2	2	3	0	0	0	1	2	1	2	3	2	3	2
CO5	3	2	2	2	3	1	0	1	2	2	2	3	3	2	2	3
Wt. AVG	2.0	1.7	1.3	1.0	2.0	0.0	0.0	0.0	0.3	1.3	0.3	2.0	3.0	2.0	1.7	1.0

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Foundations of NoSQL Databases</b>
	<ul style="list-style-type: none"> <li>Introduction to NoSQL: Evolution, Business Drivers, and Need</li> <li>Comparison with Relational Databases</li> <li>Characteristics: Schema-free, Scalability, Flexibility, Cost</li> <li>CAP Theorem: Consistency, Availability, Partition Tolerance</li> <li>ACID vs. BASE, Polyglot Persistence</li> <li>Classification of NoSQL: Key-Value, Document, Column-Family, Graph, Search</li> <li>Use Cases of NoSQL</li> <li>Conclusion of unit</li> </ul>
2.	<b>NoSQL Data Models and Storage Paradigms</b>
	<ul style="list-style-type: none"> <li>Key-Value Stores: Concepts, Use Cases (e.g., Redis, Riak)</li> <li>Document Stores: JSON/BSON, Flexibility, Partitioning</li> <li>Column-Family Databases: Cassandra Basics, CQL Introduction</li> <li>Graph Databases: Nodes, Edges, Cypher Basics, Use Cases</li> </ul>

	<ul style="list-style-type: none"> <li>• Search-Based NoSQL: Architecture, Indexing, Elasticsearch Overview</li> <li>• Comparative Analysis of NoSQL Models</li> <li>• Conclusion of unit</li> </ul>
<b>3.</b>	<b>MongoDB Essentials</b>
	<ul style="list-style-type: none"> <li>• Introduction to MongoDB and Its Architecture</li> <li>• Features and Advantages of MongoDB</li> <li>• MongoDB Installation and Setup, MongoDB Shell, Compass GUI</li> <li>• CRUD Operations in MongoDB, MongoDB Data Types and BSON</li> <li>• Conclusion of unit</li> </ul>
<b>4.</b>	<b>Advanced MongoDB: Querying, Indexing, and Aggregation</b>
	<ul style="list-style-type: none"> <li>• Introduction to Unit</li> <li>• MongoDB Query Language (MQL): Operators, Filters, Projections</li> <li>• Aggregation Framework: Pipeline Stages, Expressions, Transformations</li> <li>• Indexing in MongoDB: Types (Single, Compound, Text), Use Cases, Performance Tuning</li> <li>• Schema Design Patterns and Best Practices</li> <li>• Data Modelling Examples for Real-World Applications</li> <li>• Conclusion of Unit</li> </ul>
<b>5.</b>	<b>MongoDB for Scalability and Deployment</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Replication in MongoDB: Configuring and Managing Replica Sets</li> <li>• Sharding in MongoDB: Concepts, Partitioning, and Horizontal Scaling</li> <li>• Transactions and ACID Compliance in MongoDB</li> <li>• Backup and Restore Mechanisms</li> <li>• MongoDB Deployment Options: On-Premise vs. MongoDB Atlas (Cloud)</li> <li>• Security in MongoDB: Authentication, Authorization, and Role-Based Access</li> <li>• Case Studies and Industry Use Cases</li> <li>• Conclusion of Unit</li> </ul>

## E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Professional Nosql	Shashank Tiwari	Latest	Wrox
2.	MongoDB in Action	KYLE BANKER PETER	Latest	Manning
<b>Reference Book</b>				
1.	NoSQL for Dummies, Adam Fowler, John Wiley & Sons, Inc			
2.	NoSQL Distilled, Pramod J. Sadalage & Martin Fowler, Pearson Education, Inc.			
<b>Online Resources</b>				
1.	<a href="https://www.javatpoint.com/nosql-databases">https://www.javatpoint.com/nosql-databases</a>			
2.	<a href="https://www.tutorialspoint.com/mongodb/index.html">https://www.tutorialspoint.com/mongodb/index.html</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Course Outcomes
CO1	Remember	Recall key software engineering concepts, such as software development life cycle models (e.g., Waterfall, Agile), software requirements engineering, software design principles, and software testing techniques.
CO2	Understand	Understand the principles and methodologies of software engineering, including requirements analysis, design patterns, version control systems (e.g., Git), and software documentation practices.
CO3	Apply	Apply software engineering techniques by participating in team-based software development projects, where students work collaboratively to develop software solutions, adhering to project management methodologies (e.g., Scrum, Kanban) and utilizing relevant development tools and frameworks.
CO4	Analyze	Analyze software requirements documents, architectural designs, and codebases to identify potential flaws, inefficiencies, or areas for improvement, and propose solutions or enhancements to address them.
CO5	Evaluate	Evaluate the quality and effectiveness of software solutions developed during the lab, considering factors such as functionality, reliability, scalability, maintainability, and user satisfaction, and provide constructive feedback for further refinement.

**B. CO-PO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	-	-	-	-	-	-	-	-	-	1	1	-	-	-
CO2	2	1	2	-	-	-	-	-	-	-	-	1	2	-	-	-
CO3	1	1	-	-	-	-	-	-	-	-	-	1	1	-	-	-
CO4	1	1	-	-	-	-	-	-	-	-	1	1	1	-	-	-
CO5	1	1	-	-	-	-	-	-	-	-	-	1	11	-	-	-
Wt. AVG	1.3	1.0	2.0	-	-	-	-	-	-	-	-	1.0	1.3	-	-	-

**C. LIST OF EXPERIMENTS**

Exp. No.	Experiment
1	Prepare a SRS document in line with the IEEE recommended standards
2	Draw the Entity relationship diagram of a project.
3	Develop DFD Model (Level 0, Level 1 DFD and data dictionary) of the sample problem (Use of a CASE tool required). (1 class)
4	Develop Structured design for the DFD model developed. (1 class)
5	Develop UML Use case diagram for a problem (Use of a CASE tool any of Rational rose, ArgoUML, or Visual Paradigm etc.
6	To draw the structural view diagram for the system: Class diagram, object diagram.
7	To draw the behavioral view diagram: State-chart diagram, Activity diagram.
8	To perform the behavioral view diagram for the suggested system : Sequence diagram, Collaboration diagram
9	To perform various testing using the testing tool Junit for unit testing for a sample code of the suggested system
10	To Prepare time line chart/Gantt Chart/PERT Chart for selected software project.

#### D. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Software Engineering	K.K.Aggarwal & Yogesh Singh	2005	New Age International
2.	An Integrated Approach to Software Engineering	Pankaj Jalote,	Second Edition	Springer
<b>Reference Book</b>				
1.	Software engineering, Roger S Pressman			
<b>Online Resources</b>				
1.	<a href="https://www.javatpoint.com/software-engineering-tutorial">https://www.javatpoint.com/software-engineering-tutorial</a>			
2.	<a href="https://www.geeksforgeeks.org/software-engineering/">https://www.geeksforgeeks.org/software-engineering/</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Course Outcomes
CO1	Remember	Recall basic MongoDB commands for CRUD (Create, Read, Update, Delete) operations.
CO2	Understand	Describe how MongoDB handles data types, schema design, and document validation.
CO3	Apply	Use MongoDB's aggregation framework to perform complex queries and data transformations.
CO4	Analyze	Analyze the performance impact of various MongoDB indexing strategies on query execution.
CO5	Evaluate	Evaluate the scalability and performance of a MongoDB database under different data loads and access patterns.

**B. CO-PO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1	1	-	—	-	-	-	-	2	3	—	-	3	3
CO2	2	2	—	2	-	1	-	-	-	-	2	1	2	-	2	2
CO3	3	3	2	1	-	—	-	-	-	-	1	3	1	-	3	3
CO4	2	1	2	1	-	—	-	-	-	-	2	1	2	-	2	1
CO5	2	3	1	1	-	—	-	-	-	-	2	—	—	-	2	3

**C. LIST OF EXPERIMENT**

S.No	Experiment
1	<ul style="list-style-type: none"> <li>Prepare and install infrastructure for setting up MongoDB vlab. Download MongoDB Community Edition</li> <li>Install MongoDB Community Editions Run the Mongo DB installer</li> <li>Follow the MongoDB Community Edition installation wizard Run Mongo DB vCommunity Edition as a Windows Service</li> <li>Run MongoDB Community Edition from the Command Interpreter It is advised to follow below URL: <a href="https://docs.mongodb.com/manual/tutorial/install-mongodb-on-windows/">https://docs.mongodb.com/manual/tutorial/install-mongodb-on-windows/</a></li> </ul>
2	<ul style="list-style-type: none"> <li>Perform/execute below sets of basic commands on MongoDB lab environment. Login to Lab</li> <li>Show all Databases</li> <li>Select database to work with Authenticate and Logout from databases List down Collections, Users, Roles Create Collection</li> </ul>
3	<ul style="list-style-type: none"> <li>Perform/execute below sets of basic commands on MongoDB lab environment. Insert Document</li> <li>Save Document Update Document</li> <li>Display Collection Records Drop Function</li> </ul>
4	<ul style="list-style-type: none"> <li>Perform/execute below sets of advanced commands on MongoDB lab environment. Administrative Commands</li> <li>Projection Limit Method Skip Method Sort Records Indexing Aggregation</li> <li>Interacting with cursors</li> </ul>
5	<ul style="list-style-type: none"> <li>Execute below steps by inserting some data which we can work with.</li> <li>Paste the following into your terminal to create a petshop with some pets in it use petshop  <code>db.pets.insert({name:"Mikey", species:"Gerbil"})</code>  <code>db.pets.insert({name:"DaveyBungooligan",species:"Piranha"})</code> <code>db.pets.insert({name: "Suzy B", species: "Cat"})</code> <code>db.pets.insert({name:"Mikey", species:"Hotdog"})</code> <code>db.pets.insert({name: "Terrence", species: "Sausagedog"})</code> <code>db.pets.insert({name:"PhilomenaJones",species: "Cat"})</code> </li> </ul>

#### D. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Professional Nosql	Shashank Tiwari	Latest	Wrox
2.	MongoDB in Action	KYLE BANKER PETER	Latest	Manning
<b>Reference Book</b>				
1.	NoSQL for Dummies, Adam Fowler, John Wiley & Sons, Inc			
2.	NoSQL Distilled, Pramod J. Sadalage & Martin Fowler, Pearson Education, Inc.			
<b>Online Resources</b>				
1.	<a href="https://www.javatpoint.com/nosql-databases">https://www.javatpoint.com/nosql-databases</a>			
2.	<a href="https://www.tutorialspoint.com/mongodb/index.html">https://www.tutorialspoint.com/mongodb/index.html</a>			

# Skill Enhancement Courses

Code: BELCSE6201

Skill Enhancement Course-VI

2 Credits [LTP:0-0-4]

**FACE Domain: Advanced Algorithms**

**Course: Advanced Algorithmic Problem Solving**

Applicable for BTech (Batch 2029, 2028)

**A. COURSE OUTCOMES: On completion of the course a student will be able to:**

- Apply greedy algorithms to solve optimization problems and evaluate their limitations and use cases.
- Design solutions to complex problems using dynamic programming techniques, including memoization, tabulation, and space optimization.
- Implement backtracking algorithms to explore all feasible solutions in constraint-based problems like N-Queens and Sudoku.
- Analyze and apply string matching algorithms for pattern detection, search operations, and text manipulation tasks.
- Utilize bit manipulation techniques to solve low-level computational problems efficiently.

**B. DETAILED SYLLABUS**

S. No.	Topic	Sub-Topics
1	Greedy	Understanding Greedy Algorithms, Approach and Limitations, Classic Problems (Activity Selection, Huffman Coding, Minimum Spanning Tree) <b>Practical Exercises:</b> Programs for Greedy Problems (Fractional Knapsack, Dijkstra's Algorithm, Job Scheduling)
2	Dynamic Programming - Part 1	Introduction to Dynamic Programming, Overlapping Subproblems, Optimal Substructure, Memoization vs Tabulation, Classic Problems (Fibonacci, Knapsack) <b>Practical Exercises:</b> Programs for Dynamic Programming Problems (Longest Common Subsequence, Coin Change, Minimum Path Sum)
3	Dynamic Programming - Part 1	Introduction to Dynamic Programming, Overlapping Subproblems, Optimal Substructure, Memoization vs Tabulation, Classic Problems (Fibonacci, Knapsack) <b>Practical Exercises:</b> Programs for Dynamic Programming Problems (Longest Common Subsequence, Coin Change, Minimum Path Sum)
4	Dynamic Programming - Part 1	Introduction to Dynamic Programming, Overlapping Subproblems, Optimal Substructure, Memoization vs Tabulation, Classic Problems (Fibonacci, Knapsack) <b>Practical Exercises:</b> Programs for Dynamic Programming Problems (Longest Common Subsequence, Coin Change, Minimum Path Sum)
5	Dynamic Programming - Part 2	Advanced Dynamic Programming Concepts, State Compression, Space Optimization, Advanced Problems (Longest Increasing Subsequence, Palindromic Substring) <b>Practical Exercises:</b> Programs for Advanced Dynamic Programming (Edit Distance, Maximum Subarray Sum, Word Break Problem)
6	Dynamic Programming - Part 2	Advanced Dynamic Programming Concepts, State Compression, Space Optimization, Advanced Problems (Longest Increasing Subsequence, Palindromic Substring) <b>Practical Exercises:</b> Programs for Advanced Dynamic Programming (Edit Distance, Maximum Subarray Sum, Word Break Problem)
7	Dynamic Programming - Part 2	Advanced Dynamic Programming Concepts, State Compression, Space Optimization, Advanced Problems (Longest Increasing Subsequence, Palindromic Substring) <b>Practical Exercises:</b> Programs for Advanced Dynamic Programming (Edit Distance, Maximum Subarray Sum, Word Break Problem)
8	Backtracking	Introduction to Backtracking, Key Concepts (State Space Tree, Constraints, Feasibility), Classic Problems (N-Queens, Sudoku Solver, Permutations) <b>Practical Exercises:</b> Programs for Backtracking Problems (Rat in a Maze, Word Search, Generate All Subsets)
9	Backtracking	Introduction to Backtracking, Key Concepts (State Space Tree, Constraints, Feasibility), Classic Problems (N-Queens, Sudoku Solver, Permutations) <b>Practical Exercises:</b> Programs for Backtracking Problems (Rat in a Maze, Word Search, Generate All Subsets)

10	<b>Backtracking</b>	Introduction to Backtracking, Key Concepts (State Space Tree, Constraints, Feasibility), Classic Problems (N-Queens, Sudoku Solver, Permutations) <b>Practical Exercises:</b> Programs for Backtracking Problems (Rat in a Maze, Word Search, Generate All Subsets)
11	<b>String Algorithms</b>	Understanding String Matching Algorithms (Naive, KMP, Rabin-Karp), String Manipulations, Applications in Search and Text Processing <b>Practical Exercises:</b> Programs for String Algorithms (Pattern Matching, Longest Repeated Substring, Anagram Detection)
12	<b>Bit Manipulation</b>	Introduction to Bit Manipulation, Basic Bit Operations (AND, OR, XOR, NOT, Shifts), Common Bit Manipulation Techniques (Set Bit, Clear Bit, Toggle Bit) <b>Practical Exercises:</b> Programs for Bit Manipulation (Power of Two, Count Set Bits, Find the Missing Number)

# Skill Enhancement Courses

Code: BELCSE6202

Skill Enhancement Course-VI

2 Credits [LTP:0-0-4]

**FACE Domain: Back End Development**

**Course: Full Stack Web Development with Node.js and MongoDB**

Applicable for BTech (Batch 2029, 2028)

**A. COURSE OUTCOMES: On completion of the course a student will be able to:**

- Develop server-side applications using Node.js and Express.js, including handling HTTP requests, routing, and middleware integration.
- Build RESTful APIs with proper CRUD operations and error handling, ensuring efficient request and response flow.
- Integrate MongoDB with backend applications using Mongoose for schema definition, data modeling, and database operations.
- Design scalable data models and apply aggregation and indexing techniques for optimized database performance.
- Construct full-stack web applications by integrating backend APIs with frontend frameworks, including features like authentication and deployment.

**B. DETAILED SYLLABUS**

S. No.	Topics	Sub-Topics
1	<b>Node.js &amp; npm</b>	<b>Introduction to Node.js:</b> Running JavaScript on the server and using npm for package management. <b>Creating and Configuring Projects:</b> Initializing a project with npm init and installing dependencies.
2	<b>Node. Js</b>	Create a basic HTTP server to handle requests and responses. Implement file handling for reading and writing files asynchronously.
3	<b>Introduction to Express.js</b>	<b>Setting Up an Express Server:</b> Creating a basic server with Express. <b>Routing:</b> Defining routes and handling HTTP methods like GET, POST, PUT, DELETE.
4	<b>Express.js</b>	<b>Express.js Fundamentals:</b> Setting up an Express server, Middleware (bodyParser, cors), Routing, Error Handling, Serving Static Files, Templating Engines (EJS, Pug).
5	<b>Project</b>	Build a CRUD API for managing users or products. Handle routes for Create, Read, Update, Delete operations using Express.js.
6	<b>REST API Fundamentals</b>	<b>Creating REST Endpoints:</b> Designing endpoints for CRUD operations. <b>Handling Requests and Responses:</b> Using req and res to process and send responses.
7	<b>Error Handling in Express</b>	<b>Middleware:</b> Using middleware functions for error handling. <b>Custom Error Responses:</b> Sending custom error messages and handling common errors (404, 500).
8	<b>Project: Basic RESTful API</b>	Building a REST API with CRUD operations for managing recipes or similar data.
9	<b>MongoDB Basics</b>	<b>CRUD Operations:</b> Basic operations like inserting, updating, deleting, and querying documents. <b>MongoDB Atlas:</b> Setting up a cloud database with MongoDB Atlas and connecting it to the server.
10	<b>Mongoose Library</b>	<b>Defining Schemas and Models:</b> Creating schemas for structured data using Mongoose.

		<b>CRUD with Mongoose:</b> Performing CRUD operations on MongoDB collections with Mongoose.
11	<b>Data Modeling</b>	<b>Schema Design:</b> Structuring data for efficiency and scalability. <b>Relationships:</b> Defining references between collections for related data.
12	<b>Aggregation and Indexing</b>	<b>Aggregation Pipeline:</b> Using pipelines for data processing, filtering, sorting, and grouping. <b>Indexes:</b> Optimizing queries with indexing.
13	<b>Project: Recipe API with MongoDB</b>	Extending the REST API to use MongoDB with Mongoose for data persistence and schema validation.
14	<b>Full Stack Project - 2</b>	<b>Project Development:</b> Build a comprehensive Full Stack Project using React.js, HTML, CSS, and associated libraries, Node.js, Express.js, and MongoDB. The project should include authentication, authorization, API development, and integration with a front-end client.
15		Hands-on project development (e.g., a REST API for an e-commerce platform, a blogging engine, or a social networking site).

**FACE Domain: AWS Certification****Course: Cloud Computing with AWS**

Applicable for BTech (Batch 2029, 2028)

**A. COURSE OUTCOMES: On completion of the course a student will be able to:**

- Understand core concepts of cloud computing and AWS infrastructure, including services, regions, availability zones, and pricing models.
- Deploy and manage virtual servers, storage, and databases using AWS EC2, S3, EBS, and RDS for scalable application hosting.
- Implement secure cloud environments using IAM roles, policies, and monitoring tools like CloudWatch and CloudTrail.
- Demonstrate the ability to migrate, manage costs, and optimize cloud resources using AWS tools and best practices.
- Design and deploy a functional web application using AWS services, integrating compute, storage, and database components in a real-world project scenario.

**B. DETAILED SYLLABUS**

S. No.	Topic	Sub-Topics
1	<b>Introduction to Cloud &amp; AWS</b>	<b>Understanding Cloud Computing Basics:</b> What is cloud computing, types (IaaS, PaaS, SaaS), advantages of cloud over traditional IT. <b>Overview of AWS:</b> Services offered, market position, and use cases. <b>AWS Global Infrastructure:</b> Explanation of AWS Regions, Availability Zones, and Edge Locations.
2	<b>Computer &amp; Network Basics</b>	<b>Fundamentals of Computer and Data:</b> Basic concepts of computing and data storage. <b>Basics of Operating Systems:</b> Overview of OS roles and types. <b>Private &amp; Public Networks:</b> Understanding networking concepts, IP addressing, and network communication.
3	<b>Getting Started with AWS</b>	<b>AWS Account Setup:</b> Creating an AWS account and navigating the AWS Management Console. <b>Virtual Machines Overview:</b> Concept of virtualization and how AWS EC2 provides scalable compute resources. <b>Amazon Elastic Compute Cloud (EC2):</b> Features, benefits, and pricing.
4	<b>Linux Essentials</b>	<b>Linux OS Installation:</b> Steps for installing Linux (e.g., CentOS) as a virtual machine. <b>Linux Commands:</b> Basic commands for navigation, file operations, and user management. <b>Using CAT, VI, and VIM:</b> File creation, editing, and viewing in Linux.
5	<b>File Transfer Tools</b>	<b>Introduction to Putty:</b> Connecting to remote servers using SSH. <b>File Transfer with WinSCP:</b> Transferring files between local and remote machines securely.
6	<b>Web Project Deployment Basics</b>	<b>Setting Up a Local Web Server:</b> Installing and configuring Apache/Nginx. <b>Installing and Configuring MySQL Database:</b> Steps for database installation and basic configurations. <b>Deploying a Simple Web Application:</b> Connecting application with a database and testing.
7	<b>Project</b>	Local Web project hosting and access between two different networks (Using Private network and Linux OS)
8	<b>Compute in the Cloud</b>	<b>Benefits and Features of Amazon EC2:</b> Elasticity, scalability, and flexibility. <b>EC2 Instance Types:</b> Overview of general-purpose, compute-optimized, memory-optimized instances. <b>Elastic Load Balancing and Auto Scaling:</b> Concepts and benefits for scalability.

9	<b>Storage Basics</b>	<p><b>Overview of AWS Storage Services:</b> Different types of storage solutions (S3, EBS, EFS).</p> <p><b>Amazon S3 Benefits:</b> Durability, lifecycle policies, versioning.</p> <p><b>Introduction to Amazon EBS and EFS:</b> Persistent block storage and scalable file storage.</p>
10	<b>Database Services in AWS</b>	<p><b>Overview of AWS Database Services:</b> Relational vs. NoSQL databases.</p> <p><b>Benefits of Amazon RDS and DynamoDB:</b> Features, use cases, and advantages.</p> <p><b>Database Connections and Testing:</b> Steps to connect applications to AWS-managed databases.</p>
11	<b>Security Essentials</b>	<p><b>Introduction to IAM:</b> Creating users, roles, and policies.</p> <p><b>Basics of Security Policies:</b> Understanding and applying policies.</p> <p><b>Overview of AWS Organizations:</b> Centralized billing and resource management.</p> <p><b>Compliance with AWS:</b> Industry standards and certifications.</p>
12	<b>Monitoring and Analytics</b>	<p><b>Introduction to AWS CloudWatch:</b> Monitoring AWS resources and applications.</p> <p><b>Benefits of AWS CloudTrail:</b> Tracking API calls and user activities.</p> <p><b>Monitoring and Logging Strategies:</b> How to implement effective monitoring and logging.</p>
13	<b>Migration and Innovation</b>	<p><b>AWS Cloud Adoption Framework (CAF):</b> Six key perspectives for migration.</p> <p><b>Cloud Migration Strategies:</b> Rehosting, replatforming, and refactoring.</p> <p><b>AWS Data Migration Tools:</b> Overview of Snowcone, Snowball, and Snowmobile for data transfer.</p>
14	<b>Cost Management</b>	<p><b>Pay-as-You-Go Pricing Model:</b> Explanation of AWS's pricing philosophy.</p> <p><b>AWS Cost Explorer and Budgeting Tools:</b> Tracking and optimizing AWS spend.</p> <p><b>Best Practices for Cost Optimization:</b> Reserved instances, Spot instances, and autoscaling.</p>
15	<b>Global Infrastructure</b>	<p><b>AWS Edge Locations and CloudFront:</b> Content delivery network (CDN) benefits.</p> <p><b>Service Provisioning Methods:</b> On-demand, reserved, and spot instances.</p> <p><b>Scalability and Reliability:</b> Using AWS global network for high availability.</p>
16	<b>Capstone Project</b>	<p><b>Final Project:</b> Develop and deploy a fully functional web application using AWS services (EC2, S3, RDS).</p> <p><b>Testing and Performance Optimization:</b> Load balancing and autoscaling.</p> <p><b>Project Presentation:</b> Discuss architecture and implementation.</p>

# Summer Internship / Research Project / Dissertation

Code: BCECCE6401

Industrial Training Seminar-I

1 Credits [LTP:0-0-2]

## A. COURSE OUTCOMES: -

CO	Cognitive Abilities	Course Outcomes
CO1	Apply	Apply theoretical knowledge and engineering principles to solve practical problems encountered during industrial training.
CO2	Analyze	Analyze the industrial environment, including organizational structure, processes, and technologies used.
CO3	Apply	Apply learned skills (technical, communication, teamwork) to contribute effectively to industrial projects and tasks.
CO4	Analyze	Analyze and reflect upon the challenges faced, solutions implemented, and lessons learned during the industrial training period.
CO5	Evaluate	Evaluate personal strengths and weaknesses, identify areas for improvement, and develop a plan for lifelong learning and professional development.

## B. CO-PO-PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	1	2	1	-	-	1	-	-	2	2	2	-	-
CO2	2	3	1	2	1	1	-	-	1	-	-	1	2	1	-	-
CO3	2	2	2	2	3	1	-	-	3	2	-	2	3	3	-	-
CO4	1	3	2	3	2	-	-	-	2	2	1	2	2	2	-	-
CO5	1	2	1	1	1	1	-	-	2	2	2	3	1	1	1	-
Wt. AVG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

## C DETAILED SYLLABUS

1	Unit Details
	<p><b>Introduction to Industrial Training Seminar-II</b></p> <ol style="list-style-type: none"> <li>1. Overview and objectives</li> <li>2. Importance in the curriculum</li> <li>3. Modules                             <ul style="list-style-type: none"> <li>• Module 1: [Topic Name]                                     <ul style="list-style-type: none"> <li>○ Sub-topic 1</li> <li>○ Sub-topic 2</li> <li>○ ...</li> </ul> </li> <li>• Module 2: [Topic Name]                                     <ul style="list-style-type: none"> <li>○ Sub-topic 1</li> <li>○ Sub-topic 2</li> <li>○ ...</li> </ul> </li> <li>• Module 3: [Topic Name]                                     <ul style="list-style-type: none"> <li>• Sub-topic 1</li> <li>• Sub-topic 2</li> <li>• ...</li> </ul> </li> </ul> </li> <li>4. Assessment Methods</li> <li>5. Details on how each CO will be assessed (assignments, projects, exams, etc.)</li> <li>6. References: List of recommended textbooks and readings</li> </ol>

**B.Tech- VIIth Semester**  
**Batch: 2025-29**

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Course Outcomes
CO1	Remember	To remember the fundamentals of Big Data, its characteristics, types of digital data, and Hadoop history.
CO2	Understand	To understand the design, architecture, and functioning of HDFS and data ingestion using Flume and Sqoop.
CO3	Apply	To apply the MapReduce programming model to perform distributed data processing and analyze job execution.
CO4	Analyze	To analyze Hadoop ecosystem components like Pig, Hive, HBase, and Big SQL and their use in big data workflows.
CO5	Evaluate	To evaluate machine learning algorithms and big data analytics using R for real-world case studies.

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	<b>Introduction to Big Data and Hadoop</b>	<b>07</b>
2.	<b>HDFS (Hadoop Distributed File System)</b>	<b>08</b>
3.	<b>Map Reduce</b>	<b>08</b>
4.	<b>Hadoop Eco System</b>	<b>07</b>
5.	<b>Data Analytics with R</b>	<b>07</b>

**D. DETAILED SYLLABUS**

Unit	Unit Details
<b>1.</b>	<b>Introduction to Big Data and Hadoop</b>
	<ul style="list-style-type: none"> <li>Introduction to Big Data, Big Data Characteristics</li> <li>Types of Digital Data, Introduction to Big Data, Big Data Analytics</li> <li>Relationships and Representations, Graph Databases.</li> <li>History of Hadoop, Apache Hadoop, Analysing Data with Unix tools</li> <li>Analysing Data with Hadoop, Hadoop Streaming</li> <li>Hadoop Echo System, IBM Big Data Strategy, Introduction to Infosphere BigInsights and Big Sheets.</li> <li>Conclusion of Unit</li> </ul>
<b>2.</b>	<b>HDFS (Hadoop Distributed File System)</b>
	<ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>NoSQL, Comparison of SQL and NoSQL</li> <li>The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow,</li> <li>Data Ingest with Flume and Scoop and Hadoop archives,</li> <li>Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures Conclusion of Unit</li> </ul>
<b>3.</b>	<b>MapReduce and Data Processing Frameworks</b>
	<ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>Map Reduce Programming Model</li> <li>Phases: Map, Shuffle, Sort, Reduce</li> <li>Job Scheduling and Failure recovery</li> <li>Advanced Map Reduce examples (Word count, sorting, join)</li> <li>Introduction to Apache Spark: RDD, transformations, actions</li> <li>Conclusion of Unit</li> </ul>
<b>4.</b>	<b>NoSQL Databases and Hive, Pig</b>
	<ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>Need for NoSQL Databases</li> <li>MongoDB and Cassandra basics</li> <li>Pig: Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin,</li> </ul>

	<ul style="list-style-type: none"> <li>• User Defined Functions, Data Processing operators. Hive: Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions. Hbase: HBasics, Concepts, Clients, Example, Hbase Versus RDBMS.</li> <li>• Conclusion of Unit</li> </ul>
<b>5.</b>	<b>Data Analytics with R</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Machine Learning: Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering,</li> <li>• R programming: Syntax, Data frames and functions</li> <li>• Big Data Analytics with Big R, Case Study of Healthcare or Recommendation System,</li> <li>• Conclusion with R</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Hadoop: The Definitive Guide	Tom White	4th Edition, 2015	O'Reilly Media
2.	Big Data Analytics	Seema Acharya, Subhasini Chellappan	2nd Edition, 2021	Wiley India
<b>Reference Book</b>				
1.	Big Data: Principles and Paradigms by Rajkumar Buyya, Rodrigo N. Calheiros, and Amir Vahid Dastjerdi is published by Morgan Kaufmann in its 1st Edition (2016).			
2.	Data-Intensive Text Processing with MapReduce by Jimmy Lin and Chris Dyer is published by Morgan & Claypool Publishers in its 1st Edition (2010).			
<b>Online Resources</b>				
1.	<a href="http://www.bdbanalytics.ir/media/1121/big-data-analytics_turning-big-data-into-big-money.pdf">http://www.bdbanalytics.ir/media/1121/big-data-analytics_turning-big-data-into-big-money.pdf</a>			
2.	<a href="https://www.techtarget.com/searchbusinessanalytics/definition/big-data-analytics">https://www.techtarget.com/searchbusinessanalytics/definition/big-data-analytics</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Course Outcomes
CO1	Remember	Understand the significance of mudras in Indian art and healing traditions.
CO2	Understand	Gain proficiency in Convolutional Neural Networks (CNNs) and VGG models.
CO3	Apply	Apply machine learning techniques for image classification.
CO4	Analyze	Build and evaluate a mudra recognition model using pre-trained CNNs
CO5	Create	Address the challenges of working with culturally significant datasets.

**B. CO-PO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	–	–	2	–	–	–	–	–	–	2	3	2	–	–
CO2	3	3	–	2	3	–	–	–	–	–	–	2	3	3	–	–
CO3	3	3	2	3	3	–	–	–	–	–	–	2	3	3	2	–
CO4	3	3	3	3	3	–	1	1	2	2	2	3	3	3	2	2
CO5	2	2	3	3	3	2	2	3	2	2	2	3	2	2	2	3
Wt. AVG	3.0	2.7	2.0	2.5	2.7	-	-	-	-	-	-	2.0	3.0	2.7	2.0	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to Mudras and Indian Culture	06
2.	Deep Learning and Convolutional Neural Networks	08
3.	Pre-trained Models and Transfer Learning	09
4.	Dataset Preparation and Model Training	10
5.	Advanced Topics and Project Implementation	07

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Introduction to Mudras and Indian Culture</b>
	<p><b>Introduction of Unit</b> Overview and cultural significance of mudras in Indian art, dance (e.g., Bharatanatyam, Odissi), yoga, and Ayurveda.</p> <p><b>Topics Covered</b> Symbolism and meanings of mudras Types of mudras: Yogic, Dance, and Healing mudras Cultural diversity and regional variations in mudra usage</p> <p>• <b>Conclusion of Unit</b></p>
2.	<b>Deep Learning and Convolutional Neural Networks (CNNs)</b>
	<p><b>Introduction of Unit</b> Introduction to artificial neural networks and CNNs for image classification.</p> <p><b>Topics Covered</b> Perceptrons and Multi-layer Perceptrons (MLP) CNN layers: Convolution, Pooling, Fully Connected</p>

	<p>CNN operations and feature extraction          Training CNN models: Loss functions, optimization, evaluation metrics          Overfitting and underfitting mitigation techniques</p> <ul style="list-style-type: none"> <li>• <b>Conclusion of Unit</b></li> </ul>
<b>3.</b>	<b>Pre-trained Models and Transfer Learning</b>
	<p><b>Introduction of Unit</b></p> <ul style="list-style-type: none"> <li>• Using and fine-tuning pre-trained models (especially VGGNet) for mudra recognition.</li> </ul> <p><b>Topics Covered</b>          VGG16 and VGG19 architecture          Transfer learning and ImageNet pre-training          Dataset preparation: Labeling and collection          Image preprocessing: Normalization, resizing, augmentation          Hands-on implementation using TensorFlow/Keras</p> <ul style="list-style-type: none"> <li>• <b>Conclusion of Unit</b></li> </ul>
<b>4.</b>	<b>Dataset Preparation and Model Training</b>
	<p><b>Introduction of Unit</b>          Focus on practical aspects of building, training, and evaluating image classifiers.</p> <p><b>Topics Covered</b>          Mudra image collection and annotation          Data augmentation techniques          VGG model training and hyperparameter tuning          Model evaluation metrics: Accuracy, Precision, Recall, F1-Score          Train-validation-test split strategies</p> <ul style="list-style-type: none"> <li>• <b>Conclusion of Unit</b></li> </ul>
<b>5.</b>	<b>Advanced Topics and Project Implementation</b>
	<p><b>Introduction of Unit</b>          Application-level integration of the mudra recognition model.</p> <p><b>Topics Covered</b>          Transfer learning optimization          Confusion matrix and performance analysis          Overfitting solutions: Dropout, early stopping          Final project: Building a mudra classification application (web or mobile)          Deployment and real-time model testing</p> <ul style="list-style-type: none"> <li>• <b>Conclusion of Unit</b></li> </ul>

## E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Deep Learning with Python	François Chollet	2nd	Manning
2.	Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow	Aurélien Géron	2nd	O'Reilly
3.	The Yoga of Mudras	Swami Sivananda	–	Divine Life Society
4.	Computer Vision: Algorithms and Applications	Richard Szeliski	–	Springer
<b>Online Resources</b>				
1.	<b>Programming Language:</b> Python			
2.	<b>Libraries/Frameworks:</b> TensorFlow, Keras, OpenCV, Matplotlib, Seaborn			
3.	<b>Platforms:</b> Google Colab, Jupyter Notebook			
4.	<b>Dataset:</b> Mudra images (curated or sourced from cultural databases)			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Course Outcomes
CO1	Remember	To remember and describe the fundamental concepts of Big Data, and perform installation of Hadoop.
CO2	Understand	To understand the working principles of distributed file systems and file operations of HDFS.
CO3	Apply	To apply programming knowledge to implement MapReduce and perform analytics.
CO4	Evaluate	To evaluate and implement Big Data tools and techniques, Hive, Pig, HBase.
CO5	Analyse	To analyse healthcare, climate, and recommendation system datasets using machine learning and data mining techniques in R.

**B. CO-PO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	3	-	-	-	-	-	-	2	3	2	-	-
CO2	3	3	-	2	3	-	-	-	-	-	-	2	3	2	-	-
CO3	3	3	2	3	3	-	-	-	-	-	-	2	3	3	3	2
CO4	3	3	3	3	3	-	1	-	2	2	2	3	3	3	2	3
CO5	2	3	3	3	3	2	2	2	2	2	2	3	3	2	2	2
Wt. AVG	3.0	2.7	2.0	2.5	3.0	-	-	-	-	-	-	2.0	3.0	2.3	3.0	2.0

**C. List of Experiments: -**

1	Hadoop Installation: Cloudera QuickStart VM installation in stand-alone mode.
2	Perform basic file operations in HDFS using command-line: create, read, write, and delete files and directories.
3	Ingest structured data into HDFS using Apache Sqoop from MySQL.
4	Use Apache Flume to stream unstructured log data into HDFS.
5	Write a Word Count MapReduce program to understand the Map and Reduce phases.
6	Perform data transformation using Apache Spark (PySpark) to clean, filter, and aggregate CSV data.
7	Create and execute Pig Latin scripts to load, join, filter, group, and sort data.
8	Use Hive to create databases, tables, load data, and execute HiveQL queries (SELECT, GROUP BY, JOIN).
9	Perform CRUD operations on a NoSQL database (e.g., MongoDB or Cassandra).
10	Analyze a healthcare dataset in R using supervised learning (e.g., logistic regression or decision tree). Instructions: <ol style="list-style-type: none"> <li>Download the dataset.</li> <li>Load the dataset into R and perform exploratory data analysis (EDA): <ul style="list-style-type: none"> <li>Handle missing values</li> <li>Normalize or scale the data</li> <li>Visualize variable correlations</li> </ul> </li> <li>Split the dataset into training and testing sets.</li> <li>Apply a Logistic Regression or Decision Tree model.</li> <li>Evaluate the model with: <ul style="list-style-type: none"> <li>Confusion matrix</li> <li>Accuracy, precision, recall, F1-score</li> <li>ROC curve and AUC</li> </ul> </li> </ol> Interpret the model coefficients or tree structure to identify key predictors.
11	Use unsupervised learning (e.g., K-Means clustering) in R to segment a dataset and interpret the results. Instructions: <ol style="list-style-type: none"> <li>Load the Online Retail Dataset or a sample e-commerce dataset.</li> <li>Clean and preprocess the data:</li> </ol>

	<ul style="list-style-type: none"> <li>○ Handle nulls and duplicates</li> <li>○ Create customer-level features (RFM: Recency, Frequency, Monetary)</li> <li>○ Normalize the data</li> </ul> <ol style="list-style-type: none"> <li>3. Determine the optimal number of clusters.</li> <li>4. Apply the K-Means clustering algorithm.</li> <li>5. Visualize clusters.</li> </ol> <p>Interpret cluster characteristics and label each segment (e.g., "High-value", "Occasional", etc.)</p>
12	<p>Mini Project: Build an end-to-end big data pipeline (Ingestion → Storage → Processing → Querying/Analytics using Hive/R).</p> <p>Instructions:</p> <ol style="list-style-type: none"> <li>1. Choose a dataset (e.g., social media logs, product reviews, transaction logs).</li> <li>2. Ingestion: <ul style="list-style-type: none"> <li>○ Use Apache Sqoop or Flume to bring data into HDFS.</li> </ul> </li> <li>3. Storage: <ul style="list-style-type: none"> <li>○ Organize the data in HDFS with directories and partitioning.</li> </ul> </li> <li>4. Processing: <ul style="list-style-type: none"> <li>○ Clean and transform the data using Hive or PySpark (e.g., join/filter/group).</li> </ul> </li> <li>5. Analytics: <ul style="list-style-type: none"> <li>○ Export the processed data and perform analysis in R using: <ul style="list-style-type: none"> <li>▪ Regression / Classification / Clustering</li> <li>▪ Visualizations</li> </ul> </li> </ul> </li> </ol> <p>Document the full pipeline from raw input to decision insights.</p>

#### D. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Hadoop: The Definitive Guide	Tom White	4th Edition, 2015	O'Reilly Media
2.	Big Data Analytics	Seema Acharya, Subhasini Chellappan	2nd Edition, 2021	Wiley India
<b>Reference Book</b>				
1.	Big Data: Principles and Paradigms by Rajkumar Buyya, Rodrigo N. Calheiros, and Amir Vahid Dastjerdi is published by Morgan Kaufmann in its 1st Edition (2016).			
2.	Data-Intensive Text Processing with MapReduce by Jimmy Lin and Chris Dyer is published by Morgan & Claypool Publishers in its 1st Edition (2010).			
<b>Online Resources</b>				
1.	<a href="http://www.bdbanalytics.ir/media/1121/big-data-analytics_turning-big-data-into-big-money.pdf">http://www.bdbanalytics.ir/media/1121/big-data-analytics_turning-big-data-into-big-money.pdf</a>			
2.	<a href="https://www.techtarget.com/searchbusinessanalytics/definition/big-data-analytics">https://www.techtarget.com/searchbusinessanalytics/definition/big-data-analytics</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Course Outcomes
CO1	Understand	Understand and apply basic HCI and UI principles in screen design.
CO2	Analyze	Conduct user research and visualize the user journey for UX design.
CO3	Apply	Apply visual and interaction design principles using design tools like Figma.
CO4	Create	Develop responsive and interactive UI prototypes using Figma.
CO5	Evaluate	Evaluate UI/UX designs using usability testing and improve based on feedback and accessibility.

**B. CO-PO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	-	3	-	3	-	-	-	-	-	-	-	3	-	-	-
CO2	3	3	3	-	3	-	-	-	-	2	-	-	3	3	-	-
CO3	3	-	3	-	3	-	2	-	-	-	-	-	3	-	2	-
CO4	3	-	3	-	3	-	-	-	-	-	-	-	3	2	3	-
CO5	3	3	3	3	3	-	2	-	3	3	-	2	3	3	-	-
Wt. AVG	3.0	3.0	3.0	-	3.0	-	2.0	-	-	2.0	-	-	3.0	3.0	2.0	-

**C. List of Experiments: -**

S.No	Experiment
1	Create a login screen applying Fitts's Law.
2	Build a task flow using flowchart in Figma.
3	Conduct user research & create a journey map.
4	Draw low-fidelity wireframes using Figma for 3 screens.
5	Apply color theory, alignment, proximity in UI
6	Design mobile screens using HCI principles.
7	Design for desktop and mobile breakpoints using responsive features (Figma's Auto Layout, constraints)
8	Link screens using transitions and Smart Animate in Figma to create an interactive prototype
9	Design and code a simple web form using HTML/CSS based on UI best practices.
10	To evaluate the usability of a UI/UX prototype, gather user feedback, and improve the design through iteration.
11	Ensure color contrast, alt texts, font readability using plugins.
12	Research, wireframe, prototype & test a real-world problem app.

**C. RECOMMENDED STUDY MATERIAL**

S. No	Text Books:	Author	Edition	Publication
1.	<i>Human-Computer Interaction</i>	Alan Dix, Janet Finlay	3rd Edition	Pearson Education
2.	<i>The Essential Guide to User Interface Design: An Introduction to GUI Design</i>	Wilbert O. Galitz	3rd Edition	Wiley
<b>Reference Book</b>				
1.	Don Norman, <i>The Design of Everyday Things</i> , Revised Edition, 2013, Basic Books.			
2.	Alan Cooper, Robert Reimann, David Cronin, <i>About Face: The Essentials of Interaction Design</i> , 4th Edition, 2014, Wiley.			
3.	Don Norman, <i>The Design of Everyday Things</i> , Revised Edition, 2013, Basic Books.			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Course Outcomes
CO1	Apply	Apply the basic, sorting and searching techniques to solve the problem components etc.
CO2	Analyze	Analyze the concepts of path finding algorithms for flows and cuts, strings and greedy algorithms
CO3	Develop	Develop solutions for the back tracking algorithms and bit manipulations
CO4	Solve	Solve the number theory and knowledge of dynamic programming to the real time scenario.
CO5	Design & Implement	Design and implement algorithms for graph theory problems, including traversal and shortest path algorithms.

**B. CO-PO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	1	3	-	-	-	-	-	-	-	3	2	-	-	-
CO2	3	2	1	3	-	-	-	-	-	-	-	3	3	-	-	-
CO3	3	3	2	3	-	-	-	-	-	-	-	3	3	-	-	-
CO4	3	3	3	3	-	-	-	-	-	-	-	3	2	-	-	-
CO5	3	2	1	2	-	-	-	-	-	-	-	3	1	-	-	-
Wt. AVG	2.7	2.7	1.3	3.0	-	-	-	-	-	-	-	3.0	2.7	-	-	-

**C. List of Experiments: -**

S. No.	Problem Title	Description Summary
1	Maximum Subarray Sum	Solve using different time complexities (e.g., brute-force, divide & conquer, Kadane's algorithm).
2	Median of Two Sorted Arrays	Find the median of two sorted arrays of same or different sizes using input parsing and median rules.
3	Division with Binary Search	Use binary search to perform division of two numbers with precision handling and edge cases.
4	Find the Triplet	Find the triplet in the array with the maximum product.
5	3n+1 (Collatz Sequence)	Determine the maximum cycle length between two integers using the 3n+1 rule.
6	Matching String with Wildcard Pattern	Match a string against a pattern containing * and ? wildcards using recursion or DP.
7	Rotten Oranges	Compute minimum time to rot all fresh oranges using BFS on a 2D grid.
8	Minimum-Cost Path	Find the path with the smallest sum in a grid using DP with down, right, and diagonal moves.
9	15-Puzzle Problem	Solve a sliding tile puzzle to reach the goal state or determine if unsolvable.
10	Tug of War	Partition a group into two teams with nearly equal weight and size using recursion or DP.
11	Find First Set Bit	Return the position of the first set bit from the right in a number's binary form.
12	Coin Problem	Find the minimum number of coins to make change for a given amount using coin denominations.
13	Spirally Traversing a Matrix	Traverse a matrix in spiral order using loops or direction vectors.

**C. Experiment Details: -****1. Maximum subarray sum**

Solve the Maximum subarray sum with different time complexities.

## 2. The Median of Two Sorted Arrays

Program to find the median of two sorted arrays of same size and different size are discussed here. Firstly, let us see what is median of the array? Median is an element which divides the array into two parts - left and right. So the number of elements on the left side of the array will be equal or less than the number of elements on the right side. Now, let us consider the case of an array with odd number of elements. Array = [9,11,16,7,2] Sorted array = [2,7,9,11,16]. In this case, the median of this array is 9, since it divides the array into two parts: [2,7] and [11,16]. Further, let us consider the case of an array with even elements. Array = [1,2,3,4,5,6]. In such a case, we will take the average between the last element of the left part and the first element of the right part. In this case, the median equals  $= (3 + 4) / 2 = 3.5$ .

### Input Format

The input should contain 3 lines.

- I. First line of the input should contain two integer values which specify the number of elements in array1 and array2.
- II. Second line of the input should contain the elements of the first array.
- III. Third line of the input should contain the elements of the second array.

### Constraints

All elements must be Integers

### Output Format

The output should print only the median value.

### Sample Input 1

```
5 6
-5 3 6 12 15
-12 -10 -6 -3 4 10
```

### Sample Output 1

```
3
```

### Sample Input 2

```
4 6
2 3 5 8
10 12 14 16 18 20
```

### Sample Output 2

```
11
```

## 3. Division with Binary Search

We can modify binary search algorithm to perform division of two numbers, by defining range  $[0, \text{infinity}]$  which serves as initial low and high for the binary search algorithm. Now we need to find a mid that satisfies  $x/y = \text{mid}$  or  $x*\text{mid}$  for given two numbers  $x$  and  $y$ . Based on the comparison result based on  $x$  and  $y*\text{mid}$ , we either update low, update high or return mid. 1. If  $y*\text{mid}$  almost equal to  $x$ , we return mid. 2. If  $y*\text{mid}$  is less than  $x$ , we update low to mid 3. If  $y*\text{mid}$  is more than  $x$ , we update high to mid We need to care about division by zero and sign of the result etc. Input: one line of input should contain two numbers separated by space. Output: should print division of the numbers as a result. **Input Format**

Input: one line of input should contain two numbers separated by space.

Input1: 22 7

### Constraints

$x, y < \text{infinity}$

### Output Format

Output: should print division of the numbers as a result.

### Sample Input 1

```
22 7
```

### Sample Output 1

```
3.14286
```

#### 4. Find the Triplet

Given an array of integers, find a triplet having maximum product in the array.

**Input:** First line of input should specify the number of elements in the array. Second line of input should specify each element separated by space.

**Output:** should print Triplets. Test Cases:

##### Sample Input 1

```
5
-4 1 -8 9 6
```

##### Sample Input 1

```
-4 -8 9
```

##### Sample Input 2

```
5
1 7 2 -2 5
```

##### Sample Input 2

```
7 2 5
```

#### 5. 3n+1

Consider the following algorithm to generate a sequence of numbers. Start with an integer  $n$ . If  $n$  is even, divide by 2. If  $n$  is odd, multiply by 3 and add 1. Repeat this process with the new value of  $n$ , terminating when  $n = 1$ . For example, the following sequence of numbers will be generated for  $n = 22$ : 22 11 34 17 52 26 13 40 20 10 5 16 8 4 2 1. It is conjectured (but not yet proven) that this algorithm will terminate at  $n = 1$  for every integer  $n$ . Still, the conjecture holds for all integers up to at least 1,000,000. For an input  $n$ , the cycle-length of  $n$  is the number of numbers generated up to and including the

1. In the example above, the cycle length of 22 is 16. Given any two numbers  $i$  and  $j$ , you are to determine the maximum cycle length over all numbers between  $i$  and  $j$ , including both endpoints. The input will consist of a series of pairs of integers  $i$  and  $j$ , one pair of integers per line. All integers will be less than 1,000,000 and greater than 0. Output For each pair of input integers  $i$  and  $j$ , output  $i, j$  in the same order in which they appeared in the input and then the maximum cycle length for integers between and including  $i$  and  $j$ . These three numbers should be separated by one space, with all three numbers on one line and with one line of output for each line of input.

Sample Input	Sample Output
1 10	1 10 20
100 200	100 200 125
201 210	201 210 89
900 1000	900 1000 174

#### 6. Matching –String with wild card –pattern.

Check the given string is matches with pattern containing wild card characters („\*“ and „?“), where the „\*“ can match to any number of characters including zero characters and „?“ can match to any single character in the given input string. Check if the given input string is matches with given input pattern or not.

**Input:** Input should contain two lines.

First line of input should contain input string. Second line of input should contain pattern string.

**Output:** The output should print either „0“ or „1“.

‘1’ in the output indicates that the given string is matches with the given pattern.

‘0’ in the output indicates that the given string is not matched with the given pattern.

Sample Input 1:

abcabcccd

a?c\*d

Sample Output1

1

Sample Input 2:

abcabcccd

a?c\*c

Sample Output2

0

## 7. Rotten Oranges

Given a grid of dimension  $n \times m$  where each cell in the grid can have values 0, 1 or 2 which has the following meaning:

**0** : Empty cell

**1** : Cells have fresh oranges

**2** : Cells have rotten oranges

We have to determine what is the minimum time required to rot all oranges. A rotten orange at index  $[i,j]$  can rot other fresh orange at indexes  $[i-1,j]$ ,  $[i+1,j]$ ,  $[i,j-1]$ ,  $[i,j+1]$

(**up, down, left and right**) in unit time.

### Example 1:

**Input:** grid =  $\{\{0,1,2\},\{0,1,2\},\{2,1,1\}\}$

**Output:** 1

**Explanation:** The grid is-

0 1 2

0 1 2

2 1 1

Oranges at positions (0,2), (1,2), (2,0)

will rot oranges at (0,1), (1,1), (2,2) and (2,1) in unit time.

## 8. Minimum-Cost –Path

Find a path in an  $n \times n$  grid from the upper-left corner to the lower-right corner such that we only move down and right and diagonally lower cells from a given cell, i.e., from a given cell  $(i, j)$ , cells  $(i+1, j)$ ,  $(i, j+1)$  and  $(i+1, j+1)$  can be traversed. Assume that all costs are positive integers. Each square contains a number, and the path should be constructed so that the sum of numbers along the path is as small as possible.

1	2	3
4	8	2
1	5	3

1	2	3
4	8	2
1	5	3

The path is  $(0, 0) \rightarrow (0, 1) \rightarrow (1, 2) \rightarrow (2, 2)$ . The cost of the path is 8  $(1 + 2 + 2 + 3)$

### Sample Input 1

```
1 2 3
4 8 2
1 5 3
```

### Sample Output 1

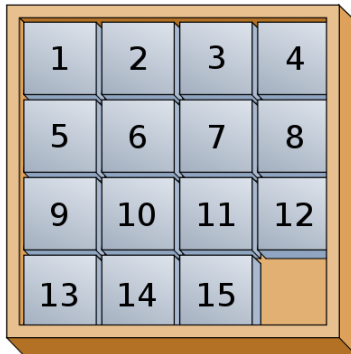
```
8
```

## 9. 15-Puzzle Problem

The 15-puzzle is a very popular game: you have certainly seen it even if you don't know it by that name. It is constructed with 15 sliding tiles, each with a different number from 1 to 15, with all tiles packed into a 4 by 4 frame with one tile missing. The object of the puzzle is to arrange the e tiles so that they are ordered as below:

The only legal operation is to exchange the missing tile with one of the 2, 3, or 4 tiles it shares an edge with. Consider the following sequence of moves:

We denote moves by the neighbor of the missing tile is swapped with it. Legal values are "R," "L," "U," and "D" for right, left, up, and down, based on the movements of the hole. Given an initial configuration of a 15-puzzle you must determine a sequence of steps that take you to the final state. Each solvable 15-puzzle input requires at most 45 steps to be solved with our judge solution; you are limited to using at most 50 steps to solve the puzzle.



**Input** The first line of the input contains an integer n indicating the number of puzzle set inputs. The next 4n lines contain n puzzles at four lines per puzzle. Zero denotes the missing tile.

**Output** For each input set you must produce one line of output. If the given initial configuration is not solvable, print the line "This puzzle is not solvable." If the puzzle is solvable, then print the move sequence as described above to solve the puzzle.

### Sample Input 1

```
2
2 3 4 0
1 5 7 8
9 6 10 12
13 14 11 15
13 1 2 4
5 0 3 7
9 6 10 12
15 8 11 14
```

### Sample Output 1

```
LLDDRDRDR
This puzzle is not solvable
```

## 10. Tug of War

CO3

Tug of war is a contest of brute strength, where two teams of people pull in opposite directions on a rope. The team that succeeds in pulling the rope in their direction is declared

the winner. A tug of war is being arranged for the office picnic. The picnickers must be fairly divided into two teams. Every person must be on one team or the other, the number of people on the two teams must not differ by more than one, and the total weight of the people on each team should be as nearly equal as possible.

**Input**

The input begins with a single positive integer on a line by itself indicating the number of test cases following, each described below and followed by a blank line.

The first line of each case contains n, the number of people at the picnic. Each of the next n lines gives the weight of a person at the picnic, where each weight is an integer between 1 and 450. There are at most 100 people at the picnic. Finally, there is a blank line between each two consecutive inputs.

**Output** For each test case, your output will consist of a single line containing two numbers: the total weight of the people on one team, and the total weight of the people on the other team. If these numbers differ, give the smaller number first. The output of each two consecutive cases will be separated by a blank line.

**Sample Input 1**

```
1
3
100
90
200
```

**Sample Output 1**

```
190 200
```

**11. Find first set bit**

Problem Statement : Given an integer an **N**. The task is to return the position of **first set bit found from the right side** in the binary representation of the number.

**Note:** If there is no set bit in the integer **N**, then return 0 from the function.

**Test case 1 Input: N = 18 Output: 2**

**Test case 2 Input: N = 12 Output: 3**

**Expected Time Complexity:**  $O(\log N)$ .

**Constraints:**

$0 \leq N \leq 10^8$

**12. Coin Problem**

Given a value **V**. You have to make change for **V** cents, given that you have infinite supply of each of  $C\{ C_1, C_2, \dots, C_m \}$  valued coins. Find the minimum number of coins to make the change and print the coins that appear in an optimal solution.

**Input:**

The first line of input contains an integer **T** denoting the number of test cases.

The first line of each test case is **V** and **N**, **V** is the value of cents and **N** is the number of coins.

The second line of each test case contains **N** input  $C[i]$ , value of available coins.

**Output:**

Print the coins appear in an optimal solution and in a newline print the minimum number of coins to make the change and, if not possible print "-1".

Constraints:

$1 \leq T \leq 100$

$1 \leq V \leq 10^6$

$1 \leq N \leq 10^6$

$1 \leq C[i] \leq 10^6$

**Sample Input 1**

```
1
7 2
```

2 1

**Sample Input 1**

2 2 2 1

4

Explanation :

Testcase 1: We can use coin with value 2 three times, and coin with value 1 one times to change a total of 7.

**13. spirally traversing a matrix**

Given a matrix of size  $r \times c$ . Traverse the matrix in spiral form.

**Test case 1:**

Input:

$r = 4, c = 4$

matrix[][] = {{1, 2, 3, 4},  
                  {5, 6, 7, 8},  
                  {9, 10, 11, 12},  
                  {13, 14, 15, 16}}

Output:

1 2 3 4 8 12 16 15 14 13 9 5 6 7 11 10

**Test case 2:**

Input:

$r = 3, c = 4$

matrix[][] = {{1, 2, 3, 4},  
                  {5, 6, 7, 8},  
                  {9, 10, 11, 12}}

Output:

1 2 3 4 8 12 11 10 9 5 6 7

**D. RECOMMENDED STUDY MATERIAL**

S. No	Text Books:
1.	Steven Halim, Felix Halim, "Competitive programming 3", Handbook for ACMICPC and IOI contestants
Reference Book	
1.	Steven S. Skiena Miguel A. Revilla "programming challenges", The Programming Contest Training Manual, Springer
2.	Antti Laaksonen . "Competitive Programmer"s Handbook
3.	Ahmed Shamsul Arefin, "Art of Programming Contest" , special online edition for UVA online judge users.
Online Resources:	
1.	<a href="https://jadi.net/wp-content/uploads/2017/07/competitive-programmers-handbook.pdf">https://jadi.net/wp-content/uploads/2017/07/competitive-programmers-handbook.pdf</a>
2.	<a href="http://acm.cs.buap.mx/downloads/Programming_Challenges.pdf">http://acm.cs.buap.mx/downloads/Programming_Challenges.pdf</a>
3.	<a href="https://www.comp.nus.edu.sg/~stevenha/myteaching/competitive_programming/cp1.pdf">https://www.comp.nus.edu.sg/~stevenha/myteaching/competitive_programming/cp1.pdf</a>
4.	<a href="https://www.comp.nus.edu.sg/~stevenha/database/Art_of_Programming_Contest_SE_for">https://www.comp.nus.edu.sg/~stevenha/database/Art_of_Programming_Contest_SE_for</a>

# Ability Enhancement Courses

Code: BUACHM7239

Employability Skills

1 Credits [LTP:0-0-2]

## A. COURSE OUTCOMES: -

CO	Cognitive Abilities	At the end of this course, learners will be able to:
CO1	Apply	Present themselves clearly and professionally in various contexts, including written, verbal, and non-verbal communication.
CO2	Apply	Show the ability to identify and analyze problems, apply logical reasoning, and develop creative solutions in a professional environment.
CO3	Understand	Understand teamwork, respecting diverse perspectives, and contributing constructively to achieve common goals.
CO4	Apply	Practice adaptation in changing circumstances, and handle setbacks.
CO5	Understand	Understand the importance of professional ethics, integrity, and responsible behavior in the workplace.

## B. CO-PO-PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	1	-	2	3	3	-	-	2	-	-	-
CO2	2	2	-	1	-	2	-	3	3	2	-	-	2	2	-	-
CO3	2	3	3	2	3	2	1	2	-	-	-	-	3	2	-	-
CO4	1	1	-	-	-	3	3	3	3	2	-	-	2	1	-	1
CO5	2	2	2	3	2	2	1	2	2	2	-	-	3	2	1	1
Wt. AVG	3	2	-	-	-	1	-	2	3	3	-	-	2	-	-	-

## C. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Digital Literacy and Technology Skills	3
2.	Time Management and Organization	3
3.	Problem Solving and Critical Thinking	3
4.	Adaptability and Flexibility	3
5.	Professionalism and Ethics	3

## D. DETAILED SYLLABUS

Unit	Unit Details
1.	<b>Digital Literacy and Technology Skills</b>
	<ul style="list-style-type: none"> <li>Basic computer skills, including operating systems, file management, and keyboard shortcuts</li> <li>Internet literacy, including effective searching, evaluating online information, and avoiding online scams</li> <li>Digital communication tools, such as email, instant messaging, and video conferencing</li> <li>Productivity software skills, such as word processing, spreadsheet manipulation, and presentation creation</li> </ul>

	<ul style="list-style-type: none"> <li>• Cyber security awareness, including best practices for data protection and online privacy</li> </ul>
<b>2.</b>	<b>Time Management and Organization</b>
	<ul style="list-style-type: none"> <li>• Setting goals and prioritizing tasks</li> <li>• Creating schedules and managing time effectively</li> <li>• Strategies for overcoming procrastination</li> <li>• Organizing workspace and managing files and documents</li> <li>• Dealing with interruptions and managing distractions</li> </ul>
<b>3.</b>	<b>Problem Solving and Critical Thinking</b>
	<ul style="list-style-type: none"> <li>• Identifying problems and analyzing situations</li> <li>• Developing creative and innovative solutions</li> <li>• Decision-making techniques and strategies</li> <li>• Critical thinking skills and logical reasoning</li> <li>• Collaboration and teamwork in problem-solving</li> </ul>
<b>4.</b>	<b>Adaptability and Flexibility</b>
	<ul style="list-style-type: none"> <li>• Embracing change and adapting to new situations</li> <li>• Resilience and coping with stress and pressure</li> <li>• Problem-solving in dynamic and uncertain environments</li> <li>• Learning agility and continuous self-improvement</li> <li>• Balancing multiple priorities and handling unexpected challenges</li> </ul>
<b>5.</b>	<b>Professionalism and Ethics</b>
	<ul style="list-style-type: none"> <li>• Understanding workplace ethics and professional conduct</li> <li>• Demonstrating integrity, honesty, and accountability</li> <li>• Building a positive personal brand and professional image</li> <li>• Networking skills and building professional relationships</li> <li>• Workplace etiquette and cultural sensitivity</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Employability Skills for Success	Richard G. Mesirov	2020	Cognella Academic Publishing
2.	The Employability Skills Handbook	Edward Oliphant	2019	Kogan Page
3.	Mastering Workplace Skills: Writing, Speaking, Problem Solving, and Teamwork	Jeffrey H. Greenhaus, Gerard A. Callanan, Veronica M. (Morris) Godshalk	2018	SAGE Publications, Inc.

# Summer Internship / Research Project / Dissertation

Code: BCECCE7301

Minor Project

2 Credits [LTP:0-0-4]

## A. COURSE OUTCOMES: -

CO	Cognitive Abilities	Course Outcomes
CO1	Apply	Apply theoretical knowledge to solve practical problems in a professional or research environment.
CO2	Analyze	Plan, execute, and manage a project from inception to completion.
CO3	Apply	Conduct research, analyze data, and draw meaningful conclusions.
CO4	Analyze	Prepare and present technical reports, research papers, or project documentation.
CO5	Evaluate	Work effectively as a member of a team and communicate results clearly to both technical and non-technical audiences.

## B. CO-PO-PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2	3	2	0	0	0	2	0	2	3	2	1	-
CO2	3	2	1	3	1	3	2	1	2	2	2	2	2	3	2	-
CO3	3	3	3	2	3	2	2	1	2	3	2	1	2	2	3	-
CO4	3	1	2	2	3	0	2	0	2	3	s2	2	2	1	3	-
CO5	3	3	3	3	3	3	3	2	3	3	2	3	3	3	3	-
Wt. AVG	3.0	2.5	2.0	2.3	2.3	2.3	1.3	0.7	1.3	2.3	1.3	1.7	2.3	2.3	2.0	-

## C. DETAILED SYLLABUS

1	Data Collection and Analysis:
2	Collection of data as per the project requirements.
3	Use of appropriate analytical methods and tools to process and analyze the data.
4	Interpretation of results in the context of the research objectives.
5	Documentation and Reporting
6	Preparation of a detailed project report or dissertation following the prescribed format.
7	Inclusion of all relevant sections such as introduction, methodology, results, discussion, conclusion, and references
8	Regular submission of progress reports and drafts to the faculty supervisor.
9	Presentation of the project findings to a panel of faculty members.
10	Defense of the project methodology, findings, and conclusions.
11	Addressing questions and feedback from the panel.
12	Final Submission
13	Submission of the final project report or dissertation.
14	Submission of any supplementary materials such as code, data sets, or models developed during the project

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Course Outcomes
CO1	Apply	Apply theoretical knowledge and engineering principles to solve practical problems encountered during industrial training.
CO2	Analyze	Analyze the industrial environment, including organizational structure, processes, and technologies used.
CO3	Apply	Apply learned skills (technical, communication, teamwork) to contribute effectively to industrial projects and tasks.
CO4	Analyze	Analyze and reflect upon the challenges faced, solutions implemented, and lessons learned during the industrial training period.
CO5	Evaluate	Evaluate personal strengths and weaknesses, identify areas for improvement, and develop a plan for lifelong learning and professional development.

**B. CO-PO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	1	2	1	-	-	1	-	-	2	2	2	-	-
CO2	2	3	1	2	1	1	-	-	1	-	-	1	2	1	-	-
CO3	2	2	2	2	3	1	-	-	3	2	-	2	3	3	-	-
CO4	1	3	2	3	2	-	-	-	2	2	1	2	2	2	-	-
CO5	1	2	1	1	1	1	-	-	2	2	2	3	1	1	1	-
Wt. AVG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

**C DETAILED SYLLABUS**

1	Unit Details
	<p><b>Introduction to Industrial Training Seminar-II</b></p> <ol style="list-style-type: none"> <li>7. Overview and objectives</li> <li>8. Importance in the curriculum</li> <li>9. Modules <ul style="list-style-type: none"> <li>• Module 1: [Topic Name] <ul style="list-style-type: none"> <li>○ Sub-topic 1</li> <li>○ Sub-topic 2</li> <li>○ ...</li> </ul> </li> <li>• Module 2: [Topic Name] <ul style="list-style-type: none"> <li>○ Sub-topic 1</li> <li>○ Sub-topic 2</li> <li>○ ...</li> </ul> </li> <li>• Module 3: [Topic Name] <ul style="list-style-type: none"> <li>• Sub-topic 1</li> <li>• Sub-topic 2</li> <li>• ...</li> </ul> </li> </ul> </li> <li>10. Assessment Methods</li> <li>11. Details on how each CO will be assessed (assignments, projects, exams, etc.)</li> <li>12. References: List of recommended textbooks and readings</li> </ol>

**B.Tech- VIII<sup>th</sup> Semester**  
**Batch: 2025-29**

# Summer Internship / Research Project / Dissertation

Code: BCECCE8301

Major Project

10 Credits [LTP:0-0-20]

## A. COURSE OUTCOMES: -

CO	Cognitive Abilities	Course Outcomes
CO1	Apply	Apply theoretical knowledge to solve practical problems in a professional or research environment.
CO2	Analyze	Plan, execute, and manage a project from inception to completion.
CO3	Apply	Conduct research, analyze data, and draw meaningful conclusions.
CO4	Analyze	Prepare and present technical reports, research papers, or project documentation.
CO5	Evaluate	Work effectively as a member of a team and communicate results clearly to both technical and non-technical audiences.

## B. CO-PO-PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2	3	2	0	0	0	2	0	2	3	2	1	-
CO2	3	2	1	3	1	3	2	1	2	2	2	2	2	3	2	-
CO3	3	3	3	2	3	2	2	1	2	3	2	1	2	2	3	-
CO4	3	1	2	2	3	0	2	0	2	3	s2	2	2	1	3	-
CO5	3	3	3	3	3	3	3	2	3	3	2	3	3	3	3	-
Wt. AVG	3.0	2.5	2.0	2.3	2.3	2.3	1.3	0.7	1.3	2.3	1.3	1.7	2.3	2.3	2.0	-

## C. DETAILED SYLLABUS

1	Data Collection and Analysis:
2	Collection of data as per the project requirements.
3	Use of appropriate analytical methods and tools to process and analyze the data.
4	Interpretation of results in the context of the research objectives.
5	Documentation and Reporting
6	Preparation of a detailed project report or dissertation following the prescribed format.
7	Inclusion of all relevant sections such as introduction, methodology, results, discussion, conclusion, and references
8	Regular submission of progress reports and drafts to the faculty supervisor.
9	Presentation of the project findings to a panel of faculty members.
10	Defense of the project methodology, findings, and conclusions.
11	Addressing questions and feedback from the panel.
12	Final Submission
13	Submission of the final project report or dissertation.
14	Submission of any supplementary materials such as code, data sets, or models developed during the project



*Your Dreams Our Goal*  
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# **FACULTY OF COMPUTER SCIENCE & ENGINEERING**

**PROGRAM: B.Tech (CSE)**

**Minor Courses**

**Professional Elective: Theory  
(SPECIALIZATION)**

- 1. Computer Science and Engineering**
- 2. Cyber Security**
- 3. Cloud and DevOps**
- 4. Artificial Intelligence & Data Science**
- 5. Full Stack Development & Mobile Application**
- 6. Artificial Intelligence & Machine Learning (SAS)**

**Batch: 2025-29**



*Your Dreams Our Goal*  
**POORNIMA**  
**UNIVERSITY**

Member of Association of Indian Universities & Approved by UGC (Govt. of India) under 2(f) & 12(B)

**Minor Courses**

**Professional Elective: Theory**

**(Computer Science & Engineering)**

**Batch: 2025-29**

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Understanding	Describe the evolution of industrial revolutions and the future trends in emerging technologies.
CO2	Applying	Explain the fundamentals of Data Science and its value chain, including data acquisition, storage, and visualization.
CO3	Analyzing	Analyze the applications of Artificial Intelligence and Internet of Things in sectors like education, business, and smart infrastructure.
CO4	Analyzing, Evaluating	Differentiate between AR, VR, and MR and examine their applications in various fields such as healthcare and education.
CO5	Evaluating, Creating	Evaluate various emerging technologies like blockchain, quantum computing, and additive manufacturing and discuss ethical issues related to cybersecurity and digital privacy.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	1	-	-	-	-	-	-	-	-	-	1	1	1	-
CO2	2	2	1	-	-	-	-	-	-	-	-	-	2	2	1	-
CO3	3	3	2	1	-	-	-	-	-	-	-	-	3	2	2	-
CO4	3	3	3	2	-	-	-	-	-	-	-	-	3	3	2	-
CO5	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3	-
Wt. AVG	2.0	2.0	1.3	1.0	-	-	-	-	-	-	-	-	2.0	1.7	1.3	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Evolution of Technologies	5
2.	Data Science	5
3.	Artificial Intelligence (AI) and Internet of Things (IoT)	5
4.	Augmented Reality (AR) and Virtual Reality (VR)	4
5.	Ethics in Technology and Other Emerging Technologies	5

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Evolution of Technologies</b> <ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>Includes Historical background of the industrial revolution, (IR1.0, IR2.0, IR3.0, IR.4.0 and IR5.0)</li> <li>Role of data for emerging technologies</li> <li>Human to Machine interaction, Cyber Physical Systems</li> <li>Future trends in emerging technologies.</li> <li>The Future of Work: Shifts Driven By Emerging Technologies</li> <li>Conclusion &amp;Real Life Application</li> </ul>
2.	<b>Data Science</b> <ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>Overview of Data Science, Data and information, Data types and representation</li> <li>Data Value Chain</li> <li>Data Acquisition, Analysis, Curating, Data storage and big data.</li> <li>Data visualization</li> <li>Conclusion &amp;Real Life Application</li> </ul>
3.	<b>Artificial Intelligence (AI) and Internet of Things (IoT)</b> <ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>AI, Levels of AI, Types of AI, Application of AI in Business and Education</li> </ul>

	<ul style="list-style-type: none"> <li>• AI tools and platforms</li> <li>• Generative AI</li> <li>• Overview of IoT, working process of IoT,</li> <li>• Overview of IoT Architecture,</li> <li>• Application of IOT at Smart grid, smart city and smart farming.</li> <li>• Conclusion &amp; Real Life Application</li> </ul>
<b>4.</b>	<b>Augmented Reality (AR) and Virtual Reality (VR)</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Introduction to AR, VR.</li> <li>• Augmented Reality Vs Mixed Reality (MR).</li> <li>• Architecture of AR systems.</li> <li>• Application of AR systems in Medical Assistance, Entertainment and Education.</li> <li>• Conclusion &amp; Real Life Application</li> </ul>
<b>5.</b>	<b>Ethics in Technology and Other Emerging Technologies</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Block Chain Technology,</li> <li>• Cloud and quantum computing</li> <li>• Additive Manufacturing Technology</li> <li>• Flying Drones</li> <li>• Ethics, Digital Privacy and cyber security</li> <li>• Engineering Security and The Transition to Prosperity</li> <li>• Conclusion &amp; Real Life Application</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Emerging Technology	Dr. Sanjay Sharma	Khanna Publishers	First Edition
2.	Emerging Technology For Engineers	Ms. Vasudha Tiwari, Dr. Sunil Kumar Chaudhary	Vayu Education Of India	First Edition
3.	IIBF X Taxmann's Emerging Technologies	Indian Institute of Banking & Finance	Taxmann Publications Private Limited	2024
<b>Reference Book</b>				
1	Emerging Exponential Technologies	Dr Deepak G Kulkarni, Dr. Prayag Gokhale	Himalaya Publishing House	2020
2	Introduction to Artificial Intelligence	Rajendra Akerkar	Eastern Economy Edition	2 <sup>nd</sup> Edition
<b>Online Resources</b>				
1.	"An introduction to Data Science", Oxford Artificial Intelligence Society. <a href="https://www.careers.ox.ac.uk/files/datascienceinformationoxfordaisocietypdf">https://www.careers.ox.ac.uk/files/datascienceinformationoxfordaisocietypdf</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	Understand and construct finite state machines
CO2	Understand	Understand the equivalence of languages described by finite state machines and regular expressions.
CO3	Apply	Construct pushdown automata and the equivalent context free grammars
CO4	Analyze	Analyze the equivalence of languages described by pushdown automata and context free grammars
CO5	Evaluate	Evaluate Turing machines and recursively Enumerable Languages

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	1	-	-	-	-	-	-	-	-	-	1	1	1	-
CO2	2	2	1	-	-	-	-	-	-	-	-	-	2	2	1	-
CO3	3	3	2	1	-	-	-	-	-	-	-	-	3	2	2	-
CO4	3	3	3	2	-	-	-	-	-	-	-	-	3	3	2	-
CO5	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3	-
Wt. AVG	4.0	-	4.0	6.0	-	-	-	-	-	-	-	-	5.5	8.0	1.5	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Fundamentals of Automata	8
2.	Regular Expressions and Languages	7
3.	Context free grammar (CFG)	7
4.	Pushdown Automata, CFL And NCFL	8
5.	Introduction to Turing Machines & Recursively Enumerable Languages	7

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Fundamentals of Automata</b>
	<ul style="list-style-type: none"> <li>Introduction of Theory of Automata</li> <li>Need of Automata and relevance to computer science</li> <li>Finite Automata, Memory requirement in a recognizer</li> <li>Types of automata &amp; working</li> <li>Deterministic Finite Automata &amp; Non Deterministic Finite Automata, Equivalence between NFA and DFA</li> <li>Minimization of Finite automata</li> <li>Automata with output - Moore machine &amp; Mealy machine, conversion of Both machine</li> <li>Finite Automata with Epsilon transitions, Equivalence of NFAs with and without <math>\epsilon</math>-moves</li> <li>Conclusion of Unit</li> </ul>
2.	<b>Regular Expressions And Regular Languages</b>
	<ul style="list-style-type: none"> <li>Introduction of Regular Expression</li> <li>The Operators of regular Expressions</li> <li>Building Regular Expressions and their Transition Graph</li> <li>Equivalence of Finite Automata and regular expressions</li> <li>Converting Regular Expressions to DFA's by Eliminating States</li> <li>Properties of Regular Languages &amp; Non-Regular Languages</li> </ul>

	<ul style="list-style-type: none"> <li>• The Pumping Lemma for Regular Languages</li> <li>• Applications of the Pumping Lemma</li> <li>• Conclusion of Unit</li> </ul>
<b>3.</b>	<b>Context free grammar (CFG)</b>
	<ul style="list-style-type: none"> <li>• Introduction of Grammar</li> <li>• Definitions, Chomsky hierarchy of Grammar</li> <li>• Unions, Concatenations and Kleene's of Context free language</li> <li>• Regular Grammar for Regular Language</li> <li>• Derivations and Ambiguity</li> <li>• Unambiguous CFG and Algebraic Expressions</li> <li>• BacosNaur Form (BNF), Normal Form – CNF. GNF</li> <li>• Conclusion of Unit</li> </ul>
<b>4.</b>	<b>Pushdown Automata, CFL And NCFL</b>
	<ul style="list-style-type: none"> <li>• Introduction of Pushdown Automata</li> <li>• Graphical Notation for PDA's, Instantaneous Descriptions of a PDA</li> <li>• Acceptance by Final State &amp; Empty Stack</li> <li>• Equivalence of PDA's and CFG's</li> <li>• Deterministic PDA, Regular Languages and DPDA's and Context-Free Languages</li> <li>• Pumping Lemma for Context-Free Languages, Closure Properties of Context-Free Languages</li> <li>• Conclusion of Unit</li> </ul>
<b>5.</b>	<b>Introduction to Turing Machines &amp; Recursively Enumerable Languages</b>
	<ul style="list-style-type: none"> <li>• Introduction to Turing Machines</li> <li>• The Instantaneous Descriptions for Turing Machines &amp; Transition Diagrams</li> <li>• The Language of a Turing Machine, Turing Machines and Halting Problem</li> <li>• Combining TM, Variations of TM, Non-Deterministic TM, Universal TM</li> <li>• Recursively and Enumerable Languages, Context sensitive languages and linear bounded automata (LBA)</li> <li>• Decidability</li> <li>• Conclusion of Unit</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Theory of Computer Science: Automata, Languages and Computation	Mishra & Chandrashekar	3rd	PHI
2.	An Introduction to Formal Languages and Automata	Peter Linz	6th	Mass Market Paperback
<b>Reference Book</b>				
1.	Introduction to Languages and the Theory of Computation, 4th by John Martin, Tata Mc Graw Hill			
2.	Introduction to computer theory By Deniel I. Cohen , Joh Wiley & Sons, Inc			
<b>Online Resources</b>				
1.	<a href="http://meru.cecs.missouri.edu/courses/cecs341/tc.html">http://meru.cecs.missouri.edu/courses/cecs341/tc.html</a>			
2.	<a href="https://www.geeksforgeeks.org/introduction-of-theory-of-computation">https://www.geeksforgeeks.org/introduction-of-theory-of-computation</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Understand	Demonstrate and distinguish between types of machine learning techniques.
CO2	Applying	Applying the fundamentals of Statistical Analysis to Regression problems.
CO3	Analyze	To analyze and understand in depth how Logistic Regression performs classification.
CO4	Applying	To apply the Ensemble learning techniques in real world scenarios
CO5	Evaluate	To learn about different evaluation metrics for Classification and Regression Models.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	1	-	-	-	-	-	-	-	-	-	1	1	1	-
CO2	2	2	1	-	-	-	-	-	-	-	-	-	2	2	1	-
CO3	3	3	2	1	-	-	-	-	-	-	-	-	3	2	2	-
CO4	3	3	3	2	-	-	-	-	-	-	-	-	3	3	2	-
CO5	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3	-
Wt. AVG	4.0	4.0	3.3	6.0	-	-	-	-	-	-	-	-	4.0	3.7	3.0	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to Machine Learning	6
2.	Regression using Statistical Analysis	6
3.	Binary and Multiclass Logistic Regression	8
4.	Probabilistic Models, Decision Trees and Ensemble Methods	8
5.	Performance Metrics for Regression and Classification Models	8

**D. DETAILED SYLLABUS**

Unit	Unit Details
<b>1.</b>	<b>Introduction to Machine Learning</b>
	<ul style="list-style-type: none"> <li>● Introduction to Machine Learning</li> <li>● Definition of Machine Learning</li> <li>● Working principles of Machine Learning</li> <li>● Classification of Machine Learning : Supervised Learning, Unsupervised Learning, Reinforcement Learning</li> <li>● Supervised Learning: Classification and Regression</li> <li>● Unsupervised Learning: Clustering and Association</li> <li>● Reinforcement Learning</li> <li>● Types of Reinforcement learning : Positive Reinforcement and Negative Reinforcement</li> <li>● Working of Reinforcement learning</li> <li>● Markov Decision Process</li> <li>● Reinforcement Learning Algorithms: Q-Learning and State Action Reward State action (SARSA)</li> <li>● Application of Reinforcement Learning</li> <li>● Conclusion of Unit</li> </ul>
<b>2.</b>	<b>Regression using Statistical Analysis</b>
	<ul style="list-style-type: none"> <li>● Introduction to Regression</li> <li>● Types of Regression: Linear regression, Logistics regression, Ridge Regression, Lasso Regression,</li> </ul>

	<ul style="list-style-type: none"> <li>Polynomial Regression</li> <li>Regression and Correlation</li> <li>Crosstabs and Scatter Plots</li> <li>Pearson's r</li> <li>Regression – Finding The line</li> <li>Regression – Describing the line</li> <li>Conclusion of Unit</li> </ul>
<b>3.</b>	<b>Binary and Multiclass Logistic Regression</b>
	<ul style="list-style-type: none"> <li>Difference Between Regression and Classification</li> <li>Sigmoid Function and Decision Boundary</li> <li>Likelihood Function and Maximum Likelihood Estimation (MLE)</li> <li>Cost Function for Logistic Regression</li> <li>Gradient Descent for Logistic Regression</li> <li>One-vs-All (OvA) Strategy</li> <li>One-vs-One (OvO) Strategy</li> <li>Softmax Function and Cross-Entropy Loss</li> </ul>
<b>4.</b>	<b>Probabilistic Models, Decision Trees and Ensemble Methods</b>
	<ul style="list-style-type: none"> <li>Concept and Assumptions of Naïve Bayes</li> <li>Gaussian Naïve Bayes, Multinomial Naïve Bayes, Bernoulli Naïve Bayes</li> <li>Applications and Limitations</li> <li>Bayesian Linear Regression</li> <li>Bayesian Logistic Regression</li> <li>Entropy and Information Gain</li> <li>Gini Impurity</li> <li>CART Algorithm</li> <li>Random Forests: Working Mechanism, Feature Importance</li> <li>Gradient Boosted Trees (GBTs)</li> <li>XGBoost: Working Mechanism, Advantages over Traditional GBTs</li> </ul>
<b>5.</b>	<b>Performance Metrics for Classification and Regression Models</b>
	<ul style="list-style-type: none"> <li>R<sup>2</sup> Score, Adjusted R<sup>2</sup></li> <li>Accuracy, Precision, Recall, F1-Score, AUCROC</li> </ul>

## E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Probabilistic Machine Learning	Kevin Murphy	MIT Press	2nd Edition
2.	Machine Learning and Pattern Recognition	Christopher Bishop	Springer Publications	First Edition
<b>Reference Book</b>				
1.	Introduction to Statistical Learning in Python, 2023, Gareth James, Springer			
2.	Elements of Statistical Learning, 2009, Trevor Hastie, Springer			
<b>Online Resources</b>				
1.	<a href="#">Online Courses — An Introduction to Statistical Learning</a>			
2.	<a href="#">Elements of Statistical Learning: data mining, inference, and prediction. 2nd Edition.</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Understanding	Understand blockchain fundamentals, architecture, and core components such as blocks, nodes, and hash functions.
CO2	Analyzing	Deploy and interact with smart contracts using Remix IDE and MetaMask on Ethereum test networks.
CO3	Applying	Develop and deploy ERC-20 tokens using Solidity and Remix IDE; demonstrate token interactions and real-world use cases.
CO4	Evaluating	Analyze the use of smart contracts in public sector applications like identity verification, land registry, and subsidy delivery.
CO5	Creating	Explore emerging trends, privacy technologies, and global research directions in blockchain; propose innovative use cases.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	2	-	-	-	-	2	-	-	2	-	-	-
CO2	3	2	3	1	3	-	-	-	-	2	-	-	3	-	-	-
CO3	3	3	3	-	3	-	-	-	-	3	-	-	3	2	-	-
CO4	3	3	-	2	2	2	-	-	-	3	-	-	-	3	-	-
CO5	3	3	3	1	3	2	-	-	-	3	-	-	3	3	-	-
Wt. AVG	5.0	-	3.0	-	4.3	-	-	-	-	-	-	-	3.7	8.0	-	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to Blockchain Architecture	8
2.	Smart Contracts and MetaMask	8
3.	Token Creation with Ethereum	8
4.	Smart Contract in Government Services	7
5.	Future Prospects and Research Directions	8

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Introduction to Blockchain Architecture</b>
	<ul style="list-style-type: none"> <li>Introduction of the Unit</li> <li>Introduction to Blockchain and Key Concepts</li> <li>History and evolution of Blockchain technology</li> <li>Core Components of Blockchain</li> <li>Structure of a Block and Hash Functions</li> <li>Distributed Peer-to-Peer (P2P) Network</li> <li>Blockchain Architecture and Types</li> <li>Conclusion of the unit</li> </ul>
2.	<b>Smart Contracts and MetaMask</b>
	<ul style="list-style-type: none"> <li>Introduction to Smart Contracts</li> <li>Working for Smart Contracts</li> <li>Ethereum and the Ethereum Virtual Machine (EVM)</li> <li>MetaMask: Installation and Setup</li> <li>Connecting MetaMask with Test Networks</li> <li>Writing and Deploying Smart Contracts Using Remix IDE</li> </ul>

	<ul style="list-style-type: none"> <li>• Use Cases of Smart Contracts</li> <li>• Conclusion of unit</li> </ul>
<b>3.</b>	<b>Token Creation with Ethereum</b>
	<ul style="list-style-type: none"> <li>• Introduction to Tokens and ERC Standards</li> <li>• Setting Up the Development Environment</li> <li>• Understanding ERC-20 Token Structure</li> <li>• Writing the Smart Contract</li> <li>• Compiling and Deploying the Contract</li> <li>• Interacting with the Token</li> <li>• Use Cases and Extensions</li> <li>• Real-world use cases of smart contracts (e.g., token creation, voting systems)</li> <li>• Conclusion of unit</li> </ul>
<b>4.</b>	<b>Smart Contract in Govt Services</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Introduction to E-Governance and Smart Contracts</li> <li>• Use Case: Identity and Credential Verification</li> <li>• Use Case: Public Procurement and Tendering</li> <li>• Use Case: Land Registry and Property Transfer</li> <li>• Use Case: Social Welfare and Subsidy Distribution</li> <li>• Legal and Regulatory Considerations</li> <li>• Challenges and Future of Smart Contracts in Governance</li> <li>• Conclusion of the unit</li> </ul>
<b>5.</b>	<b>Future Prospects and Research Directions</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Emerging Trends in Blockchain Governance</li> <li>• Towards Decentralized Autonomous Governance</li> <li>• Cross-border Interoperability and Global Standards</li> <li>• Decentralized Governance and DAOs</li> <li>• Privacy Enhancements and Zero-Knowledge Proofs</li> <li>• Policy, Regulation, and Standardization</li> <li>• Conclusion of the unit</li> </ul>

## E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Blockchain Basics: A Non-Technical Introduction in 25 Steps	Daniel Drescher	1st Edition (2017)	Apress (Springer)
2.	Mastering Blockchain: Unlocking the Power of Cryptocurrencies	Imran Bashir	3rd Edition (2020)	Packt Publishing
3.	Ethereum Smart Contract Development	Mayukh Mukhopadhyay	2nd Edition	Packt Publishing
<b>Reference Book</b>				
1.	Imran Bashir <i>Mastering blockchain Distributed ledger technology, decentralization, and smart contracts explained</i> , 2 <sup>nd</sup> edition, Packt Publication, 2018.			
2.	Chris Dannen <i>Introducing Ethereum and Solidity Foundations of Cryptocurrency and Blockchain Programming for Beginners</i> , 1 edition, Apress Publication, 2017.			
<b>Online Resources</b>				
1.	<a href="https://www.geeksforgeeks.org/smart-contracts-in-blockchain/">https://www.geeksforgeeks.org/smart-contracts-in-blockchain/</a>			
2.	<a href="https://www.investopedia.com/terms/s/smart-contracts.asp">https://www.investopedia.com/terms/s/smart-contracts.asp</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	The assessments and activities in the course should be designed to evaluate the students memorization and understanding of foundational concepts in Android application development.
CO2	Understand	Students will gain a comprehensive understanding of Android development at various Bloom's Taxonomy levels, enabling them to design and build functional and user-centric Android applications.
CO3	Apply	This course outcome aligns with the Bloom's Taxonomy levels, specifically focusing on application, analysis (breaking down complex concepts), and evaluation (making judgments about the value of information).
CO4	Analyze	These outcomes are structured to align with the cognitive skills progression from remembering basic concepts to creating comprehensive solutions, as per Bloom's Taxonomy.
CO5	Evaluate	Assessing the effectiveness of cross-platform development in terms of cost, time, and resource efficiency. Critically assess the suitability of Xamarin Studio for specific cross- platform development requirements.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1	-	-	2	-	-	-	-	-	-	3	-	1	3
CO2	3	2	1	-	2	-	-	-	-	-	-	-	3	1	-	3
CO3	3	1	2	-	-	1	-	-	-	-	-	-	2	-	3	-
CO4	3	1	-	2	1	-	-	-	-	-	-	-	2	-	2	2
CO5	2	-	-	1	-	-	-	-	-	-	-	-	-	1	2	1
Wt. AVG	4.7	2.3	1.3	-	3.0	1.5	-	-	-	-	-	-	3.3	2.0	4.0	4.5

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to Mobile Application Development	07
2.	Mobile Application Architectures	08
3.	User Interface	08
4.	Android Application	07
5.	iOS Application	07

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Introduction to Mobile Application Development</b>
	<ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>Brief history of mobile applications</li> <li>Introduction to Android Development &amp; The Android Platform</li> <li>Android SDK</li> <li>Operating system platforms: Android, Apple iOS.</li> <li>Types of Mobile Apps: Native, Web, &amp; Hybrid</li> <li>Conclusion of Unit</li> </ul>
2.	<b>Mobile Application Architectures:</b>
	<ul style="list-style-type: none"> <li>Introduction of Unit</li> </ul>

	<ul style="list-style-type: none"> <li>• Client-Server-Connection</li> <li>• Mobile Infrastructure: Mobile Device Types, Mobile Device Components</li> <li>• Mobile Client Applications: Thin Client-Fat Client-Web Page Hosting.</li> <li>• Frameworks and Tools</li> <li>• Conclusion of Unit</li> </ul>
<b>3.</b>	<b>User Interface</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• User Interface Screen elements</li> <li>• User Interfaces Designing with Layouts</li> <li>• VUIs and Mobile Apps</li> <li>• Text-to-Speech Techniques</li> <li>• Designing the Right UI</li> <li>• Multichannel and Multimodal UIs</li> <li>• Conclusion of Unit</li> </ul>
<b>4.</b>	<b>Android Application</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• History of Android OS</li> <li>• Understanding the Android OS platform</li> <li>• Architecture of Android-based devices</li> <li>• Understanding basics of Java</li> <li>• Architecture of Android-based devices</li> <li>• Understanding Android application structure</li> <li>• Conclusion of Unit</li> </ul>
<b>5.</b>	<b>iOS Application</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• History of iOS platform</li> <li>• Architecture of Apple devices</li> <li>• Understanding basics of Swift</li> <li>• Conclusion of Unit</li> </ul>

## E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Professional Mobile Application Development	Jeff McWherter	1 <sup>st</sup> edition	Wrox
2.	Android Programming with Kotlin for Beginners	John Horton	Latest	Packt
<b>Reference Book</b>				
1.	Android Programming: The Big Nerd Ranch Guide" by Bill Phillips and Brian Hardy			
2.	"iOS Programming: The Big Nerd Ranch Guide" by Christian Keur and Aaron Hillegass			
<b>Online Resources</b>				
1.	Google's Android Developer Documentation: <a href="http://developer.android.com">developer.android.com</a>			
2.	Apple's iOS Developer Documentation: <a href="http://developer.apple.com/documentation">developer.apple.com/documentation</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Knowledge	Implement general concepts of Internet of Things (IoT) and recognize various devices, sensors and applications (Recognize.)
CO2	Apply	Applicable design concept to IoT solutions and fundamental enable techniques.
CO3	Analyze	Analyze various IoT Model and Architecture M2M and IoT architectures
CO4	Evaluate	Evaluate design issues in IoT applications, Back-end and Data Handling Analysis
CO5	Create	Create IoT solutions using sensors, actuators, devices with cloud computing and Case Study.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	1	-	-	-	-	-	-	-	-	-	1	1	1	-
CO2	2	2	1	-	-	-	-	-	-	-	-	-	2	2	1	-
CO3	3	3	2	1	-	-	-	-	-	-	-	-	3	2	2	-
CO4	3	3	3	2	-	-	-	-	-	-	-	-	3	3	2	-
CO5	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3	-
Wt. AVG	4.0	-	4.0	6.0	-	-	-	-	-	-	-	-	5.5	8.0	1.5	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Fundamentals of IoT	6
2.	IoT Hardware and Sensor Technologies	6
3.	IoT Communication and Networking Protocols	8
4.	IoT Software and Cloud Integration	8
5.	IoT Security, Applications, and Future Trends	8

**D. DETAILED SYLLABUS**

Unit	Unit Details
<b>1.</b>	<b>Fundamentals of IoT</b>
	<ul style="list-style-type: none"> <li>Introduction of the Unit</li> <li>Introduction to IoT: Definitions, Scope, and Applications</li> <li>Evolution of IoT and Historical Milestones</li> <li>IoT Architecture and Layers</li> <li>Components of IoT Systems: Sensors, Actuators, Microcontrollers</li> <li>IoT Communication Models and IoT vs Traditional Embedded Systems</li> <li>IoT and Cloud Computing Integration</li> <li>Challenges in IoT: Scalability, Security, Privacy, and Standardization</li> <li>Emerging Trends and Future Scope of IoT</li> <li>Conclusion of the Unit</li> </ul>
<b>2.</b>	<b>IoT Hardware and Sensor Technologies</b>
	<ul style="list-style-type: none"> <li>Introduction of the Unit</li> <li>Overview of IoT Hardware: Microcontrollers vs Microprocessors,</li> <li>Types of Sensors and Actuators in IoT</li> <li>IoT Connectivity Modules: Wi-Fi, Bluetooth, Zigbee, LoRa, NB-IoT</li> </ul>

	<ul style="list-style-type: none"> <li>• Power Management and Energy Harvesting Techniques</li> <li>• IoT Prototyping Boards: Raspberry Pi, Arduino, ESP8266</li> <li>• Embedded Systems for IoT Applications</li> <li>• Integration of AI Chips in IoT and Wearable Technologies</li> <li>• Design Considerations for Low-Power and Reliable IoT Devices</li> <li>• Conclusion of the Unit</li> </ul>
<b>3.</b>	<b>IoT Communication and Networking Protocols</b>
	<ul style="list-style-type: none"> <li>• Introduction of the Unit</li> <li>• IoT Networking Concepts and Architectures (Edge, Fog, Cloud)</li> <li>• IoT Connectivity: LPWAN, 5G, Satellite, Protocols: MQTT, CoAP, HTTP, WebSockets, IPv6</li> <li>• Wireless Sensor Networks (WSNs) and Routing Protocols</li> <li>• IoT Gateway Design and Implementation, Security in IoT Networking: Encryption, Threats, Intrusion Detection</li> <li>• Role of 5G in Enabling Real-Time IoT Applications</li> <li>• Conclusion of the Unit</li> </ul>
<b>4.</b>	<b>IoT Software and Cloud Integration</b>
	<ul style="list-style-type: none"> <li>• Introduction of the Unit</li> <li>• IoT Software Stack and Development Platforms</li> <li>• Operating Systems for IoT: RIOT, TinyOS, Contiki</li> <li>• Cloud and Edge Computing Synergy in IoT, Middleware, APIs, and Data Storage in Cloud</li> <li>• Real-Time Processing and Machine Learning Integration</li> <li>• Data Analytics and Visualization in IoT Systems</li> <li>• Open Source IoT Frameworks and Low-Code Development Tools</li> <li>• Digital Twin and Virtualization in IoT Applications</li> <li>• Conclusion of the Unit</li> </ul>
<b>5.</b>	<b>IoT Security, Applications, and Future Trends</b>
	<ul style="list-style-type: none"> <li>• Introduction of the Unit</li> <li>• Security Challenges in IoT Devices and Networks</li> <li>• Authentication, Encryption, Blockchain in IoT</li> <li>• Regulatory Frameworks: GDPR, Privacy Concerns</li> <li>• AI for Threat Detection and Secure Communication</li> <li>• Applications of IoT in Smart Cities, Healthcare, Industry, Agriculture</li> <li>• Role of AI and ML in Smart Systems (AIoT)</li> <li>• Future Trends: 6G, Brain-Computer Interfaces, Quantum IoT</li> <li>• Ethical, Legal, and Social Implications of IoT, IoT and the Metaverse/Web 3.0</li> <li>• Conclusion of the Unit</li> </ul>

## E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	INTERNET OF THINGS Architecture and Design Principles	Raj Kamal	6 <sup>th</sup>	McGraw Hill
2.	IoT (Internet of things) and its Application	Ashish Avasthi	1 <sup>st</sup> Edition	RK Publication
3.	Internet of Things	RMD Sundaram Shriram K Vasudevan, Abhishek S	Latest	WILEY
<b>Reference Book</b>				
1.	Designing the Internet of Things, Adrian McEwen, Hakim Cassimally, John Wiley and Sons			
2.	Internet of Things (A Hands-on Approach), Vijay Madiseti and Arshdeep Bahga, 1 <sup>st</sup> Edition, VPT, 2014			
<b>Online Resources</b>				
1.	<a href="https://data-flair.training/blogs/iot-tutorial/">https://data-flair.training/blogs/iot-tutorial/</a>			
2.	<a href="https://www.javatpoint.com/iot-internet-of-things">https://www.javatpoint.com/iot-internet-of-things</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember, Understand	Demonstrate the knowledge of fundamentals of software testing.
CO2	Understand, Apply	Communicate clearly and effectively use the technical language of testing correctly.
CO3	Apply, Analyze	Able to test software in structured, organized and dynamic ways.
CO4	Analyze, Evaluate	Develop and validate a test plan and know about regression testing.
CO5	Apply, Create	Document test plans and test cases designed & Use automatic testing tools.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2	2	-	-	2	1	1	2	2	-	3	2	-
CO2	2	2	2	2	2	-	-	2	1	1	2	2	-	3	2	-
CO3	2	2	2	2	2-	-	-	2	1	1	2	2	-	3	2	-
CO4	2	2	2	2	2	-	-	2	1	1	2	2	-	3	2	-
CO5	2	2	2	2	2	-	-	3	1	1	2	2	-	3	2	-
Wt. AVG	3.3	3.3	3.3	3.3	4.0	-	-	3.7	1.7	1.7	3.3	3.3	-	5.0	3.3	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Testing Methodology	08
2.	Software Testing Terminology	08
3.	Dynamic Testing Techniques	08
4.	Static and Regression Testing	09
5.	Managing the Test Process and Test Automation	07

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Testing Methodology</b>
	<ul style="list-style-type: none"> <li>• Introduction to Effective Software Testing,</li> <li>• Evolution of Software Testing, Software Testing Myths,</li> <li>• Goals of Software Testing,</li> <li>• Psychology for Software Testing,</li> <li>• Software Testing Definitions,</li> <li>• Model for Software Testing,</li> <li>• Role of tester- testing as a process</li> <li>• Overview of Testing maturity model</li> <li>• Defects -Hypothesis and tests</li> </ul>
2.	<b>Software Testing Terminology</b>
	<ul style="list-style-type: none"> <li>• Definitions, Life Cycle of a Bug, Bug Classification based on SDLC, Testing Principles,</li> <li>• Software Testing Life Cycle (STLC), Software Testing Methodology, Software Testing Strategy, Test Strategy Matrix,</li> <li>• Verification and Validation, Verification and Validation Activities, How to verify Requirements and Objectives,</li> <li>• Verification of High level Design, Verification of Data Design,</li> </ul>

	<ul style="list-style-type: none"> <li>• Verification of Architectural Design, Verification of Low level Design, Unit Verification.</li> </ul>
<b>3.</b>	<b>Dynamic Testing Techniques</b>
	<ul style="list-style-type: none"> <li>• Dynamic Testing : Black Box Testing Techniques, Boundary Value Analysis, Boundary value checking, Equivalence Class Testing, Identification of Equivalence classes, State Table based Testing, Decision Table based Testing, Cause Effect Graphing based Testing</li> <li>• White Box Testing : Need of White box testing, Logic Coverage Criteria, Basis Path Testing, Control Flow Graph, Path Testing, Terminology, Cyclomatic Complexity,</li> <li>• Cyclomatic complexity. Guidelines for Basis Path Testing, Applications of Path Testing, Graph Matrices Graph Matrix, Connection Matrix, Loop Testing, Data Flow Testing, Static Data flow testing, Dynamic Data flow testing, Mutation Testing, Mutation Testing Process.</li> </ul>
<b>4.</b>	<b>Static and Regression Testing</b>
	<ul style="list-style-type: none"> <li>• Static Testing: Inspections, Inspection Process, Walkthroughs, Technical Reviews, Unit Validation Testing, Integration Testing Types of Incremental Integration Testing, Pair-wise Integration, Path Based Integration, Function Testing, System Testing, Performance Testing, Usability Testing, performing the system tests, Acceptance Testing.</li> <li>• Regression Testing: Progressive vs Regression Testing, Regression testing produces quality software Regression Testability, Objectives of Regression Testing, Regression Testing Types Regression Testing Techniques, Selective Retest Techniques, Strategy for Test Case Selection, Regression Test selection Techniques, Evaluating Regression Test Selection Techniques, Minimization Technique, Regression Test Prioritization, Types of Test case Prioritization, Prioritization Techniques, Prioritization Techniques, Code-based test case prioritization Vs coverage based test case prioritization.</li> </ul>
<b>5.</b>	<b>Managing the Test Process and Test Automation</b>
	<ul style="list-style-type: none"> <li>• Test Management, Test Organization, Test Planning, Test Plan Hierarchy, Master Test Plan, Verification Test Plan, Validation Test Plan, Unit Test Plan, Integration Test Plan, Function Test Plan, System Test Plan, Acceptance Test Plan,</li> <li>• Detailed Test Design and Test Specifications, Test Log, Test Reports, Software Metric, Testing</li> <li>• Metrics for Monitoring and Controlling the Testing Process, Testing Process Maturity Models.</li> <li>• Automation and Testing Tools, Need of Automation, Categorization of Testing Tools Static and Dynamic Testing Tools, Testing Activity Tools, Selection of Testing Tools Costs incurred in Testing Tools, Guidelines for Automated Testing, Overview of some commercial Testing Tools.</li> </ul>

## E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Software Testing-Principle and Practices	Naresh Chauhan	3rd	Oxford
2.	Fundamentals of Software Engineering,	RajibMall	PHI	2018
<b>Reference Books</b>				
1.	The Art of Software Testing, 3rd Edition by Glenford J. Myers, Corey Sandler, Tom Badgett.			
2.	Software Testing, 2nd Edition by Ron Patton			
<b>Online Resources</b>				
1.	<a href="https://www.javatpoint.com/software-testing-tutorial">https://www.javatpoint.com/software-testing-tutorial</a>			
2.	<a href="https://www.guru99.com/software-testing.html">https://www.guru99.com/software-testing.html</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	will know all root concept of asp.net and compiling their website.
CO 2	Understand	Will be able to integrate all kind of server controls and ceating their own web application
CO3	Apply	Will be able to manage sessions and validations.
CO4	Analyze	will be able to create their own MVC projects.
CO5	Evaluate	will be able to create and integrate their own web API.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	1	-	2	-	-	-	-	-	-	-	-	1	-	2
CO2	3	-	-	2	-	-	-	-	-	-	-	-	-	-	-	3
CO3	2	1	1	-	1	-	-	-	-	-	-	-	-	1	3	2
CO4	2	-	2	-	-	-	-	-	-	-	-	-	-	-	1	2
CO5	2	1	2	-	2	-	-	-	-	-	-	-	-	-	3	2
Wt. AVG	3.7	2.5	3.0	2.0	2.5	-	-	-	-	-	-	-	-	1.0	7.0	3.7

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	ASP.NET Overview and developing a web application	07
2.	Application structure and state's standard web forms	08
3.	Working with navigation and validation controls, Web parts Control	07
4.	Working with database controls and ADO.net	08
5.	ASP.net MVC and Web API	07

**D. DETAIL SYLLABUS**

Unit	Unit Details
1.	<b>ASP.NET Overview and developing a web application</b> <ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>Exploring New Features of ASP.NET 4.5, ASP.NET Technologies, The ASP.NET Life Cycle, Exploring a Sample ASP.NET Web Application, Creating a Sample ASP.NET Website, Specifying a Location for a Web Application, File Types in ASP.NET</li> <li>Exploring ASP.NET Web Pages, ASP.NET Coding Model, Understanding ASP.NET Directives, Working with Server Controls, Understanding the Provider Model in ASP.NET, Implementing Code Sharing, Compilation in ASP.NET, Dynamic Compilation in ASP.NET</li> <li>Conclusion of Unit</li> </ul>
2.	<b>Application structure and state's standard web forms</b> <ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>Structure of an Application, The Global.asax Application File, Using States, HTTP Handlers, Postback and</li> <li>Cross-Page Posting, Using the Global.asax File, Using Application State, Session State, View state.</li> <li>Creating an HTTP Handler Application, Working with Postback and Cross-Page Posting, Web Forms-Standard Controls</li> <li>Conclusion of Unit</li> </ul>
3.	<b>Working with navigation and validation controls, Web parts Control</b> <ul style="list-style-type: none"> <li>Introduction of Unit.</li> </ul>

	<ul style="list-style-type: none"> <li>Using the Tree View Class, The Tree View Control, Using the Menu Class, The Menu Control,</li> <li>Using the SiteMapPath Class, The SiteMapPath Control, Creating All Controls and Validation Controls.</li> <li>Creating web pages with Web PartManager Control, The Proxy Web ParManager Control, The Connections Zone Control, Creating all controls.</li> <li>Conclusion of Unit</li> </ul>
<b>4.</b>	<b>Working with database controls and ADO.net</b>
	<ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>The Grid View Control, The Data List Control, The Details View Control,</li> <li>The Form View Control, The List View Control, The Repeater Control, The DataPager Control, The Chart Control, The Query Extender Control</li> <li>The SQL Data Source Control, The AccessDataSource Control, The Link DataSource Control.</li> <li>The Object Data Source Control, The XmlDataSource Control</li> <li>The Exntity Data SourceControl, The SiteMap Data Source Control,developing application with ADO.Net.</li> <li>Conclusion of Unit</li> </ul>
<b>5.</b>	<b>ASP.net MVC and Web API</b>
	<ul style="list-style-type: none"> <li>Introduction to ASP.NET MVC</li> <li>First ASP.NET MVC application.</li> <li>Exploring with MVC Controllers</li> <li>Installing ASP.NET Core SDK and Runtime</li> <li>New Web API project with Visual Studio</li> <li>Default ASP.Net core project files</li> <li>Testing the Web API Project with Postman and Swagger</li> <li>Conclusion of Unit</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	ASP.NET 4.5	Kogent	Fourth Edition	Learning Solutions Inc,
2.	Programming ASP.NET Core	Dino Esposito	Professional Edition	Microsoft
<b>Reference Book</b>				
1.	The Complete Reference ASP.NET Matthew MacDonald Indian Edition.			
2.				
<b>Online Resources</b>				
1	<a href="https://www.w3schools.com">https://www.w3schools.com</a>			
2	<a href="https://www.udemy.com/courses/search/?src=ukw&amp;q=ASP.NET">https://www.udemy.com/courses/search/?src=ukw&amp;q=ASP.NET</a>			
3	<a href="https://www.microsoft.com/en-in/search/explore?q=asp+net+notes">https://www.microsoft.com/en-in/search/explore?q=asp+net+notes</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remembering	Understand the fundamentals, evolution, and key characteristics of cloud computing.
CO2	Understanding	Explain the role of virtualization and data centers in enabling cloud infrastructure.
CO3	Applying	Compare different cloud service providers and their core services (IaaS, PaaS, SaaS).
CO4	Evaluating	Analyze cloud security challenges and management practices for secure cloud deployment.
CO5	Analyzing	Examine real-world cloud computing companies and evaluate cloud migration strategies.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	1	-	-	-	-	-	-	-	-	-	1	1	1	-
CO2	2	2	1	-	-	-	-	-	-	-	-	-	2	2	1	-
CO3	3	3	2	1	-	-	-	-	-	-	-	-	3	2	2	-
CO4	3	3	3	2	-	-	-	-	-	-	-	-	3	3	2	-
CO5	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3	-
Wt. AVG	4.0	-	4.0	6.0	-	-	-	-	-	-	-	-	5.5	8.0	1.5	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to Cloud Computing	7
2.	Virtualization and Data Centers	7
3.	Cloud Service Providers and Technologies	8
4.	Cloud Security and Management	8
5.	Cloud Computing Companies and Migrating to Cloud	8

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Introduction to Cloud Computing</b>
	<ul style="list-style-type: none"> <li>Introduction to Cloud Computing: Definition of Cloud – Evolution of Cloud Computing –</li> <li>Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics – Elasticity in</li> <li>Cloud – On - demand Provisioning, Service models: IaaS, PaaS, SaaS, Deployment models: Public,</li> <li>Private, Hybrid, Community , Cloud reference architecture , Use cases of cloud in industry .</li> </ul>
2.	<b>Virtualization and Data Centers</b>
	<ul style="list-style-type: none"> <li>Basics of Virtualization - Types of virtualization - Difference between cloud and virtualization -</li> </ul>

	<ul style="list-style-type: none"> <li>Physical infrastructure and virtual infrastructure - Virtualization approaches -Partitioning - Hosting -</li> <li>Isolation - Hardware independence - Virtual machine – Hypervisor - Types of hypervisor - Virtual machine manager - Types of hypervisor - Introduction to datacenter</li> </ul>
<b>3.</b>	<b>Cloud Service Providers and Technologies</b>
	<ul style="list-style-type: none"> <li>Overview of leading cloud providers: AWS, Azure, Google Cloud, Introduction to AWS: EC2,</li> <li>Instances, Amazon Machine Images (AMIS), Modifying Existing Images. Amazon Storage, S3</li> <li>Storage Basics, Buckets and Objects, RDS, IAM, Introduction to Microsoft Azure and Google Cloud,</li> <li>Cloud storage: Object storage, Block storage, File storage . Managing Voluminous Information with EBS</li> </ul>
<b>4.</b>	<b>Cloud Security and Management</b>
	<ul style="list-style-type: none"> <li>Security challenges in the cloud, Cloud security principles: - Confidentiality, Integrity, Availability,</li> <li>Identity and Access Management (IAM), Data encryption, firewall, and VPNs, Cloud compliance</li> <li>and legal issues (e.g., GDPR), SLA and QoS in cloud, Monitoring and billing in cloud,</li> <li>Case studies of cloud adoption ,Open-source cloud platforms: OpenStack, Eucalyptus .</li> </ul>
<b>5.</b>	<b>Cloud Computing Companies and Migrating to Cloud</b>
	<ul style="list-style-type: none"> <li>Web-based business services, Delivering Business Processes from the Cloud: Business process</li> <li>examples, Broad Approaches to Migrating into the Cloud, The Seven-Step Model of Migration into a</li> <li>Cloud, Efficient Steps for migrating to cloud. Risks: Measuring and assessment of risks, Company</li> <li>concerns Risk Mitigation methodology for Cloud computing, Case Studies</li> </ul>

## E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Cloud Computing: Concepts, Technology & Architecture	Thomas Erl	1st Edition (2013)	Prentice Hall
2.	Cloud Computing: Principles and Paradigms	Rajkumar Buyya, James Broberg, Andrzej Goscinski	1st Edition (2011)	Wiley
3.	Virtualization Essentials	Matthew Portnoy	2nd Edition (2016)	Wiley
<b>Reference Book</b>				
1.	Cloud Computing: Concepts, Technology & Architecture Thomas Erl Prentice Hall			
2.	Cloud Computing: Principles and Paradigms Rajkumar Buyya, James Broberg, Andrzej Goscinski Wiley			
<b>Online Resources</b>				
1.	<a href="https://aws.amazon.com/what-is-cloud-computing">https://aws.amazon.com/what-is-cloud-computing</a>			
2.	<a href="https://www.tutorialspoint.com/cloud_computing">https://www.tutorialspoint.com/cloud_computing</a>			



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Member of Association of Indian Universities & Approved by UGC (Govt. of India) under 2(f) & 12(B)

**Minor Courses**

**Professional Elective: Theory**

**(Artificial Intelligence & Data Science)**

**Batch: 2025-29**

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remembering	Recall fundamental concepts of Artificial Intelligence including definitions, history, agent types, and the PEAS framework.
CO2	Understanding	Explain various problem-solving strategies in AI using uninformed and informed search techniques.
CO3	Applying	Apply AI techniques in real-world scenarios using Natural Language Processing and Expert Systems.
CO4	Analyzing	Analyze the data science workflow by examining data types, sources, and quality to perform basic exploratory data analysis.
CO5	Evaluating	Evaluate different data handling and visualization techniques using Python libraries to interpret and communicate data insights effectively.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	-	-	-	-	-	-	1	3	-	-	3
CO2	3	3	2	-	-	-	-	-	-	-	-	1	3	-	1	3
CO3	2	2	3	-	2	-	-	1	-	1	-	1	2	-	3	2
CO4	2	3	-	2	3	-	-	-	-	1	-	2	2	-	2	2
CO5	3	2	2	2	3	-	-	1	1	2	1	2	2	-	3	3
Wt. AVG	4.3	4.0	3.5	-	8.0	-	-	2.0	-	4.0	-	2.3	4.0	-	4.5	4.3

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to Artificial Intelligence	7
2.	Problem solving by Search	8
3.	AI Applications	7
4.	Introduction to Data Science	7
5.	Data Handling and Visualization	7

**D. DETAILED SYLLABUS**

Unit	Unit Details
<b>1.</b>	<b>Introduction to Artificial Intelligence</b>
	<ul style="list-style-type: none"> <li>Introduction to Artificial Intelligence</li> <li>Definition of Artificial Intelligence, A brief history of Artificial Intelligence</li> <li>Views of AI: Acting Humanly, Thinking Humanly, Thinking Rationally and Acting Rationally, Areas of AI, Agents and environments</li> <li>PEAS (Performance measure, Environment, Actuators, Sensors)</li> <li>Environment types, Agent types: Simple reflex agents, Model-based reflex agents,</li> <li>Goal-based agents and Utility-based agents, Examples of Agent</li> <li>Conclusion of the Unit</li> </ul>
<b>2.</b>	<b>Problem solving by Search</b>
	<ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>Problem-solving agents, Problem formulation, 8-Puzzle problem and 8-queens problem</li> <li>Basic search algorithms, Un-informed search strategies: Breadth-first search, Depthfirst search, Depth-limited search, Uniform-cost search and Iterative deepening search</li> <li>Informed Search Algorithms: Best-first search, A* search, Hill-climbing search</li> <li>Conclusion of the Unit</li> </ul>

<b>3.</b>	<b>AI Applications</b>
	<ul style="list-style-type: none"> <li>• Introduction to AI applications</li> <li>• Natural Language Processing (NLP): NLP Pipeline: Text preprocessing (tokenization, stop words, stemming, lemmatization), Part-of-Speech Tagging, Sentiment analysis, chatbots, machine translation, speech recognition</li> <li>• Expert Systems: Definition and characteristics of expert systems, Components: Knowledge base, Inference engine, User interface</li> <li>• Conclusion of the Unit</li> </ul>
<b>4.</b>	<b>Introduction to Data Science</b>
	<ul style="list-style-type: none"> <li>• Introduction to DS</li> <li>• Differences between AI, ML, and DS</li> <li>• Importance of data quality and ethics</li> <li>• DS Lifecycle: Data Collection, Cleaning, Analysis, Visualization.</li> <li>• Types of data (structured, unstructured, semi-structured)</li> <li>• Data sources and collection methods</li> <li>• Exploratory Data Analysis (EDA) on Titanic Dataset</li> <li>• Conclusion of the Unit</li> </ul>
<b>5.</b>	<b>Data Handling and Visualization</b>
	<ul style="list-style-type: none"> <li>• Introduction to basic data handling</li> <li>• Concepts of data cleaning, transformation, and feature selection</li> <li>• Python libraries (Pandas, NumPy), Visualization tools</li> <li>• Data Visualization – Matplotlib/Seaborn (Bar, Histogram, Scatter Plots)</li> <li>• Applications of DS in fields like health, finance, and education</li> <li>• Conclusion of the Unit</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Artificial Intelligence: A Modern Approach	S. Russell and P. Norvig	Third Edition	Prentice Hall
2.	Artificial Intelligence: A Systems Approach	M. Tim Jones	2023	Infinity Science Press
3.	Python for Data Analysis	Wes McKenney	2013	O'Reilly
<b>Reference Book</b>				
1.	Data Science from Scratch, Joel Grus, 2019			
2.	Natural Language Processing with Python, Steven Bird, Ewan Klein, Edward Loper, 2009			
<b>Online Resources</b>				
1.	Google AI Education – <a href="https://ai.google/education/">https://ai.google/education/</a>			
2.	IBM Cognitive Class - AI & Data Science Courses – <a href="https://cognitiveclass.ai/">https://cognitiveclass.ai/</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	Understand and apply linear algebra concepts such as vectors, matrices, and eigenvalues in the context of data representation and dimensionality reduction in machine learning.
CO2	Understand	Explain and implement concepts from analytic geometry and vector spaces relevant to model interpretation and feature engineering.
CO3	Apply	Apply matrix factorization techniques ( Singular Value Decomposition, Principal Component Analysis) for dimensionality reduction and data compression in machine learning.
CO4	Analyze	To analyze the user defined data types including structures and unions to solve problems.
CO5	Evaluate	Formulate and solve optimization problems involving cost functions and constraints in machine learning using appropriate mathematical tools.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	1	-	-	-	-	-	-	-	-	-	1	1	1	-
CO2	2	2	1	-	-	-	-	-	-	-	-	-	2	2	1	-
CO3	3	3	2	1	-	-	-	-	-	-	-	-	3	2	2	-
CO4	3	3	3	2	-	-	-	-	-	-	-	-	3	3	2	-
CO5	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3	-
Wt. AVG	4.0	-	4.0	6.0	-	-	-	-	-	-	-	-	5.5	8.0	1.5	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to ML Models	6
2.	Probability and Distributions	6
3.	Statistics for Machine Learning	8
4.	Multivariable Calculus	8
5.	Unconstrained Optimization	8

**D. DETAILED SYLLABUS**

Unit	Unit Details
<b>1.</b>	<b>Introduction to ML Models</b>
	<ul style="list-style-type: none"> <li>Understand the linear algebra tools used in ML models.</li> <li>Topics Covered: Scalars, Vectors, Matrices, Tensors Matrix</li> <li>Operations: Addition, Multiplication, Transposition, Identity, Inverse, and Orthogonal Matrices,</li> <li>Vector Spaces, Basis, and Rank, Eigenvalues and Eigenvectors,</li> <li>Singular Value Decomposition (SVD),</li> <li>Applications in Principal Component Analysis (PCA) relevant to machine learning.</li> </ul>
<b>2.</b>	<b>Probability and Distributions</b>
	<ul style="list-style-type: none"> <li>Probability and Distributions (8 Hours)</li> <li>Basics of Probability Theory</li> <li>Conditional Probability and Bayes' Theorem</li> <li>Random Variables: Discrete and Continuous</li> <li>Probability Distributions:</li> <li>Binomial, Bernoulli, Normal, Uniform, Poisson</li> <li>Expectation, Variance, Covariance</li> </ul>

	<ul style="list-style-type: none"> <li>• Joint and Marginal Distributions</li> <li>• Probability Density and Mass Functions</li> </ul>
<b>3.</b>	<b>Statistics for Machine Learning</b>
	<ul style="list-style-type: none"> <li>• Objective: Apply statistical techniques for inference and learning.</li> <li>• Descriptive Statistics: Mean, Median, Mode,</li> <li>• Inferential Statistics: Hypothesis Testing,</li> <li>• Confidence Intervals and Significance Tests, Correlation and Regression Analysis,</li> <li>• Maximum Likelihood Estimation (MLE),</li> <li>• Central Limit Theorem and Law of Large Numbers,</li> <li>• p-values, t-test, and chi-square test</li> </ul>
<b>4.</b>	<b>Multivariable Calculus (8 Hours)</b>
	<ul style="list-style-type: none"> <li>• Objective: Learn how calculus underpins gradient-based optimization in ML.</li> <li>• Topics Covered: Functions of Multiple Variables, Partial Derivatives and Gradient,</li> <li>• Jacobian and Hessian Matrix.</li> <li>• Chain Rule for Vector-Valued Functions,</li> <li>• Taylor Series Expansion,</li> <li>• Directional Derivatives,</li> <li>• Applications in Gradient Descent</li> </ul>
<b>5.</b>	<b>Unconstrained Optimization</b>
	<ul style="list-style-type: none"> <li>• Unconstrained Optimization. Convex and Non-convex Functions, Gradient Descent and Variants (Stochastic, Mini-batch), Newton's Method</li> <li>• Lagrange Multipliers Constrained Optimization, Applications in Cost Function Minimization and Entropy, Cross-Entropy, and KL Divergence</li> <li>• Mutual Information, Information Gain in Decision Trees, Minimum Description Length, Bayesian Inference</li> <li>• Applications in Regularization, Model Selection, and Feature Ranking</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Mathematics for Machine Learning (English, Paperback, Deisenroth Marc Peter)	Deisenroth Marc Peter	Cambridge University Press	PHI
2.	<b>Mathematics for Machine Learning</b>	Jean Gallier and Jocelyn Quaintance	Cambridge University Press	Mass Market Paperback
<b>Reference Book</b>				
1.	Linear Algebra and Learning from Data Gilbert Strang, Publisher: Wellesley-Cambridge Press, Year: 2019, ISBN: 9780692196380			
2.	The Elements of Statistical Learning Authors: Trevor Hastie, Robert Tibshirani, Jerome Friedman, Publisher: Springer, Edition: 2nd Edition (2009), ISBN: 9780387848570			
<b>Online Resources</b>				
1.	<a href="https://www.coursera.org/specializations/mathematics-machine-learning">https://www.coursera.org/specializations/mathematics-machine-learning</a>			
2.	<a href="https://www.khanacademy.org/math/linear-algebra">https://www.khanacademy.org/math/linear-algebra</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Understand	Demonstrate and distinguish between types of machine learning techniques.
CO2	Applying	Applying the fundamentals of Statistical Analysis to Regression problems.
CO3	Analyze	To analyze and understand in depth how Logistic Regression performs classification.
CO4	Applying	To apply the Ensemble learning techniques in real world scenarios
CO5	Evaluate	To learn about different evaluation metrics for Classification and Regression Models.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	1	-	-	-	-	-	-	-	-	-	1	1	1	-
CO2	2	2	1	-	-	-	-	-	-	-	-	-	2	2	1	-
CO3	3	3	2	1	-	-	-	-	-	-	-	-	3	2	2	-
CO4	3	3	3	2	-	-	-	-	-	-	-	-	3	3	2	-
CO5	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3	-
Wt. AVG	4.0	4.0	3.3	6.0	-	-	-	-	-	-	-	-	4.0	3.7	3.0	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to Machine Learning	6
2.	Regression using Statistical Analysis	6
3.	Binary and Multiclass Logistic Regression	8
4.	Probabilistic Models, Decision Trees and Ensemble Methods	8
5.	Performance Metrics for Regression and Classification Models	8

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Introduction to Machine Learning</b>
	<ul style="list-style-type: none"> <li>Introduction to Machine Learning</li> <li>Definition of Machine Learning</li> <li>Working principles of Machine Learning</li> <li>Classification of Machine Learning : Supervised Learning, Unsupervised Learning, Reinforcement Learning</li> <li>Supervised Learning: Classification and Regression</li> <li>Unsupervised Learning: Clustering and Association</li> <li>Reinforcement Learning</li> <li>Types of Reinforcement learning : Positive Reinforcement and Negative Reinforcement</li> <li>Working of Reinforcement learning</li> <li>Markov Decision Process</li> <li>Reinforcement Learning Algorithms: Q-Learning and State Action Reward State action (SARSA)</li> <li>Application of Reinforcement Learning</li> <li>Conclusion of Unit</li> </ul>
2.	<b>Regression using Statistical Analysis</b>
	<ul style="list-style-type: none"> <li>Introduction to Regression</li> <li>Types of Regression: Linear regression, Logistics regression, Ridge Regression, Lasso Regression,</li> </ul>

	<ul style="list-style-type: none"> <li>Polynomial Regression</li> <li>Regression and Correlation</li> <li>Crosstabs and Scatter Plots</li> <li>Pearson's r</li> <li>Regression – Finding The line</li> <li>Regression – Describing the line</li> <li>Conclusion of Unit</li> </ul>
<b>3.</b>	<b>Binary and Multiclass Logistic Regression</b>
	<ul style="list-style-type: none"> <li>Difference Between Regression and Classification</li> <li>Sigmoid Function and Decision Boundary</li> <li>Likelihood Function and Maximum Likelihood Estimation (MLE)</li> <li>Cost Function for Logistic Regression</li> <li>Gradient Descent for Logistic Regression</li> <li>One-vs-All (OvA) Strategy</li> <li>One-vs-One (OvO) Strategy</li> <li>Softmax Function and Cross-Entropy Loss</li> </ul>
<b>4.</b>	<b>Probabilistic Models, Decision Trees and Ensemble Methods</b>
	<ul style="list-style-type: none"> <li>Concept and Assumptions of Naïve Bayes</li> <li>Gaussian Naïve Bayes, Multinomial Naïve Bayes, Bernoulli Naïve Bayes</li> <li>Applications and Limitations</li> <li>Bayesian Linear Regression</li> <li>Bayesian Logistic Regression</li> <li>Entropy and Information Gain</li> <li>Gini Impurity</li> <li>CART Algorithm</li> <li>Random Forests: Working Mechanism, Feature Importance</li> <li>Gradient Boosted Trees (GBTs)</li> <li>XGBoost: Working Mechanism, Advantages over Traditional GBTs</li> </ul>
<b>5.</b>	<b>Performance Metrics for Classification and Regression Models</b>
	<ul style="list-style-type: none"> <li>R<sup>2</sup> Score, Adjusted R<sup>2</sup></li> <li>Accuracy, Precision, Recall, F1-Score, AUCROC</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Probabilistic Machine Learning	Kevin Murphy	MIT Press	2nd Edition
2.	Machine Learning and Pattern Recognition	Christopher Bishop	Springer Publications	First Edition
<b>Reference Book</b>				
1.	Introduction to Statistical Learning in Python, 2023, Gareth James, Springer			
2.	Elements of Statistical Learning, 2009, Trevor Hastie, Springer			
<b>Online Resources</b>				
1.	<a href="#">Online Courses — An Introduction to Statistical Learning</a>			
2.	<a href="#">Elements of Statistical Learning: data mining, inference, and prediction. 2nd Edition.</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Understand	Explain the foundational concepts of Artificial Neural Networks, including the role of activation functions, loss functions, and the basic principles of training using gradient descent and backpropagation.
CO2	Apply	Apply various optimization algorithms and regularization techniques to train deep neural networks effectively and address common issues like overfitting and vanishing gradients.
CO3	Creating	Construct and train basic Convolutional Neural Networks (CNNs) for image classification tasks, demonstrating an understanding of convolutional and pooling operations, and utilize pre-trained models for transfer learning.
CO4	Analyze	Analyze sequential data and effectively implement Recurrent Neural Networks (RNNs) and Long Short-Term Memory (LSTM) networks for fundamental sequence processing tasks such as text classification.
CO5	Evaluate	Evaluate the performance of deep learning models using appropriate metrics, identify and apply effective data preprocessing strategies, and discuss the critical ethical considerations and societal impacts of deep learning applications.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	3	2	-	-	-	-	-	-	-	-	2	-	1	-
CO3	1	1	3	-	3	-	-	-	-	-	-	-	2	-	1	-
CO4	1	2	3	-	-	-	-	-	-	-	-	-	-	-	1	-
CO5	2	-	-	2	-	1	-	-	-	-	-	-	-	-	-	-
Wt. AVG	2.7	3.0	4.5	2.5	3.0	-	-	-	-	-	-	-	2.0	-	2.0	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to Deep Learning	8
2.	Training Deep Neural Networks	6
3.	Convolutional Neural Networks (CNNs)	8
4.	Recurrent Neural Networks (RNNs)	8
5.	Practical Deep Learning and Ethics	6

**D. DETAILED SYLLABUS**

Unit	Unit Details
<b>1.</b>	<b>Introduction to Deep Learning</b>
	<ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>What is Deep Learning?</li> <li>Relationship with Machine Learning and AI.</li> <li>Real-world applications overview</li> <li>Artificial Neural Networks (ANNs): Biological vs. Artificial Neuron (Perceptron), Feed Forward networks, Activation Functions: ReLU (focus), Sigmoid, Tanh, Concept of Layers (Input, Hidden, Output), Loss Functions, Backpropagation, Learning Rate.</li> </ul>
<b>2.</b>	<b>Training Deep Neural Networks</b>
	<ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>Challenges in Training Deep Networks: Vanishing/Exploding Gradients, Overfitting and Underfitting.</li> <li>Optimization Algorithms: Beyond basic Gradient Descent: Momentum, Adaptive Learning Rate</li> </ul>

	<p>methods: Adam (focus).</p> <ul style="list-style-type: none"> <li>Regularization Techniques: L2 Regularization (Weight Decay).</li> </ul>
<b>3.</b>	<b>Convolutional Neural Networks (CNNs)</b>
	<ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>Introduction to Image Data: Digital image representation (pixels, channels), Challenges in image recognition.</li> <li>Core CNN Concepts: Convolutional Operation: Filters/Kernels, Feature Maps, Stride, Padding (key focus), Pooling Layers (Max Pooling): Purpose and effect., Typical CNN Architecture: Conv -&gt; ReLU -&gt; Pool -&gt; FC.</li> <li>Building Simple CNNs: Understanding the role of each layer, Designing a basic CNN for image classification.</li> <li>Conclusion of the Unit</li> </ul>
<b>4.</b>	<b>Recurrent Neural Networks (RNNs)</b>
	<ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>The concept of memory and hidden states, Unrolling RNNs, Limitations (briefly mention long-term dependencies).</li> <li>Long Short-Term Memory (LSTM) networks: High-level understanding of gates (Forget, Input, Output).</li> <li>Gated Recurrent Unit (GRU): Simplified alternative</li> <li>Word Embeddings (conceptual introduction, e.g., Word2Vec).</li> <li>Simple Text Classification (e.g., sentiment analysis) using RNNs.</li> <li>Understanding how RNNs process time series data (e.g., predicting next value).</li> <li>Conclusion of the Unit</li> </ul>
<b>5.</b>	<b>Practical Deep Learning and Ethics</b>
	<ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>Data Handling and Preprocessing: Data Augmentation (for images), Normalization/Standardization, Train-Validation-Test split.</li> <li>Key Metrics for Classification (Accuracy, Precision, Recall, F1-Score – conceptual, and when to use which).</li> <li>Overfitting /Underfitting identification from evaluation metrics.</li> <li>Confusion Matrix (basic understanding).</li> <li>Ethical Considerations in Deep Learning: Bias in datasets and models, Fairness and accountability, Privacy implications.</li> <li>Conclusion of the Unit</li> </ul>

## E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow	Aurelien Geron	Third Edition	O'Reilly
2.	Deep Learning with Python	Francois Chollet	Manning, 2017	Manning
<b>Reference Book</b>				
1.	Neural Networks and Deep Learning, Second Edition, Charu C Agarwal, Springer, 2023			
2.	Deep Learning (Adaptive Computation and Machine Learning series), Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press, 2016			
<b>Online Resources</b>				
1.	<a href="https://www.coursera.org/specializations/deep-learning">https://www.coursera.org/specializations/deep-learning</a>			
2.	<a href="https://www.fast.ai/">https://www.fast.ai/</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	Recall the fundamental concepts of digital image representation, various image types, and basic pixel-level image manipulation techniques.
CO2	Understand	Explain the principles behind different image preprocessing and filtering techniques, including noise reduction, enhancement, and edge detection algorithms.
CO3	Apply	Implement appropriate image segmentation and feature extraction methods to process images and prepare them for higher-level computer vision tasks.
CO4	Analyze	Analyze the strengths and weaknesses of both traditional pattern recognition and introductory deep learning approaches (CNNs) for various object recognition and classification problems in Computer Vision.
CO5	Evaluate	Evaluate the applicability and limitations of different Computer Vision techniques (including object detection and tracking) in solving real-world challenges and diverse application scenarios.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	-	-	-	-	-	-	-	-	-	-	1	-	-	2
CO2	3	2	-	1	1	-	-	-	-	-	-	-	1	-	-	3
CO3	3	2	2	2	3	-	-	-	-	-	-	-	2	-	2	3
CO4	3	3	2	3	2	1	-	-	-	1	-	-	2	-	1	3
CO5	3	3	3	3	2	2	1	1	1	2	1	-	3	-	1	3
Wt. AVG	4.7	3.7	7.0	4.5	4.0	-	-	-	-	-	-	-	3.0	-	4.0	4.7

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to Computer Vision & Image Fundamentals	7
2.	Image Preprocessing & Filtering	7
3.	Image Segmentation & Feature Extraction	8
4.	Object Recognition & Introduction to Machine Learning in Computer Vision	8
5.	Advanced Computer Vision Concepts & Applications	7

**D. DETAILED SYLLABUS**

Unit	Unit Details
<b>1.</b>	<b>Introduction to Computer Vision &amp; Image Fundamentals</b>
	<ul style="list-style-type: none"> <li>Introduction to Computer Vision: What is Computer Vision? Goals and challenges. Brief history and major milestones, Relationship with Image Processing, Machine Learning, and AI, Key applications</li> <li>Image Formation: Human visual system (brief overview), Basic camera model (pinhole camera), Projection and perspective., Digital Image Representation: Image as a matrix, pixels.</li> <li>Image types: Binary, Grayscale, Color (RGB, HSV - conceptual). Image resolution and spatial sampling. Quantization and intensity levels. Common image file formats (JPEG, PNG, BMP).</li> <li>Basic Image Manipulation: Reading, displaying, and saving images. Basic pixel-level operations (e.g., intensity adjustment, thresholding), Geometric transformations: Scaling, Translation, Rotation (conceptual, basic implementation).</li> <li>Conclusion of Unit</li> </ul>
<b>2.</b>	<b>Image Preprocessing &amp; Filtering</b>
	<ul style="list-style-type: none"> <li>Image Noise: Types of noise (e.g., Salt-and-Pepper, Gaussian). Noise reduction techniques: Averaging filter, Gaussian filter, Median filter.</li> <li>Image Enhancement: Contrast stretching and Histogram Equalization, Image sharpening: Laplacian filter.</li> <li>Edge Detection: Concept of image gradients, Gradient-based methods: Sobel, Prewitt operators, Marr-Hildreth edge detector (conceptual).</li> <li>Canny Edge Detector: Principles (smoothing, non-max suppression, hysteresis thresholding).</li> </ul>

	<ul style="list-style-type: none"> <li>• Morphological Operations: Introduction to binary morphology.</li> <li>• Erosion and Dilation: Concepts and applications (e.g., noise removal, object thinning).</li> <li>• Opening and Closing operations.</li> <li>• Conclusion of Unit</li> </ul>
<b>3.</b>	<b>Image Segmentation &amp; Feature Extraction</b>
	<ul style="list-style-type: none"> <li>• Image Segmentation Introduction: Goals of segmentation, Types of segmentation (pixel-level, region-level).</li> <li>• Basic Segmentation Techniques: Thresholding: Global thresholding, Adaptive thresholding, Region-based segmentation: Region growing, Region splitting and merging (conceptual), Introduction to watershed algorithm (conceptual).</li> <li>• Feature Extraction Basics: What are features? Why extract them? Points, Lines, Edges as features, Contour following.</li> <li>• Corner Detection &amp; Feature Descriptors: Harris Corner Detector: Principle and application, Introduction to Scale-Invariant Feature Transform (SIFT) and Speeded Up Robust Features (SURF) - conceptual understanding of their purpose (robust feature matching).</li> <li>• Conclusion of Unit</li> </ul>
<b>4.</b>	<b>Object Recognition &amp; Introduction to Machine Learning in Computer Vision</b>
	<ul style="list-style-type: none"> <li>• Object Recognition Overview: Problem statement: Identifying and localizing objects. Basic approaches: Template matching, Feature matching for object recognition.</li> <li>• Traditional Machine Learning for CV: Brief review of classification concepts (features, labels, training).</li> <li>• Introduction to classifiers in CV context: K-Nearest Neighbors (k-NN), Support Vector Machines (SVM) - high-level understanding of their application for object classification using extracted features.</li> <li>• Convolutional Neural Networks (CNNs): High-level architecture (Convolutional layers, Pooling layers, Fully Connected layers). Why CNNs are effective for images (shared weights, local receptive fields). Conceptual understanding of feature learning by CNNs.</li> <li>• Image Classification with CNNs: Training and inference (basic understanding).</li> <li>• Transfer Learning: Concept of using pre-trained CNNs for new tasks.</li> <li>• Conclusion of Unit</li> </ul>
<b>5.</b>	<b>Advanced Computer Vision Concepts &amp; Applications</b>
	<ul style="list-style-type: none"> <li>• Object Detection: Problem definition: Classification + Localization. Early approaches: Sliding window. Modern approaches (conceptual overview): Region-based CNNs (R-CNN, Fast R-CNN, Faster R-CNN - focus on the "region proposal" idea), Single-shot detectors (YOLO, SSD - focus on real-time aspect). Introduction to bounding boxes and object scores.</li> <li>• Object Tracking: Basic principles of tracking, Optical Flow (conceptual), Simple tracking methods (e.g., centroid tracking, Kalman filter conceptual).</li> <li>• Image Registration: Aligning multiple images (conceptual understanding), Applications (e.g., medical imaging, panorama stitching).</li> <li>• Selected Applications and Future Trends: Face Detection and Recognition (brief), Gesture Recognition. Medical Image Analysis, Autonomous Driving (perception aspects).</li> <li>• Conclusion of Unit</li> </ul>

## E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Computer Vision: Algorithms and Applications	Richard Szeliski	2nd Edition	Springer
2.	Computer Vision: A Modern Approach	David Forsyth and Jean Ponce.	2015	Pearson
3.	Learning OpenCV 4 Computer Vision with Python 3	Joseph Howse, Joe Minichino, and OpenCV team	Third Edition	Packt Publishing
<b>Reference Book</b>				
1.	Digital Image Processing by Rafael C. Gonzalez and Richard E. Woods			
2.	Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow by Aurélien Géron			
<b>Online Resources</b>				
1.	<a href="https://www.google.com/search?q=https://www.geeksforgeeks.org/computer-vision-tutorial/">https://www.google.com/search?q=https://www.geeksforgeeks.org/computer-vision-tutorial/</a>			
2.	<a href="https://learnopencv.com/">https://learnopencv.com/</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Understand	Understand the core concepts of Natural Language Processing and implement neural embedding techniques for language representation.
CO2	Analyze	Design and evaluate deep sequence models using RNNs, LSTMs, and Transformer-based attention mechanisms.
CO3	Apply	Apply autoregressive models and prompt engineering techniques to generate coherent and contextually relevant text.
CO4	Apply	Fine-tune large language models using parameter-efficient techniques and apply alignment strategies such as RLHF and DPO.
CO5	Apply	Develop, integrate, and deploy generative NLP applications using open-source toolchains, while addressing ethical considerations.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2	2	1	-	-	-	2	-	2	3	2	2	-
CO2	3	3	2	2	3	-	-	-	-	2	-	2	3	2	2	-
CO3	2	3	2	2	3	-	-	-	1	2	-	3	2	1	3	-
CO4	2	3	2	3	3	1	1	2	1	3	2	3	2	2	3	-
CO5	2	2	3	3	3	2	2	2	2	3	2	3	2	2	3	-
Wt. AVG	2.4	2.8	2.2	2.4	2.8	1.3	1.5	2.0	1.3	2.4	2.0	2.6	2.4	1.8	2.6	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Foundations of NLP and Deep Learning	6
2.	Sequence Models and Attention Mechanisms	6
3.	Generative Models and Text Generation	8
4.	Fine-tuning, PEFT, and LLM Alignment	8
5.	Applications, Toolchains, and Deployment	8

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Foundations of NLP and Deep Learning</b>
	<ul style="list-style-type: none"> <li>NLP pipeline, challenges, tokenization (BPE, WordPiece)</li> <li>Basics of deep learning: Neural networks, backpropagation</li> <li>Embeddings: Word2Vec, GloVe, FastText</li> <li>Contextual embeddings: BERT, ELMo</li> </ul>
2.	<b>Sequence Models and Attention Mechanisms</b>
	<ul style="list-style-type: none"> <li>RNNs, LSTMs, GRUs: Structure, limitations</li> <li>Attention mechanism: Scaled dot-product, additive</li> <li>Transformer architecture (encoder-decoder, positional encoding)</li> <li>Pretraining tasks: MLM, CLM, Seq2Seq</li> </ul>
3.	<b>Generative Models and Text Generation</b>
	<ul style="list-style-type: none"> <li>Autoregressive transformers: GPT, LLaMA, Mistral</li> <li>VAEs and Diffusion models for text (overview)</li> <li>Prompt Engineering: Zero-shot, Few-shot, Chain-of-Thought</li> <li>Instruction tuning, Prompt tuning</li> </ul>
4.	<b>Fine-tuning, PEFT, and LLM Alignment</b>

	<ul style="list-style-type: none"> <li>• Fine-tuning with LoRA, QLoRA, AdapterFusion</li> <li>• Direct Preference Optimization (DPO), RLHF fundamentals</li> <li>• Evaluating generative models: BLEU, ROUGE, perplexity</li> <li>• Bias, safety, hallucinations, alignment strategies</li> </ul>
<b>5.</b>	<b>Applications, Toolchains, and Deployment</b>
	<ul style="list-style-type: none"> <li>• LLM pipelines: Retrieval-Augmented Generation (RAG)</li> <li>• LangChain, Haystack for QA &amp; agent design</li> <li>• OpenLLM, vLLM, FastAPI for deployment</li> <li>• Capstone project with real-world LLM application</li> <li>• Ethics and responsible AI practices</li> </ul>

## E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Deep Learning Book	Yoshua Bengio	2016	MIT Press
2.	Probabilistic Machine Learning	Kevin Murphy	2022	MIT Press
<b>Reference Book</b>				
1.	Dive into Deep Learning, 2023, Smola, Cambridge Press			
2.	Transformers with Natural Language Processing, 2022, Rothman, Oreilly			
<b>Online Resources</b>				
1.	<a href="#">Dive into Deep Learning — Dive into Deep Learning 1.0.3 documentation</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Understand	Understand and apply tokenization strategies and Transformer-based language models to solve NLP tasks.
CO2	Analyze	Implement and fine-tune large language models to perform text generation, prompt engineering, and instruction-based learning.
CO3	Apply	Utilize CNNs and vision transformers to perform visual recognition, segmentation, and self-supervised learning on image data.
CO4	Apply	Design and evaluate generative models such as GANs, VAEs, and diffusion models to generate realistic text and image content.
CO5	Apply	Develop and deploy multimodal AI systems capable of linking vision and language through cross-modal generation and understanding.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2	2	1	-	-	-	2	-	2	3	2	2	-
CO2	3	3	2	2	3	-	-	-	-	2	-	2	3	2	2	-
CO3	2	3	2	2	3	-	-	-	1	2	-	3	2	1	3	-
CO4	2	3	2	3	3	1	1	2	1	3	2	3	2	2	3	-
CO5	2	2	3	3	3	2	2	2	2	3	2	3	2	2	3	-
Wt. AVG	2.4	2.8	2.2	2.4	2.8	1.3	1.5	2.0	1.3	2.4	2.0	2.6	2.4	1.8	2.6	-

**B. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Foundations of Modern Deep NLP	6
2.	Large Language Models and Text Generation	6
3.	Vision Transformers and Foundation Models	8
4.	Generative Models for Text and Visual Content	8
5.	Multimodal and Cross-Modal Generative AI	8

**D. DETAILED SYLLABUS**

Unit	Unit Details
<b>1.</b>	<b>Foundations of Modern Deep NLP</b>
	<ul style="list-style-type: none"> <li>Tokenization: BPE, WordPiece, SentencePiece</li> <li>Word and contextual embeddings: Word2Vec, BERT, RoBERTa</li> <li>Transformer architecture: Self-attention, Multi-head attention</li> <li>Pretraining strategies: MLM, NSP, Causal LM</li> <li>Transfer learning for NLP tasks</li> </ul>
<b>2.</b>	<b>Large Language Models and Text Generation</b>
	<ul style="list-style-type: none"> <li>Decoder-only architectures: GPT-2, GPT-3, GPT-4</li> <li>Instruction tuning and RLHF (e.g., InstructGPT, ChatGPT)</li> <li>Prompt Engineering and In-Context Learning</li> <li>Retrieval-Augmented Generation (RAG)</li> <li>Alignment &amp; Safety: Constitutional AI</li> </ul>
<b>3.</b>	<b>Vision Transformers and Foundation Models</b>
	<ul style="list-style-type: none"> <li>CNNs and ConvNeXt overview</li> <li>Vision Transformers: ViT, Swin</li> <li>Foundation Vision Models: SAM, DINOv2, MAE</li> <li>CLIP, EVA-CLIP, OpenCLIP</li> </ul>

	<ul style="list-style-type: none"> <li>• BLIP-2, Flamingo – bridging vision and language</li> </ul>
<b>4.</b>	<b>Generative Models for Text and Visual Content</b>
	<ul style="list-style-type: none"> <li>• Variational Autoencoders (VAEs)</li> <li>• Generative Adversarial Networks (GANs): DCGAN, StyleGAN</li> <li>• Diffusion Models: DDPM, Latent Diffusion, Imagen, DALL-E 2</li> <li>• Personalized generation: LoRA, DreamBooth</li> <li>• Evaluation metrics: FID, IS, CLIP score</li> </ul>
<b>5.</b>	<b>Multimodal and Cross-Modal Generative AI</b>
	<ul style="list-style-type: none"> <li>• Multimodal architectures: LLaVA, GPT-4V, Gemini</li> <li>• Text-to-image, image captioning, visual question answering</li> <li>• Text-to-video, generative search interfaces</li> <li>• Applications in design, creative AI, and digital storytelling</li> <li>• Evaluation: CIDEr, SPICE, CLIP similarity</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Deep Generative Modeling	Jakub M. Tomczak	1st	Springer
2.	GANs in Action	Jakub Langr and Vladimir Bok	1st	Manning Publications
<b>Reference Book</b>				
1.	Dive into Deep Learning, Smola, 2023, Cambridge			
<b>Online Resources</b>				
1.	<a href="#">Dive into Deep Learning — Dive into Deep Learning 1.0.3 documentation</a>			
2.				

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	To remember the fundamentals of Big Data, its characteristics, types of digital data, and Hadoop history.
CO2	Understand	To understand the design, architecture, and functioning of HDFS and data ingestion using Flume and Sqoop.
CO3	Apply	To apply the MapReduce programming model to perform distributed data processing and analyze job execution.
CO4	Analyze	To analyze Hadoop ecosystem components like Pig, Hive, HBase, and Big SQL and their use in big data workflows.
CO5	Evaluate	To evaluate machine learning algorithms and big data analytics using R for real-world case studies.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	–	–	2	–	–	–	–	–	–	2	3	2	–	–
CO2	3	3	–	2	3	–	–	–	–	–	–	2	3	3	–	–
CO3	3	3	2	3	3	–	–	–	–	–	–	2	3	3	2	–
CO4	3	3	3	3	3	–	1	1	2	2	2	3	3	3	2	2
CO5	2	2	3	3	3	2	2	3	2	2	2	3	2	2	2	3
Wt. AVG	2.8	2.6	2.7	2.8	2.8	2.0	1.5	2.0	2.0	2.0	2.0	2.4	2.8	2.6	2.0	2.5

**B. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to Big Data and Hadoop	07
2.	HDFS (Hadoop Distributed File System)	08
3.	Map Reduce	08
4.	Hadoop Eco System	07
5.	Data Analytics with R	07

**C. DETAIL SYLLABUS**

Unit	Unit Details
<b>1.</b>	<b>Introduction to Big Data and Hadoop</b>
	<ul style="list-style-type: none"> <li>Introduction to Big Data, Big Data Characteristics</li> <li>Types of Digital Data, Introduction to Big Data, Big Data Analytics</li> <li>Relationships and Representations, Graph Databases.</li> <li>History of Hadoop, Apache Hadoop, Analysing Data with Unix tools</li> <li>Analysing Data with Hadoop, Hadoop Streaming</li> <li>Hadoop Echo System, IBM Big Data Strategy, Introduction to Infosphere BigInsights and Big Sheets.</li> <li>Conclusion of Unit</li> </ul>
<b>2.</b>	<b>HDFS (Hadoop Distributed File System)</b>
	<ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>NoSQL, Comparison of SQL and NoSQL</li> <li>The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow,</li> <li>Data Ingest with Flume and Scoop and Hadoop archives,</li> <li>Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures Conclusion of Unit</li> </ul>
<b>3.</b>	<b>Map Reduce</b>
	<ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>MongoDB: Why Mongo DB - Terms used in RDBMS and Mongo DB</li> </ul>

	<ul style="list-style-type: none"> <li>• Data Types, MongoDB Query Language</li> <li>• Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort,</li> <li>• Task Execution, Map Reduce Types and Formats, Map Reduce Features.</li> <li>• Conclusion of Unit</li> </ul>
<b>4.</b>	<b>Hadoop Eco System</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Pig: Introduction to PIG, Execution Modes of Pig, Comparison of Pig with</li> <li>• Databases, Grunt, Pig Latin,</li> <li>• User Defined Functions, Data Processing operators. Hive: Hive Shell, Hive Services,</li> <li>• Hive Metastore, Comparison with Traditional Databases,</li> <li>• HiveQL, Tables, Querying Data and User Defined Functions. Hbase: HBasics, Concepts, Clients, Example, Hbase Versus RDBMS.</li> <li>• Big SQL: Introduction</li> <li>• Conclusion of Unit</li> </ul>
<b>5.</b>	<b>Data Analytics with R</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Machine Learning: Introduction, Supervised Learning, Unsupervised</li> <li>• Learning, Collaborative Filtering,</li> <li>• Big Data Analytics with BigR, Case Study of Healthcare using R,</li> <li>• Conclusion with R</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Hadoop: The Definitive Guide	Tom White	4th Edition, 2015	O'Reilly Media
2.	Big Data Analytics	Seema Acharya, Subhasini Chellappan	2nd Edition, 2021	Wiley India
<b>Reference Books</b>				
1.	Big Data: Principles and Paradigms by Rajkumar Buyya, Rodrigo N. Calheiros, and Amir Vahid Dastjerdi is published by Morgan Kaufmann in its 1st Edition (2016).			
2.	Data-Intensive Text Processing with MapReduce by Jimmy Lin and Chris Dyer is published by Morgan & Claypool Publishers in its 1st Edition (2010).			
<b>Online Resources</b>				
1.	<a href="http://www.bdbanalytics.ir/media/1121/big-data-analytics_turning-big-data-into-big-money.pdf">http://www.bdbanalytics.ir/media/1121/big-data-analytics_turning-big-data-into-big-money.pdf</a>			
2.	<a href="https://www.techtarget.com/searchbusinessanalytics/definition/big-data-analytics">https://www.techtarget.com/searchbusinessanalytics/definition/big-data-analytics</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	To define the key concepts, terminology, and life cycle of MLOps.
CO2	Understand	To explain the use of tools and technologies in model tracking and deployment.
CO3	Apply	To implement MLOps workflows using version control, containerization, CI/CD.
CO4	Analyze	To analyze infrastructure needs and evaluate deployment strategies.
CO5	Evaluate	To evaluate performance, security, and governance of MLOps pipelines

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	-	-	-	-	-	-	-	-	-	3	2	1	-
CO2	3	3	2	2	2	-	-	-	-	-	-	-	3	3	2	-
CO3	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3	2
CO4	3	3	3	3	2	-	-	-	-	-	-	-	3	3	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3	3
Wt. AVG	3.0	2.8	2.4	2.8	2.5	-	-	-	-	-	-	-	3.0	2.8	2.4	2.7

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	<b>Introduction to MLOps &amp; ML Lifecycle</b>	6
2.	<b>Tools, Versioning, and Experiment Tracking</b>	6
3.	<b>Infrastructure, CI/CD &amp; Automation</b>	8
4.	<b>Deployment Strategies, Serving &amp; Inference</b>	8
5.	<b>Monitoring, Governance, and Security in MLOps</b>	8

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Introduction to MLOps &amp; ML Lifecycle</b>
	<ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>Overview of MLOps and its importance</li> <li>Difference between MLOps, DevOps, and DataOps</li> <li>Key concepts and terminologies</li> <li>Stages of the ML lifecycle: problem definition, data preprocessing, model development</li> <li>Model evaluation, deployment, monitoring, and continuous integration/improvement phases</li> <li>Conclusion &amp; Real Life Applications</li> </ul>
2.	<b>Tools, Versioning, and Experiment Tracking</b>
	<ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>Overview of MLOps platforms and tools</li> <li>Git and version control for code</li> <li>Data versioning with DVC</li> <li>Model serialization and packaging (<i>Pickle, ONNX</i>)</li> <li>API development and deployment using <i>FastAPI</i></li> <li>Experiment tracking with <i>MLflow, Kubeflow</i></li> <li>Model registries</li> </ul>

	<ul style="list-style-type: none"> <li>• Conclusion &amp; Real Life Applications</li> </ul>
<b>3.</b>	<b>Infrastructure, CI/CD &amp; Automation</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Scalable infrastructure setup (Cloud, Hybrid)</li> <li>• Cloud services: AWS, GCP, Azure</li> <li>• Infrastructure as Code (IaC) with Terraform</li> <li>• CI/CD pipeline design and tools (Jenkins, GitHub Actions, GitLab CI)</li> <li>• Conclusion &amp; Real Life Applications</li> </ul>
<b>4.</b>	<b>Deployment Strategies, Serving &amp; Inference</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Batch vs. real-time inference</li> <li>• Model serving with TensorFlow Serving, KServe</li> <li>• Canary releases, A/B testing</li> <li>• Multi-armed bandits</li> <li>• Edge deployment (TensorFlow Lite)</li> <li>• Streaming analytics with Kafka, AWS IoT</li> <li>• Conclusion &amp; Real Life Applications</li> </ul>
<b>5.</b>	<b>Monitoring, Governance, and Security in MLOps</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Monitoring, alerting, and logging (Prometheus, Grafana)</li> <li>• Model performance metrics</li> <li>• Model drift detection</li> <li>• Governance and explainability (SHAP, LIME)</li> <li>• Security and compliance in ML systems</li> <li>• Ethical considerations and privacy-preserving ML</li> <li>• Conclusion &amp; Real Life Applications</li> </ul>

## E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Introducing MLOps: How to Scale Machine Learning Projects	Mark Treveil, Alok Shukla	1st Edition	O'Reilly Media
2.	Practical MLOps: Operationalizing Machine Learning Models	Noah Gift	1st Edition	O'Reilly Media
3.	Machine Learning Engineering	Andriy Burkov	1st Edition	True Positive Inc.
<b>Reference Book</b>				
1.	Designing Machine Learning Systems, Chip Huyen, 1 <sup>st</sup> Edition, O'Reilly Media			
2.	Machine Learning Operations (MLOps): With Practical Examples Using MLflow, Docker, and Kubernetes, Emmanuel Raj, 1st Edition, Apress, 2021			
<b>Online Resources</b>				
1.	<a href="https://ml-ops.org/">https://ml-ops.org/</a>			
2.	<a href="https://cloud.google.com/architecture/mlops-continuous-delivery-and-automation-pipelines-in-machine-learning">https://cloud.google.com/architecture/mlops-continuous-delivery-and-automation-pipelines-in-machine-learning</a>			



*Your Dreams Our Goal*  
**POORNIMA**  
**UNIVERSITY**

Member of Association of Indian Universities & Approved by UGC (Govt. of India) under 2(f) & 12(B)

**Minor Courses**  
**Professional Elective: Theory**  
**(Cyber Security)**  
**Batch: 2025-29**

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	Recall the basic concepts of cyber security, common attacks, and key terminologies such as the CIA triad and attack vectors.
CO2	Understand	Explain the process of setting up a cybersecurity lab and the fundamental concepts of Linux, Windows, and Active Directory environments.
CO3	Apply	Use networking knowledge to interpret how the web and common protocols function within cyber security contexts.
CO4	Apply	Apply cryptographic techniques and tools to ensure data confidentiality, integrity, and authentication in secure communications.
CO5	Analyze	Analyze application vulnerabilities, security tools, and current trends like IoT and AI in cybersecurity for evaluating modern threat landscapes.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	-	-	-	-	-	-	1	3	-	-	-
CO2	3	3	2	-	2	-	-	-	-	-	-	2	3	-	-	-
CO3	3	3	-	-	2	-	-	-	-	-	-	2	3	2	-	-
CO4	3	2	3	-	3	-	-	-	-	-	-	2	2	2	-	2
CO5	3	3	2	2	2	-	-	-	-	-	-	3	2	-	-	2
Wt. AVG	3.0	2.6	2.3	2.0	2.3	-	-	-	-	-	-	2.0	2.6	2.0	-	2.0

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Cyber Security Fundamentals	7
2.	Lab Environment Setup & Operating System Basics	7
3.	Networking Security Essentials	7
4.	Cryptography and Data Protection	7
5.	Application Security, Tools & Emerging Trends	8

**D. DETAILED SYLLABUS**

Unit	Unit Details
<b>1.</b>	<b>Cyber Security Fundamentals</b>
	<ul style="list-style-type: none"> <li>Introduction to Unit</li> <li>CIA Triad and Core Security Terminologies</li> <li>Types of Cyber Threats and Attack Vectors</li> <li>Common Cyber Attacks (e.g., Phishing, DDoS, MITM)</li> <li>Overview of Offensive and Defensive Security</li> <li>Careers and Certifications in Cyber Security</li> <li>Conclusion of Unit</li> </ul>
<b>2.</b>	<b>Lab Environment Setup &amp; Operating System Basics</b>
	<ul style="list-style-type: none"> <li>Introduction to Unit</li> <li>Setting up a Cyber Security Lab (VirtualBox/VMware, ISOs)</li> <li>Linux Fundamentals and Linux Shell Basics</li> <li>File System Permissions and User Management in Linux/Windows</li> <li>Windows Fundamentals and PowerShell Basics</li> <li>Introduction to Active Directory and Domain Concepts</li> </ul>

	<ul style="list-style-type: none"> <li>• Google Hacking Techniques and Search Operators</li> <li>• Conclusion of Unit</li> </ul>
<b>3.</b>	<b>Networking Security Essentials</b>
	<ul style="list-style-type: none"> <li>• Introduction to Unit</li> <li>• OSI Model and TCP/IP Model in Context of Cyber Security</li> <li>• Common Network Protocols Intro (TCP, UDP, ICMP, DNS, DHCP, etc.)</li> <li>• Network Services (SSH, FTP, SMB, NFS etc.)</li> <li>• How the Web Works (URL, DNS, Hosting, IP, Ports)</li> <li>• Deep Dive into HTTP and HTTPS for Web Security</li> <li>• Network Security Devices: Firewalls, IDS, IPS</li> <li>• VPNs and Encrypted Communication</li> <li>• Wireless Network Security and Network Segmentation</li> </ul>
<b>4.</b>	<b>Cryptography and Data Protection</b>
	<ul style="list-style-type: none"> <li>• Introduction to Unit</li> <li>• Basics of Cryptography and its Role in Cyber Security</li> <li>• Symmetric vs Asymmetric Encryption</li> <li>• Hashing Algorithms (MD5, SHA, etc.)</li> <li>• Digital Signatures and Message Authentication</li> <li>• Public Key Infrastructure (PKI)</li> <li>• Cryptographic Protocols (SSL/TLS, IPSec)</li> <li>• Password Cracking and Other Cryptography Tools Intro</li> <li>• Conclusion of Unit</li> </ul>
<b>5.</b>	<b>Application Security, Tools &amp; Emerging Trends</b>
	<ul style="list-style-type: none"> <li>• Introduction to Unit</li> <li>• Common Web Vulnerabilities (OWASP Top 10, CVEs)</li> <li>• Key Tools Overview: Burp Suite, Nmap, Metasploit, Hydra, Wireshark</li> <li>• Security Awareness &amp; Social Engineering</li> <li>• Security Policies and Cyber Governance</li> <li>• Emerging Areas: IoT Security, Cloud Security, AI in Security</li> <li>• Conclusion of Unit</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	<i>Computer security fundamentals</i> (5th ed.)	Easttom, W.	1 <sup>st</sup> , 2023	Pearson IT
2.	Introduction to Cyber Security	Jeetendra Pandey	1st Edition, 2017	Uttarakhand Open University,
<b>Reference Book</b>				
1.	Fundamental of Cyber Security Mayank Bhusan, Rajkumar Singh Rathore, Aatif Jamshed, (Principles, Theory and Practices) BPB Publications 2018.			
2.	Cyber Security Essentials, James Graham, Richard Howard, Ryan Olson, CRC Press			
<b>Online Resources</b>				
1.	<a href="https://tryhackme.com/path/outline/presecurity">https://tryhackme.com/path/outline/presecurity</a>			
2.	<a href="https://tryhackme.com/path/outline/jrpenetrationtester">https://tryhackme.com/path/outline/jrpenetrationtester</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	To remember theoretical and cross-disciplinary approaches (criminological, political, legal and information security/management)
CO2	Understand	Understand the structure, mechanics and evolution of the Internet in the context of emerging crime threats and technological and other trends in cyberspace.
CO3	Apply	To apply structure, mechanics and evolution of the Internet in the context of emerging crime threats and technological and other trends in cyberspace.
CO4	Analyze	Analyse and assess the impact of cybercrime on government, businesses, individuals and society.
CO5	Evaluate	Evaluate the effectiveness of cyber-security, cyber-laws (e.g. the Budapest Convention) and other countermeasures against cybercrime and cyber warfare.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	1	1	—	—	—	—	—	—	—	—	2	—	—	2
CO2	3	2	1	2	—	—	—	—	—	—	—	—	2	—	—	3
CO3	2	3	2	1	—	—	—	—	—	—	—	—	1	—	—	2
CO4	2	2	2	1	—	—	—	—	—	—	—	—	2	—	—	2
CO5	2	3	1	1	—	—	—	—	—	—	—	—	2	—	—	2

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Cyber Crime Introduction	07
2.	Introduction to Cyber Laws	08
3.	Indian Cyber Laws: Related Issues and Provisions	08
4.	Computer Forensics	07
5.	IPR in Cyberspace	07

**D. DETAILED SYLLABUS**

Unit	Unit Details
<b>1.</b>	<b>Introduction to Cyber Crime</b>
	<ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>Introduction to Conventional Crime and Cyber Crime</li> <li>Classification of Conventional and Cyber Crime, Difference between Conventional and Unconventional Cyber Crime</li> <li>Cyber Criminal Mode and Manner of Committing Cyber Crime</li> <li>Reasons for Cyber Crime, Cyber law and IPR, Need for cyber law, Evolution of key terms and concepts</li> <li>Cyber Crimes and Jurisprudence of Cyber Law</li> <li>Introduction of IT Act, Computer crime prevention measures</li> <li>Conclusion of Unit</li> </ul>
<b>2.</b>	<b>Introduction to Cyber Laws</b>
	<ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>Provisions in Indian Laws in dealing with Cyber Crimes and its critical analysis, Information Technology Act, 2000, Penalties and Offences under IT Act</li> <li>Offences related with Digital Signature and Electronic Signature under IT Act, Statutory Provisions</li> <li>Establishment of Authorities under IT Act and their functions, powers such as Controller,</li> </ul>

	<ul style="list-style-type: none"> <li>• Certifying Authorities ,Cyber Regulation Appellate Tribunal, Adjudicating officer</li> <li>• Conclusion of Unit</li> </ul>
<b>3.</b>	<b>Indian Cyber Laws: Related Issues and Provisions</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit – Relevance of Cyber Laws in the Digital Era</li> <li>• International Organizations and Their Roles: ICANN, UDRP, WTO, WIPO, and TRIPS in Cyber Regulations</li> <li>• Evolution and Key Features of the Information Technology (IT) Act, 2000</li> <li>• Digital and Electronic Signatures – Legal Recognition and Technical Analysis under Indian Law</li> <li>• E-Commerce: Legal Issues, Contracts, Consumer Protection, and Regulatory Provisions in India</li> <li>• E-Governance in India: Framework, Challenges, and Legal Enforceability</li> <li>• E-Taxation and Legal Challenges in Cyberspace: Compliance and Enforcement</li> <li>• Cybercrime and Legal Remedies under Indian Cyber Law</li> <li>• Conclusion of Unit</li> </ul>
<b>4.</b>	<b>Computer Forensics</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Introduction to Computer Forensics, Subdivisions, Steps of Computer Forensics, need for computer forensics</li> <li>• Analyzing the suspected Computer, Incidence Response, Cyber Forensics and Digital Evidence</li> <li>• Digital Forensic Science , Digital Forensics Life Cycle, Chain of custody concept and Challenges in Computer Forensics, Forensic Imaging</li> <li>• Conclusion of Unit</li> </ul>
<b>5.</b>	<b>IPR in Cyberspace</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Concept of Copyright and Patent in Cyberspace, Copyright in the Digital Medium</li> <li>• Copyright in Computer Programmes, Copyright and WIPO Treaties</li> <li>• Concept of Patent Right, Relevant provisions of Patent Act 1970</li> <li>• Data Storage on a Hard Drive, Data Storage on a Hard Drive, Hard Disk Drive addressing</li> <li>• Hard Disk Drive addressing, File corruption and Recovery, Fundamentals of drive imaging</li> <li>• Cloning and Issues in Imaging</li> <li>• Conclusion of Unit</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Cyber security - understanding cybercrimes, computer forensics and legal perspectives	Nina godbole and sunit belapure	1st	WILEY
2.	Computer Forensics: Principles And Practices	Linda Volonino, Reynaldo Anzaldua And Jana Godwin	1st	PEARSON
<b>Reference Book</b>				
1.	System Forensics Ankit Fadia,Boonlia, Prince Komal, 1st Vikas Publication			
2.	Cyber law in India, Farooq Ahmad 1st Pioneer Publishers, New Delhi			
<b>Online Resources</b>				
1.	<a href="http://www.vjolt.net/vol12/issue3/v12i3_a1-Azam.pdf">http://www.vjolt.net/vol12/issue3/v12i3_a1-Azam.pdf</a>			
2.	<a href="https://www.wipo.int/export/sites/www/amc/en/docs/wipointaudrp.pdf">https://www.wipo.int/export/sites/www/amc/en/docs/wipointaudrp.pdf</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	Recall fundamental ethical hacking terminologies, hacker types, phases, and basic pentesting lab setup.
CO2	Understand	Explain the concepts and differences between passive and active reconnaissance using OSINT and enumeration tools.
CO3	Analyze	Analyze captured network traffic and sniffing scenarios to identify vulnerabilities and potential threats.
CO4	Apply	Demonstrate exploitation of common web vulnerabilities like SQLi, XSS, and CSRF using Juice Shop and security tools.
CO5	Apply	Develop simple scripts and payloads using Python, Bash, or JavaScript for automation and wireless hacking tasks.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	-	-	-	-	-	2	-	-	-	1	2	-	-	-
CO2	2	2	-	-	2	-	-	-	-	-	-	1	2	-	-	-
CO3	2	3	2	3	2	-	-	-	-	-	-	1	3	2	-	-
CO4	2	3	3	2	3	-	-	-	-	-	-	1	2	3	2	2
CO5	2	2	3	2	3	-	-	-	-	-	-	2	2	2	3	2
Wt. AVG	2.0	2.2	2.7	2.3	2.5	-	-	2.0	-	-	-	1.2	2.2	2.3	2.5	2.0

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to Ethical Hacking	7
2.	Reconnaissance & Enumeration	8
3.	Network Hacking & Exploitation Tools	8
4.	Web Application Hacking	9
5.	Wireless Hacking & Programming for Hackers	7

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Introduction to Ethical Hacking</b>
	<ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>Ethical Hacking and Important Terminologies</li> <li>Types of Hackers and Legal Considerations</li> <li>Phases of Ethical Hacking</li> <li>Principles of Security (Cyber Kill Chain and Mitre Framework)</li> <li>Pentesting Fundamentals</li> <li>Setting Up Lab (Kali Linux, Parrot OS, Basic Tools)</li> <li>Conclusion of Unit</li> </ul>
2.	<b>Reconnaissance &amp; Enumeration</b>
	<ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>Passive vs Active Recon</li> <li>OSINT Tools and Techniques (Google Dorking, Social Recon, Shodan, DNS Recon, GitHub Recon)</li> <li>Subdomain Enumeration and Directory Bruteforcing</li> <li>Service Enumeration (Nmap, Netcat, Enum4linux, RustScan, MasScan)</li> <li>Tools: Maltego, Foca, Recon-ng, Whois, theHarvester, Shodan, Dnsrecon, Photon, Sherlock,</li> </ul>

	<ul style="list-style-type: none"> <li>Spiderfoot, holehe</li> <li>• Conclusion of Unit</li> </ul>
<b>3.</b>	<b>Network Hacking &amp; Exploitation Tools</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Packet Capturing &amp; Analysis (Wireshark, Tcpdump)</li> <li>• Sniffing Attacks and Countermeasures</li> <li>• Session Hijacking (Cookie Theft, Sidejacking)</li> <li>• Metasploit, Nmap, Hydra</li> <li>• Burp Suite Advanced</li> <li>• Conclusion of Unit</li> <li>• Wireless Network Security and Network Segmentation</li> </ul>
<b>4.</b>	<b>Web Application Hacking</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• OWASP Top 10, Juice Shop Setup, Web Security Academy</li> <li>• HTTP Request and Response Headers and Codes, Cookies, JWTs</li> <li>• Authentication Bypass &amp; Broken Access Explained with Juice Shop</li> <li>• SQLi, XSS, CSRF, IDOR, File Inclusion Explained with Juice Shop</li> <li>• Web Shells and Remote Code Execution</li> <li>• Tools: Burp Suite, SQLmap</li> <li>• Conclusion of Unit</li> </ul>
<b>5.</b>	<b>Wireless Hacking &amp; Programming for Hackers</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Wireless Hacking Basics</li> <li>• Scripting for Automation (Python, Bash Basics)</li> <li>• Simple Viruses and Keloggers Coding</li> <li>• JavaScript Basics for XSS</li> <li>• Note Taking: CherryTree, Notion, Documentation</li> <li>• Conclusion of Unit</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Ethical Hacking and Penetration Testing Guide	Rafay Baloch	1st Edition, 2014	CRC Press
2.	Hands-On Ethical Hacking and Network Defense	Michael T. Simpson, Nicholas Antill	4th Edition, 2020	Cengage Learning
<b>Reference Book</b>				
1.	The Web Application Hacker's Handbook, Dafydd Stuttard, Marcus Pinto, Wiley, 2011 q			
2.	Black Hat Python: Python Programming for Hackers and Pentesters, Justin Seitz, No Starch Press, 2021			
<b>Online Resources</b>				
1.	<a href="https://tryhackme.com/path/outline/redteaming">https://tryhackme.com/path/outline/redteaming</a>			
2.	<a href="https://tryhackme.com/path/outline/jrpenetrationtester">https://tryhackme.com/path/outline/jrpenetrationtester</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	Provide fundamentals of database security, access control techniques
CO2	Understand	Understand and implement classical models and algorithms.
CO3	Analyze	Analyze the data and identify the problems
CO4	Apply	Choose the relevant models and algorithms to apply
CO5	Analyze	Assess the strengths and weaknesses of various access control models and to analyze their behavior.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-	3	2	-	-
CO3	2	3	3	2	-	-	-	-	-	-	-	-	2	2	-	-
CO4	2	3	3	3	2	-	-	-	-	-	-	-	3	3	-	-
CO5	3	3	3	2	-	-	-	-	-	-	-	-	3	2	-	-
Wt. AVG	2.6	2.8	2.8	2.3	2.0	-	-	-	-	-	-	-	2.8	2.3	-	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to Access Control	8
2.	Role-based Access Control:	6
3.	Models	9
4.	Smartcard Security:	7
5.	Database Security:	9

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Introduction to Access Control</b>
	<ul style="list-style-type: none"> <li>Introduction to Access Control, Purpose and fundamentals of access control, brief history, Policies of Access Control, Models of Access Control and Mechanisms, Discretionary Access Control (DAC), Non- Discretionary Access Control, Mandatory Access Control (MAC).</li> <li>Capabilities and Limitations of Access Control Mechanisms: Access Control List (ACL) and Limitations, Capability List and Limitations.</li> </ul>
2.	<b>Role-based Access Control:</b>
	<ul style="list-style-type: none"> <li>Role-Based Access Control (RBAC) and Limitations, Core RBAC,</li> <li>Hierarchical RBAC, Statically Constrained RBAC, Dynamically Constrained RBAC, Limitations of RBAC. Comparing RBAC to DAC and MAC Access control policy</li> </ul>
3.	<b>Models</b>
	<ul style="list-style-type: none"> <li>Biba's integrity model, Clark-Wilson model, Domain type enforcement model, mapping the enterprise view to the system view,</li> <li>Role hierarchies inheritance schemes, hierarchy structures and inheritance forms, using SoD in real system Temporal Constraints in RBAC, MAC AND DAC.</li> <li>Integrating RBAC with enterprise IT infrastructures: RBAC for WFMSs,</li> </ul>

	<ul style="list-style-type: none"> <li>• RBAC for UNIX and JAVA environments Case study: Multi line Insurance Company</li> </ul>
<b>4.</b>	<b>Smartcard Security</b>
	Smart Card based Information Security, Smart card operating system fundamentals, design and implantation principles, memory organization, smart card files, file management, atomic operation, smart card data transmission ATR, PPS Security techniques- user identification, smart card security, quality assurance and testing, smart card life cycle-5 phases, smart card terminals.
<b>5.</b>	<b>Database Security</b>
	<ul style="list-style-type: none"> <li>• Recent trends in Database security and access control mechanisms. Case study of Role-Based Access Control (RBAC) systems.</li> <li>• Recent Trends related to data security management, vulnerabilities in different DBMSs.</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Role-Based Access Control	David F. Ferraiolo, D. Richard Kuhn, Ramaswamy Chandramouli	Role-Based Access Control	David F. Ferraiolo, D. Richard Kuhn, Ramaswamy Chandramouli
2.	Database Security: Concepts, Approaches, and Challenges	Alfred Basta, Melissa Zgola	Database Security: Concepts, Approaches, and Challenges	Alfred Basta, Melissa Zgola
<b>Reference Book</b>				
1	Role-Based Access Control	David F. Ferraiolo, D. Richard Kuhn, Ramaswamy Chandramouli		
2	Database Security: Concepts, Approaches, and Challenges	Alfred Basta, Melissa Zgola		
<b>Online Resources</b>				
1.	<a href="http://www.smartcard.co.uk/tutorials/sct-itsc.pdf">http://www.smartcard.co.uk/tutorials/sct-itsc.pdf</a> : Smart Card Tutorial.			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	Learn and recall the fundamentals of processes and models used in the entertainment software industry of Game Technology
CO2	Understand	Understand the history of gaming hardware, including the evolution of console architecture over the decades.
CO3	Apply	Apply their knowledge of types and variations of input devices, including touch devices, controllers, keyboards, and mice
CO4	Analyze	Analyze the functions of a GPU in games, understanding its role in rendering graphics and enhancing gaming experiences
CO5	Evaluate	Evaluate the need for multi-threading in games, considering its importance in enhancing performance and responsiveness.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	1	-	-	-	-	-	-	-	-	3	2	3	3
CO2	3	3	2	2	-	-	-	-	-	-	-	-	3	2	2	3
CO3	2	2	3	1	-	-	-	-	-	-	-	-	2	1	1	2
CO4	2	2	1	-	-	-	-	-	-	-	-	-	2	1	-	2
CO5	2	1	1	-	-	-	-	-	-	-	-	-	1	-	-	2
Wt. AVG	2.4	2.2	1.8	1.3	-	-	-	-	-	-	-	-	2.2	1.5	2.0	2.4

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Foundation for IT Audit, Assurance and Process	07
2.	Computer Assisted Audit Tools and Techniques	08
3.	Managing Information technology Audit System	08
4.	Security consideration for ERP Applications	07
5.	Risk Management	07

**D. DETAILED SYLLABUS**

Unit	Unit Details
<b>1.</b>	<b>Foundation for IT Audit, Assurance and Process</b>
	<ul style="list-style-type: none"> <li>Assurance Services - Need for Assurance - Characteristics of Assurance Services-Types of Assurance Services ECommerce and Electronic Funds Transfer - Future of electronic payment system.</li> <li>Audit Standards - Types of Auditors and their functions - Internal Audit Function and External Auditor. Audit Plan - Developing an Audit Schedule - Audit Budget - Preliminary Review - Audit Findings - Analysis Re-examination - Verification - Recommendations - Communication Strategy</li> <li>Conclusion of Unit</li> </ul>
<b>2.</b>	<b>Computer Assisted Audit Tools and Techniques</b>
	<ul style="list-style-type: none"> <li>Auditor Productivity Tools</li> <li>Data and Resource Management, Flowcharting Techniques - Flowcharting as an analysis tool</li> <li>Developing Audit Data Flow Diagrams, Appropriateness of flowcharting techniques</li> <li>Computer assisted tools for operational reviews, Web Analysis tools</li> <li>Conclusion of Unit</li> </ul>
<b>3.</b>	<b>Managing Information technology Audit System</b>
	<ul style="list-style-type: none"> <li>Evaluating IT Audit Quality and Effectiveness</li> </ul>

	<ul style="list-style-type: none"> <li>• Criteria for Assessing the IT Audit Process</li> <li>• Criteria for Assessing IT Auditors and Audit Teams</li> <li>• Best Practices in IT Audit Planning and Risk Assessment</li> <li>• IT Governance and Compliance: Frameworks and Performance Measurement</li> <li>• IT Controls and Risk Management in Audit</li> <li>• Metrics and Management – Metric Reporting, Dashboards, and Independent Assurance</li> <li>• Use of Technology in IT Audits: Automation and Data Analytics</li> <li>• Conclusion of Unit</li> </ul>
<b>4.</b>	<b>Security consideration for ERP Applications</b>
	<ul style="list-style-type: none"> <li>• Information Security Policy</li> <li>• Security Standards - ISO 27002 and National Institute of Standards and Technology</li> <li>• Information Security Controls</li> <li>• Information Owner Responsibilities - Third- Party Responsibilities</li> <li>• Intranet/Extranet Security. Identity Theft</li> <li>• E-Commerce Application Security as a strategic and structural problem</li> <li>• Planning and Control Approach to E-Commerce Security Management</li> <li>• Internet Security and Mobile Computing Security</li> <li>• ERP Data Warehouse-Data Warehouse integrity checklist</li> <li>• ERP-Security features of the basic component.</li> <li>• Conclusion of Unit</li> </ul>
<b>5.</b>	<b>Risk Management</b>
	<ul style="list-style-type: none"> <li>• Introduction to risk</li> <li>• Source and evaluation of risks, Risk management</li> <li>• Evaluation of Risk Management Strategies</li> <li>• Risk model, Credit risk measurement and management</li> <li>• Conclusion of Unit</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	<u>Information Technology Control and Audit</u>	<u>Sandra Senft, Frederick Gallegos, Aleksandra Davis</u>	<u>4th</u>	<u>CRC Press, 2012.</u>
2.	<u>Derivatives &amp; Risk Management</u>	<u>R.P. Rustagi</u>	<u>Latest</u>	<u>Taxmann</u>
<b>Reference Book</b>				
1.	<u>Information System Audit and Assurance, D P Dube, V P Gulati, Tata Mc-Graw Hill, 2008</u>			
2.	<u>Micheal E. Whitman, Herbert J. Mattor, "Principles of Information Security", Course Technology, Delmar Cengage Learning, Fourth Edition, 2012.</u>			
<b>Online Resources</b>				
1.	<a href="http://www.isaca.org/">http://www.isaca.org/</a>			
2.	<a href="https://www.youtube.com/watch?v=w0I4M82c1dc">https://www.youtube.com/watch?v=w0I4M82c1dc</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	Recall the phases, types, and concepts of VAPT including lab setup tools like Kali Linux and Juice Shop.
CO2	Understand	Explain the process of web application reconnaissance and common vulnerabilities including OWASP Top 10 and SANS 25.
CO3	Analyze	Analyze network services and system configurations to identify and exploit vulnerabilities using manual and automated tools.
CO4	Apply	Conduct vulnerability scans, validate results, and document findings using tools like OpenVAS, Nessus, and CVE databases.
CO5	Evaluate	Evaluate VAPT findings, map them to industry standards, and formulate effective remediation and reporting strategies.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	-	-	1	-	-	-	-	-	-	-	2	1	-	-
CO2	2	2	1	-	2	-	-	-	-	-	-	-	1	2	-	-
CO3	2	3	2	2	3	-	-	-	1	-	-	-	2	3	-	-
CO4	2	2	3	2	3	-	-	-	1	2	-	-	2	2	-	1
CO5	2	2	3	2	2	1	-	2	1	2	2	-	2	2	-	2
Wt. AVG	2.0	2.0	2.3	2.0	2.2	1.0	-	2.0	1.0	2.0	2.0	-	1.8	2.0	-	1.5

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	VAPT Fundamentals	7
2.	Web Application Vulnerability Assessment	9
3.	Infrastructure & System Pentesting	9
4.	Vulnerability Assessment	7
5.	VAPT Reporting & Remediation	7

**D. DETAILED SYLLABUS**

Unit	Unit Details
<b>1.</b>	<b>VAPT Fundamentals</b>
	<ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>VAPT Concepts and Lifecycle</li> <li>Difference: VA vs PT vs Red Teaming</li> <li>Testing Types: Black Box, White Box, Grey Box</li> <li>Phases of VAPT, Lab Setup For VAPT (Kali linux, Juice Shop and Web Security Academy)</li> <li>Conclusion of Unit</li> </ul>
<b>2.</b>	<b>Web Application Vulnerability Assessment</b>
	<ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>Complete Web Recon (Subdomains, DNS, SiteMap, Hidden Directories, Certs, Technologies, Testing Scopes, Information Disclosers)</li> <li>OWASP Top 10 and SANS 25 Vulnerabilities</li> <li>Advanced Injection Attacks: SQLi, Command Injection</li> <li>XSS, Authentication, Business Logic, SSRF, CSRF, IDOR, SSTI, RCE</li> <li>Tools: Amass, Sublist3r, Assetfinder, SQLmap, Dig, Nslookup, Dnsrecon, Gobuster, Dirsearch, FFUF</li> <li>Conclusion of Unit</li> </ul>

<b>3.</b>	<b>Infrastructure &amp; System Pentesting</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Open Ports and Services Enumeration</li> <li>• Manual Exploitation (SMB, RDP, SNMP, FTP, Web Server, any vulnerable service etc.)</li> <li>• Automated Exploitation (SMB, RDP, SNMP, FTP, Web Server, any vulnerable service etc.)</li> <li>• Linux &amp; Windows Privilege Escalation Techniques</li> <li>• Tools: Nmap, Masscan, Nikto, Enum4linux, Metasploit, LinPEAS, WinPEAS etc.</li> <li>• Conclusion of Unit</li> </ul>
<b>4.</b>	<b>Vulnerability Assessment</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Vulnerability Scanning Process, Understanding CVE, CWE, CVSS</li> <li>• Manual Validation vs False Positives, Sample Project: Scan, Validate &amp; Document</li> <li>• Tools: OpenVAS, Nessus, Nikto, Burp Suite, CVE Details, ExploitDB, CVSS Calculator, Vulnerability Database, CWE Database</li> <li>• Conclusion of Unit</li> </ul>
<b>5.</b>	<b>VAPT Reporting &amp; Remediation</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• VAPT Report Structure and Essentials</li> <li>• Mapping findings to OWASP, CWE, and MITRE ATT&amp;CK</li> <li>• Writing Effective Remediation Steps, Real-World VAPT Case Studies</li> <li>• Capstone Mini Project: End-to-End VAPT Exercise</li> <li>• Conclusion of Unit</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	The Basics of Hacking and Penetration Testing	Patrick Engebretson	2nd Edition, 2013	Syngress
2.	Penetration Testing: A Hands-On Introduction to Hacking	Georgia Weidman	1st Edition, 2014	No Starch Press
<b>Reference Book</b>				
1.	Advanced Penetration Testing: Hacking the World's Most Secure Network, <i>Wil Allsop, Wiley</i>			
2.	The Hacker Playbook 3: Practical Guide To Penetration Testing, Peter Kim, Independently published			
<b>Online Resources</b>				
1.	<a href="https://portswigger.net/web-security">https://portswigger.net/web-security</a>			
2.	<a href="https://tryhackme.com">https://tryhackme.com</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	Apply various aspects of securing network infrastructure and importance of classifying information.
CO2	Understand	Evaluate threats to information security, analyze their impact and propose suitable countermeasures.
CO3	Apply	Create asset management along with the objective to create awareness in Digital Rights Management
CO4	Analyze	Gain knowledge about basic concepts and importance of information security
CO5	Evaluate	Synthesize student to understand the concepts of IT security, Threats, Vulnerabilities, Impact and control measures.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	1	-	-	-	-	-	-	-	-	-	1	1	1	-
CO2	2	2	1	-	-	-	-	-	-	-	-	-	2	2	1	-
CO3	3	3	2	1	-	-	-	-	-	-	-	-	3	2	2	-
CO4	3	3	3	2	-	-	-	-	-	-	-	-	3	3	2	-
CO5	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3	-
Wt. AVG	2.4	2.4	2.0	2.0	-	-	-	-	-	-	-	-	2.4	2.2	1.8	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to Cyber Forensics	07
2.	Storage Devices & Data Recover Methods	08
3.	Forensics Techniques I	08
4.	Forensics Techniques II	07
5.	Cyber Law	07

**D. DETAILED SYLLABUS**

Unit	Unit Details
<b>1.</b>	<b>Introduction to Cyber Forensics</b>
	<ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>Definition, scope, objectives, and its role in cybercrime investigation and evidence preservation.</li> <li>Forms of Cyber Crime, Categories including ransomware, phishing, identity theft, cyberstalking, deepfake abuse, and IoT exploitation.</li> <li>First Responder Procedure -Non-Technical Staff, Technical Staff, Forensics Expert Roles and responsibilities during incident response including evidence preservation and documentation.</li> <li>Computer Investigation Procedure-Steps such as identification, acquisition, analysis, and reporting with adherence to chain of custody.</li> <li>Conclusion &amp; Real Life Application</li> </ul>
<b>2.</b>	<b>Storage Devices &amp; Data Recovery Methods</b>
	<ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>Storage Devices – Magnetic Medium, Non-Magnetic Medium, and Optical Medium Overview of HDDs, SSDs, flash memory, optical drives, and network-based storage.</li> <li>Working of Storage Devices – Platter, Head Assembly, Spindle Motor</li> </ul>

	<ul style="list-style-type: none"> <li>Internal architecture and function of physical storage components.</li> <li>Data Acquisition-Techniques such as static and live imaging, use of write blockers, and cloning with forensic tools.</li> <li>Conclusion &amp; Real Life Application</li> </ul>
<b>3.</b>	<b>Forensics Techniques I</b>
	<ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>Windows Forensic-Registry analysis, system logs, browser history, user activity, and timeline generation.</li> <li>Linux Forensics-Audit logs, bash history, file integrity checking, and user behavior profiling.</li> <li>Mobile Forensics-Logical and physical acquisition, app data recovery, GPS metadata, and encrypted messaging analysis using tools like Cellebrite.</li> <li>Steganography, Application-Detecting and extracting hidden content in digital media, analyzing stego files using specialized tools.</li> <li>Conclusion of the Unit</li> </ul>
<b>4.</b>	<b>Forensics Techniques II</b>
	<ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>Dictionary Attack, Password cracking using pre-defined wordlists and optimization strategies.</li> <li>Rainbow Attack-Use of rainbow tables to reverse hashed passwords and understanding their effectiveness and limitations. Email Tracking – Header Option of SMTP, POP3, IMAP Header analysis to trace the origin, route, and potential spoofing in email communications.</li> <li>Arsenal – Surveillance Tools, Analysis and detection of spyware, keyloggers, and monitoring software commonly used for unauthorized surveillance.</li> <li>Conclusion of the Unit</li> </ul>
<b>5.</b>	<b>Cyber Law</b>
	<ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>Corporate Espionage-Case studies and methods used in digital theft of intellectual property and trade secrets.</li> <li>Evidence Handling Procedure-Guidelines for secure evidence collection, labeling, hashing, and preservation to maintain integrity.</li> <li>Chain of Custody-Documenting evidence handling from seizure to court submission, ensuring no tampering or loss of credibility.</li> <li>Main Features of Indian IT Act 2008 (Amendment)-Key sections on cybercrime, digital signatures, intermediary liability, and provisions on cyber terrorism and privacy.</li> <li>Conclusion of the Unit</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Guide to Computer Forensics and Investigations	B. Nelson	First Edition	Cengage, 2010 BBS
2.	Hacking Exposed Computer Forensics	Aaron Philipp, David Cowen, Chris Davis	First Edition	McGraw Hill-2011
1.	Introduction to Computer Forensics and Digital Investigation, Rauf gauney			
2.	MariE-Helen Maras, "Computer Forensics: Cybercriminals, Laws, and Evidence", Jones & Bartlett Learning; 2nd Edition, 2014			
1.	<a href="https://www.techtarget.com/searchsecurity/definition/computer-forensics">https://www.techtarget.com/searchsecurity/definition/computer-forensics</a>			
2.	<a href="https://intellipaat.com/blog/what-is-cyber-forensics/">https://intellipaat.com/blog/what-is-cyber-forensics/</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	Recall and explain fundamental concepts of malware types, attack patterns, and malware lifecycle.
CO2	Understand	Interpret and differentiate between static and dynamic malware analysis techniques, and explain how malware behaves at various system levels.
CO3	Apply	Use tools and techniques to perform advanced static analysis, disassembly, and reverse engineering of malware samples.
CO4	Analyze	Examine malware behaviour using debugging and dynamic analysis tools; analyze system and network traces of malware activity.
CO5	Evaluate	Assess malware functionalities including persistence, covert launching, and countermeasure mechanisms; evaluate encoding and obfuscation methods.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	2	-	-	-	-	-	-	2	3	2	-	-
CO2	3	3	-	2	3	-	-	-	-	-	-	2	3	3	-	-
CO3	3	3	2	3	3	-	-	-	-	-	-	2	3	3	2	-
CO4	3	3	3	3	3	-	1	1	2	2	2	3	3	3	2	2
CO5	2	2	3	3	3	2	2	3	2	2	2	3	2	2	2	3
Wt. AVG	2.8	2.6	2.7	2.8	2.8	2.0	1.5	2.0	2.0	2.0	2.0	2.4	2.8	2.6	2.0	2.5

**B. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction & Data Collection Methods	07
2.	Windows Basics & Dynamic Malware Analysis	08
3.	Basic Static Analysis & Advanced Static Analysis Reverse Engineering	08
4.	Android Malware Analysis	07
5.	Wireless Security	07

**C. DETAIL SYLLABUS**

Unit	Unit Details
1.	<b>Basic Analysis</b>
	<ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>Fundamentals of Malware Analysis (MA), Introduction To Malware, Operating System Security Concepts, Malware Threats.</li> <li>Evolution of Malware, Malware Types - Viruses, Worms, Rootkits, Trojans, Bots, Spyware, Adwares.</li> <li>Logic Bombs, Malware Analysis, Static Malware Analysis, Dynamic Malware Analysis, Categories of Malware, Patterns Of Malware Attack, Classification Of Malware By Malicious Behaviours, Malware Attack Life Cycle.</li> <li>Conclusion of Unit</li> </ul>
2.	<b>Advanced Static Analysis</b>
	<ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>X86 Disassembly: Levels Of Abstraction, Reverse-Engineering, X86 Architecture: Main Memory, Instructions, Opcodes And Endianness, Operands, Registers, Simple Instructions,</li> <li>The Stack, Conditionals, Branching, Rep Instructions, C Main Method And Offsets, Analysing Malicious Windows Programs, Portable Executable File Format, Disassembling Malicious.</li> <li>Executable Programs. Malware Components, Malware Distribution Mechanisms, YARA.</li> <li>Conclusion of Unit</li> </ul>
3.	<b>Advanced Dynamic Analysis</b>

	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Debugging Malware, Ollydbg, Kernel Debugging With Windbg, Setting Virtual Environments- Sandboxes, Emulators, Hypervisors, Virtual Machines, Live Malware Analysis, Dead Malware Analysis.</li> <li>• Analysing Traces Of Malware- System calls, API Calls, Registries, Network Activities. Debugging Tricks For Unpacking Malware.</li> <li>• Conclusion of Unit</li> </ul>
<b>4.</b>	<b>Malware Functionality</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Malware Behaviour: Downloaders, Backdoors, Credential Stealers, Persistence Mechanisms, Privilege Escalation, Covert malware launching: Launchers, Process Injection, Process Replacement, Hook Injection, Detours, APC Injection.</li> <li>• Data encoding: Simple Ciphers, Common Cryptographic Algorithms, Custom Encoding, Decoding, Malware-Focused Network Signatures: Network Countermeasures, Safely Investigate an Attacker Online, Content-Based Network</li> <li>• Conclusion of Unit</li> </ul>
<b>5.</b>	<b>Wireless Security</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• WLAN topologies, 802.11 standards, Wireless Access Points, Wireless Bridges, Wireless Antennas.</li> <li>• WLAN Discovery Tools, Penetration Testing Tools, Password Capture &amp; Decryption Tools.</li> <li>• Bluetooth Security , Ad hoc and sensor network security</li> <li>• Student presentations in other related areas that instructor did not cover (security and privacy in RFID systems, vehicular networks, wireless mesh networks, satellite networks, etc.)</li> <li>• Conclusion of Unit</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Malware Forensics Field Guide for Linux Systems	Cameron H. Malin	2014	Elsevier
2.	<b>802.11 Wireless Networks</b>	Matthew Fast		O'relly
<b>Reference Books</b>				
1.	Cameron H. Malin, Eoghan Casey, James M. Aquilina and Curtis W. Rose, Malware Forensics Field Guide for Windows Systems, Syngress, Elsevier, 2012			
2.	Christopher C. Elisan , Advanced Malware Analysis, Tata McGraw Hill, 2015 3.Cameron H. Malin, Eoghan Casey, James M. Aquilina and Curtis W. Rose, Malware			
<b>Online Resources</b>				
1.	<a href="https://www.cybrary.it/resources/study-guides/comptia-security-plus/">https://www.cybrary.it/resources/study-guides/comptia-security-plus/</a>			
2.	<a href="https://www.tutorialspoint.com/wireless_security/index.htm">https://www.tutorialspoint.com/wireless_security/index.htm</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Understand	Explain the fundamentals of DevSecOps, its tools, and its integration in the CI/CD pipeline.
CO2	Apply	Implement automated security practices using tools and scripting in software development life cycle.
CO3	Analyze	Examine and evaluate vulnerabilities in automated systems and develop mitigation strategies.
CO4	Create	Design and integrate secure automation pipelines for software delivery.
CO5	Evaluate	Assess the performance and security compliance of DevSecOps practices in real-world scenarios.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2			2								2			
CO2	2	3	3		2				2				3	2		
CO3	3	3	2	3						2			2	3		
CO4	2	2	3		3					2		2	3		2	
CO5	2		3	3							2		2	2	3	
Wt. AVG	2.4	2.5	2.8	3.0	2.3	-	-	-	2.0	2.0	2.0	2.0	2.4	2.3	2.5	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to DevSecOps and Security Automation	8
2.	DevSecOps Tools, Pipelines & Practices	10
3.	Secure CI/CD Implementation	8
4.	Threat Modeling, Vulnerability Management	9
5.	Case Studies, Compliance & Security Auditing	10

**D. DETAILED SYLLABUS**

Unit	Unit Details
<b>1.</b>	<b>Introduction to DevSecOps and Security Automation</b>
	<ul style="list-style-type: none"> <li>Evolution from DevOps to DevSecOps</li> <li>Core principles and practices</li> <li>Key components of security automation</li> <li>Importance of shift-left security</li> </ul>
<b>2.</b>	<b>DevSecOps Tools, Pipelines &amp; Practices</b>
	<ul style="list-style-type: none"> <li>Introduction to Jenkins, GitLab CI/CD, GitHub Actions</li> <li>Security tools: SonarQube, OWASP ZAP, Snyk, Checkmarx</li> <li>Infrastructure as Code (IaC) and automation scripts</li> </ul>
<b>3.</b>	<b>Secure CI/CD Implementation</b>
	<ul style="list-style-type: none"> <li>CI/CD pipeline security layers</li> <li>Secrets management and container security (Docker, Kubernetes)</li> <li>Artifact and dependency scanning</li> </ul>

	<ul style="list-style-type: none"> <li>Automating code reviews and policy enforcement</li> </ul>
<b>4.</b>	<b>Threat Modeling, Vulnerability Management</b>
	<ul style="list-style-type: none"> <li>STRIDE and DREAD models</li> <li>Static and Dynamic Application Security Testing (SAST/DAST)</li> <li>CVEs, vulnerability scanners (Nessus, OpenVAS)</li> <li>Integration of scanning in pipelines</li> </ul>
<b>5.</b>	<b>Case Studies, Compliance &amp; Security Auditing</b>
	<ul style="list-style-type: none"> <li>Real-world DevSecOps implementation case studies</li> <li>Security monitoring and logging (SIEM, ELK Stack)</li> <li>Compliance (ISO 27001, NIST, GDPR, HIPAA)</li> <li>Auditing tools and best practices</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	DevSecOps: A Leader's Guide to Producing Secure Software Without Compromise	Jim Bird	1st	O'Reilly
2.	Hands-On Security in DevOps	Tony Hsiang-Chih Hsu	1st	Packt Publishing
3.	Practical Security Automation and Testing	Tony Hsiang-Chih Hsu	1st	Packt Publishing
<b>Reference Book</b>				
1.	The DevOps Handbook, Gene Kim, Jez Humble, Patrick Debois, John Willis			
2.	Building Secure and Reliable Systems, Google Cloud SRE Team			
<b>Online Resources</b>				
1.	<a href="#">OWASP DevSecOps Guide</a>			
2.	<a href="#">DevSecOps.org – Community best practices and toolkits</a>			



*Your Dreams Our Goal*  
**POORNIMA**  
**UNIVERSITY**

Member of Association of Indian Universities & Approved by UGC (Govt. of India) under 2(f) & 12(B)

**Minor Courses**

**Professional Elective: Theory**

**(Artificial Intelligence & Machine  
Learning (SAS))**

**Batch: 2025-29**

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	Recall the SAS programming process.
CO2	Understand	Implement SAS programming tools effectively.
CO3	Apply	Implement and interpret SAS syntax correctly.
CO4	Apply	Access and import data into SAS.
CO5	Analyze	Explore, filter, format, and sort SAS data.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	-	-	1	2	-	-	-	-	-	3	-	-	-
CO2	3	2	-	3	3	-	-	-	-	-	-	-	3	2	-	-
CO3	3	2	2	3	3	-	-	-	-	-	-	-	3	2	-	-
CO4	3	3	2	3	3	1	-	-	-	-	-	-	3	3	-	-
CO5	3	3	2	3	3	1	2	-	-	-	-	-	3	3	-	-
Wt. AVG	3.0	2.5	2.0	3.0	3.0	1.0	2.0	-	-	-	-	-	3.0	2.5	-	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Essentials	06
2.	Accessing Data	06
3.	Exploring and Validating Data	08
4.	Preparing Data	08
5.	Analyzing and Reporting on Data	08

**D. DETAILED SYLLABUS**

Unit	Unit Details
<b>1.</b>	<b>Essentials</b>
	<ul style="list-style-type: none"> <li>The SAS programming process.</li> <li>Using SAS programming tools.</li> <li>Understanding SAS syntax.</li> </ul>
<b>2.</b>	<b>Accessing Data</b>
	<ul style="list-style-type: none"> <li>Understanding SAS data.</li> <li>Accessing data through libraries.</li> <li>Importing data into SAS.</li> </ul>
<b>3.</b>	<b>Exploring and Validating Data</b>
	<ul style="list-style-type: none"> <li>Exploring data.</li> <li>Filtering rows.</li> <li>Formatting columns.</li> <li>Sorting data and removing duplicates.</li> </ul>
<b>4.</b>	<b>Preparing Data</b>
	<ul style="list-style-type: none"> <li>Reading and filtering data.</li> <li>Computing new columns.</li> <li>Conditional processing.</li> </ul>
<b>5.</b>	<b>Analyzing and Reporting on Data</b>
	<ul style="list-style-type: none"> <li>Enhancing reports with titles, footnotes, and labels.</li> </ul>

	<ul style="list-style-type: none"> <li>• Creating frequency reports.</li> <li>• Creating summary statistics reports.</li> </ul> <p><b>Exporting Results</b></p> <ul style="list-style-type: none"> <li>• Exporting data.</li> <li>• Exporting reports.</li> </ul> <p><b>Using SQL in SAS</b></p> <ul style="list-style-type: none"> <li>• Using Structured Query Language in SAS.</li> <li>• Joining tables using SQL in SAS.</li> </ul>
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#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	<i>The Little SAS Book: A Primer</i>	Lora D. Delwiche, Susan J. Slaughter	6th	SAS Institute
2.	<i>Learning SAS by Example: A Programmer's Guide</i>	Ron Cody	2nd	SAS Institute
3.	<i>SAS Essentials: Mastering SAS for Data Analytics</i>	Alan C. Elliott, Wayne A. Woodward	2nd	Wiley
<b>Reference Book</b>				
1.	<i>SAS Certification Prep Guide: Base Programming for SAS 9</i>			
2.	<i>Applied Statistics and the SAS Programming Language</i>			
<b>Online Resources</b>				
1.	SAS Certification Prep Guide: Base Programming for SAS 9			
2.	Applied Statistics and the SAS Programming Language			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	Recall key components, servers, and terminologies used in the SAS Viya platform.
CO2	Understand	Describe the architecture and functioning of SAS Viya, including CAS and Compute servers.
CO3	Apply	Use SAS Viya tools to load, process, and manage data using CAS, SQL, and DATA steps.
CO4	Apply	Distinguish between SAS 9 and Viya environments in terms of code execution and performance.
CO5	Analyze	Assess the efficiency and scalability of SAS Viya for cloud-based analytical processing.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	1	1	-	-	-	-	-	-	-	-	-	2	-	-
CO2	2	2	1	3	-	-	-	-	-	-	-	-	2	—	-	-
CO3	2	3	2	2	-	-	-	-	-	-	-	-	1	—	-	-
CO4	2	2	2	1	-	-	-	-	-	-	-	-	2	—	-	-
CO5	1	3	1	1	-	-	-	-	-	-	-	-	2	—	-	-
AVG	2	3	1	1	-	-	-	-	-	-	-	-	-	2	-	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	SAS Viya Platform Overview	07
2.	Managing Data in SAS Cloud Analytic Services	08
3.	Running SAS Procedures in SAS Cloud Analytic Services (CAS)	07
4.	Modifying SQL Code to Run in SAS Cloud Analytic Services (CAS)	08
5.	Using the Native CAS Language (CASL)	07

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>SAS Viya Platform Overview</b> <ul style="list-style-type: none"> <li>Introducing the SAS Viya platform.</li> <li>SAS Viya programming interfaces.</li> <li>SAS Viya servers and processing environments</li> <li>Overview of running SAS code on the SAS Compute Server.</li> <li>SAS Viya Compute Server overview.</li> <li>Running SAS 9 Code on the Compute Server in SAS Viya.</li> <li>CAS fundamentals.</li> <li>Understanding caslibs.</li> <li>Conclusion of Unit</li> </ul>
2.	<b>Managing Data in SAS Cloud Analytic Services</b> <ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>Loading data to in-memory tables.</li> <li>Accessing DBMS data.</li> <li>Saving and dropping in-memory tables</li> <li>Modifying DATA step code to run in SAS Cloud Analytic Services (CAS)</li> <li>.Conclusion of Unit</li> </ul>

<b>3.</b>	<b>Running SAS Procedures in SAS Cloud Analytic Services (CAS)</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Introduction to SAS procedures in SAS Viya.</li> <li>• Running CAS-enabled SAS procedures.</li> <li>• Conclusion of Unit</li> </ul>
<b>4.</b>	<b>Modifying SQL Code to Run in SAS Cloud Analytic Services (CAS)</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Modifying SQL code to run in CAS.</li> <li>• Column data types in CAS.</li> <li>• Conclusion of Unit</li> </ul>
<b>5.</b>	<b>Using the Native CAS Language (CASL)</b>
	<ul style="list-style-type: none"> <li>• Introduction to CASL.</li> <li>• Using CAS actions.</li> <li>• Conclusion of Unit</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1	The Little SAS Enterprise Guide Book	Susan Slaughter & Lora Delwiche	Latest	SAS
2	SAS Certification Prep Guide		3rd	SAS Institute
<b>Reference Book</b>				
1.	Learn SAS By example A Programmer Guide By Ron Cody			
<b>Online Resources</b>				
1.	<a href="https://www.sas.com/de_de/training/courses/learning-formats/e-learning.html">https://www.sas.com/de_de/training/courses/learning-formats/e-learning.html</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	To recall foundational statistical concepts and techniques for exploratory data analysis.
CO2	Understand	To interpret common probability distributions and inferential statistics used in ML.
CO3	Apply	To apply hypothesis testing, regression, and correlation analysis to real-world ML data.
CO4	Apply	To analyze relationships and patterns in datasets using statistical methods.
CO5	Analyze	To evaluate machine learning models using statistical metrics and reasoning.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	-	-	-	-	-	-	-	-	-	2	2	1	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-	3	2	2	-
CO3	3	3	3	2	-	-	-	-	-	-	-	-	3	3	2	-
CO4	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3	-
CO5	3	3	3	3	1	-	-	-	-	-	-	-	3	3	3	-
AVG. WT.	3.0	2.8	2.4	2.67	0.2	-	-	-	-	-	-	-	2.8	2.6	2.2	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Descriptive Statistics & EDA	6
2.	Probability Theory & Distributions	6
3.	Hypothesis Testing & Statistical Inference	8
4.	Regression & Correlation Analysis	8
5.	Statistical Evaluation in Machine Learning	8

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Descriptive Statistics &amp; EDA</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Measures of central tendency (Mean, Median and Mode)</li> <li>• Dispersion (Range, Variance, Standard Deviation, IQR)</li> <li>• Skewness, kurtosis</li> <li>• EDA using histogram (frequency distribution) and boxplot (median, quartiles and outliers)</li> <li>• Real-life use cases: anomaly detection, data preparation for ML</li> <li>• Conclusion of the Unit</li> </ul>
2.	<b>Probability Theory &amp; Distributions</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Basic probability rules, conditional probability, independence</li> <li>• Bayes' Theorem with ML examples (Naive Bayes)</li> <li>• Discrete (Binomial, Poisson) and continuous (Normal, Uniform) distributions</li> <li>• Real-life use cases: fraud detection, recommendation system</li> <li>• Conclusion of the Unit</li> </ul>

<b>3.</b>	<b>Hypothesis Testing &amp; Statistical Inference</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Sampling methods and sampling distributions</li> <li>• Formulating null and alternative hypotheses</li> <li>• t-test, chi-square test, ANOVA, and confidence intervals</li> <li>• A/B testing for comparing ML model variants</li> <li>• Conclusion of the Unit</li> </ul>
<b>4.</b>	<b>Regression &amp; Correlation Analysis</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Linear and multiple regression modeling</li> <li>• R-squared, adjusted R-squared, residual analysis</li> <li>• Pearson and Spearman correlation and multicollinearity</li> <li>• Real-life use cases: demand forecasting, price prediction</li> <li>• Conclusion of the Unit</li> </ul>
<b>5.</b>	<b>Statistical Evaluation in Machine Learning</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Bias-variance trade-off, underfitting vs overfitting</li> <li>• Model evaluation metrics: accuracy, precision, recall, F1, AUC-ROC</li> <li>• Statistical tests for comparing classifiers: <b>Paired t-test</b>, <b>McNemar's test</b>, and <b>Wilcoxon test</b></li> <li>• Feature selection techniques: chi-square, mutual information</li> <li>• Real-life use cases: ML pipelines in industry, model comparison and hyperparameter tuning</li> <li>• Conclusion of the Unit</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Practical Statistics for Data Scientists	Peter Bruce, Andrew Bruce, Peter Gedeck	2nd Edition	O'Reilly Media
2.	Statistics for Machine Learning	Pratap Dangeti	1st Edition	Packt Publishing
3.	Statistics for Engineers and Scientists	William Navidi	5th Edition	McGraw-Hill Education
<b>Reference Book</b>				
1.	Think Stats: Exploratory Data Analysis in Python, Allen B. Downey, 2nd Edition, O'Reilly Media			
2.	Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, Aurélien Géron, 2nd Edition, O'Reilly Media			
<b>Online Resources</b>				
1.	<a href="https://www.kaggle.com/learn/statistics">https://www.kaggle.com/learn/statistics</a>			
2.	<a href="https://www.coursera.org/specializations/statistics-with-python">https://www.coursera.org/specializations/statistics-with-python</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	Use the point-and-click interface of Model Studio and SAS Visual Text Analytics.
CO2	Understand	Explore collections of text documents to discover key topics. Interpret term maps.
CO3	Apply	Identify key textual topics automatically in your large document collections.
CO4	Apply	Create robust models for categorizing the content according to your organization's specific needs.
CO5	Analyze	Create, modify, and enable (or disable) custom concepts and test linguistic rule definitions with validation checks within the same interactive GUI.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	1	1	–	–	–	–	–	–	–	–	2	–	–	–
CO2	3	2	1	2	–	–	–	–	–	–	–	–	2	–	–	–
CO3	2	3	2	1	–	–	–	–	–	–	–	–	1	–	–	–
CO4	2	2	2	1	–	–	–	–	–	–	–	–	2	–	–	–
CO5	2	3	1	1	–	–	–	–	–	–	–	–	2	–	–	–
WT. AVG	2.2	2.6	1.4	1.2									1.8			

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to SAS Visual Text Analytics	7
2.	SAS Visual Text Analytics Demonstrations	8
3.	SAS Visual Text Analytics Nodes	8
4.	Concept and Category Rule Definitions	8
5.	Case Studies	8

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	Introduction to SAS Visual Text Analytics <ul style="list-style-type: none"> <li>SAS Visual Text Analytics.</li> <li>Language challenges (self-study).</li> </ul>
2.	SAS Visual Text Analytics Demonstrations <ul style="list-style-type: none"> <li>Converting documents for analysis using SAS Data Explorer.</li> <li>Creating a project with no predefined concepts.</li> <li>Creating a project with custom concepts.</li> </ul>
3.	SAS Visual Text Analytics Nodes <ul style="list-style-type: none"> <li>Projects.</li> <li>Concepts and terms.</li> <li>Machine-generated topics.</li> <li>Categories., Document scoring.</li> </ul>
4.	Concept and Category Rule Definitions <ul style="list-style-type: none"> <li>SAS Visual Text Analytics rules.</li> <li>SAS Visual Text Analytics concept rules.</li> </ul>

	<ul style="list-style-type: none"> <li>• SAS Visual Text Analytics demo category rules.</li> </ul>
<b>5.</b>	<b>Case Studies</b>
	<ul style="list-style-type: none"> <li>• Retrieving information about anxiety and depression from drug reports.</li> <li>• Automatic categorization of ASRS incident reports.</li> <li>• Retrieving mortgage complaints from the CFPB customer complaints data.</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Cloud Computing: Principles and Paradigms	Rajkumar Buyya, James Broberg, Andrzej M. Goscinski		John Wiley and Sons Publications
2.	Cloud Computing For Dummies	Fern Halper, Robin Bloor		
<b>Reference Book</b>				
1.	Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online - Michael Miller - Que 2008			
2.	Cloud Computing: Web-Based Applications That Change the Way You Work by Micheal Miller			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	To understand Data analytics, its types and its applications.
CO2	Understand	To get knowledge about R studio installation and R programming fundamental concepts like variable, data types, commands.
CO3	Apply	To apply the basics in R programming in terms of functions, loops, decision making and data structure.
CO4	Apply	To design various experiments based on graphs and charts for data visualization in R programming.
CO5	Analyze	To apply of statistical computations for data analytics.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	2	2	-	-	2	1	-	-	3	-	2	2	3
CO2	3	3	2	-	-	2	-	1	2	-	-	3	-	-	1	3
CO3	3	3	3	2	-	-	1	-	2	-	-	3	-	-	-	-
CO4	2	2	3	2	2	-	-	3	1	2	-	3	-	2	-	-
CO5	2	3	3	3	-	1	-	2	2	2	2	3	-	3	3	2
Wt. AVG	2.6	2.6	2.8	2.3	2.0	1.5	1.0	2.0	1.6	2.0	2.0	3.0	-	2.3	2.0	2.7

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to Data Analysis	08
2.	Fundamentals of R Programming	09
3.	Programming Constructs in R	09
4.	Data Visualization and External Data Handling in R	07
5.	Statistical Analysis using R	09

**D. DETAILED SYLLABUS**

Unit	Unit Details
<b>1.</b>	<b>Introduction to Data Analysis</b>
	<ul style="list-style-type: none"> <li>Fundamentals of Data Analytics</li> <li>Importance and Applications of Data Analytics</li> <li>Nature and Classification of Data: <ul style="list-style-type: none"> <li>Structured, Semi-Structured, Unstructured</li> </ul> </li> <li>Characteristics of Data (Volume, Variety, Velocity, Veracity, Value)</li> <li>Real-world Use Cases and Domains: Healthcare, Finance, Marketing, etc.</li> </ul>
<b>2.</b>	<b>Fundamentals of R Programming</b>
	<ul style="list-style-type: none"> <li>Introduction to R and RStudio</li> <li>Features and Applications of R</li> <li>Installing R and RStudio</li> <li>Creating, Editing, and Running R Scripts, Clearing Console and Environment</li> <li>Basic Syntax, R Commands, Variables and Data Types</li> </ul>

	<ul style="list-style-type: none"> <li>Operators and Keywords, Scope of Variables</li> </ul>
<b>3.</b>	<b>Programming Constructs in R</b>
	<ul style="list-style-type: none"> <li>Taking Input from the User</li> <li>Displaying Output using print() and cat()</li> <li>Conditional Statements: if, if-else, nested if, switch</li> <li>Looping Statements: for, while, repeat, Control Statements: break, next, return</li> <li>Functions and User-defined Functions</li> <li>Data Structures in R: Vectors, Lists, Matrices, Arrays, Data Frames</li> </ul>
<b>4.</b>	<b>Data Visualization and External Data Handling in R</b>
	<ul style="list-style-type: none"> <li>Importing Data into R from External Sources: <ul style="list-style-type: none"> <li>CSV, Excel, JSON, XML, Web APIs, Databases</li> </ul> </li> <li>Data Cleaning Basics</li> <li>Basic Data Visualization Techniques: <ul style="list-style-type: none"> <li>Bar Charts, Line Graphs, Scatter Plots</li> <li>Histograms, Pie Charts, Boxplots</li> </ul> </li> <li>Introduction to ggplot2 (optional/bonus)</li> </ul>
<b>5.</b>	<b>Statistical Analysis using R</b>
	<ul style="list-style-type: none"> <li>Descriptive Statistics: <ul style="list-style-type: none"> <li>Mean, Median, Mode, Variance, Standard Deviation</li> </ul> </li> <li>Probability Distributions: <ul style="list-style-type: none"> <li>Normal Distribution</li> <li>Binomial Distribution</li> </ul> </li> <li>Inferential Statistics: <ul style="list-style-type: none"> <li>Hypothesis Testing</li> <li>One-Way and Two-Way ANOVA</li> </ul> </li> <li>Regression Techniques: <ul style="list-style-type: none"> <li>Linear Regression</li> <li>Multiple Linear Regression</li> <li>Logistic Regression</li> </ul> </li> <li>Introduction to: <ul style="list-style-type: none"> <li>Time Series Analysis</li> </ul> </li> <li>Survival Analysis (basic overview)</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Big Data Fundamentals	Thomas Erl, Wajid Khattak, and Paul Buhler	1st or 2nd Edition	Pearson, Latest Edition.
2.	An Introduction to Statistical Learning with Applications in R	Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani	-	Springer
<b>Reference Book</b>				
1.	"Introductory Statistics with R", P Dalgaard, Second edition.			
2.	"Beginning R-The statistical Programming language", Mark Gardner, John wiley & sons 2012, Latest Edition.			
3.	"An Introduction to R", Notes on R: A Programming Environment for Data Analysis and Graphics. W. N. Venables, D.M. Smith and the R Development Core Team. Version 3.0.1 (2013-05-16). URL: <a href="https://cran.rproject.org/doc/manuals/r-release/R-intro.pdf">https://cran.rproject.org/doc/manuals/r-release/R-intro.pdf</a>			
<b>Online Resources</b>				
1.	<a href="https://www.kaggle.com/">https://www.kaggle.com/</a>			
2.	<a href="https://www.datacamp.com/">https://www.datacamp.com/</a>			
3.	Data Mining with R" by Great Learning or Simplilearn on Youtube			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	Define and understand deep learning.
CO2	Understand	Build models using deep learning techniques.
CO3	Apply	Apply models to score (inference) new data.
CO4	Apply	Modify data for better analysis results.
CO5	Analyze	Search the hyperparameter space of a deep learning model.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	1	1	-	-	-	-	-	-	-	-	2	-	-	-
CO2	3	2	1	2	-	-	-	-	-	-	-	-	2	-	-	-
CO3	2	3	2	1	-	-	-	-	-	-	-	-	1	-	-	-
CO4	2	2	2	1	-	-	-	-	-	-	-	-	2	-	-	-
CO5	2	3	1	1	-	-	-	-	-	-	-	-	2	-	-	-
WT. AVG	2.2	2.6	1.4	1.2									1.8			

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to Deep Learning	8
2.	Convolutional Neural Networks	8
3.	Recurrent Neural Networks	8
4.	Tuning a Neural Network	9
5.	Additional Topics	7

**D. DETAILED SYLLABUS**

Unit	Unit Details
<b>1.</b>	<b>Introduction to Deep Learning</b>
	<ul style="list-style-type: none"> <li>Introduction to neural networks.</li> <li>Introduction to deep learning., ADAM optimization., Dropout.</li> <li>Batch normalization., Autoencoders</li> <li>Building level-specific autoencoders (self-study)</li> </ul>
<b>2.</b>	<b>Convolutional Neural Networks</b>
	<ul style="list-style-type: none"> <li>Applications, Input layers., Convolutional layers.</li> <li>Padding, Pooling layers., Traditional layers</li> <li>Types of skip-layer connections, Image pre-processing and data enrichment.</li> <li>Training convolutional neural networks</li> </ul>
<b>3.</b>	<b>Recurrent Neural Networks</b>
	<ul style="list-style-type: none"> <li>Introduction</li> <li>Recurrent neural networks overview, Sub-types of recurrent neural networks.</li> <li>Time series analysis using recurrent neural networks.</li> <li>Sentiment analysis using recurrent neural networks</li> </ul>

<b>4.</b>	<b>Tuning a Neural Network</b>
	<ul style="list-style-type: none"> <li>• Selecting hyperparameters.</li> <li>• Hyperband.</li> </ul>
<b>5.</b>	<b>Additional Topics</b>
	<ul style="list-style-type: none"> <li>• Types of transfer learning.</li> <li>• Transfer learning basics, Transfer learning strategies.</li> <li>• Transfer learning with unsupervised pretraining.</li> <li>• Customizations with FCMP.</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Professional Nosql	Shashank Tiwari		Wrox
2.	MongoDB in Action	KYLE BANKER PETER	Second Edition	Manning
<b>Reference Book</b>				
1.	NoSQL for Dummies, Adam Fowler, John Wiley & Sons, Inc			
2.	NoSQL Distilled, Pramod J. Sadalage & Martin Fowler, Pearson Education, Inc.			
3.	Making Sense of NoSQL, Dan McCreary& Ann Kelly, Manning Shelter Island			
<b>Online Resources</b>				
1.	<a href="https://www.javatpoint.com/nosql-databases">https://www.javatpoint.com/nosql-databases</a>			
2.	<a href="https://www.tutorialspoint.com/mongodb/index.htm">https://www.tutorialspoint.com/mongodb/index.htm</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	Recall the fundamental concepts and terminologies associated with reinforcement learning and Markov decision processes, including elements of reinforcement learning, Markov decision processes, and policies.
CO2	Understand	Understand the principles and frameworks of reinforcement learning, including the history of reinforcement learning, Markov decision processes,
CO3	Apply	value functions, and solution techniques such as dynamic programming and model-free methods.
CO4	Apply	Apply efficient solution frameworks in reinforcement learning, including batch reinforcement learning algorithms, kernel-based approximate dynamic programming, and neural fitted Q iteration.
CO5	Analyze	Analyze constructive and representational directions in reinforcement learning, such as function approximation, hierarchical approaches, and evolutionary computation for reinforcement learning.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	-	1	-	-	-	-	-	-	-	-	-	3	-	1	-
CO2	-	2	1	-	-	-	-	-	-	-	-	-	-	1	-	-
CO3	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	-
Wt. AVG	3.0	1.3	1.3	1.5	-	-	-	-	-	-	-	-	3.0	1.0	1.0	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Reinforcement Learning and Markov Decision Process	6
2.	Efficient Solution Framework	8
3.	Constructive- Representational Directions	8
4.	Probabilistic Model for Self and Other	7
5.	Domain and Background	7

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Reinforcement Learning and Markov Decision Process</b>
	<ul style="list-style-type: none"> <li>Introduction- Reinforcement Learning</li> <li>Examples OF Reinforcement Learning-Elements of Reinforcement Learning- Example: Tic-Tac-Toe - History of Reinforcement Learning -Learning Sequential</li> <li>decision Making-A Formal Frame Work on Markov Decision Process and Policies- Value Function and Bellman Equations-Solving Markov Decision Process Dynamic Programing Model Based Solution Technique-Reinforcement Learning Model Free Solution Technique</li> </ul>
2.	<b>Efficient Solution Framework</b>

	<ul style="list-style-type: none"> <li>• Introduction- The Batch Reinforcement Learning Problem- Foundations of Batch Reinforcement Learning Algorithms</li> <li>• ch Reinforcement Learning Algorithms: Kernel-Based Approximate Dynamic Programming- Fitted Q Iteration- Least-Squares Policy Iteration- Identifying Batch Algorithms.</li> <li>• storyof Batch Reinforcement Learning- Neural Fitted Q Iteration (NFQ)- Batch Reinforcement Learning for Learning in Multi-agent Systems</li> <li>• p Fitted Q Iteration. Least-Squares Methods for Approximate Policy Evaluation- Least- Squares Policy Iteration- Performance Guarantees.</li> </ul>
<b>3.</b>	<b>Constructive- Representational Directions</b>
	<ul style="list-style-type: none"> <li>• Reinforcement learning in continuous state and action space: Function Approximation- Approximate Reinforcement Learning.</li> <li>• ving Relational and first-order logical Markov decision: Introduction to sequential decision in relational Reinforcement Learning- model based solution techniques- model free solution-</li> <li>• rarchical Approaches- Approaches to hierarchical reinforcement learning – Evolutionary computation for Reinforcement Learning: Neuro-evolution - Hybrids- Coevolution.</li> </ul>
<b>4.</b>	<b>Probabilistic Model For Self and Other</b>
	<ul style="list-style-type: none"> <li>• Design Reinforcement Learning: Model free Bayesian Reinforcement Learning - Model based Bayesian Reinforcement Learning- Partially observable Markov decision process: Decision making in partially observable environments- model based techniques-</li> <li>• Dictively defined representation of state: PSRs- Learning a PSR model- Game theory and multi agent Reinforcement Learning – Reinforcement Learning in Repeated games- Sequential games.</li> </ul>
<b>5.</b>	<b>Domain and Background</b>
	<ul style="list-style-type: none"> <li>• enforcement Learning in games- challenges of applying Reinforcement Learning to games</li> <li>• enforcement Learning in Robotics: challenges in robot REINFORCEMENT LEARNING</li> <li>• nations of Robotic Reinforcement Learning- tractability through simulation, Representation and prior knowledge.</li> </ul>

## E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Neural Networks	Ruchi sehwat		Neural Networks
2.	Deep Learning	Ian Goodfellow and Yoshua		Deep Learning
3.	Chris Bishop's Pattern recognitionand machine learning	Christopher M. Bishop		Chris Bishop's Pattern recognition and machine learning
<b>Reference Book</b>				
1.	Deep Learning Methods and Applications by Deng & Yu's monograph			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	Remember the basic concepts and terminology of mathematical optimization, including linear programming, nonlinear programming, and integer/mixed-integer linear programming.
CO2	Understand	Understand optimization problems and their applications in various real-world problems.
CO3	Apply	Apply the SIMPLEX procedure to formulate and solve linear programming problems using index sets and arrays.
CO4	Apply	Analyze various methods used to solve nonlinear and mixed-integer programming problems and their effectiveness.
CO5	Analyze	Evaluate the different optimization methods and recommend the best technique based on the simplicity, applicability, and cost in the selected method.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3												3			
CO2	3	3												2		
CO3	2		3											3		
CO4			3										2			
CO5	3	1											2		2	
Wt. AVG	2.8	2.0	3.0	-	-	-	-	-	-	-	-	-	2.3	2.5	2.0	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to Mathematical Optimization	7
2.	Linear Programming	8
3.	Nonlinear Programming	8
4.	Integer and Mixed-Integer Linear Programming	7
5.	Open-Source Interactivity	8

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Introduction to Mathematical Optimization</b>
	<ul style="list-style-type: none"> <li>Introduction.</li> <li>A simple example.</li> <li>The OPTMODEL procedure.</li> </ul>
2.	<b>Linear Programming</b>
	<ul style="list-style-type: none"> <li>Introduction to linear programming.</li> <li>Formulating and solving linear programming problems using the OPTMODEL procedure. Using index sets and arrays in the OPTMODEL procedure.</li> <li>Dual values and reduced costs in the simplex method (self-study).</li> <li>Applied data envelopment analysis (self-study)</li> <li>Reading SAS data sets (self-study).</li> </ul>
3.	<b>Nonlinear Programming</b>
	<ul style="list-style-type: none"> <li>Introduction to nonlinear programming.</li> </ul>

	<ul style="list-style-type: none"> <li>Solving nonlinear programming problems using the OPTMODEL procedure.</li> </ul>
<b>4.</b>	<b>Integer and Mixed-Integer Linear Programming</b>
	<ul style="list-style-type: none"> <li>Introduction to integer and mixed-integer linear programming.</li> <li>Solving integer and mixed-integer linear programming problems using PROC OPTMODEL</li> </ul>
<b>5.</b>	<b>Open-Source Interactivity</b>
	<ul style="list-style-type: none"> <li>SAS Viya and open-source integration.</li> <li>SAS Viya Python APIs</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	The Complete Reference Linux		Seventh Edition	Mc graw hill
2.	Linux Bible	Christopher Negus	Kindle Edition	Wiley
<b>Reference Book</b>				
1.	Windows 10 Portable, Wiley, Paul Mac Fedrics.			
2.	Desktop OS for Expert, Sayan Banerjee and Swati Goel			
<b>Online Resources</b>				
1.	<a href="https://www.bu.edu/tech/files/2018/05/2018-Summer-Tutorial-Intro-to-Linux.pdf">https://www.bu.edu/tech/files/2018/05/2018-Summer-Tutorial-Intro-to-Linux.pdf</a>			
2.	<a href="https://www.youtube.com/watch?v=67keaaWOKzE">https://www.youtube.com/watch?v=67keaaWOKzE</a>			
3.	<a href="https://www.coursera.org/os">https://www.coursera.org/os</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	Describe the mechanisms of human speech production systems and methods for speech feature extraction.
CO2	Understand	Understand basic algorithms of speech analysis and speech recognition.
CO3	Apply	Explain basic techniques in digital video processing, including imaging characteristics and sensors.
CO4	Apply	
CO5	Analyze	Apply motion estimation and object tracking algorithms on video sequence.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	-	-	-	3	1	-	-	-	-	-	-	-	2	-	-	-
CO2	1	2	3	1	2	-	-	-	-	-	-	-	-	2	-	-
CO3	2	1	1	2	3	-	-	-	-	-	--	-	-	-	3	-
CO4	1	1	2	2	3	-	-	-	-	-	-	-	-	1	-	-
CO5	-	-	3	1	2	-	-	-	-	-	-	-	-	-	1	-
Wt. AVG	1.3	2.0	-	2.0	2.0	-	-	-	-	-	-	-	-	1.5	2.0	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Speech processing concepts	6
2.	Speech recognition	8
3.	Basics of Video Processing	8
4.	Motion estimation Techniques	6
5.	object tracking and segmentation	8

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Speech processing concepts</b>
	<ul style="list-style-type: none"> <li>The speech production mechanism,</li> <li>Discrete time speech signals,</li> <li>Pole-Zero modeling of speech, relevant properties of the fast</li> <li>Fourier transform for speech recognition,</li> <li>convolution, linear and nonlinear filter banks,</li> <li>spectral estimation of speech using DFT.</li> <li>Linear Prediction analysis of speech.</li> </ul>
2.	<b>Speech recognition</b>
	<ul style="list-style-type: none"> <li>Real and Complex Cepstrum, application of cepstral analysis to speech signal,</li> <li>feature extraction for speech,</li> <li>static and dynamic feature for speech recognition, robustness issues,</li> <li>discrimination in the feature space, feature selection,</li> <li>MFCC, LPCC,</li> <li>Distance measures, vector quantization models.</li> <li>Gaussian Mixture model, HMM.</li> </ul>

<b>3.</b>	<b>Basics of Video Processing</b>
	<ul style="list-style-type: none"> <li>• Video formation, perception and representation:</li> <li>• Principle of color video, video cameras, video display,</li> <li>• pinhole model, CAHV model, Camera motion, Shape model, motion model, Scene model,</li> <li>• wo-dimensional motion models.</li> <li>• Three-Dimensional Rigid Motion, Approximation of projective mapping.</li> </ul>
<b>4.</b>	<b>Motion estimation Techniques</b>
	<ul style="list-style-type: none"> <li>• Optical flow, motion representation, motion estimation criteria,</li> <li>• optimization methods, pixel-based motion estimation,</li> <li>• Block matching algorithm, gradient Based, Intensity matching, feature matching,</li> <li>• frequency domain motion estimation, Depth from motion.</li> <li>• Motion analysis applications: Video Summarization, video surveillance.</li> </ul>
<b>5.</b>	<b>Object tracking and segmentation</b>
	<ul style="list-style-type: none"> <li>• 2D and 3D video tracking, blob tracking,</li> <li>• kernel based counter tracking, feature matching, filtering Mosaicing,</li> <li>• video segmentation, mean shift based, active shape model,</li> <li>• video shot boundary detection. Interframe compression,</li> <li>• Motion compensation</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Fundamentals of Speech recognition	L. Rabiner and B. Juang	3rd	Prentice Hall signal processing series.
2.	Digital Video processing	A Murat Tekalp	2nd	Prentice Hall.
<b>Reference Book</b>				
1.	"Speech and Audio Signal Processing", B.Gold and N. Morgan, Wiley.			
2.	"Digital image sequence processing, Compression, and analysis", Todd R. Reed, CRC Press			
3.	"Handbook of Image and Video processing", Al Bovik, Academic press, second Edition			
<b>Online Resources</b>				
1.	URL: <a href="https://www.geeksforgeeks.org">https://www.geeksforgeeks.org</a>			



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**Minor Courses**  
**Professional Elective: Theory**  
**(Cloud and DevOps)**

**Batch: 2025-29**

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	Study importance of Cloud computing, various deployment and Service models.
CO2	Understand	Analyse three Layered Architectural Requirement of Cloud computing.
CO3	Apply	Study Comparative Analysis of Requirement at various layers.
CO4	Apply	Understand various threats and security issues of cloud computing with solutions.
CO5	Analyze	Study how virtualization improves performance and capacity of cloud services.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	2	2	-	-	-	-	-	-	-	3	-	-	-
CO2	2	3	3	1	-	-	2	-	-	-	-	-	1	-	-	-
CO3	3	2	2	3	2	-	-	-	-	-	-	-	3	-	-	-
CO4	2	1	1	2	-	-	2	-	-	-	-	-	2	-	-	-
CO5	3	1	2	1	-	-	2	-	-	-	-	-	2	-	-	-
Wt. AVG	2.6	1.8	2.0	2.0	-	-	-	-	-	-	-	-	2.0	-	-	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Understanding cloud computing	8
2.	Cloud computing technology	8
3.	Fault Tolerance	7
4.	Security Management in Cloud	7
5.	Virtualization	6

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Understanding cloud computing</b>
	<ul style="list-style-type: none"> <li>• Introduction to Cloud Computing</li> <li>• Benefits and Drawbacks –</li> <li>• History and Evolution of Cloud Computing,</li> <li>• Types of clouds, Private and Public clouds,</li> <li>• Cloud Computing architecture, Cloud computing infrastructure,</li> <li>• Merits of Cloud computing, Practical applications of cloud computing,</li> <li>• Cloud computing delivery models and services (IaaS, PaaS, SaaS)</li> <li>• Obstacles for cloud technology, Cloud vulnerabilities, Cloud challenges,</li> <li>• Conclusion of the Unit</li> </ul>
2.	<b>Cloud Architecture Technology and Architectural Requirements</b>
	<ul style="list-style-type: none"> <li>• The Business Case for Clouds</li> <li>• Hardware and Infrastructure</li> </ul>

	<ul style="list-style-type: none"> <li>• Accessing the cloud ,Broad Approaches to Migrating into the Cloud, The Seven-Step Model of Migration into a Cloud, Cloud Storage – Standards, Software as a Service</li> <li>• Discovering Cloud Services Development tools</li> <li>• Three Layered Architectural Requirement, Provider Requirements</li> <li>• Service Centric Issues - Interoperability – QoS.</li> <li>• Conclusion of Unit</li> </ul>
<b>3.</b>	<b>Fault Tolerance</b>
	<ul style="list-style-type: none"> <li>• Fault Tolerance</li> <li>• Data Management Storage and Processing</li> <li>• Virtualization Management-Scalability</li> <li>• Load Balancing, Cloud Deployment for Enterprises</li> <li>• User Requirement, Comparative Analysis of Requirement.</li> <li>• Conclusion of Unit</li> </ul>
<b>4.</b>	<b>Security Management in Cloud</b>
	<ul style="list-style-type: none"> <li>• Security Management Standards</li> <li>• Security Management in the Cloud Availability Management</li> <li>• SaaS Availability Management - PaaS Availability Management –</li> <li>• IaaS Availability Management</li> <li>• Access Control - Security Vulnerability, Patch, and Configuration</li> <li>• Management – Privacy in Cloud</li> <li>• The Key Privacy Concerns in the Cloud - Security in Cloud Computing</li> <li>• Conclusion of Unit</li> </ul>
<b>5.</b>	<b>Virtualization</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Objectives - Benefits - Virtualization Technologies –</li> <li>• Data Storage Virtualization – Storage Virtualization</li> <li>• Improving Availability using Virtualization,</li> <li>• Improving Performance using Virtualization</li> <li>• Conclusion of Unit</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Cloud Computing and SOA Convergence in your Enterprise A Step by Step Guide	David S Linthicum		Addison Wesley Information Technology Series
2.	Cloud Computing: Principles and Paradigms	Rajkumar Buyya, James Broberg, Andrzej M. Goscinski		John Wiley and Sons Publications, 2011
3.	Cloud Computing Theory and Practice	Dan C Marinescu, Elsevier		2013
<b>Reference Book</b>				
1.	Michael Miller, “Cloud Computing – Web-Based Applications that Change the Way You Work and Collaborate Online”, Pearson Education, New Delhi, 2009.			
2.	Cloud Computing Specialist Certification Kit – Virtualization Study Guide			
<b>Online Resources</b>				
1.	<a href="https://www.geeksforgeeks.org/cloud-computing/">https://www.geeksforgeeks.org/cloud-computing/</a>			
2.	<a href="https://aws.amazon.com/what-is-cloud-computing/">https://aws.amazon.com/what-is-cloud-computing/</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	Understand DevOps concepts and execute basic to advanced Linux commands.
CO2	Understand	Version control using Git and differentiate VCS types.
CO3	Apply	Implement CI with Jenkins and analyze configuration management tools.
CO4	Apply	Use Docker for containerization and explain orchestration basics.
CO5	Analyze	Evaluate monitoring and logging tools in DevOps with real-world context.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	1	-	-	-	-	-	-	-	-	-	1	1	1	-
CO2	2	2	1	-	-	-	-	-	-	-	-	-	2	2	1	-
CO3	3	3	2	1	-	-	-	-	-	-	-	-	3	2	2	-
CO4	3	3	3	2	-	-	-	-	-	-	-	-	3	3	2	-
CO5	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3	-
Wt. AVG	2.4	2.4	2.0	2.0	-	-	-	-	-	-	-	-	2.4	2.2	1.8	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to DevOps and Basic Linux	6
2.	Version Control System vs Distributed Version Control System	6
3.	Continuous Integration and Configuration Management	8
4.	Containerization and DevOps Infrastructure	8
5.	Monitoring, Logging, and DevOps on Cloud	8

**D. DETAILED SYLLABUS**

Unit	Unit Details
<b>1.</b>	<b>Introduction to DevOps and Basic Linux</b>
	<ul style="list-style-type: none"> <li>Definition, Goals, and Importance , History and evolution of DevOps , DevOps vs Agile vs Traditional Models , DevOps Lifecycle: Plan, Develop, Test, Release, Deploy, Operate, Monitor.</li> <li>Linux for DevOps: Linux architecture overview ,</li> <li>History of Linux , File system hierarchy structure ,Command-line interface (CLI) basics , Advance command, Linux commands (file handling, user management, process control),</li> <li>File permissions, ownership, and basic shell navigation .</li> </ul>
<b>2.</b>	<b>Version Control System vs Distributed Version Control System</b>
	<ul style="list-style-type: none"> <li>Introduction to Version Control Systems (VCS) , Centralized vs Distributed VCS , Git Features and Workflow , Git commands: init, clone, add, commit, status, log, branch, Brief History of Version Control Systems,</li> <li>Basic Operations in a VCS, Examples of Version Control Systems, Concurrent Versions System (CVS),</li> <li>Subversion (SVN), Mercurial, Git, The Making - History of Git, Advantages of Git</li> </ul>
<b>3.</b>	<b>Continuous Integration and Configuration Management</b>
	<ul style="list-style-type: none"> <li>DevOps CI/CD Pipeline Overview ,Continuous Integration: Concept and Benefits</li> <li>Jenkins: Architecture and components , Jenkins dashboard and job creation , Pipeline concept</li> </ul>

	(declarative vs scripted) <ul style="list-style-type: none"> <li>● Introduction to Configuration Management , Concept, benefits, and comparison with manual setup ,</li> <li>● Overview of Ansible, Puppet, and Chef ,Infrastructure as Code (IaC) principles , Role of automation in DevOps</li> </ul>
<b>4.</b>	<b>Containerization and DevOps Infrastructure</b>
	<ul style="list-style-type: none"> <li>● Introduction to Containerization ,Virtualization vs Containerization ,Use cases and benefits of containers in DevOps</li> <li>● Docker: Basic concepts of images, containers, volumes, networks Docker architecture and components Dockerfile structure and image creation ,Docker Hub and image sharing</li> <li>● Overview of Orchestration Tools: Introduction to Kubernetes and Docker Compose (Basic idea of Pods, Services, and Clusters in Kubernetes.</li> </ul>
<b>5.</b>	<b>Monitoring, Logging, and DevOps on Cloud</b>
	<ul style="list-style-type: none"> <li>● Importance of Monitoring in DevOps , Basics of application and infrastructure monitoring Introduction to monitoring tools: Prometheus: metrics-based monitoring Grafana: dashboard and visualization</li> <li>● Logging Concepts: Importance of log management , Centralized logging overview (ELK Stack)</li> <li>● DevOps Toolchain Integration Overview , Real-world case study of a CI/CD pipeline.</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	The DevOps Handbook: How to Create World-Class Agility	Gene Kim, Jez Humble, Patrick Debois	1st Edition	th IT Revolution Press
2.	Learning DevOps: Continuously Deliver Better Software	Mikael Krief	Latest	Packt Publishing
3.	Docker Deep Dive	Nigel Poulton	Latest	Leanpub Publishing
<b>Reference Book</b>				
1.	Ansible for DevOps Jeff Geerling. Geerling Media			
2.	Kubernetes Up & Running Kelsey Hightower et al. O'Reilly Media			
<b>Online Resources</b>				
1.	<a href="https://www.tutorialspoint.com/-,devops,-/index.htm">https://www.tutorialspoint.com/-,devops,-/index.htm</a>			
2.	<a href="https://www.atlassian.-,com,-/devops">https://www.atlassian.-,com,-/devops</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	Explain the principles and types of virtualization.
CO2	Understand	Configure and manage virtual machines using hypervisors.
CO3	Apply	Compare container and hypervisor-based virtualization.
CO4	Apply	Apply virtualization techniques in cloud platforms.
CO5	Analyze	Analyze the impact of virtualization on cloud security and performance.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	1	-	-	-	-	-	-	-	-	-	1	1	1	-
CO2	2	2	1	-	-	-	-	-	-	-	-	-	2	2	1	-
CO3	3	3	2	1	-	-	-	-	-	-	-	-	3	2	2	-
CO4	3	3	3	2	-	-	-	-	-	-	-	-	3	3	2	-
CO5	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3	-
Wt. AVG	2.4	2.4	2.0	2.0	-	-	-	-	-	-	-	-	2.4	2.2	1.8	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to Virtualization	6
2.	Types and Techniques of Virtualization	8
3.	Virtualization Platforms & Tools	8
4.	Container-based Virtualization	9
5.	Virtualization in Cloud Providers	7

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Introduction to Virtualization</b>
	<ul style="list-style-type: none"> <li>Definition and History of Virtualization</li> <li>Importance in Cloud Computing Physical vs. Virtual Infrastructure</li> <li>Benefits and Limitations of Virtualization</li> <li>Virtualization Terminologies (VM, Host, Guest, Snapshot, Clone)</li> <li>Compare Cloud Computing and Virtualization , Virtual machine manager,</li> <li>Introduction to datacenter virtualization Esxi - Difference between Esxi and Esx - Versions of Esxi ,</li> </ul>
2.	<b>Types and Techniques of Virtualization</b>
	<ul style="list-style-type: none"> <li>Full Virtualization vs. Para Virtualization</li> <li>Hardware-level vs. OS-level Virtualization Types of Virtualization</li> <li>Server Virtualization, Network Virtualization, Storage Virtualization Hypervisors: Type-1 and Type-2 (VMware ESXi, Hyper-V, KVM, VirtualBox) ,</li> <li>Hypervisor security in cloud ,Virtual Machine Lifecycle and Management</li> </ul>
3.	<b>Virtualization Platforms &amp; Tools</b>
	<ul style="list-style-type: none"> <li>Introduction to VMware vSphere, ESXi, vCenter , VirtualBox: Setup and Configuration , Resource Allocation: CPU, Memory, Storage, Network ,</li> </ul>

	<ul style="list-style-type: none"> <li>VM Migration: Live Migration and Storage Migration , Distributed Resource Scheduling and Load Balancing</li> </ul>
<b>4.</b>	<b>Container-based Virtualization</b>
	<ul style="list-style-type: none"> <li>Introduction to Containers</li> <li>Differences Between VMs and Container</li> <li>Docker Architecture, Images, Containers, Dockerfile</li> <li>Docker Hub, Volumes, and Networking</li> <li>Introduction to Kubernetes: Pods, ReplicaSets, Deployments, Services</li> </ul>
<b>5.</b>	<b>Virtualization in Cloud Providers And Security</b>
	<ul style="list-style-type: none"> <li>Virtualization in AWS (EC2 Instances, AMIs, EBS)</li> <li>Virtualization in Microsoft Azure and Google Cloud</li> <li>Role of Virtualization in IaaS, PaaS, Virtualization Security Considerations</li> <li><b>On Premises Vs On Cloud</b></li> <li>Cloud Services Using Virtualization in AWS ,Cloud Computing Security ,</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Cloud Computing: Principles and Paradigms	<i>Rajkumar Buyya,</i> Wiley	1st Edition	Wiley
2.	Kubernetes Up & Running	<i>Brendan Burns,</i> O'Reilly	3rd Edition	O'Reilly Media
3.	Architecting the Cloud	<i>Michael Kavis,</i> Wiley	1st Edition	Wiley
<b>Reference Book</b>				
1.	Cloud Computing: Principles and Paradigms			
2.	Architecting the Cloud			
<b>Online Resources</b>				
1.	<a href="https://www.vmware.com/topics/glossary/content/virtualization.html">https://www.vmware.com/topics/glossary/content/virtualization.html</a>			
2.	<a href="https://www.geeksforgeeks.org/cloud-computing">https://www.geeksforgeeks.org/cloud-computing</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	Define and recall key Docker concepts, terminology, architecture components (Daemon, Client, Host, Registry), and its role in cloud environments.
CO2	Understand	Explain the features and operations of Docker Hub, Docker Cloud, and the benefits of containerization for deployment.
CO3	Apply	Execute basic and advanced Docker and Linux commands to manage containers, images, and networking operations in real-world environments.
CO4	Apply	Differentiate between Docker images and containers, evaluate the Docker architecture, and analyze Docker Compose setups and containerization flows.
CO5	Analyze	Compare Docker Swarm and Kubernetes, assess the efficiency of Docker-based virtualization and networking approaches, and justify the use of multi-container orchestration tools.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	1	1	-	-	-	-	-	-	-	-	2	-	-	-
CO2	3	2	1	2	-	-	-	-	-	-	-	-	2	-	-	-
CO3	2	3	2	1	-	-	-	-	-	-	-	-	1	-	-	-
CO4	2	2	2	1	-	-	-	-	-	-	-	-	2	-	-	-
CO5	1	1	2	2	-	-	-	-	-	-	-	-	1	-	-	-
Wt. AVG	2.0	2.2	1.6	1.4	-	-	-	-	-	-	-	-	1.6	-	-	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction of Docker	8
2.	Docker deployment orchestration	8
3.	Docker container	7
4.	Web services of docker container	8
5.	Mongo DB	8

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Introduction to Dockers over the cloud computing</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Introduction to Docker, features of Docker</li> <li>• Important terminology in Docker</li> <li>• Architecture of Docker: Docker Daemon, Docker client, host, Docker registry, Docker objects</li> <li>• Docker images</li> <li>• Docker Containers</li> <li>• Docker Storage, types</li> <li>• Docker Networking, types</li> <li>• Conclusion of Unit</li> </ul>
2.	<b>Docker Hub</b>

	<ul style="list-style-type: none"> <li>• Introduction of Docker hub</li> <li>• Docker Hub features</li> <li>• Advantages of docker hub</li> <li>• Push and Pull images from Docker hub</li> <li>• Docker cloud, terminologies of Docker Cloud</li> <li>• Operation of Docker cloud</li> <li>• Docker cloud features</li> <li>• Understand the containerization</li> <li>• Container enhance the deployment process</li> <li>• Conclusion of Unit</li> </ul>
<b>3.</b>	<b>Docker Linux command environment</b>
	<ul style="list-style-type: none"> <li>• Docker Linux command environment</li> <li>• Docker instruction commands</li> <li>• Running commands inside Docker Container</li> <li>• Docker –user instruction</li> <li>• Docker images</li> <li>• Uses of Docker Images</li> <li>• Difference between Docker images and Docker container</li> <li>• Structure of Docker image</li> <li>• Conclusion of unit</li> </ul>
<b>4.</b>	<b>Working with Docker Images</b>
	<ul style="list-style-type: none"> <li>• Docker images listing. Their names and tags</li> <li>• Filters to list images, Pulling Docker images with specific tags</li> <li>• Publishing images to Docker hub</li> <li>• Docker customized images from container</li> <li>• Containerization using Docker</li> <li>• Containerization</li> <li>• Docker architecture, components, compose, network</li> <li>• Advantages of Docker</li> <li>• Conclusion of unit</li> </ul>
<b>5.</b>	<b>Virtualization with Docker containers</b>
	<ul style="list-style-type: none"> <li>• Introduction of virtualization with Docker container</li> <li>• Provide the static IP to a Docker container Docker compose tool to run multi container application</li> <li>• Introduction Docker swarm mode</li> <li>• Working process of Docker Swarm</li> <li>• Used of Docker swarm</li> <li>• Different mode of Docker swarm</li> <li>• Features of Docker swarm</li> <li>• Difference between Docker Container and Docker swarm</li> <li>• Difference between Docker swarm and Kubernetes</li> <li>• Conclusion of unit</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	CloudComputing: Concepts, Technology & Architecture	Zaigham Mahmood, Ricardo Puttini, and Thomas Erl	20013	Pearson Education
<b>Reference Book</b>				
1.	"Cloud Computing For Dummies" by Judith Hurwitz			
<b>Online Resources</b>				
1.	<a href="https://www.geeksforgeeks.org/kubernetes-tutorial/">https://www.geeksforgeeks.org/kubernetes-tutorial/</a>			
2.	<a href="https://www.javatpoint.com/cloud-computing">https://www.javatpoint.com/cloud-computing</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	Understand Cloud Computing and Amazon Web Services.
CO2	Understand	Understand AWS Technologies like EC2(Elastic Compute Cloud) and Create Servers and AMI (Amazon Machine Image)
CO3	Apply	Deploy Web Applications with the help of AWS Elastic Beanstalk. And Understand Cloud Watch for create alarms and alerts
CO4	Apply	Understand AWS Cloud Security with the help of IAM (identity Access Management)
CO5	Analyze	Understand and create AWS Storage (S3,Buckets,)

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	2	3	-
CO2	3	-	2	-	-	-	-	-	-	-	-	-	1	2	3	-
CO3	2	-	2	-	-	-	-	-	-	-	-	-	1	2	3	-
CO4	2	1	-	2	-	-	-	-	-	-	-	-	1	2	3	-
CO5	3	-	2	-	-	-	-	-	-	-	-	-	1	2	3	-
Wt. AVG	2.6	1.5	2.0	2.0	-	-	-	-	-	-	-	-	1.0	2.0	3.0	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to Cloud Computing and Amazon Web Services	8
2.	Introduction to Amazon Web Services	8
3.	Introduction to EC2	7
4.	Web Applications and Security, AWS Storage	7
5.	AWS Storage	6

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Introduction to Cloud Computing and Amazon Web Services</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Introduction to Cloud Computing, Cloud Service Delivery Models (IAAS, PAAS, SAAS),</li> <li>• Cloud Deployment Models (Private, Public, Hybrid and Community),</li> <li>• AWS Global Infrastructure, AWS Services, AWS Cloud Computing Security-AWS Shared Responsibility Model, AWS IAM, Identity and Access Management, Securing a New AWS Account, Securing Accounts, Securing Data, AWS Directory Service, AWS Key Management Service, Securing Data at Rest and In Motion, Cloud Computing Security,</li> <li>• Introduction to Amazon Web Services, AWS Storage Options,</li> <li>• AWS Compute Options, AWS Database Options, AWS Workflow Automation</li> <li>• AWS Orchestration Options, AWS Systems Management and Monitoring Options,</li> <li>• AWS Virtual, Private Cloud Introduction</li> <li>• Conclusion of Unit</li> </ul>
2.	<b>Introduction to Amazon Web Services</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Why Amazon? Use Cases, AWS Storage Options, AWS Compute Options, AWS Database</li> </ul>

	<p>Options, AWS Workflow Automation and Orchestration Options, AWS Systems Management and Monitoring Options, AWS Virtual Private Cloud Introduction, Pricing Concepts. Networking and Content Delivery-Networking and Content Delivery, Networking Basics, Amazon VPC, VPC Wizard, VPC Networking, VPC Security, Route 53, CloudFront</p> <ul style="list-style-type: none"> <li>• Introduction To EC2, Instance Types And Uses, Auto scaling Instances,</li> <li>• Amazon Machine Images (AMIS), Modifying Existing Images,</li> <li>• Creating New Images of Running Instances,</li> <li>• Converting An Instance Store AMI To An EBS AMI,</li> <li>• Instances Backed By Storage Types,</li> <li>• Conclusion of Unit</li> </ul>
<b>3.</b>	<b>Introduction to EC2</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Introduction To EC2, Instance Types and Uses, Auto scaling Instances, Amazon Machine Images (AMIS), Modifying Existing Images, Creating New Images of Running Instances, Converting An Instance Store AMI To An EBS AMI, Instances Backed By Storage Types, Amazon EC2 Cost Optimization, Container Services, AWS Lambda, AWS Elastic Beanstalk Elastic IPS, Elastic Load Balancing.</li> <li>• Conclusion of Unit</li> </ul>
<b>4.</b>	<b>Web Applications and Security, AWS Storage</b>
	<ul style="list-style-type: none"> <li>• Introduction to Cloud Watch, Describe Amazon Cloud Watch metrics and alarms,</li> <li>• AWS Messaging Services (SNS, SQS, SES). Amazon Storage, S3 Storage Basics,</li> <li>• Buckets and Objects, Creating A Web Server Using S3 Endpoints,</li> <li>• Managing Voluminous Information with EBS, Glacier Storage Service, Describe Amazon Dynamo, understand key aspects of Amazon RDS, Launch an Amazon RDS instance,</li> <li>• Conclusion of Unit</li> </ul>
<b>5.</b>	<b>Cloud Architecture</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• AWS Well-Architected Framework Design Principles, Operational Excellence,</li> <li>• Security, Reliability, Cost Optimization, Reliability, AWS Trusted Advisor,</li> <li>• Auto Scaling and Monitoring, Elastic Load Balancing, Amazon CloudWatch, Amazon EC2 Auto Scaling</li> <li>• Conclusion of Unit</li> </ul>

## E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Cloud Computing: Principles and Paradigm	Rajkumar Buyya, James Broberg, Andrzej M. Goscinski		John Wiley and Sons Publications
2.	Cloud Computing For Dummies	Fern Halper,Robin Bloor		
<b>Reference Book</b>				
1.	Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online - Michael Miller - Que 2008			
2.	Cloud Computing: Web-Based Applications That Change the Way You Work by Micheal Miller			
<b>Online Resources</b>				
1.	<a href="https://www.tutorialspoint.com/amazon_web_services/index.html">https://www.tutorialspoint.com/amazon_web_services/index.html</a>			
2.	<a href="https://www.geeksforgeeks.org/aws-tutorial/">https://www.geeksforgeeks.org/aws-tutorial/</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	Understand DevOps principles, lifecycle, and compare DevOps with traditional and Agile methodologies.
CO2	Understand	Demonstrate the use of Git for version control and collaboration in CI/CD pipelines.
CO3	Apply	Apply Jenkins for continuous integration and automate deployment using Docker containers.
CO4	Apply	Use Infrastructure as Code principles and configure automation using Ansible with playbooks and modules.
CO5	Analyze	Monitor DevOps environments using Prometheus and Grafana, and evaluate security tools like SAST, DAST, and Software Composition Analysis.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	1	-	-	-	-	-	-	-	-	-	1	1	1	-
CO2	2	2	1	-	-	-	-	-	-	-	-	-	2	2	1	-
CO3	3	3	2	1	-	-	-	-	-	-	-	-	3	2	2	-
CO4	3	3	3	2	-	-	-	-	-	-	-	-	3	3	2	-
CO5	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3	-
Wt. AVG	2.4	2.4	2.0	2.0	-	-	-	-	-	-	-	-	2.4	2.2	1.8	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to DevOps	6
2.	Version Control With Git	6
3.	Continuous Integration and Continuous Deployment (CI/CD)	10
4.	Continuous Management and Automation	10
5.	Monitoring, and Security Tools	8

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Introduction to DevOps</b>
	<ul style="list-style-type: none"> <li>Introduction to devops ,</li> <li>Phases of Software Lifecycle,</li> <li>Minimum Viable Product (MVP) &amp; Cross-functional Teams,</li> <li>Agile development methodologies,</li> <li>A deep dive into the principles, culture, and</li> <li>History of DevOps. Exploring the advantages of DevOps</li> <li>DevOps vs. Traditional Development and Operations , The DevOps Lifecycle .</li> </ul>
2.	<b>Version Control With Git :</b>
	<ul style="list-style-type: none"> <li>Introduction, Overview of Version Control Systems,</li> <li>Role of Version Control System,</li> <li>Types of Control Systems and their Supporting Tools,</li> <li>Importance of version control in CICD pipeline.</li> </ul>

	<ul style="list-style-type: none"> <li>• Git Fundamentals: Learning the basics of Git, version control, and repositories.</li> <li>• Understanding how to work collaboratively on code using Git.</li> </ul>
<b>3.</b>	<b>Continuous Integration and Continuous Deployment (CI/CD)</b>
	<ul style="list-style-type: none"> <li>• Continuous Integration: <ul style="list-style-type: none"> <li>- Introduction to Jenkins. Creating Views and Jobs in Jenkins:</li> <li>- The Jenkins user interface, Jobs in Jenkins, Creating Views, Managing Views and Jobs in Jenkins:</li> <li>- Managing Views in Jenkins, Job Execution,</li> <li>- The Job Execution Configuration Panel, The Status Panel, Console Panel.</li> </ul> </li> <li>• Continuous Deployment: <ul style="list-style-type: none"> <li>- Overview of Docker, Benefits of Docker Workflow,Architecture, Docker Containers,</li> <li>- Dockerfile,Building an Image, Running an Image, Custom base Images, Storing Images</li> </ul> </li> </ul>
<b>4.</b>	<b>Continuous Management and Automation</b>
	<p>Overview of Infrastructure as a code,  Benefits of Infrastructure as Code, The Four Key Metrics,  Three Core Practices for Infrastructure as Code,  The Parts of an Infrastructure System, Infrastructure Platforms, Infrastructure Resources,  Compute Resources.  Ansible  Ansible Introduction , Architecture,  Ansible and Infrastructure Management, Local Infrastructure Development: Ansible ,  Playbook Concepts , Ansible Inventroy and Configuration , Ansible Modules</p>
<b>5.</b>	<b>Monitoring, and Security Tools</b>
	<ul style="list-style-type: none"> <li>• Monitoring with Prometheus: Prometheus installation and configuration ,</li> <li>• Metrics collection and querying (PromQL)</li> <li>• Visualization with Grafana: Creating dashboards and visualizations ,</li> <li>• Integrating with Prometheus and other data sources</li> <li>• Security Tools: Static Application Security Testing</li> <li>• Dynamic Application Security Testing Software Composition Analysis .</li> </ul>

## E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	The DevOps Handbook	Gene Kim, Patrick Debois, John Willis, Jez Humble	1st Edition, 2016	IT Revolution Press
2.	Learning Ansible	Jesse Keating	2nd Edition, 2020	O'Reilly Media
3.	Docker: Up & Running	Karl Matthias, Sean P. Kane	2nd Edition, 2020	O'Reilly Media
<b>Reference Book</b>				
1.	The DevOps Handbook Gene Kim, Patrick Debois, John Willis, Jez Humble			
2.	Learning Ansible Jesse Keating			
<b>Online Resources</b>				
1.	<a href="https://docs.ansible.com/">https://docs.ansible.com/</a>			
2.	<a href="https://www.jenkins.io/doc/">https://www.jenkins.io/doc/</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	Explain the principles and importance of configuration management and automation in DevOps.
CO2	Understand	Describe Infrastructure as Code (IaC) and demonstrate its role in automated infrastructure.
CO3	Apply	Implement configuration management using Ansible playbooks and inventory configurations.
CO4	Apply	Use Puppet and Chef to automate software provisioning and configuration tasks.
CO5	Analyze	Monitor infrastructure using tools like Prometheus and Grafana and evaluate performance data.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	1	-	-	-	-	-	-	-	-	-	1	1	1	-
CO2	2	2	1	-	-	-	-	-	-	-	-	-	2	2	1	-
CO3	3	3	2	1	-	-	-	-	-	-	-	-	3	2	2	-
CO4	3	3	3	2	-	-	-	-	-	-	-	-	3	3	2	-
CO5	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3	-
Wt. AVG	2.4	-	2.0	2.0	-	-	-	-	-	-	-	-	2.8	2.7	1.5	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to Configuration Management and Automation	6
2.	Infrastructure as Code (IaC)	8
3.	Ansible for Configuration Management	8
4.	Puppet and Chef Automation Tools	6
5.	Continuous Configuration and Monitoring	8

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Introduction to Configuration Management and Automation</b>
	<ul style="list-style-type: none"> <li>Overview of DevOps principles , Role of automation in DevOps , What is configuration management , Benefits of automated configuration and deployment , Manual vs. automated configuration , Immutable infrastructure , Push vs pull-based configuration models.</li> <li>Introduction to Common tools : Puppet, Chef, Ansible, SaltStack</li> </ul>
2.	<b>Infrastructure as Code (IaC)</b>
	<ul style="list-style-type: none"> <li>Concept of Infrastructure as Code ,principles of IaC , Declarative vs. imperative configuration ,Benefits and challenges of IaC</li> <li>Introduction to tools: Terraform, Use cases of terraform , Installation and setup ,Terraform CLI commands ( <b>init</b> , <b>plan</b> , <b>apply</b> , <b>destroy</b> ) , Basics of HCL ,Providers, Resources, State File</li> <li>AWS CloudFormation, Benefits of using CloudFormation in DevOps , Compare CloudFormation vs Terraform , Ansible Versioning infrastructure code , Security and compliance in IaC</li> </ul>
3.	<b>Ansible for Configuration Management</b>
	<ul style="list-style-type: none"> <li>Introduction to Ansible , Agentless , Declarative ,YAML syntax and Ansible Playbooks ,Modules, roles, and inventories , File Structure &amp; Configuration , Writing playbooks to automate tasks</li> <li>Modules and Their Use , Ansible Galaxy and reuse of roles , Security &amp; Vault , Integrating with DevOps Workflows .</li> </ul>

<b>4.</b>	<b>Puppet and Chef Automation Tools</b>
	Puppet architecture and manifest files , Chef architecture and cookbooks/recipes ,Puppet DSL and Chef Ruby-based syntax ,Nodes, modules, classes, and environments
<b>5.</b>	<b>Continuous Configuration and Monitoring</b>
	<ul style="list-style-type: none"> <li>• Continuous Configuration concept in DevOps , Integration of configuration tools with CI/CD pipelines (e.g., Jenkins + Ansible) ,Monitoring configurations and drift detection</li> <li>• Tools for monitoring: Basics of Nagios, Prometheus, Grafana</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	The DevOps Handbook	Gene Kim, Patrick Debois, John Willis, Jez Humble	1st Edition, 2016	IT Revolution Press
2.	Learning Ansible	Jesse Keating	2nd Edition, 2020	O'Reilly Media
3.	Learning Continuous Integration with Jenkins	Nikhil Pathania	1st Edition, 2017	Packt Publishing
<b>Online Resources</b>				
1.	<a href="https://www.jenkins.io/doc/">https://www.jenkins.io/doc/</a>			
2.	<a href="https://docs.ansible.com/">https://docs.ansible.com/</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	Explain the principles of DevSecOps and identify key components of secure software development lifecycles.
CO2	Understand	Analyze and implement security in version control systems and CI/CD pipelines using tools like GitHub, Jenkins, and OWASP tools.
CO3	Apply	Apply configuration management security practices using tools like Ansible and Terraform while enforcing compliance using policy-as-code frameworks.
CO4	Apply	Evaluate and implement container and Kubernetes security practices, including runtime threat detection and monitoring.
CO5	Analyze	Demonstrate cloud security and compliance practices across AWS, Azure, and GCP, including IAM and posture management.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	1	-	-	-	-	-	-	-	-	-	1	1	1	-
CO2	2	2	1	-	-	-	-	-	-	-	-	-	2	2	1	-
CO3	3	3	2	1	-	-	-	-	-	-	-	-	3	2	2	-
CO4	3	3	3	2	-	-	-	-	-	-	-	-	3	3	2	-
CO5	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3	-
Wt. AVG	2.4	-	2.0	2.0	-	-	-	-	-	-	-	-	2.8	2.7	1.5	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to DevSecOps and Security Basics	7
2.	Secure Version Control and CI/CD Pipelines	8
3.	Configuration Management and Compliance	8
4.	Container Security and Monitoring	8
5.	Cloud Security and Governance in DevOps	8

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Introduction to DevSecOps and Security Basics</b> <ul style="list-style-type: none"> <li>What is DevSecOps, Evolution of DevSecOps , Principles of DevOps Security ,</li> <li>Threat modeling and risk assessment in DevOps , Secure software development lifecycle (SSDLC) ,CIA Triad (Confidentiality, Integrity, Availability)</li> <li>Shift Left Security ,Threat Modeling and Attack Surface ,OWASP Top 10 Security Risks ,DevOps vs DevSecOps – Comparison</li> </ul>
2.	<b>Secure Version Control and CI/CD Pipelines</b> <ul style="list-style-type: none"> <li>Git and GitHub Security ,Secrets Management in Code Repositories</li> <li>CI/CD Security :Integrating SAST, DAST, and SCA ,Securing Jenkins/GitLab CI/CD pipelines</li> <li>Artifact Signing and Validation ,Dependency and Vulnerability Scanning (e.g., OWASP Dependency-Check)</li> </ul>
3.	<b>Configuration Management and Compliance</b> <ul style="list-style-type: none"> <li>Infrastructure as Code (IaC) Security: Ansible, Terraform</li> <li>Policy as Code: Open Policy Agent (OPA), Sentinel Automating Compliance Checks (e.g., CIS Benchmarks, SCAP)</li> <li>Immutable Infrastructure and Compliance</li> <li>Role-Based Access Control (RBAC)</li> </ul>

<b>4.</b>	<b>Container Security and Monitoring</b>
	<ul style="list-style-type: none"> <li>• Securing Docker Images (best practices, Trivy, Clair) ,Kubernetes Security: RBAC, Network Policies, Pod Security Policies , Runtime Threat Detection with Falco</li> <li>• Logging and Monitoring Security Events (e.g., ELK, Prometheus + Grafana)</li> <li>• Incident Response Automation</li> </ul>
<b>5.</b>	<b>Cloud Security and Governance in DevOps</b>
	<ul style="list-style-type: none"> <li>• Cloud Security Fundamentals (AWS, Azure, GCP) ,IAM Best Practices in the Cloud</li> <li>• Cloud Compliance Frameworks: HIPAA, SOC2, GDPR, ISO 27001 ,Cloud Security Posture Management (CSPM) ,</li> <li>• Case Study: DevSecOps Pipeline in AWS</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Securing DevOps	Julien Vehent	1st Edition	Manning Publications
2.	Hands-On Security in DevOps	Tony Hsiang-Chih Hsu	1st Edition	Packt Publishing
3.	Infrastructure as Code	Kief Morris	2nd Edition	O'Reilly
<b>Reference Book</b>				
1.	Securing DevOps Julien Vehent, 1st Edition			
2.	Infrastructure as Code Kief Morris 2nd Edition			
<b>Online Resources</b>				
1.	<a href="https://owasp.org">https://owasp.org</a>			
2.	<a href="https://learn.hashicorp.com">https://learn.hashicorp.com</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	Defining of Linux Server
CO2	Understand	Predicating server technology resources
CO3	Apply	Determining Installing, configuring, and managing a Linux server and relevant services and applications.
CO4	Apply	Distinguishing the importance of maintaining a secure Linux server.
CO5	Analyze	Validating File system management

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	-	-	1	-	-	-	-	-	-	1	-	1	-	-
CO2	3	1	1	-	2	-	-	-	-	-	3	2	2	2	-	-
CO3	1	2	2	-	3	-	-	-	-	-	2	3	1	3	2	-
CO4	2	3	3	-	3	-	-	-	-	-	3	3	3	2	2	-
CO5	3	2	3	3	2	-	-	-	-	1	1	2	2	3	3	-
Wt. AVG	2.0	1.8	2.3	3.0	2.2	-	-	-	-	1.0	2.3	2.2	2.0	2.2	2.3	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to Linux	7
2.	Package, User and group Management & File System Management	8
3.	Configuration Server and file system & Configuring Server for Security and Shell Scripting	8
4.	Managing system and infrastructure services Configuring Server for Security	7
5.	Open SSH and Linux Security & Setting up Web Services and Linux in the Cloud and Virtualization	7

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<p><b>Introduction to Linux</b></p> <ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• History of Linux, Open source licensing , Unix Vs Linux - Flavors of Linux – Benefits and characteristics of Linux - Installation of Linux, Linux booting process , Log in and switch users in multiuser run levels , Shell and bash features , Linux kernel - sudo vs su ,Date and time configuration – Linux run levels.</li> <li>• <b>Directories and files:</b> Directory structure , System directory , Absolute path and relative path ,Creating and removing directory ,Working with directory , Links – hard link and soft link , Input and output redirection , Filters and pipes ,Locate - read - and use system documentation including man page</li> <li>• Working as root, working with the Shell, Using Bash to Best Effect, Managing Bash with Key Sequences,</li> <li>• Performing Basic File System Management Tasks, Working with Directories, Working with Files, Viewing the Content of Text Files, Finding Files That Contain Specific Text , Creating Empty Files,</li> </ul>

	<ul style="list-style-type: none"> <li>• Piping and Redirection, Piping, Redirection, Finding Files, Working with Vi Editor: Vi Modes, Saving and Quitting, Cut, Copy, and Paste, Deleting Text. Getting Help: Using man to Get Help, Getting Information on Installed Packages</li> <li>• <b>System Administration</b></li> <li>• Linux Boot Process and System Initialization, Managing System Logs with journalctl and rsyslog, Managing Disk Partitions and File Systems, Introduction to LVM (Logical Volume Manager), Basic Backup Tools (rsync, tar), System Monitoring Tools (top, htop, df).</li> <li>• Conclusion of Unit</li> </ul>
<b>2.</b>	<b>Package, User and group Management &amp; File System Management</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• RPM ,YUM ,Archive , Compress - unpack and uncompressed files using tar , star , gzip - and bzip2 , Create, delete ,and modify local user accounts , Change passwords for local user accounts , Create - delete - and modify local groups and group memberships , Changing owner and modes.</li> <li>• Mounting Disks, Using the mount Command, Un-mounting Devices, Automating Mounts with /etc/fstab, Checking File System Integrity, Working with Links: Working with Symbolic Links, Working with Hard Links. Configuring Storage, Comparing File Systems, Creating File Systems, Working with Logical Volumes</li> <li>• Networking Basics</li> <li>• Networking Concepts and Configuration: ifconfig, ip, netplan, nmcli), Configuring Network Interfaces (ifconfig, ip, nmcli), Network Services: DHCP, DNS, NFS, FTP, Introduction to Firewalls (iptables, firewallld), SSH: Secure Remote Access, Basic Network Troubleshooting (ping, traceroute).</li> <li>• Conclusion of Unit</li> </ul>
<b>3.</b>	<b>Configuration local storage and file system</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• List ,create , delete , and partition type for primary , extended - and logical partitions - Create and remove physical volumes</li> <li>• Assign physical volumes to volume groups , Create and delete logical Volumes. , Create ,mount ,unmounts ,ext2 , ext3 and ext4 file systems. Mount ,unmount and LUKS-encrypted file systems ,Access control list. Setting Up User Accounts, Commands for User Management, Managing Passwords, Modifying and</li> <li>• Deleting User Accounts, Configuration Files, Creating Groups, Commands for Group Management, /etc/group, Using Group Passwords, Managing the User's Shell Environment, Configuring Permissions,</li> <li>• Read, Write, and Execute: The Three Basic Linux Permissions, Permissions and the Concept of Ownership, Working with Advanced Linux Permissions, Setting Permissions, Using umask to Set Default</li> <li>• Permissions for New Files, Working with Access Control Lists, Preparing the File System for ACLs, ACL</li> <li>• Limitations, Applying File Attributes, Apply Quota to Allow a Maximum Amount of Files, Installing the Quota Software, Preparing the File System for Quota, Initializing Quota, Setting Quota for Users and Groups, Configuring Administrator Tasks with sudo.</li> <li>• Shell Scripting</li> <li>• Basics of Shell Scripting (Variables, Loops, Conditional Statements), Automating Tasks using cron Jobs, Managing and Parsing Files using awk, sed, and cut, Introduction to Text Processing Tools (grep, awk, sed), Introduction to Configuration Management Tools (Ansible Basics).</li> <li>• Conclusion of Unit</li> </ul>
<b>4.</b>	<b>Managing system and infrastructure services</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Managing system services - Shutting down - suspending and hibernating the system – Controlling system on remote machine - Creating and modifying systemd unit files</li> <li>• DHCP Configuration - HTTP server Configuration - FTP server Configuration , Samba server Configuration</li> <li>• Configuring DNS, Methods of Name Resolution, Structure of the DNS Hierarchy, Introducing Forward and Reverse DNS, Configuring DNS, Configuring Reversed Lookup, Testing Your Name Server, Mail server Configuration ,Configuring DHCP, Understanding the DHCP Protocol, Creating the DHCP Server Configuration, The DHCP Process, The /etc/dhcp/dhcpd.conf Configuration File, Advanced DHCP Configuration Options,</li> <li>• NTP server Configuration ,NFS server Configuration ,Configuring NTP, How NTP Works, Configuring a Stand-Alone NTP Time Server, Pulling or Pushing the Time, Configuring an NTP Client, Checking NTP Synchronization Status, Customizing Your NTP Server, Starting Services with xinetd, Setting up Xinetd, Setting Up Mail Servers, Clients</li> <li>• Security Essentials</li> </ul>

	<ul style="list-style-type: none"> <li>Advanced User and Group Management: ACLs, Quotas, File and Directory Permissions, Special Permissions (Sticky Bits, SetUID, SetGID), Securing Linux Systems: SELinux/AppArmor Basics, System Hardening Techniques: Security Updates, Intrusion Detection, Managing Secure Connections: VPN, SSL Certificates.</li> <li>Conclusion of Unit</li> </ul>
<b>5.</b>	<b>OpenSSH and Linux Security &amp; Setting up Web Services</b>
	<ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>OPENSSSH - The SSH Protocol, Configuring OpenSSH and Starting an OpenSSH Server KeyBased Authentication in OpenSSH - OpenSSH Clients Using the ssh Utility ,scp Utility and sftp Utility ,Configure firewall settings using system-configfirewall or iptables ,Set enforcing and permissive modes for SELinux - List and identify SELinux file and process context</li> <li>Setting up Apache, Apache Components, Starting, Stopping, and Testing the Apache Web Server, The Structure of the Apache Configuration Files, Checking the Configuration, Working with Virtual Hosts, Configuring Virtual Hosts, Managing Access to the Web Server, Configuring Host-Based Access Restrictions, Configuring User-Based Access Restrictions Enabling HTTPS, Creating a Self-Signed Certificate, Configuring Apache to Use the Self-Signed Certificate Using PHP, Setting Up MySQL, Setting the MySQL Root Password, Creating a MySQL Database, Configuring a Squid Proxy Server,</li> <li>Installing a Squid Proxy Cache, Configuring Squid Access Control Policies, Configuring User Authentication</li> <li>Linux in the Cloud and Virtualization</li> <li>Virtualization Techniques(KVM, VirtualBox), Containerization Basics: Docker, LXC , Working with Cloud Platforms: AWS EC2 Basics, CLI Management, Linux Automation in Cloud Environments (Terraform Basics) Troubleshooting Virtualization and Containers</li> <li>Conclusion of Unit</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	RHCSA/RHCE Red Hat Linux Certification Study Guide Exams EX200 & EX300	Orsaria, Jang		McGraw-Hill Education
2.	Red Hat RHCSA/RHCE 7 Cert Guide: Red Hat Enterprise Linux 7 (EX200 and EX300)	Sander Van Vugt		Phi Learning Pvt Ltd
<b>Reference Book</b>				
1.	Linux Pocket Guide: Essential Commands			
2.	Linux: The Complete Reference			
<b>Online Resources</b>				
1.	<a href="https://www.redhat.com/en/topics/linux/linux-server">https://www.redhat.com/en/topics/linux/linux-server</a>			
2.	<a href="https://www.geeksforgeeks.org/what-is-a-linux-server-and-why-use-it/">https://www.geeksforgeeks.org/what-is-a-linux-server-and-why-use-it/</a>			



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**Professional Elective: Theory**

**(Full Stack Development & Mobile  
Application)**

**Batch: 2025-29**

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	Develop dynamic and interactive web interfaces using JavaScript, DOM manipulation, and external libraries such as jQuery and jQuery UI.
CO2	Understand	Demonstrate proficiency in TypeScript and ES6 features including classes, modules, promises, and transpilation techniques.
CO3	Apply	Build modular, scalable single-page applications (SPAs) using Angular with components, services, routing, and dependency injection.
CO4	Apply	Create rich user interfaces using ReactJS by managing states, components, and performing CRUD operations with backend integration.
CO5	Analyze	Implement asynchronous web applications using Node.js, Express, and Promises for building responsive and real-time APIs.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	-	1	2	1	-	-	-	-	-	-	-	3	-	-	-	-
CO2	-	2	3	2	3	-	-	-	-	-	-	-	-	-	-	-
CO3	-	2	3	2	3	-	-	-	-	-	-	-	-	-	-	-
CO4	-	1	3	2	3	-	-	-	-	-	-	-	-	-	-	-
CO5	-	2	2	1	-	-	-	-	-	-	-	3	-	-	-	-
Wt. AVG	-	1.6	2.6	1.6	3.0	-	-	-	-	-	-	3.0	-	-	-	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	JavaScript and jQuery	7
2.	TypeScript and ECMAScript (ES6)	8
3.	Angular	7
4.	React JS	7
5.	Web APIs and Asynchronous Applications	7

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>JavaScript and jQuery</b>
	<ul style="list-style-type: none"> <li>Introduction to Unit</li> <li>Understanding the DOM,</li> <li>DHTML and manipulating the HTML5 Document,</li> <li>Validating UI,</li> <li>Working with external JavaScript libraries like jQuery and jQueryUI</li> <li>Conclusion of the Unit</li> </ul>
2.	<b>TypeScript and ECMAScript (ES6)</b>
	<ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>Understanding TypeScript and ECMAScript,</li> <li>Understanding Prototypes,</li> <li>Classes, Properties, Methods, Events, and Constructors,</li> </ul>

	<ul style="list-style-type: none"> <li>• Scoping and Modules,</li> <li>• Understanding and Working with Promise,</li> <li>• Transpiling TypeScript</li> <li>• Conclusion of the Unit</li> </ul>
<b>3.</b>	<b>Angular</b>
	<ul style="list-style-type: none"> <li>• Introduction to Unit</li> <li>• How Angular works, Angular Modules, Angular Components,</li> <li>• Templates and Styles</li> <li>• Routing, Observables, Components and Databinding,</li> <li>• Services and Dependency Injection,</li> <li>• Data binding the UI</li> <li>• Conclusion of the Unit</li> </ul>
<b>4.</b>	<b>React JS</b>
	<ul style="list-style-type: none"> <li>• Introduction to Unit</li> <li>• How ReactJS works,</li> <li>• JSX, React Components,</li> <li>• Event Management, State Management,</li> <li>• Data binding the UI and performing CRUD operations with the Web API using MongoDB,</li> <li>• React Enriching the UX</li> <li>• Conclusion of the Unit</li> </ul>
<b>5.</b>	<b>Web APIs and Asynchronous Applications</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Node &amp; Express Environment,</li> <li>• HTTP Requests &amp; Routes-Handle requests to an Express with routes,</li> <li>• Asynchronous JavaScript- Manage asynchronous JavaScript control flow with Promises</li> <li>• Conclusion of the Unit</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Full Stack Development with MongoDB	Manu Sharma	BPB Publications	Full Stack Development with MongoDB
2.	Front-End: Curso Completo de HTML, CSS e JavaScript	P A Gabrie	Tech Stuff House	Front-End: Curso Completo de HTML, CSS e JavaScript
3.	Front End Web Design and Development	Dr. Isha Gupta	Authorspres s	Front End Web Design and Development
<b>Reference Book</b>				
1.	"HTML and CSS: Design and Build Websites" by Jon Duckett			
2.	"Eloquent JavaScript" by Marijn Haverbeke (3rd Edition)			
<b>Online Resources</b>				
1.	<a href="https://developer.mozilla.org/">https://developer.mozilla.org/</a>			
2.	<a href="https://www.freecodecamp.org/">https://www.freecodecamp.org/</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	Define and explain fundamental software deployment concepts, types of deployment, environments, and popular tools.
CO2	Understand	Demonstrate the ability to deploy static and dynamic web applications using hosting platforms like Netlify, Vercel, Firebase, and Heroku.
CO3	Apply	Build, sign, and distribute Android applications through Firebase App Distribution and Google Play Console.
CO4	Apply	Design and configure continuous integration and continuous deployment pipelines using Jenkins and GitHub Actions.
CO5	Analyze	Implement containerized deployments using Docker and evaluate modern cloud deployment services and serverless functions.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	1	1	1	1	1	1	1	1	2	2	1	-	-
CO2	2	3	3	2	3	1	1	1	1	2	2	3	3	2	-	-
CO3	2	2	3	2	3	1	1	1	2	2	2	3	3	3	-	-
CO4	3	3	3	3	3	1	1	1	2	3	3	3	3	2	-	-
CO5	3	3	3	3	3	1	1	1	2	3	3	3	3	3	-	-
Wt. AVG	2.6	2.6	2.6	2.2	2.6	1.0	1.0	1.0	1.6	2.2	2.2	2.8	2.8	2.2	-	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Fundamentals of Software Deployment	6
2.	Web Application Deployment	6
3.	Mobile Application Deployment	8
4.	Continuous Integration and Deployment Automation	8
5.	Modern Deployment Trends: Containers and Cloud	8

**D. DETAILED SYLLABUS**

Unit	Unit Details
<b>1.</b>	<b>Fundamentals of Software Deployment</b>
	<ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>Introduction to Software Deployment, Definition, Objectives, and Lifecycle Stages</li> <li>Deployment Environment Concepts, Development, Staging, Production, Testing environments</li> <li>Manual Deployment, Automated Deployment</li> <li>Rolling Deployment, Blue-Green Deployment, Canary Deployment</li> <li>Introduction to DevOps, Principles and Advantages , CI/CD Concepts and Workflow</li> <li>Overview of Version Control System, Popular Deployment Tools</li> <li>Conclusion &amp; Real Life Application</li> </ul>
<b>2.</b>	<b>Web Application Deployment</b>
	<ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>Static vs. Dynamic Web Application Hosting</li> <li><b>Netlify:</b> Free vs. Paid Plans, Deployment Workflow, Continuous Deployment</li> <li>Environment Variables, Redirect Rules, and Build Plugins</li> <li><b>Vercel:</b> Deploying React/Next.js/Angular apps</li> <li>Setting up Custom Domains , Environment variables and preview deployments</li> </ul>

	<ul style="list-style-type: none"> <li>• <b>Heroku:</b> Setting up a Heroku Account, Dynos, and CLI usage</li> <li>• Deploying Java, Node.js, Python applications</li> <li>• Integrating Databases: PostgreSQL, Redis , Procfile and Environment Variables</li> <li>• Firebase Hosting:</li> <li>• Deploying Progressive Web Apps (PWAs),Hosting Single Page Applications (SPAs)</li> <li>• GitHub Pages: Creating User and Project Pages</li> <li>• Conclusion &amp;Real Life Application</li> </ul>
<b>3.</b>	<b>Mobile Application Deployment</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit, Android App Deployment Lifecycle</li> <li>• Android Build Variants: Debug, Release, and Custom Build Types</li> <li>• Generating Signed APK/AAB files using Android Studio</li> <li>• Firebase App Distribution: Setting up Projects, Inviting Testers, and Tracking Feedback</li> <li>• Crashlytics Integration for Crash Reports</li> <li>• Google Play Console: Developer Account Setup and Dashboard Overview</li> <li>• Managing App Releases: Internal, Alpha, Beta, Production, App Bundles vs. APKs</li> <li>• Creating and Managing App Listings, Handling App Updates and Rollbacks</li> <li>• Introduction to iOS App Deployment</li> <li>• Conclusion of the Unit</li> </ul>
<b>4.</b>	<b>Continuous Integration and Deployment Automation</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• CI/CD Lifecycle and Workflow Stages, Jenkins: Installation, Configuration, and Plugins</li> <li>• Creating and Running Pipelines using Declarative Syntax</li> <li>• Integrating with GitHub and Web hooks , Build Triggers and Notifications</li> <li>• GitHub Actions: Workflow Files, Events, and Job Matrix</li> <li>• Using Pre-built Actions and Marketplace , Managing Secrets for Secure Deployments</li> <li>• Comparison of Jenkins vs. GitHub Actions,</li> <li>• Introduction to GitLab CI/CD and Bitbucket Pipelines</li> <li>• Conclusion of the Unit</li> </ul>
<b>5.</b>	<b>Modern Deployment Trends: Containers and Cloud</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Introduction to Containerization: Virtual Machines vs. Containers</li> <li>• Benefits of Containerized Deployment</li> <li>• Docker Fundamentals: Installing Docker, Docker Images, Docker Hub ,Docker Containers and Dockerfile Basics , Docker Compose, Deploying Dockerized Web Applications</li> <li>• Introduction to Cloud Services for Deployment: AWS Elastic Beanstalk, Azure App Service, GCP App Engine</li> <li>• Firebase Hosting for Web Apps and APIs</li> <li>• Concept of Serverless Deployment (Intro): AWS Lambda, Google Cloud Functions, Netlify Functions</li> <li>• Conclusion of the Unit</li> </ul>

## E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation	<i>Jez Humble, David Farley</i>	Addison-Wesley	Addison-Wesley
2.	The DevOps Handbook: How to Create World-Class Agility, Reliability, & Security in Technology Organizations	<i>Gene Kim, Patrick Debois, John Willis, Jez Humble</i>	IT Revolution Press	IT Revolution Press
<b>Reference Book</b>				
1.	Docker Deep Dive, Nigel Poulton .			
2.	Learning Continuous Integration with Jenkins, Nikhil Pathania, Packt Publishing			
<b>Online Resources</b>				
1.	<a href="https://docs.github.com/">https://docs.github.com/</a>			
2.	<a href="https://firebase.google.com/docs">https://firebase.google.com/docs</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	Recall fundamental Kotlin syntax, data types, and control structures.
CO2	Understand	Describe Android architecture, app lifecycle, and components.
CO3	Apply	Develop basic Android applications using Kotlin, layouts, and controls.
CO4	Apply	Analyze code logic and structure using object-oriented concepts in Kotlin.
CO5	Analyze	Design and build real-time Android apps integrating UI, storage, and media.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO3	3	3	3	2	3	-	-	-	2	-	-	-	3	3	2	-
CO4	3	3	3	3	3	-	-	-	2	-	-	-	3	3	2	-
CO5	3	3	3	3	3	-	-	-	2	2	2	2	3	3	3	2
Wt. AVG	3.0	2.8	3.0	2.7	3.0	-	-	-	2.0	2.0	2.0	2.0	2.8	3.0	2.3	2.0

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Kotlin Programming Basics	6
2.	Object-Oriented Kotlin & Android Fundamentals	6
3.	Android UI Development	8
4.	Intermediate Android Concepts	8
5.	Data Storage & Deployment	8

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Kotlin Programming Basics</b>
	<ul style="list-style-type: none"> <li>Kotlin Features and Environment Setup</li> <li>Structure of Kotlin Program</li> <li>Tokens: Keywords, Identifiers, Variables, Constants, Datatypes, Operators, NULL Safety</li> <li>Control Statements: if, when, loops, jump statements</li> </ul>
2.	<b>Object-Oriented Kotlin &amp; Android Fundamentals</b>
	<ul style="list-style-type: none"> <li>Functions, Arrays, Collections (List, Set, Map)</li> <li>Object-Oriented Programming in Kotlin: Classes, Objects, Inheritance, Interface, Data Classes, Enums, Inner and Inline classes</li> <li>Introduction to Android: Architecture, Emulator Setup, Project Structure</li> <li>Basic Android Controls: TextView, Button</li> </ul>
3.	<b>Android UI Development</b>
	<ul style="list-style-type: none"> <li>Layouts: Linear, Relative, Constraint</li> <li>Activities and Intents</li> <li>UI Components: EditText, ImageView, RecyclerView, ListView</li> <li>ViewPager, Tabs, Toolbar, Navigation</li> <li>Toasts, Snackbar, Dialogs, AlertDialog</li> </ul>

<b>4.</b>	<b>Intermediate Android Concepts</b>
	<ul style="list-style-type: none"> <li>• Form Handling and Validations</li> <li>• Media Player Integration: Playing, Pausing, Stopping audio/video</li> <li>• Fragment Lifecycle and Communication</li> <li>• Basic State Management using ViewModel</li> <li>• Creating dynamic UI: Tabbed Activities, ViewPager, etc.</li> <li>• Working with Contacts, Dialer, Email Intents</li> </ul>
<b>5.</b>	<b>Data Storage &amp; Deployment</b>
	<ul style="list-style-type: none"> <li>• Internal/External Storage, Shared Preferences</li> <li>• SQLite Database &amp; Firebase Realtime Database (CRUD)</li> <li>• JSON Parsing (SAX, DOM), Web APIs</li> <li>• App Testing (basic Unit &amp; UI Tests)</li> <li>• APK Generation &amp; Play Store Deployment</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Kotlin Programming: The Big Nerd Ranch Guide	Josh Skeen, David Greenhalgh	1st Edition	Pearson
2.	Android Programming with Kotlin for Beginners	John Horton	2nd Edition	Packt Publishing
3.	Head First Android Development	Dawn Griffiths & David Griffiths	1st Edition	O'Reilly
	Kotlin in Action	Dmitry Jemerov, Svetlana Isakova	1st Edition	Manning Publications
<b>Reference Book</b>				
1.	Android Programming with Kotlin for Beginners by John Horton, Packt Publishing, ISBN: 978-1801813303.			
2.	Kotlin for Android Developers by Antonio Leiva, Leanpub, ISBN: 978-1519615185.			
3.	Android Development with Kotlin by Marcin Moskala and Igor Wojda, Packt Publishing, ISBN: 978-1787123687.			
4.	Kotlin Programming: The Big Nerd Ranch Guide by Josh Skeen and David Greenhalgh, Pearson, ISBN: 978-0135161630.			
<b>Online Resources</b>				
1.	<a href="https://developer.android.com">https://developer.android.com</a>			
2.	<a href="https://kotlinlang.org">https://kotlinlang.org</a>			
3.	<a href="https://firebase.google.com">https://firebase.google.com</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	Explain core concepts of JavaScript and Node.js for backend development.
CO2	Understand	Create and structure Node.js applications using modules and packages.
CO3	Apply	Build RESTful APIs using Express.js with routing and middleware.
CO4	Apply	Integrate applications with a NoSQL database (MongoDB).
CO5	Analyze	Develop and deploy a simple backend application.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	-	-	-	-	-	-	-	-	-	2	2	1	-
CO2	2	2	2	1	-	-	-	-	-	-	-	-	2	2	2	-
CO3	3	3	3	2	-	-	-	-	-	-	-	-	3	3	2	-
CO4	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3	-
CO5	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3	-
Wt. AVG	2.6	2.6	2.4	2.3	-	-	-	-	-	-	-	-	2.6	2.6	2.2	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	JavaScript for Backend Basics	06
2.	Node.js Fundamentals	08
3.	Working with REST APIs	07
4.	Express.js Essentials	08
5.	MongoDB Integration & Mini Project	08

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>JavaScript for Backend Basics</b> <ul style="list-style-type: none"> <li>• <b>Variables and Scoping:</b> var, let, const, block vs function scope.</li> <li>• <b>Data Types:</b> Primitive and non-primitive types in JavaScript (string, number, object, array, etc.).</li> <li>• <b>Functions:</b> Function declarations, expressions, arrow functions, default parameters.</li> <li>• <b>ES6+ Features:</b> Destructuring, template literals, spread/rest operators, module import/export.</li> <li>• <b>Promises and Async/Await:</b> Understanding asynchronous flow, chaining promises, using async/await.</li> <li>• <b>Event Loop &amp; Callback Queue:</b> How JavaScript handles concurrency; concepts of call stack and event loop.</li> <li>• <b>Error Handling:</b> try, catch, finally, and custom error objects.</li> </ul>
2.	<b>Node.js Fundamentals</b> <ul style="list-style-type: none"> <li>• <b>Introduction to Node.js:</b> What is Node.js? How it works (event-driven, non-blocking I/O).</li> <li>• <b>Installing Node.js and npm:</b> Installation on different OS platforms, verifying versions.</li> <li>• <b>Working with npm (Node Package Manager):</b> Installing packages locally and globally, understanding package.json, semantic versioning.</li> <li>• <b>Node.js Module System:</b> Using built-in (fs, path, os, http, events) and custom modules; module.exports and require().</li> </ul>

	<ul style="list-style-type: none"> <li>• <b>File System Module (fs):</b> Reading, writing, updating, and deleting files (synchronously and asynchronously).</li> <li>• <b>EventEmitter Class:</b> Understanding event-driven architecture in Node.js.</li> </ul>
<b>3.</b>	<b>Working with REST APIs</b>
	<ul style="list-style-type: none"> <li>• <b>Understanding REST Architecture:</b> Concepts of resources, endpoints, HTTP verbs (GET, POST, PUT, DELETE), and status codes.</li> <li>• <b>Creating HTTP Server:</b> Using the native http module to create a basic web server.</li> <li>• <b>Handling HTTP Requests and Responses:</b> Parsing incoming data, handling routes, sending responses.</li> <li>• <b>Request Routing Without Frameworks:</b> Manual route management to understand the need for Express.js.</li> <li>• <b>Using Postman:</b> Testing API endpoints with request payloads and parameters.</li> </ul>
<b>4.</b>	<b>Express.js Essentials</b>
	<ul style="list-style-type: none"> <li>• <b>Introduction to Express.js:</b> Why Express? Installing and initializing Express apps.</li> <li>• <b>Routing in Express:</b> Defining routes for different HTTP methods, route parameters, and query strings.</li> <li>• <b>Middleware in Express:</b> Understanding middleware flow, built-in middleware (e.g., express.json()), third-party (e.g., morgan), and custom middleware.</li> <li>• <b>Serving Static Files:</b> Using express.static() to serve HTML, CSS, and JS files.</li> <li>• <b>Error Handling:</b> Implementing centralized error handling using Express middleware.</li> <li>• <b>Template Engines (Optional):</b> Brief introduction to EJS for rendering dynamic HTML (optional based on available time).</li> </ul>
<b>5.</b>	<b>MongoDB Integration &amp; Mini Project</b>
	<ul style="list-style-type: none"> <li>• <b>Introduction to MongoDB:</b> Understanding NoSQL concepts, collections, and documents.</li> <li>• <b>Connecting Node.js with MongoDB Atlas:</b> Using Mongoose ODM for schema design and validation.</li> <li>• <b>CRUD Operations:</b> Creating, reading, updating, and deleting records using Mongoose.</li> <li>• <b>Building a RESTful CRUD API:</b> Combining Express and MongoDB to implement a complete data-driven service.</li> <li>• <b>Mini Project:</b> Develop a simple API-based application such as a To-Do app, Student Record Manager, or Blog backend.</li> <li>• <b>Basic Deployment Overview:</b> Introducing platforms like Render, Railway, or Vercel for hosting Node.js apps.</li> </ul>

## E. RECOMMENDED STUDY MATERIAL

S.No	Title	Author(s)	Edition	Publication
1	Learning Node.js Development	Andrew Mead	1st Edition	O'Reilly
2	Express in Action: Writing, Building, and Testing Node.js Applications	Evan Hahn	1st Edition	Manning Publications
<b>Reference Book</b>				
1	Node.js Design Patterns	Mario Casciaro, Luciano Mammino	3rd Edition	Packt Publishing
2	MongoDB: The Definitive Guide	Kristina Chodorow	3rd Edition	O'Reilly
3	Eloquent JavaScript	Marijn Haverbeke	3rd Edition	No Starch Press
<b>Online Resources</b>				
1.	<a href="https://nodejs.org/docs/latest/api/">https://nodejs.org/docs/latest/api/</a>			
2.	<a href="https://expressjs.com/">https://expressjs.com/</a>			
3.	<a href="https://university.mongodb.com/">https://university.mongodb.com/</a>			
4.	<a href="https://mongoosejs.com/docs/">https://mongoosejs.com/docs/</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	Recall the fundamental concepts of PHP, including syntax, variables, data types, and control structures.
CO2	Understand	Explain the use of functions, strings, arrays, sessions, cookies, and file handling in PHP for dynamic web development.
CO3	Apply	Implement Laravel framework basics including routing, controllers, views, and Blade templating to build structured web applications.
CO4	Apply	Analyze and handle exceptions, validate user input, and manage sessions and files securely in Laravel.
CO5	Analyze	Design and develop a database-driven web application by integrating PHP/Laravel with MySQL using CRUD operations.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	-	-	—	—	—	—	—	3	—	—	—	3	2
CO2	3	3	2	-	-	—	—	—	—	—	3	1	1	—	3	3
CO3	2	3	3	2	2	—	—	—	—	—	3	2	2	3	2	3
CO4	2	2	3	3	2	—	—	—	—	—	3	2	2	2	2	2
CO5	3	3	3	3	3	—	—	—	—	—	3	2	3	3	3	3
Wt. AVG	2.6	2.6	2.4	2.7	2.3	-	-	-	-	-	3.0	1.8	2.0	2.7	2.6	2.6

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Core PHP – Fundamentals	8
2.	Advanced PHP Concepts	8
3.	Laravel Framework – Basics and Concepts	8
4.	Laravel – Advanced Topics	9
5.	Database Connectivity with MySQL	9

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Core PHP – Fundamentals</b>
	<ul style="list-style-type: none"> <li>Introduction to PHP: Evaluation and History</li> <li>Features and Applications</li> <li>Basic Syntax, Tags and Statements, Embedding in HTML</li> <li>Variables and Constants (<code>define()</code>, <code>const</code>)</li> <li>PHP Data Types, Operators (Arithmetic, Assignment, Comparison, Logical)</li> <li>Operator Precedence</li> </ul>
2.	<b>Advanced PHP Concepts</b>
	<ul style="list-style-type: none"> <li><b>Control Structures:</b> <code>if</code>, <code>else</code>, <code>switch</code>, <code>for</code>, <code>while</code>, <code>do-while</code>, <code>foreach</code></li> <li><b>Functions:</b> User-defined, Parameter Passing (By Value/Reference), Recursive Functions</li> <li><b>Strings:</b> Creation, Access, Searching, Replacing, Formatting, Library Functions</li> <li><b>Arrays:</b> Indexed, Associative, Traversing (<code>for</code>, <code>foreach</code>, <code>each</code>), Array Functions</li> </ul>
3.	<b>Laravel Framework – Basics and Concepts</b>
	<ul style="list-style-type: none"> <li>Introduction to Laravel: Features, MVC Architecture</li> <li>Installation and Environment Setup</li> <li>Routing and Controllers: Definitions, Parameters, Middleware</li> </ul>

	<ul style="list-style-type: none"> <li>• Blade Templating: Syntax, Inheritance</li> <li>• Request and Response Handling</li> </ul>
<b>4.</b>	<b>Laravel – Advanced Topics</b>
	<ul style="list-style-type: none"> <li>• Forms and Validation: CSRF, Rules</li> <li>• Session and Cookie Management</li> <li>• File Handling: Uploading, Storing, Downloading</li> <li>• Error and Exception Handling (try, catch, throw)</li> <li>• Debugging Tools (e.g., Laravel Debugbar)</li> </ul>
<b>5.</b>	<b>Database Connectivity with MySQL</b>
	<ul style="list-style-type: none"> <li>• Database Concepts, SQL Basics</li> <li>• Connecting PHP/Laravel with MySQL (PDO, Eloquent ORM)</li> <li>• Configuration and Migrations</li> <li>• CRUD Operations</li> <li>• <b>Project Work:</b> Mini project using Laravel &amp; MySQL</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	PHP: The Complete Reference	Steven Holzner	1st (2017)	TMH
<b>Reference Book</b>				
1.	Learning PHP, MySQL & JavaScript with jQuery, CSS & HTML5 – 1st January 2015			
<b>Online Resources</b>				
1.	<a href="https://www.w3schools.com/php/">https://www.w3schools.com/php/</a>			
2.	<a href="https://www.tutorialspoint.com/php/index.htm">https://www.tutorialspoint.com/php/index.htm</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	Recall and understand the fundamental concepts of mobile application development, Android materials and Figma design materials
CO2	Understand	Understand the concepts of dart programming language in the development of mobile app using flutter.
CO3	Apply	Implement the App Navigation, layout creation and various Android APIs to learn all concept of flutter
CO4	Apply	Analyse the working stateless and stateful widgets in Android Application.
CO5	Analyze	Design basic android applications with proper UI using Figma, VS code and Android Studio.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	-	1	1	-	-	-	-	-	-	-	-	2	1	1	-
CO2	3	3	2	2	-	-	-	-	-	-	-	-	2	1	1	-
CO3	2	3	-	1	-	-	-	-	-	-	-	-	1	3	2	-
CO4	2	2	3	2	3	-	-	-	-	-	-	-	2	3	2	-
CO5	3	3	3	3	2	-	-	-	-	-	-	-	3	3	3	-
Wt. AVG	2.4	2.8	2.3	1.8	2.5	-	-	-	-	-	-	-	2.0	2.2	1.8	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	App UI & Material Design	6
2.	Dart Programming for Mobile Development	6
3.	Introduction to Flutter Framework	8
4.	State Management, Navigation & User Inputs	8
5.	Backend, Firebase Integration & Deployment	8

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>App UI &amp; Material Design</b> <ul style="list-style-type: none"> <li>Introduction to Android Material Design</li> <li>Material Components: Themes, Typography, Elevation, Layouts</li> <li>Figma for UI Design: Components, Frames, Prototyping</li> <li>Hands-on with Figma and Android Studio UI Builder</li> </ul>
2.	<b>Dart Programming for Mobile Development</b> <ul style="list-style-type: none"> <li>Introduction to Dart: Features, Syntax, Tools</li> <li>Data Types, Variables, Constants</li> <li>Control Flow: If, Switch, Loops</li> <li>Functions: Definition, Parameters, Return Types, Higher-order Functions</li> <li>Object-Oriented Programming in Dart: Classes, Objects, Inheritance, Mixins, Interfaces</li> <li>Collections: Lists, Sets, Maps, Iterators</li> <li>Exception Handling and Assertions</li> <li>File I/O and Packages in Dart</li> <li>Null Safety and Asynchronous Programming (async/await, Futures, Streams)</li> </ul>
3.	<b>Introduction to Flutter Framework</b> <ul style="list-style-type: none"> <li>Flutter Architecture and Setup</li> <li>Project Structure and Widgets Overview</li> </ul>

	<ul style="list-style-type: none"> <li>• Basic Widgets: Text, Image, Container, Column, Row</li> <li>• Hot Reload and Debugging in Flutter</li> <li>• Layouts and Styling Widgets</li> <li>• Stateless vs Stateful Widgets</li> <li>• Custom Widgets and Composition</li> </ul>
<b>4.</b>	<b>State Management, Navigation &amp; User Inputs</b>
	<ul style="list-style-type: none"> <li>• App Navigation: Routes, Named Routes, Passing Data</li> <li>• State Management Techniques: setState, Provider, Riverpod (intro)</li> <li>• Form Handling and Validation</li> <li>• Input Widgets: TextField, Checkbox, RadioButton</li> </ul>
<b>5.</b>	<b>Backend, Firebase Integration &amp; Deployment</b>
	<ul style="list-style-type: none"> <li>• Firebase Setup and Authentication (Email/Password)</li> <li>• Firebase Database Integration and CRUD Operations</li> <li>• Connecting Flutter to APIs (HTTP, REST)</li> <li>• Google Maps Integration</li> <li>• App Testing: Unit Test, Widget Test, Integration Test</li> <li>• App Deployment: App Bundle, Signing, Publishing</li> </ul>

## E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Beginning Flutter: A Hands-On Guide to App Development	Marco L. Napoli	1st Edition	Wiley
2.	Flutter for Beginners: An Introductory Guide to Building Cross-Platform Mobile Applications with Flutter and Dart 2	Alessandro Biessek	2nd Edition	Packt Publishing
3.	Flutter in Action	Eric Windmill	1st Edition	Manning Publications
<b>Reference Book</b>				
S. No	Title	Author(s)	Publisher	Year
1	Beginning Flutter: A Hands-On Guide to App Development	Marco L. Napoli	Wiley	2019
2	Flutter Cookbook	Simone Alessandria & Brian Kayfitz	Packt Publishing	2022
3	Programming Flutter	Carmine Zaccagnino	Pragmatic Bookshelf	2020
4	Learn Google Flutter Fast: 65 Example Apps	Mark Clow	Independently Published	2019
<b>Online Resources</b>				
1.	Flutter Official Documentation			
2.	Dart Programming Language Documentation			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	To recall modern JavaScript concepts essential for web frameworks.
CO2	Understand	To understand the basics of React.js and how it builds user interfaces.
CO3	Apply	To apply React features like hooks, forms, and routing to develop web apps.
CO4	Apply	To analyze how AngularJS uses directives, filters, and controllers for UI control.
CO5	Analyze	To evaluate and build AngularJS apps using forms, services, and routing.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	1	-	-	-	-	-	-	-	-	-	1	1	1	-
CO2	2	2	1	-	-	-	-	-	-	-	-	-	2	2	1	-
CO3	3	3	2	1	-	-	-	-	-	-	-	-	3	2	2	-
CO4	3	3	3	2	-	-	-	-	-	-	-	-	3	3	2	-
CO5	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3	-
Wt. AVG	2.4	2.4	2.0	2.0	-	-	-	-	-	-	-	-	2.4	2.2	1.8	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	JavaScript Essentials	7
2.	Starting with React.js	8
3.	React.js in Action	8
4.	Introduction to AngularJS	9
5.	Forms, Services & Routing in AngularJS	8

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>JavaScript Essentials</b> <ul style="list-style-type: none"> <li>What is JavaScript? Why is it used in web development?</li> <li>Variables and Data Types</li> <li>Writing Conditions (if/else) and Loops (for/while)</li> <li>Functions and Arrow Functions</li> <li>Arrays and Objects (JavaScript building blocks)</li> <li>Working with the Browser (DOM basics)</li> <li>How to handle simple errors in code</li> <li>Introduction to JSON – how data is exchanged online</li> </ul>
2.	<b>Starting with React.js</b> <ul style="list-style-type: none"> <li>What is React.js? Why is it so popular?</li> <li>Installing and setting up your first React project</li> <li>What is JSX and how do we write HTML in JavaScript?</li> <li>Creating and using React components</li> <li>Understanding Props (passing data) and State (changing data)</li> </ul>

	<ul style="list-style-type: none"> <li>• Handling events like button clicks</li> <li>• Displaying lists of data</li> <li>• Showing or hiding things with conditions</li> </ul>
<b>3.</b>	<b>React.js in Action</b>
	<ul style="list-style-type: none"> <li>• Working with forms and inputs</li> <li>• Reusing code with child components</li> <li>• useState and useEffect Hooks (React's special tools)</li> <li>• How to create pages using React Router?</li> <li>• Making your app organized and clean</li> <li>• Small introduction to managing complex data (Context API)</li> </ul>
<b>4.</b>	<b>Introduction to AngularJS</b>
	<ul style="list-style-type: none"> <li>• What is AngularJS and what makes it different from React?</li> <li>• Setting up AngularJS</li> <li>• Using Angular expressions and data binding</li> <li>• Learning about Directives (like ng-model and ng-click)</li> <li>• Using Filters to format data</li> <li>• Working with Controllers and \$scope to control your app</li> <li>• Creating simple custom filters</li> </ul>
<b>5.</b>	<b>Forms, Services &amp; Routing in AngularJS</b>
	<ul style="list-style-type: none"> <li>• How to create forms and add validation?</li> <li>• Adding custom rules and styles to your forms</li> <li>• Understanding AngularJS Modules and how they keep things organized</li> <li>• Creating and using Services to reuse code</li> <li>• Introduction to AJAX (getting data from a server)</li> <li>• Using AngularJS routing to build single-page apps</li> <li>• Final integration and mini project guidance</li> </ul>

## E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	React – Up and Running	Stoyan Stefanov	1st Edition, 2016	O'Reilly Media
2.	AngularJS: Up and Running	Shyam Seshadri & Brad Green	1st Edition, 2014	O'Reilly Media
<b>Reference Book</b>				
1.	Pro React – Cassio de Sousa Antonio, Apress			
2.	Pro AngularJS – Adam Freeman, Apress			
3.	Learning React – Alex Banks & Eve Porcello, O'Reilly			
<b>Online Resources</b>				
1.	<a href="https://reactjs.org">https://reactjs.org</a>			
2.	<a href="https://angularjs.org">https://angularjs.org</a>			
3.	<a href="https://www.w3schools.com/react/">https://www.w3schools.com/react/</a>			
4.	<a href="https://www.tutorialspoint.com/angularjs/">https://www.tutorialspoint.com/angularjs/</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	Explain basics of Node.js
CO2	Understand	Establishing connection with the database using node.js
CO3	Apply	Applying different modules of Node.js
CO4	Apply	Deploying on the server using node.js
CO5	Analyze	Creating web server using node.js

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	3	-	-	-	-	-	-	-	-	-	2	-	-	1
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wt. AVG	1.0	2.2	3.0	-	-	-	-	-	-	-	-	-	2.0	-	-	1.0

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to Node JS	07
2.	Node JS Modules	08
3.	File System	07
4.	Creating Web server	08
5.	Database connectivity	07

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Introduction to Node JS</b> <ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>Introduction to Node JS</li> <li>Features of Node.js</li> <li>Who Uses Node.js?</li> <li>Advantages of Node JS</li> <li>Traditional Web Server Model</li> <li>Node.js Process Model</li> <li>Conclusion of Unit</li> </ul>
2.	<b>Node JS Modules</b> <ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>Functions,</li> <li>Buffer- Creating Buffers, Writing to Buffers, Reading from Buffer, Convert Buffer to JSON, Concatenate Buffers, Compare Buffers, Copy Buffer, Slice Buffer, Buffer Length</li> <li>Module, Module Types -Core Modules, Local Modules, Module.Exports</li> <li>Conclusion of Unit</li> </ul>

<b>3.</b>	<b>File System</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Open a File, Get File Information – Reading a File, Writing a File,</li> <li>• Closing a File, Truncate a File, Delete a File</li> <li>• Create a Directory, Read a Directory, Remove a Directory</li> <li>• Conclusion of Unit</li> </ul>
<b>4.</b>	<b>Creating Web server</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Creating web server using Node</li> <li>• Handling http requests</li> <li>• Sending requests</li> <li>• Conclusion of Unit</li> </ul>
<b>5.</b>	<b>Database connectivity</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Connection string</li> <li>• Configuring</li> <li>• Working with select command</li> <li>• Updating records, Deleting records</li> <li>• Conclusion of Unit</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Node.js in Action	Mike Cantelon, Marc Harter	Latest	Mann ing
2.	Mastering Node.js: Build robust and scalable real-time server-side web applications efficiently	Sandro Pasquali (Author), Kevin Faaborg	Latest	Packt
<b>Reference Book</b>				
1.	Beginning Node.js by Basarat Ali Syed 2014 (Apress)			
2.	Advanced Node.js Development by Mead Andrew, (Packt)			
<b>Online Resources</b>				
1.	<a href="https://www.tutorialspoint.com/nodejs/nodejs_tutorial.pdf">https://www.tutorialspoint.com/nodejs/nodejs_tutorial.pdf</a>			
2.	<a href="https://riptutorial.com/Download/node-js.pdf">https://riptutorial.com/Download/node-js.pdf</a>			
3.	<a href="https://www.simplilearn.com/tutorials/nodejs-tutorial/nodejs-backend">https://www.simplilearn.com/tutorials/nodejs-tutorial/nodejs-backend</a>			

**A. COURSE OUTCOMES: -**

CO	Cognitive Abilities	Students will be able to:
CO1	Remember	Describe Android OS architecture and core app components (Activities, Intents, Fragments, Services). Explain Android permissions model and basic data storage options.
CO2	Understand	Identify security threats in Wi-Fi, Telecom, PAN, NFC, and Bluetooth on Android. Explain Android's network permissions and security configurations.
CO3	Apply	Analyze security risks in payment, VoIP, multimedia apps, and secure Web API connections. Apply secure practices in Intent handling, WebView, and data storage.
CO4	Apply	Explain Android OS security architecture and internals (DAC, MAC, TEE). Analyze rooting risks and TCP/IP based attacks on Android.
CO5	Analyze	Apply reverse engineering and security testing tools for Android apps. Evaluate common Android app vulnerabilities and recommend defenses.

**B. COPO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	-	-	-	-	-	-	-	-	-	3	3	2	-
CO2	2	2	-	-	-	-	-	-	-	-	-	-	2	2	2	-
CO3	3	3	2	2	-	-	-	-	-	-	-	-	3	2	2	-
CO4	3	3	3	2	-	-	-	-	-	-	-	-	3	3	2	-
CO5	3	3	3	3	2	-	-	-	-	-	-	-	3	3	3	-
Wt. AVG	2.8	2.0	2.0	2.3	2.0	-	-	-	-	-	-	-	2.8	2.7	2.0	-

**C. OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to Android Architecture & Components	6
2.	Security of Mobile Networks	7
3.	Security of Android Mobile Applications	7
4.	Security of Android Mobile Platform	8
5.	Application Security Testing & Vulnerabilities	8

**D. DETAILED SYLLABUS**

Unit	Unit Details
1.	<b>Introduction to Android Architecture &amp; Components</b>
	<ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>Android app components: Activities, Intents, Fragments, Services</li> <li>Activity lifecycle and interaction between components</li> <li>Android permissions model (normal vs dangerous permissions)</li> <li>Data storage basics: Shared Preferences, SQLite, Room, Files</li> <li>Introduction to Networking &amp; Web APIs on Android</li> <li>Conclusion &amp; Real Life Application</li> </ul>
2.	<b>Security of Mobile Networks</b>
	<ul style="list-style-type: none"> <li>Introduction of Unit</li> <li>Wi-Fi security in Android</li> <li>Telecom network security on Android devices</li> <li>Personal Area Networks (PAN) security</li> <li>NFC and Bluetooth security</li> </ul>

	<ul style="list-style-type: none"> <li>• Pairing vulnerabilities and prevention</li> <li>• Eavesdropping prevention</li> <li>• Android's NFC and Bluetooth permissions and security model</li> </ul>
<b>3.</b>	<b>Security of Android Mobile Applications</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Payment application security on Android</li> <li>• VoIP application security</li> <li>• Multimedia application security</li> <li>• Secure Web API connections (HTTPS, SSL pinning)</li> <li>• Intent security (prevent spoofing, validate Intents)</li> <li>• WebView security (disable unnecessary JS, block file access)</li> <li>• Secure data storage (EncryptedSharedPreferences, Keystore)</li> <li>• Conclusion of the Unit</li> </ul>
<b>4.</b>	<b>Security of Android Mobile Platform</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Android OS security architecture</li> <li>• DAC &amp; MAC permissions model</li> <li>• Android internals: Framework, Init, Zygote, Binder, Service Manager, Activity Manager</li> <li>• Trusted Execution Environment (TEE) basics</li> <li>• Device rooting risks</li> <li>• TCP/IP attacks on Android</li> <li>• Networking security (TLS, certificate validation)</li> <li>• Conclusion of the Unit</li> </ul>
<b>5.</b>	<b>Application Security Testing &amp; Vulnerabilities</b>
	<ul style="list-style-type: none"> <li>• Introduction of Unit</li> <li>• Reverse engineering tools: Apktool, Ghidra, Jadx</li> <li>• Static &amp; dynamic code analysis</li> <li>• Runtime instrumentation and smali patching</li> <li>• Security testing with Drozer and BurpSuite</li> <li>• Common Android app vulnerabilities: XSS, StrandHogg, overlay attacks, code injection</li> <li>• Malware analysis and Google Play Protect</li> <li>• Defenses: ASLR, ROP, system call hardening, framework exploit protections</li> <li>• Conclusion of the Unit</li> </ul>

#### E. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Android Security Internals: An In-Depth Guide to Android's Security Architecture	Nikolay Elenkov	1st	No Starch Press, 2015
2.	Android Hacker's Handbook	Joshua J. Drake, Zach Lanier, Collin Mulliner, et al.	1st	Wiley, 2014
<b>Reference Book</b>				
1.	Learning Pentesting for Android Devices , Aditya Gupta, Packt Publishing ,2014			
2.	Android Malware and Analysis, Ken Dunham, CRC Press ,2018			



*Your Dreams Our Goal*  
**POORNIMA**  
**UNIVERSITY**

Member of Association of Indian Universities & Approved by UGC (Govt. of India) under 2(f) & 12(B)

# **FACULTY OF COMPUTER SCIENCE & ENGINEERING**

**PROGRAM: B.Tech (CSE)**

**Minor Courses**

**Professional Elective: Laborites  
(SPECIALIZATION)**

- 1. Computer Science and Engineering**
- 2. Cyber Security**
- 3. Cloud and DevOps**
- 4. Artificial Intelligence & Data Science**
- 5. Full Stack Development & Mobile Application**
- 6. Artificial Intelligence & Machine Learning (SAS)**

**Batch: 2025-29**



*Your Dreams Our Goal*  
**POORNIMA**  
**UNIVERSITY**

Member of Association of Indian Universities & Approved by UGC (Govt. of India) under 2(f) & 12(B)

**Minor Courses**  
**Professional Elective: Laborites**  
**(Computer Science & Engineering)**

**Batch: 2025-29**

**A. Course Outcomes: -**

CO	Cognitive Abilities	Students will be able to:
CO – 01	Remember	Implement and distinguish various machine learning types such as supervised, unsupervised, and reinforcement learning through practical coding exercises.
CO – 02	Understand	Apply statistical tools to develop and evaluate regression models using techniques like linear, ridge, and lasso regression.
CO – 03	Apply	Analyze the behavior of logistic regression in binary and multiclass settings using both manual and library-based implementations.
CO – 04	Analyze	Build ensemble models like Random Forests and Gradient Boosted Trees to solve real-world classification and regression problems.
CO – 05	Evaluate	Evaluate and interpret machine learning model performance using metrics such as R <sup>2</sup> , AUC-ROC, F1-score, and other classification and regression indicators.

**B. CO-PO-PSO Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
CO1	3	-	3	-	-	-	-	-	-	-	-	-	3	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	2	2	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	2
CO4	-	-	-	3	2	-	-	-	-	-	-	-	-	-	-	2
CO5	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
Wt. AVG	3.0	-	-	-	-	-	-	-	-	-	-	-	2.5	-	-	4.0

**C. List of Experiments: -**

S. No	Experiment
1	Identify and distinguish between supervised and unsupervised learning approaches through practical implementation on real-world datasets.
2	Apply linear regression techniques and visualize the regression line to interpret relationships between variables.
3	Demonstrate the use of Ridge and Lasso regression to regularize linear models and reduce overfitting.
4	Implement binary logistic regression using gradient descent to understand the optimization behind classification.
5	Use One-vs-All and One-vs-One strategies to perform multiclass classification using logistic regression.
6	Develop and compare Naïve Bayes classifiers (Gaussian, Multinomial, Bernoulli) for text classification tasks.
7	Train Decision Trees and Random Forests on a Dataset.
8	Train Gradient Boosted Trees on a Dataset.
9	Analyze and interpret regression and classification model performance using metrics such as R <sup>2</sup> , Adjusted R <sup>2</sup> , and AUC-ROC.
10	Evaluate classification models using metrics like accuracy, precision, recall, and F1-score to assess model effectiveness.

**D. Recommended Study Material**

S.No	TextBooks:	Author	Edition	Publication
1	Machine Learning-An Algorithmic Perspective	Stephen Marsland	1st ,2nd Edition	CRC Press
2	Data Mining Concepts and Techniques	JiaweiHan and Micheline Kamber	2nd Edition	Elsevier
<b>Reference Books</b>				
1.	Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series), Third Edition, MIT Press, Ethem Alpaydin.			
2.	Machine Learning:The Art and Science of Algorithms that Make Sense of Data, 1st Edition, Cambridge University Press, PeterFlach.			
<b>Online Resources</b>				
1.	<a href="https://nptel.ac.in/courses/106106182">https://nptel.ac.in/courses/106106182</a>			

**A. Course Outcomes: -**

CO	Cognitive Abilities	Students will be able to:
CO – 01	Remember, Understanding	Understand how to set up blockchain tools such as MetaMask and connect to Ethereum test networks.
CO – 02	Understand, Apply	Write and deploy basic smart contracts using Solidity on Remix IDE and testnets
CO – 03	Apply, Analyze	Interact with deployed contracts, transfer tokens or Ether, and manage blockchain wallet activities.
CO – 04	Analyze, Evaluate	Design and implement custom tokens (ERC-20) and observe transaction behavior on block explorers like Etherscan.
CO – 05	Analyze, Create	Analyze smart contract functionality and gas usage, and build simple dApps (e.g., voting system, storage).

**B. CO-PO-PSO Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	-	1	-	-	-	-	-	-	-	2	1	2	-
CO2	2	2	2	1	2	-	-	-	-	-	-	1	2	2	-	-
CO3	2	2	2	-	2	-	-	-	-	-	-	1	3	2	2	-
CO4	3	2	2	2	3	-	-	-	-	-	-	2	3	3	2	-
CO5	3	3	3	2	3	-	-	-	-	-	-	2	3	2	3	-
Wt. AVG	4.0	3.7	3.3	5.0	3.7	-	-	-	-	-	-	3.0	4.3	3.3	4.5	-

**C. List of Experiments: -**

S. No	Experiment
1	Install the MetaMask browser extension, create a new Ethereum wallet using MetaMask, and configure it to connect to an Ethereum test network
2	Develop a basic smart contract using the Solidity programming language that performs a simple function—such as storing and retrieving a message or number
3	To Interact with a Deployed Smart Contract
4	Define basic token properties such as name, symbol, total supply, and decimals. Compile and deploy the token contract on an Ethereum testnet (e.g., Goerli) using Remix IDE, and manage it through MetaMask.
5	Use MetaMask to transfer test Ether from one account to another within the Ethereum testnet environment
6	To Add a Custom Token to MetaMask
7	To View Transaction Details Using Etherscan ( viewing transaction hash, sender and receiver addresses, gas used, status (success or failure), timestamp, block number, and any data or token transfers involved)
8	To write, deploy, and interact with a simple Solidity smart contract that stores a number and allows updating and retrieving it using public functions
9	To create, deploy, and interact with a simple Solidity smart contract that allows users to vote for candidates and view the voting results on the Ethereum blockchain using Remix IDE and MetaMask.
10	To analyze and estimate the amount of gas consumed during the execution of a smart contract function or deployment on an Ethereum testnet, using Remix IDE and MetaMask.

**D. Recommended Study Material**

S. No	Text Books:	Author	Edition	Publication
1	Mastering Ethereum: Building Smart Contracts and DApps	Andreas M. Antonopoulos, Gavin Wood	1 <sup>st</sup> Edition	O'Reilly Media
2	Hands-On Smart Contract Development with Solidity and Ethereum	Kevin Solorio, Randall Kanna, David Hoover	1 <sup>st</sup> Edition	O'Reilly Media
Reference Book				
1.	<i>Blockchain: Blueprint for a New Economy</i> , Melanie Swan, O'Reilly Media, 1st Edition			
2.	<i>Solidity Programming Essentials</i> , Ritesh Modi, Packt Publishing, 2nd Edition			

**A. Course Outcomes: -**

CO	Cognitive Abilities	Students will be able to:
CO – 01	Remember	Students will be able to recall and identify key concepts, tools, and techniques used in mobile application development.
CO – 02	Understand	Students will understand the fundamental principles of mobile application design and development.
CO – 03	Apply	Students will be able to apply programming concepts and techniques to develop functional mobile applications.
CO – 04	Analyze	Students will analyze user requirements and translate them into technical specifications for mobile app development.
CO – 05	Evaluate	Students will evaluate the usability and effectiveness of mobile applications based on user feedback and testing.

**B. CO-PO-PSO Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2	3	1	-	-	-	2	-	2	-	-	2	3
CO2	3	2	2	2	3	1	-	1	1	2	-	2	-	-	2	3
CO3	2	2	2	3	3	1	-	-	-	1	-	2	-	-	2	3
CO4	2	3	3	2	3	1	1	-	2	2	2	2	-	-	2	3
CO5	3	3	3	2	3	1	1	1	2	3	2	3	-	-	2	3
Wt. AVG	2.6	2.6	2.4	2.2	3.0	1.0	1.0	1.0	1.7	2.0	2.0	2.2	-	-	2.0	3.0

**C. List of Experiments**

1		Installation of Android studio.
2	A	Develop a program to display Hello World on screen.
	B	Develop a program to implement linear layout and absolute layout.
	C	Develop a program to implement frame layout, table layout and relative layout.
3	A	Develop a program to implement Text View and Edit Text.
	B	Develop a program to implement Auto Complete Text View.
4	A	Develop a program to implement Button, Image Button and Toggle Button.
	B	Develop a program to implement a login window using above UI controls.
	C	Develop a program to implement Checkbox.
	D	Develop a program to implement Radio Button and Radio Group.
	E	Develop a program to implement Progress Bar.
5		Develop a program to implement List View, Grid View, Image View and Scroll View.
6	A	Develop a program to implement Custom Toast Alert.
	B	Develop a program to implement Date and Time Picker.
7	A	Develop a program to create an activity.
	B	Develop a program to implement new activity using explicit intent and implicit intent.
8	A	Develop a program to implement a content provider.
	B	Develop a program to implement service.
	C	Develop a program to implement a broadcast receiver.
	D	Develop a program to implement sensors.

9	A	Develop a program to build cameras.
	B	Develop a program for providing Bluetooth connectivity.
10		Develop a program for animation.
11	A	Perform Async task using SQLite.
	B	Create a sample application with a login module. (Check username and password) On successful login, Change TextView —Login Successfull. And on login fail, alert user using Toast —Login faill.
	C	Create a login application where you will have to validate username and password till the username and password is not validated, login button should remain disabled.
12	A	Develop a program to a) Send SMS b)Receive SMS.
	B	Develop a program to send and receive e-mail.
	C	Deploy map based application.

#### D. Recommended Study Material

S. No	Text Books:	Author	Edition	Publication
1.	Hello, Android Introducing Google's Mobile Development Platform	Ed Burnette	Ed Burnett 4th Edition, 2015	The Pragmatic Bookshelf
2.	Android Application Development in 24 Hours	Sams Teach	4th Edition, 2016	SAMS Teach Yourself
<b>Reference Book</b>				
1.	Head First Android Development: A Brain-Friendly Guide.			
2.	Android Programming for Beginners by John Horton, 2016.			
<b>Online Resources</b>				
1.	<a href="https://www.tutorialspoint.com/android">https://www.tutorialspoint.com/android</a>			
2.	<a href="https://www.tutorialspoint.com/android/android_advanced_tutorial.pdf">https://www.tutorialspoint.com/android/android_advanced_tutorial.pdf</a>			

**A. Course Outcomes: -**

CO	Cognitive Abilities	Students will be able to:
CO – 01	Remember	To remember the concept of interfacing in Raspberry Pi.
CO – 02	Understand	To understand the use of an MCU Raspberry Pi to identify various sensors
CO – 03	Apply	To create the circuit by implementing the ultrasonic and IR sensor using Pi
CO – 04	Analyze	To create a small program using an MCU, sensors, and actuators in Python
CO – 05	Evaluate	To control the device by using the programs written in Python compiled on the Pi microcontroller

**B. CO-PO-PSO Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	-	-	-	-	-	-	-	-	-	3	2	-	-
CO2	3	3	3	2	-	-	-	-	-	-	-	-	2	3	-	-
CO3	1	-	-	-	-	-	-	-	-	-	-	-	3	2	-	-
CO4	2	2	-	2	2	-	-	-	-	-	-	-	-	2	-	-
CO5	2	2	2	-	-	-	-	-	-	-	-	-	-	3	-	-
Wt. AVG	2.2	2.3	2.7	2.0	2.0	-	-	-	-	-	-	-	2.7	2.4	-	-

**C. LIST OF EXPERIMENTS**

1	Interface digital I/O switch -LED Turn ON & OFF.
2	Automatic Identification Based on an IR sensor, an Ultrasonic sensor with Raspberry Pi.
3	Controlling the LED blink rate with the potentiometer, interfacing with the Raspberry Pi.
4	Display the entered Keypad message in the serial monitor.
5	Acquired Analog Sensor signal data (LDR/LM35) and display on LCD.
6	Interface Digital I/O-LED-Turn ON LED.
7	Interfacing the Active Buzzer with Arduino or Python.
8	Interface Digital I/O-LED-Turn ON LED.
9	Send or receive SMS using GSM in Raspberry Pi.
10	Interface Pi with the display service (RGB LED) to convey signal information.
11	Pi is connected with the Actuator. Pi Connected with LDR sensor.
12	Pi is connected with a PIR sensor and also the Cloud to write data. Pi connected with an LDR sensor and cloud to read data.

**D. Recommended Study Material**

S. No	Text Books:	Author	Edition	Publication
1	Raspberry Pi Projects for Dummies	Mike Cook, Jonathan Evans, Brock Craft	Oct 2015, I Edition	A Wiley Brand
2	Programming the Raspberry Pi	Simon Monk McGraw-Hill	2nd Edition, 2015	Mc Graw Hill Education
<b>Reference Book</b>				
1.	Deploying Raspberry Pi in the Classroom by Guy Hart-Davis			
<b>Online Resources</b>				
1.	<a href="https://www.raspberrypi.com/software/">https://www.raspberrypi.com/software/</a>			

**A. Course Outcomes: -**

CO	Cognitive Abilities	Students will be able to:
CO – 01	Remember	Recall fundamental concepts of software testing, including types of testing (e.g., unit testing, integration testing, system testing, acceptance testing), testing strategies (e.g., black-box testing, white-box testing), and testing techniques (e.g., equivalence partitioning, boundary value analysis).
CO – 02	Understand	Understand the principles and objectives of software testing, such as ensuring software quality, detecting defects, and validating software functionality against requirements.
CO – 03	Apply	Apply software testing techniques by writing test cases, test plans, and test scripts for various software modules or components, utilizing testing frameworks (e.g., JUnit, Selenium) and tools (e.g., TestNG, JIRA) to automate testing processes and execute test suites.
CO – 04	Analyze	Analyze software requirements documents and system specifications to derive test scenarios and identify testable features, ensuring comprehensive coverage of software functionality and validation of non-functional requirements (e.g., performance, security).
CO – 05	Evaluate	Evaluate the effectiveness of software testing strategies and methodologies employed during the lab, assessing their ability to detect defects, improve software quality, and ensure compliance with user requirements, and provide recommendations for refining testing approaches.

**B. CO-PO-PSO Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2	3	-	-	-	-	2	-	2	-	-	-	-
CO2	3	2	2	2	3	-	-	1	1	2	-	2	-	-	2	-
CO3	2	2	2	3	3	-	-	-	-	1	-	2	-	-	2	-
CO4	2	3	3	2	3	-	1	-	2	2	2	2	-	-	2	-
CO5	3	3	3	2	3	-	1	1	2	3	2	3	-	-	2	-

**C. List of Experiments**

1	<p>Find the test cases and coverage using JaButi.Tool</p> <p>Write a program that calculates the area and perimeter of the circle. And find the Coverage &amp; Test Cases of that program.</p> <p>Write a program which read the first name and last name from console and matching with expected result.</p> <p>Write a program that takes three double numbers from the java console representing , respectively, the three coefficients a,b, and c of a quadratic equation.</p>
2	<p>Write a program that reads commercial website URL from a url from file .you should expect that the URL starts with www and ends with .com. retrieve the name of the site and output it. For instance, if the user inputs www.yahoo.com, you should output yahoo. After that find the test cases and coverage using JaButi.</p>
3	<p>Write a program that reads two words representing passwords from the java console and outputs the number of characters in the smaller of the two. For example, if the words are open and sesame, then the output should be 4, the length of the shorter word, open. And test this program using JaButi.</p>
4	<p>Analyze the performance of the following website using JMeter.</p> <p>Site Amazon Website Amazon.com Type shopping.</p> <p>Flipkart Flipkart.com shopping.</p> <p>Railway reservation Irctc.co.in Ticket booking site.</p> <p>Train searching Erail.in Train searching.</p>
5	<p>Calculate the coverage analysis of given programs using EclEmma Free open source Tool.</p> <p>Write a program that takes three double numbers from the java console representing , respectively, the three coefficients a,b, and c of a quadratic equation.</p>

	Write a program that calculates the area and perimeter of the circle. And find the Coverage and Test Cases of that program. Write a program which read the first name and last name from console and matching with expected result.
6	Find the Pass or fail test cases using unit testing tool Junit
7	Find the Pass or fail test cases using unit testing tool TestNG.
8	Calculate the mutation score of programs using jumble Tool: Write a program which read the first name and last name from the console and matches with the expected result. Write a program that calculates the area and perimeter of the circle. And find the Coverage & Test Cases of that program. Write a program that takes three double numbers from the java console representing , respectively, the three coefficients a,b, and c of a quadratic equation.
9	Generate Test sequences and validate using Selenium tool for given websites below: a. Site Amazon Website Amazon.com Type shopping b. Flip kart Flipkart.com shopping c. Railway reservation Irctc.co.in Ticket booking site d. Train searching Erail.in Train searching
10	Write a program for a calculator and find the test case and coverage and Def-use-graph.

#### D. Recommended Study Material

S. No	Text Books:	Author	Edition	Publication
1.	Software Testing-Principle and Practices	Naresh Chauhan	3rd	Oxford
2.	Fundamentals of Software Engineering,	RajibMall	PHI	2018
<b>Reference Book</b>				
1.	The Art of Software Testing, 3rd Edition by Glenford J. Myers, Corey Sandler, Tom Badgett.			
2.	Software Testing, 2nd Edition by Ron Patton			
<b>Online Resources</b>				
1.	<a href="https://www.javatpoint.com/software-testing-tutorial">https://www.javatpoint.com/software-testing-tutorial</a>			
2.	<a href="https://www.guru99.com/software-testing.html">https://www.guru99.com/software-testing.html</a>			

**A. Course Outcomes: -**

CO	Cognitive Abilities	Students will be able to:
CO – 01	Remember	Remember basic ASP.Net concepts, terminologies, and development environment.
CO – 02	Understand	Understand Understand the structure and components of ASP.Net applications.
CO – 03	Apply	Apply Implement form handling, validation, and state management in ASP.Net applications.
CO – 04	Analyze	Analyze Analyze the functionality and performance of ASP.Net applications.
CO – 05	Evaluate	Evaluate Evaluate the security aspects and best practices in ASP.Net applications.

**B. CO-PO-PSO Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-	3	1	-	-
CO3	-	2	2	1	2	-	-	-	-	-	-	-	3	2	-	-
CO4	-	2	1	2	2	-	-	-	1	-	-	-	1	2	-	3
CO5	-		2	1	1	-	1	-	1	-	-	-		1	2	2

**C. List of Experiments**

1	Write a program to display the addition using the windows application.
2	Write a program to perform all string operations using windows application.
3	Write a program for simple calculator using windows application.
4	Write a program working with page using ASP.NET.
5	Write a program working with forms using ASP.NET.
6	Write a program working with validation controls.
7	Write a program for connectivity with Oracle database.
8	Write a program to perform WebPartManager Control.
9	Write a program to access data source through ADO.NET.
10	Write a program to manage the session.
11	Write a program to perform a GridView Control.
12	Develop an applet that displays a simple message in center of the screen.
13	Design and develop a first MVC application.
14	Design and develop the new web API project.

**D. Recommended Study Material**

S. No	Text Books:	Author	Edition	Publication
1.	ASP.NET 4.5 in simple steps	Kogent Learning Solutions Inc.	Ed Burnett 4th Edition, 2015	Fourth Learning Solutions
2.	Programming ASP.NET Core	Dino Esposito	4th Edition, 2016	Professional Edition Microsoft
<b>Reference Book</b>				
1.	The Complete Reference ASP.NET Matthew MacDonald Indian Edition			
<b>Online Resources</b>				
1.	<a href="https://www.w3schools.com">https://www.w3schools.com</a>			
2.	<a href="https://www.udemy.com/courses/search/?src=ukw&amp;q=ASP.NET">https://www.udemy.com/courses/search/?src=ukw&amp;q=ASP.NET</a>			

## A. Course Outcomes: -

CO	Cognitive Abilities	Course Outcomes
CO – 01	Remember/ Apply	Install and configure virtualization tools like VirtualBox or VMware to create and run virtual machines.
CO – 02	Understand/ Apply	Demonstrate the creation, configuration, and management of AWS EC2 instances using Red Hat AMIs.
CO – 03	Apply	Perform essential AWS storage operations including creating S3 buckets, managing files, and assigning IAM permissions.
CO – 04	Analyze	Configure and manage IAM roles, policies, and users for secure access control in AWS environments.
CO – 05	Evaluate	Deploy and manage cloud applications using EC2 or Elastic Beanstalk and evaluate migration checklists for cloud readiness.

## B. CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	2	-	-	-	-	2	-	3	2	-	2	3
CO2	2	-	3	-	2	-	-	-	-	-	-	2	-	-	2	3
CO3	2	2	3	-	3	-	-	-	-	-	-	2	-	-	3	3
CO4	2	3	3	2	3	-	-	-	-	-	-	3	-	2	2	3
CO5	2	3	3	-	3	-	-	-	-	-	-	3	-	-	2	3

## C. List of Experiments

1	Install and configure VirtualBox or VMware Workstation
2	Create and Run a Virtual Machine (VM) on VirtualBox
3	Introduction of AWS – EC2 ,Types of EC2 services.
4	How to create Instance in EC2 AWS service with the help of Redhat AMI.
5	Create a custom AMI, launch instance from AMI.
6	Create bucket, upload/download files, set permissions.
7	Create IAM user with assign S3 full access permission.
8	Configure IAM roles and policies.
9	Deploy a web app (PHP/Node.js) on AWS EC2 or Elastic Beanstalk.
10	Create a migration checklist for a sample on-prem app .
11	Modify EC2 security group to allow specific traffic.
12	Understand physical vs virtual Partitioning.

## D. Recommended Study Material

S. No	Text Books:	Author	Edition	Publication
1	Mastering VMware vSphere 6.7	Martin Gavanda, Andrea Mauro	2nd Edition	Packt Publishing
2	Cloud Computing: Principles and Paradigms	Rajkumar Buyya	1st Edition	Wiley
3	Learning Docker	Jeeva S. Chelladurai	2nd Edition	Packt Publishing
Reference Book				
1	<a href="https://www.geeksforgeeks.org/cloud-computing">https://www.geeksforgeeks.org/cloud-computing</a>			
2.	<a href="https://www.tutorialspoint.com/cloud_computing">https://www.tutorialspoint.com/cloud_computing</a>			

**Minor Courses**

**Professional Elective: Laborites**

**(Artificial Intelligence and Data Science)**

**Batch: 2025-29**

**A. Course Outcomes: -**

CO	Cognitive Abilities	Students will be able to:
CO – 01	Remember	Apply statistical methods for data exploration and visualization.
CO – 02	Understand	Utilize R for data preprocessing, cleaning, and transformation.
CO – 03	Apply	Implement R packages for machine learning and predictive modeling.
CO – 04	Analyse	Apply and analyze regression, classification, and clustering techniques.
CO – 05	Evaluate	Evaluate and communicate results from data analysis.

**B. CO-PO-PSO Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
CO1	3	-	3	-	-	-	-	-	-	-	-	-	3	-	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-	2	2	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO4	-	-	-	3	2	-	-	-	-	-	-	-	-	-	2	-
CO5	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-

**C. List of Experiments**

1	Read a dataset into a Pandas DataFrame and display the first few rows using the "head" function in Python.
2	Work with Pandas and Xlsx Writer.
3	Work with CSV files in Python and apply preprocessing techniques such as Scaling, Normalization, Binarization, Standardization, and Data Labeling, as well as divide the data into train and test split.
4	Implement Simple Linear Regression to predict house prices using datasets from any data source.
5	Implement Logistic Regression to predict car prices in Python.
6	Use Logistic Regression to recognize hand-written digits (0 to 9) by loading the dataset from any data source in Python.
7	Build a classifier on a set of email data and determine if they are spam or not using SVM in Python.
8	Implement Decision Tree classifier on the Pima Indian Diabetes dataset in Python.
9	Implement Random Forest classification in Python on the Iris dataset from its web link.
10	Use Naïve Bayes with training examples of individuals categorized into high, medium, and low credit-worthiness in Python.
11	Implement K-means clustering on a simple digits dataset. K-means will try to identify similar digits without using the original label information in Python.
12	Implement the Mean-Shift algorithm on a 2D dataset containing 4 different blobs in Python.

**D. Recommended Study Material**

S. No	Text Books:	Author	Edition	Publication
1	Machine Learning - An Algorithmic Perspective	Stephen Marsland	2nd Edition	Routledge
2	Data Mining: Concepts and Techniques	Jiawei Han and Micheline Kamber	2nd Edition	Elsevier
<b>Reference Book</b>				
1.	Introduction to Machine Learning, 3 <sup>rd</sup> Edition (Adaptive Computation and Machine Learning Series), Ethem Alpaydin, Third Edition, MIT Press			
2.	Machine Learning: The Art and Science of Algorithms that Make Sense of Data, Peter Flach, 1 <sup>st</sup> Edition, Cambridge University Press			
<b>Online Resources</b>				
1	<a href="https://nptel.ac.in/courses/106106182">https://nptel.ac.in/courses/106106182</a>			

**A. Course Outcomes: -**

CO	Cognitive Abilities	Students will be able to:
CO – 01	Remember Apply	Recall the fundamental components of an artificial neuron and apply basic Python operations to simulate its decision-making process and visualize key activation functions.
CO – 02	Understand Apply	Understand how "error" is quantified in machine learning models and apply simple adjustments to training parameters to observe their immediate impact on a model's learning behavior.
CO – 03	Apply	Apply the core concepts of convolution and pooling by manually or programmatically demonstrating their effects on small image-like data grids for feature extraction and dimensionality reduction.
CO – 04	Analyze	Analyze how information can be carried forward through sequential steps in a basic program, demonstrating the intuitive concept of "memory" in sequence processing.
CO – 05	Evaluate	Evaluate the observable performance and behavior of simple learning models by interpreting basic outputs and identifying high-level signs of issues like overfitting.

**B. CO-PO-PSO Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	2	3	-	-	-	-	-	-	-	1	-	3	-
CO2	3	2	-	2	3	-	-	-	-	-	-	-	1	-	1	-
CO3	3	2	-	2	3	-	-	-	-	-	-	-	3	-	2	-
CO4	2	3	-	3	3	-	-	-	-	-	-	-	1	-	1	-
CO5	2	2	-	3	3	-	-	-	-	-	-	-	1	-	1	-

**C. List of Experiments**

1	Implement and train a simple MLP for classification
2	Build a simple feedforward neural network using Keras for handwritten digit recognition. Focus on dense layers, ReLU, Softmax, and categorical cross-entropy.
3	Develop a Multi-Layer Perceptron (MLP) for MNIST Digit Classification
4	Train the MLP from Experiment 2, but this time compare the performance when using different activation functions (e.g., Sigmoid vs. ReLU vs. Tanh) in the hidden layers.
5	Create two NN models to demonstrate underfitting and overfitting.
6	Build and train a simple CNN for image classification.
7	Create a Basic RNN for Text Generation
8	Introduce Dropout Regularization on MNIST
9	Create a basic LSTM for binary classification of text.
10	Create a single Conv2D layer with 1 filter (e.g., kernel_size=(3,3), filters=1). Pass a sample image through it and display the single output feature map.
11	Train a simple RNN or LSTM model on a very short text sequence. After training, feed a short starting sequence to the model to predict the next character.
12	Train a simple RNN or LSTM model on a very short text sequence. After training, feed a short starting sequence to the model to predict the next character.

**D. Recommended Study Material**

S. No	Text Books:	Author	Edition	Publication
1	Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow	Aurelien Geron	Third Edition	O'Reilly
2	Deep Learning with Python	Francois Chollet	Manning, 2017	Manning
Reference Book				
1.	Neural Networks and Deep Learning, Second Edition, Charu C Agarwal, Springer, 2023			
2.	Deep Learning (Adaptive Computation and Machine Learning series), Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press, 2016			

**A. Course Outcomes: -**

CO	Cognitive Abilities	Students will be able to:
CO – 01	Remember / Apply	Recall and demonstrate fundamental image handling operations, including loading, displaying, and basic pixel-level manipulation using a programming library.
CO – 02	Understand / Apply	Understand and practically illustrate the effects of various image preprocessing techniques such as smoothing, enhancement, and binary operations on digital images.
CO – 03	Apply	Apply specific Computer Vision algorithms and tools to perform tasks like edge detection, feature detection, simple image segmentation, and template matching.
CO – 04	Analyze	Analyze and interpret the outputs of different image processing algorithms (e.g., comparing filter results, evaluating detected features) for given image data.
CO – 05	Evaluate	Evaluate the observable performance and suitability of basic Computer Vision techniques for simple classification and object detection tasks.

**B. CO-PO-PSO Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	-	-	2	-	-	-	-	-	-	1	1	-	2	-
CO2	3	2	1	1	3	-	-	-	-	-	-	1	2	-	2	-
CO3	3	3	2	2	3	-	-	-	-	-	-	2	3	-	3	-
CO4	3	3	1	3	2	-	-	-	-	1	-	2	3	-	2	-
CO5	3	3	2	3	3	1	-	1	-	1	-	3	3	-	2	-

**C. List of Experiments: -**

1	Load, display, and print properties (dimensions, pixel values) of an image.
2	Adjust image brightness/contrast and resize an image.
3	Add noise to an image and smooth it with a Gaussian filter.
4	Enhance image contrast using histogram equalization.
5	Detect edges in an image using the Canny edge detector.
6	Convert a grayscale image to binary using thresholding and apply an erosion operation.
7	Detect prominent corners in an image using a Harris corner detector.
8	Segment a specific color object from an image using color masking.
9	Find a small template image within a larger image using template matching.
10	Classify a small dataset of simple images using a K-Nearest Neighbors (K-NN) classifier based on basic image features (e.g., histograms).
11	Extract deep features from an image using a pre-trained Convolutional Neural Network (CNN).
12	Detect faces in an image using a pre-trained Haar Cascade classifier.

**D. RECOMMENDED STUDY MATERIAL**

S. No	Text Books:	Author	Edition	Publication
1	Computer Vision: Algorithms and Applications	Richard Szeliski	2nd Edition	Springer
2	Learning OpenCV 4 Computer Vision with Python 3	Joseph Howse, Joe Minichino, and OpenCV team	Third Edition	Packt Publishing
Reference Book				
1.	Digital Image Processing by Rafael C. Gonzalez and Richard E. Woods			
2.	Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow by Aurélien Géron			

## A. Course Outcomes: -

CO	Cognitive Abilities	Course Outcomes
CO – 01	Understand	Understand the core concepts of Natural Language Processing and implement neural embedding techniques for language representation.
CO – 02	Analyze	Design and evaluate deep sequence models using RNNs, LSTMs, and Transformer-based attention mechanisms.
CO – 03	Apply	Apply autoregressive models and prompt engineering techniques to generate coherent and contextually relevant text.
CO – 04	Apply	Fine-tune large language models using parameter-efficient techniques and apply alignment strategies such as RLHF and DPO.
CO – 05	Apply	Develop, integrate, and deploy generative NLP applications using open-source toolchains, while addressing ethical considerations.

## B. CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	POv1 1	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2	2	1	-	-	-	2	-	2	3	2	2	-
CO2	3	3	2	2	3	-	-	-	-	2	-	2	3	2	2	-
CO3	2	3	2	2	3	-	-	-	1	2	-	3	2	1	3	-
CO4	2	3	2	3	3	1	1	2	1	3	2	3	2	2	3	-
CO5	2	2	3	3	3	2	2	2	2	3	2	3	2	2	3	-
Wt. AVG	2.4	2.8	2.2	2.4	2.8	1.3	1.5	2.0	1.3	2.4	2.0	2.6	2.4	1.8	2.6	-

## C. List of Experiments

1	Implement basic NLP preprocessing steps (tokenization, stop word removal, stemming, lemmatization) using NLTK.
2	Train and visualize Word2Vec and GloVe embeddings on a custom corpus using Gensim and Pytorch.
3	Implement a sequence classification model using LSTM and evaluate it on sentiment analysis (IMDb/Twitter).
4	Build a transformer from scratch and train it for a masked language modeling task using a small dataset.
5	Generate coherent text using pre pre-trained GPT-2 model with zero-shot and few-shot prompts using Hugging Face.
6	Experiment with Chain-of-Thought prompting and instruction tuning using OpenAI API or LLaMA model.
7	Fine-tune a small LLM (e.g., DistilGPT2 or LLaMA) using LoRA/QLoRA on a custom dialogue dataset.
8	Perform alignment using RLHF or DPO and evaluate using BLEU/ROUGE/perplexity metrics.
9	Build a Retrieval-Augmented Generation (RAG) pipeline using LangChain + Hugging Face + FAISS.
10	Deploy a fine-tuned chatbot using FastAPI and vLLM with proper safety filters and ethical handling.

## D. Recommended Study Material

S.No.	Textbooks	Author	Edition	Publication
1	Deep Learning Book	Yoshua Bengio	2016	MIT Press
2	Probabilistic Machine Learning	Kevin Murphy	2022	MIT Press
Reference Book				
1	Dive into Deep Learning, 2023, Smola, Cambridge Press			
2	Transformers with Natural Language Processing, 2022, Rothman, Oreilly			
Online Resources				
1	Dive into Deep Learning — Dive into Deep Learning 1.0.3 documentation			

**A. Course Outcomes: -**

CO	Cognitive Abilities	Course Outcomes
CO – 01	Understand	Understand and apply tokenization strategies and Transformer-based language models to solve NLP tasks.
CO – 02	Analyze	Implement and fine-tune large language models to perform text generation, prompt engineering, and instruction-based learning.
CO – 03	Apply	Utilize CNNs and vision transformers to perform visual recognition, segmentation, and self-supervised learning on image data.
CO – 04	Apply	Design and evaluate generative models such as GANs, VAEs, and diffusion models to generate realistic text and image content.
CO – 05	Apply	Develop and deploy multimodal AI systems capable of linking vision and language through cross-modal generation and understanding.

**B. CO-PO-PSO Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	POv1 1	PO 12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2	2	1	-	-	-	2	-	2	3	2	2	-
CO2	3	3	2	2	3	-	-	-	-	2	-	2	3	2	2	-
CO3	2	3	2	2	3	-	-	-	1	2	-	3	2	1	3	-
CO4	2	3	2	3	3	1	1	2	1	3	2	3	2	2	3	-
CO5	2	2	3	3	3	2	2	2	2	3	2	3	2	2	3	-

**C. List of Experiments**

1	Implement Byte Pair Encoding (BPE) on a small corpus and train Word2Vec embeddings using gensim or PyTorch.
2	Load a pre-trained BERT model using Hugging Face Transformers and fine-tune it on the IMDB or SST-2 sentiment dataset.
3	Use OpenAI’s GPT-3 or Hugging Face GPT-2 to perform zero-shot and few-shot prompting tasks (e.g., summarization, Q&A, classification).
4	Fine-tune GPT-Neo (or LLaMA if resources permit) on a domain-specific corpus (e.g., legal or medical) for text generation.
5	Use Hugging Face or timm library to fine-tune a Vision Transformer on the CIFAR-10 or EuroSAT dataset.
6	Load Meta’s SAM model and apply it on custom images for zero-shot object segmentation.
7	Generate synthetic images from text prompts using Stable Diffusion via Hugging Face Diffusers.
8	Implement and train a GAN or VAE from scratch using PyTorch to generate handwritten digits from the MNIST dataset.
9	Use Salesforce’s BLIP-2 to generate image captions from a set of test images and evaluate them using BLEU or CIDEr scores.
10	Integrate LLaVA to create a chatbot that can answer questions based on uploaded images (Visual Question Answering).

**D. Recommended Study Material**

S.NO.	Textbooks	Author	Edition	Publication
1	Deep Generative Modelling	Jakub M. Tomczak	1st	Springer
2	GANs in Action	Jakub Langer and Vladimir Bok	1st	Manning Publications
<b>Reference Book</b>				
1	Dive into Deep Learning, Smola, 2023, Cambridge			
<b>Online Resources</b>				
1	Dive into Deep Learning — Dive into Deep Learning 1.0.3 documentation			

## A. Course Outcomes: -

CO	Cognitive Abilities	Students will be able to:
CO – 01	Apply	Understand and apply the basic of data analytics concepts of statistics and probability.
CO – 02	Understand	Apply the data processing techniques on Data Frame using Python Libraries.
CO – 03	Implement	Implement and evaluate the data analytics techniques using MATLAB, R and Python tools.
CO – 04	Evaluate	Able to evaluate or assess models with the large volume of data with the help of modern tools
CO – 05	Explain	Define and explain to python for data cleaning and visualization as a data analytics tool.

## B. CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	1	1									2			1
CO2	1	1	1	1	1				1			1	1	2		1
CO3	1	1		1	1							1		2	2	1
CO4		1		1	1				1	1			2		1	
CO5		1	1	2					1	1		2	2		2	
Wt. AVG	1.0	1.7	1.5	2.0	1.5	-	-	-	3.0	-	-	2.0	3.5	2.0	5.0	1.0

## C. List of Experiments

Exp No	Experiment
1	Write a Python Program to Get Total Price of all FuelType from Toyota.csv file and show it using a line plot with the following Style properties. Generated line plot must include following Style properties: <ul style="list-style-type: none"> <li>Line Style dotted and Line-color should be red</li> <li>Show legend at the lower right location.</li> <li>X label name = Fuel Type,                      • Y label name = Price</li> <li>Add a circle marker.,                      • Line marker color as red</li> <li>Line width should be 3</li> </ul>
2	Write a Python Program to Read 'Petrol' and 'CNG' FuelType sales data from Toyota.csv file and show it using the bar chart
3	Write a Python program to create and display a DataFrame from a specified dictionary data which has the index labels. exam_data = {'name': ['Dinesh', 'Suresh', 'Rahul', 'Ravi', 'Manoj', 'Hari', 'Yatharth', 'Saurabh', 'Kapil', 'Salini'], 'score': [12.5, 9, 16.5, np.nan, 9, 20, 14.5, np.nan, 8, 19], 'attempts': [1, 3, 2, 3, 2, 3, 1, 1, 2, 1], 'qualify': ['yes', 'no', 'yes', 'no', 'no', 'yes', 'yes', 'no', 'no', 'yes'] labels = ['a', 'b', 'c', 'd', 'e', 'f', 'g', 'h', 'i', 'j']
4	Write a Python program to display a summary of the basic information like index, columns, non null values of each column, memory usage etc. about a specified DataFrame which is Toyota.csv.
5	WAP in Python to insert a column named "AGE_IN_MONTH" and then fill the values into inserted column on the basis of "AGE" column using user defined function where function return a value. AGE_IN_MONTH=AGE*12
6	Write a program that accepts a sequence of words as input and write the words in a comma-separated sequence file after sorting them alphabetically.
7	WAP in Python to copy line-by-line contents of a file into another file.
8	WAP to enter characters one by one and then stored lower characters in the LOWER file and upper characters stored in the UPPER file and other characters stored in the OTHER file.
9	Explain and Understand the steps to solve the following system of linear equations using MATLAB: $2x-3y+4z=5$ $y+4z+x=10$ AND $-2z+3x+4y=0$
10	The dataset Toyota.csv may be found on the web page. This dataset contains Car information: Price, Age, KM, FuelType, KM, CC and Doors. Save this file and use read.table to import it into R. What are the means and standard deviations of the data variables (excluding Age)? Apply Data Analytic tool.

**A. Course Outcomes: -**

CO	Cognitive Abilities	Students will be able to:
CO – 01	Remember Apply	To define and implement key MLOps concepts and ML lifecycle stages.
CO – 02	Understand Apply	To use tools for version control, experiment tracking, and model packaging.
CO – 03	Apply	To implement CI/CD pipelines and containerized deployments.
CO – 04	Analyze	To analyze deployment strategies and infrastructure needs.
CO – 05	Evaluate	To evaluate model monitoring, security, and governance in MLOps pipelines.

**B. CO-PO-PSO Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	3	-	-	-	-	-	-	-	3	2	2	-
CO2	3	2	3	2	3	-	-	-	-	-	-	-	3	3	2	-
CO3	3	3	3	2	3	-	-	-	-	-	-	-	3	3	2	-
CO4	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3	-
CO5	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3	-

**C. List of Experiments**

1	To implement an end-to-end ML lifecycle to predict customer churn for a telecom company.
2	To use Git and GitHub to version control ML code for a fintech fraud detection pipeline.
3	To apply DVC to manage and version sentiment analysis datasets in an e-commerce platform.
4	To serialize a loan approval model using Pickle and ONNX for cross-platform deployment.
5	To develop and serve a movie recommendation system as a REST API using FastAPI.
6	To containerize diabetes prediction model using Docker for hospital cloud deployment.
7	To create a CI/CD pipeline to automate insurance risk model deployment.
8	To deploy a face detection model for real-time access control using TensorFlow Serving or KServe
9	To perform A/B testing to compare CTR prediction model versions in a digital ad platform.
10	To monitor performance of a stock price prediction model using Prometheus and Grafana.
11	To detect and alert model drift in a deployed weather forecasting application.
12	To use SHAP and LIME to explain credit card fraud model predictions for audit compliance.

**D. Recommended Study Material**

S. No	Text Books:	Author	Edition	Publication
1	Introducing MLOps: How to Scale Machine Learning in the Enterprise	Mark Treveil, Alok Shukla	1 <sup>st</sup> Edition	O'Reilly Media, 2021
2	Machine Learning Engineering	Andriy Burkov	1 <sup>st</sup> Edition	True Positive Inc., 2020
<b>Reference Book</b>				
1.	Practical MLOps: Operationalizing Machine Learning Models, Noah Gift, O'Reilly Media, 2021			
2.	Building Machine Learning Pipelines: Automating Model Life Cycles with TensorFlow Hannes Hapke, Catherine Nelson, O'Reilly Media, 2020			
3.	Kubeflow for Machine Learning: From Lab to Production Trevor Grant, Holden Karau et al., O'Reilly Media, 2020			

**Minor Courses**  
**Professional Elective: Laborites**

**(Cyber Security)**

**Batch: 2025-29**

**A. Course Outcomes: -**

CO	Cognitive Abilities	Students will be able to:
CO – 01	Remember	Recall fundamental ethical hacking tools and terminologies used in setting up penetration testing environments.
CO – 02	Understand	Explain the concepts and techniques of passive and active reconnaissance using OSINT and enumeration tools.
CO – 03	Apply	Demonstrate the use of scanning, packet sniffing, and brute force tools to identify and exploit vulnerabilities in network and web applications.
CO – 04	Analyze	Analyze network traffic and exploit attempts to detect potential vulnerabilities, such as session hijacking and exposed services.
CO – 05	Evaluate	Evaluate the security posture of a simulated target through a full-scope ethical hacking assessment and prepare a structured penetration testing report.

**B. CO-PO-PSO Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	–	–	–	2	–	–	2	–	–	–	–	1	2	–	1
CO2	2	2	–	–	3	–	–	–	1	–	–	–	2	2	1	1
CO3	3	3	2	2	3	–	–	–	2	–	–	–	3	3	2	2
CO4	2	3	2	3	3	–	–	–	2	–	–	–	3	3	2	2
CO5	2	2	3	2	2	–	–	2	2	–	–	–	2	2	1	3

**C. List of Experiments**

1	Ethical Hacking Lab Setup (Set up Kali Linux, Explore basic pentesting tools like Nmap, Netcat, and Burp Suite)
2	Reconnaissance: Passive OSINT Gathering (Use Google Dorking, Shodan, and GitHub to gather information on a target domain.)
3	Active Recon: Subdomain and Directory Enumeration (Perform subdomain enumeration using tools like Amass, Sublist3r, and Assetfinder.)
4	Service Enumeration and Network Scanning (Scan the target network for open ports and services using Nmap, RustScan, and Masscan)
5	Packet Capture and Sniffing Analysis (Capture network traffic with Wireshark and Tcpdump.)
6	Session Hijacking Techniques (Demonstrate cookie theft and sidejacking)
7	Exploitation with Metasploit Framework (Use Metasploit to exploit a known vulnerable service)
8	Password Cracking and Brute Forcing (Use Hydra and other brute force tools on FTP, SSH, or HTTP login forms).
9	Burp Suite Proxy, Intruder, Repeater Demo
10	Mini Project : End-to-End Ethical Hacking Assessment

**D. Recommended Study Material**

S. No	Text Books:	Author	Edition	Publication
1.	The Basics of Hacking and Penetration Testing	Patrick Engebretson	2nd Edition, 2013	Syngress
2.	Penetration Testing: A Hands-On Introduction to Hacking	Georgia Weidman	1st Edition, 2014	No Starch Press
<b>Reference Book</b>				
1.	Advanced Penetration Testing: Hacking the World's Most Secure Network, Wil Allsop, Wiley			
2.	The Hacker Playbook 3: Practical Guide To Penetration Testing, Peter Kim, Independently published			
<b>Online Resources</b>				
1.	<a href="https://portswigger.net/web-security">https://portswigger.net/web-security</a>			
2.	<a href="https://tryhackme.com">https://tryhackme.com</a>			

**A. Course Outcomes: -**

CO	Cognitive Abilities	Students will be able to:
CO – 01	Remember	Recall fundamental database security concepts such as authentication, authorization, encryption, and auditing. Define terms related to database threats, vulnerabilities, and security mechanisms.
CO – 02	Understand	Explain the principles behind various database security models, including Discretionary Access Control (DAC) and Role-Based Access Control (RBAC). Describe common database vulnerabilities like SQL injection and their potential impact. Summarize the importance of secure backup and recovery procedures.
CO – 03	Apply	Implement user accounts, roles, and privileges within a database management system (DBMS) to enforce access control. Apply data encryption techniques to protect sensitive information stored in a database. Utilize secure coding practices to prevent SQL injection vulnerabilities in database applications.
CO – 04	Analyze	Identify and analyze potential vulnerabilities in a given database system or application. Compare and contrast different database security mechanisms and models to determine their suitability for specific scenarios. Interpret audit logs and security reports to detect and assess security incidents.
CO – 05	Evaluate	Assess the strengths and weaknesses of various access control models and security configurations in a database system. Evaluate the effectiveness of implemented security controls and propose improvements. Recommend appropriate security measures and remediation strategies for identified database vulnerabilities.

**B. CO-PO-PSO Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1										1	2	1		
CO2	3	2	1									1	2	2		
CO3	3	3	3	2	2							2	3	3	1	
CO4	2	3	2	3	2		1					2	3	3	2	
CO5	2	2	3	2	1	2	1	1				3	3	2	2	1
Wt. AVG	2.6	2.2	2.3	2.3	1.7	2.0	1.0	1.0	-	-	-	1.8	2.6	2.2	1.7	-

**C. List of Experiments**

Exp No.	Experiment Title	Objective	Tasks
1	Exploring User Accounts and Access Control	To understand how to create and manage database user accounts with varying levels of privileges.	<ul style="list-style-type: none"> <li>- Create different user accounts (e.g., administrator, standard user, read-only).</li> <li>- Grant and revoke specific privileges (e.g., SELECT, INSERT, UPDATE, DELETE) on different tables.</li> <li>- Log in as each user and verify their access.</li> </ul>
2	Implementing Strong Password Policies and Account Lockout	To enforce strong password policies and configure account lockout mechanisms to deter brute-force attacks.	<ul style="list-style-type: none"> <li>- Implement a strong password policy (minimum length, complexity).</li> <li>- Configure automatic account locking after failed login attempts.</li> <li>- Test login attempts to trigger and observe account lockout.</li> </ul>
3	Demonstrating and Preventing SQL Injection Attacks	To understand how SQL injection attacks work and learn techniques to prevent them.	<ul style="list-style-type: none"> <li>- Set up a vulnerable web application connected to a database.</li> <li>- Perform a SQL injection attack to gain unauthorized access or extract data.</li> </ul>

			<ul style="list-style-type: none"> <li>- Implement parameterized queries or prepared statements to prevent SQL injection.</li> <li>- Re-test the application to confirm prevention effectiveness.</li> </ul>
4	Exploring Different Data Encryption Techniques	To learn about different encryption algorithms and their application in database security.	<ul style="list-style-type: none"> <li>- Use symmetric keys (e.g., AES) to encrypt and decrypt sensitive data within the database.</li> <li>- Experiment with field-level encryption for specific columns.</li> <li>- Observe the impact of encryption on storage and retrieval time.</li> </ul>
5	Implementing Database Auditing and Activity Monitoring	To set up and configure database auditing to detect suspicious activity.	<ul style="list-style-type: none"> <li>- Enable standard or fine-grained auditing for specific events (e.g., login attempts, data modifications).</li> <li>- Analyze audit logs or trails to identify unusual or unauthorized actions.</li> <li>- Implement measures to protect the integrity of the audit trail.</li> </ul>
6	Securing Communication Between Web Applications and Databases	To understand and implement secure communication protocols for web applications accessing databases.	<ul style="list-style-type: none"> <li>- Configure SSL/TLS for encrypted connections between the web server and the database server.</li> <li>- Test the application with and without encryption to observe the impact on security.</li> <li>- Implement input validation and output encoding to prevent cross-site scripting attacks.</li> </ul>
7	Conducting Vulnerability Assessment on a Database System	To learn how to scan for and identify vulnerabilities in a database system.	<ul style="list-style-type: none"> <li>- Use a vulnerability scanning tool or manual techniques to find weaknesses.</li> <li>- Identify known vulnerabilities and suggest remediation.</li> <li>- Create a report detailing findings and recommended actions.</li> </ul>
8	Implementing Secure Backup and Recovery Procedures	To learn how to create and manage secure database backups and test recovery processes.	<ul style="list-style-type: none"> <li>- Create regular, encrypted backups of the database.</li> <li>- Store backups securely, potentially off-site or across different storage locations.</li> <li>- Perform a test restore to verify integrity and availability of data.</li> </ul>
9	Restricting Network Access and Firewalling Database Ports	To limit network access to the database server using firewalls and network segmentation.	<ul style="list-style-type: none"> <li>- Configure a firewall to restrict access to database ports (e.g., close default ports).</li> <li>- Implement IP allowlists to limit database connections to trusted sources.</li> <li>- Test network connectivity from unauthorized sources to confirm access denial.</li> </ul>
10	Implementing the Principle of Least Privilege	To apply the principle of least privilege by granting only the minimum necessary permissions to users and applications.	<ul style="list-style-type: none"> <li>- Create a database user account for a web application and grant only necessary privileges (e.g., read-only for specific tables).</li> <li>- Attempt to perform unauthorized actions with this account and observe access denial.</li> <li>- Review and adjust privileges as needed to maintain least privilege.</li> </ul>
11	Updating and Patching Database Management Systems (DBMS)	To understand the importance of keeping DBMS software updated and applying security patches.	<ul style="list-style-type: none"> <li>- Identify available updates and security patches for the chosen DBMS.</li> <li>- Apply updates and patches to a test database environment.</li> <li>- Verify the functionality and security of the updated system.</li> </ul>
12	Securing Database User Accounts and Credentials	To implement best practices for securing database user accounts and handling credentials.	<ul style="list-style-type: none"> <li>- Avoid using default passwords and enforce strong password policies.</li> <li>- Store credentials securely, not in code or plain text.</li> <li>- Implement measures to deactivate or adjust account access when employees change roles or leave the company.</li> </ul>

#### D. Recommended Study Material

S. No	Text Books:	Author	Edition	Publication
1.	Database Systems: Design, Implementation, & Management	Thomas Connolly and Carolyn Begg	Current Edition	Pearson Education or Cengage Learning
2.	Database Security: Protecting Against Internal and External Threats	(Various)	(Various)	McGraw Hill, Springer, Pears on Education
<b>Reference Book</b>				
1	Handbook of Database Security: Applications and Trends	Michael Gertz and Sushil Jajodia (Editors)	2007 Edition	Springer US
2	Implementing Database Security and Auditing	Ron Ben Natan	Current Edition	Digital Press
3	Practical Oracle Security: Your Unauthorized Guide to Relational Database Security	Josh Shaul and Aaron Ingram	Current Edition	Syngress
<b>Online Resources</b>				
1.	Oracle Database Security Documentation and Resources			
2.	IBM Cloud database security best practices and resources			
3	OWASP (Open Web Application Security Project) documentation and guides			
4	SANS Institute Cyber Ranges and Training Programs			

## A. Course Outcomes: -

CO	Cognitive Abilities	Students will be able to:
CO – 01	Remember	Understand and implement classical and modern cryptographic algorithms
CO – 02	Understand	Analyze the strength and vulnerabilities of encryption and hashing techniques
CO – 03	Apply	Apply secure key generation, encryption, and decryption for data protection
CO – 04	Analyze	Demonstrate digital signatures, authentication protocols, and data integrity methods
CO – 05	Evaluate	Evaluate cryptographic algorithms for confidentiality, integrity, and authentication

## B. CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	1	1	-	-	-	1	-	-	3	2	-	-
CO2	3	3	3	2	2	1	-	-	-	-	-	-	3	2	-	-
CO3	3	2	3	3	2	1	-	-	1	-	-	-	3	3	-	-
CO4	2	2	2	2	2	1	-	-	1	-	-	-	2	3	-	-
CO5	2	2	3	3	3	2	-	-	-	-	-	-	3	3	-	-
Wt. AVG	2.6	2.2	2.6	2.4	2.0	1.2	-	-	1.0	1.0	-	-	2.8	2.6	-	-

## B. LIST OF EXPERIMENTS:

1	<b>Implement Caesar Cipher and Monoalphabetic Substitution Cipher</b> Practice classical encryption techniques and analyze their weaknesses.
2	<b>Design and Implement the Playfair Cipher and Vigenère Cipher</b> Explore polyalphabetic encryption schemes and frequency analysis resistance.
3	<b>Develop a Program for Hill Cipher Encryption and Decryption</b> Understand matrix-based encryption methods and invertibility conditions.
4	<b>Implement DES (Data Encryption Standard) Algorithm</b> Perform symmetric key encryption and analyze key scheduling.
5	<b>Design AES (Advanced Encryption Standard) for Data Protection</b> Explore various rounds, key sizes, and security features of AES.
6	<b>Apply RSA Algorithm for Secure Data Transmission</b> Generate public and private keys, encrypt/decrypt messages using RSA.
7	<b>Implement Hash Functions like MD5 and SHA-256</b> Understand integrity protection and how hash values are generated.
8	<b>Simulate Digital Signature Generation and Verification</b> Use hashing and asymmetric encryption to implement signature mechanisms.
9	<b>Use Diffie-Hellman Key Exchange Algorithm</b> Simulate secure key exchange over insecure channels.
10	<b>Implement Message Authentication Code (MAC) and HMAC Algorithms</b> Learn about data authentication and message integrity.
11	<b>Simulate a Secure File Transfer System using Symmetric and Asymmetric Encryption</b> Combine different cryptographic methods for end-to-end data security.
12	<b>Compare Performance and Security Levels of Cryptographic Algorithms</b> Analyze efficiency and resistance against attacks for RSA, AES, DES, etc.

### C. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Cryptography and Network Security	William Stallings	7th	Pearson
2.	Cryptography and Network Security	Behrouz A. Forouzan	1st	McGraw-Hill
3.	Understanding Cryptography	Christof Paar & Jan Pelzl	1st	Springer
<b>Reference Book</b>				
4	MariE-Helen Maras, "Computer Forensics: Cybercriminals, Laws, and Evidence", Jones & Bartlett Learning; 2nd Edition, 2014			
5.	Majid Yar, "Cybercrime and Society", SAGE Publications Ltd, Hardcover, 2nd Edition, 2013			
<b>Online Resources</b>				
6.	<a href="https://www.infosecinstitute.com/skills/learning-paths/computer-forensics/">https://www.infosecinstitute.com/skills/learning-paths/computer-forensics/</a>			
7.	<a href="https://www.edx.org/learn/computer-forensics">https://www.edx.org/learn/computer-forensics</a>			

**A. Course Outcomes: -**

CO	Cognitive Abilities	Course Outcomes
CO – 01	Remember	Learn and Implement the Private and public key cryptography algorithms
CO – 02	Understand	Understand Implementation of tools and techniques of Vulnerability analysis.
CO – 03	Apply	Monitoring the network and system traffic to find suspicious activity using IDS Tool.
CO – 04	Analyze	Analyze the Risk assessment for web application
CO – 05	Evaluate	Evaluate the Threat and Vulnerability analysis of the email system

**B. CO-PO-PSO Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	–	–	–	2	–	–	2	–	–	–	–	1	2	–	1
CO2	2	2	–	–	3	–	–	–	1	–	–	–	2	2	1	1
CO3	3	3	2	2	3	–	–	–	2	–	–	–	3	3	2	2
CO4	2	3	2	3	3	–	–	–	2	–	–	–	3	3	2	2
CO5	2	2	3	2	2	–	–	2	2	–	–	–	2	2	1	3

**C. List of Experiments**

1	Write a program in python/Java/JavaScript to implement Private and Public key encryption.
2	Write a program in <b>Python/Java/JavaScript</b> to <b>encrypt and decrypt data</b> using the generated <b>Public and Private Keys</b> .
3	Write a program in python to implement encryption and decryption of RSA – Public Key Cryptography Algorithm.
4	Installation of Intrusion detection System (IDS) tool.
5	Using IDS tool monitor the network and system traffic for any suspicious activity.
6	Installation Acunetix tool to perform web vulnerability analysis.
7	Case study on Threat and Vulnerability analysis of the email system.
8	Case study on Web application Vulnerability analysis using web Vulnerability scanners - acunetix .
9	Write test cases for Penetration Testing to perform Vulnerability Assessment.
10	Project on Vulnerability Analysis and Cyber Risk. (or) Project on Vulnerability Analysis on Network Security. (or) Project on Vulnerability Analysis on Computer Security.

#### D. RECOMMENDED STUDY MATERIAL

<b>Text Books:</b>	<b>Author</b>	<b>Edition</b>	<b>Publication</b>
Network Security Essentials: Applications and Standards	William Stallings	4 th Edition	Prentice Hall,
Introduction to Computer Security	Michael T Goodrich and Roberto Tamassia	2011	Addiaon Wesley
<b>Reference Book</b>			
2. Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software			
3. Michael Sikorski, Andrew Honig publisher Williampollock			
<b>Online Resources</b>			
i. <a href="https://www.edx.org/course/cybersecurity-risk-management">https://www.edx.org/course/cybersecurity-risk-management</a>			
ii. <a href="https://www.udemy.com/topic/computer-network/">https://www.udemy.com/topic/computer-network/</a>			
iii. <a href="https://www.researchgate.net/publication/344803532_information_security_Risk_Analysis">https://www.researchgate.net/publication/344803532_information_security_Risk_Analysis</a>			
iv. <a href="https://www.acuntetix.com">https://www.acuntetix.com</a>			

**A. Course Outcomes: -**

CO	Cognitive Abilities	Students will be able to:
CO – 01	Remember	Describe algorithms and processes used in cryptography for authentication and communication security
CO – 02	Understand	Analyze and design hash, MAC algorithms, and digital signatures
CO – 03	Apply	Gain knowledge about Intruders, Intruder Detection mechanisms, and malicious software
CO – 04	Analyze	Understand and analyze Data Encryption Standard
CO – 05	Evaluate	Apply cryptographic algorithms and techniques for future enhancements

**B. CO-PO-PSO Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	1	-	-	-	-	-	-	-	-	3	2	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-	-	3	2	-	-
CO3	2	2	3	3	2	1	-	-	-	-	-	-	3	3	-	-
CO4	2	3	3	3	2	-	-	-	-	1	-	-	3	3	-	-
CO5	2	2	3	3	3	1	-	-	-	-	-	-	3	3	-	-
Wt. AVG	2.4	2.4	2.4	2.4	2.3	1.0	-	-	-	1.0	-	-	3.0	2.6	-	-

**B. LIST OF EXPERIMENTS:**

1	Perform live and dead data acquisition using write blockers, ensuring chain of custody with tools like FTK Imager or Autopsy.
2	Hands-on disassembly of PCs/laptops to isolate hard drives or SSDs for forensic duplication using forensic bridges.
3	Boot Sequence and Power-On Self-Test (POST) Analysis
4	Analyze Linux directories, log files, shadow/passwd files, and bash history using open-source forensic tools like Sleuth Kit.
5	Investigate Time Machine backups, system logs, metadata, and keychain files from macOS environments.
6	Extract embedded metadata, recover deleted/hidden content, and detect steganography using tools like ExifTool and StegSolve.
7	Perform brute force, dictionary, and rainbow table attacks using Hashcat/John the Ripper on protected files and hashes.
8	Trace browsing history, analyze downloaded files, inspect cookies and cache, and identify malware behavior using Cuckoo Sandbox.
9	Perform logical recovery, slack space analysis, and bad sector cloning using tools like R-Studio or X-Ways.
10	Apply carving techniques to recover deleted or formatted files from portable storage using tools like PhotoRec and TestDisk.
11	Internet forensic and Malware analysis.
12	Data recovery techniques for Pen drive and CD

**D. RECOMMENDED STUDY MATERIAL**

S. No	Text Books:	Author	Edition	Publication
1.	Computer Forensics: Cybercriminals , Laws, and Evidence	MariE-Helen Maras	2nd	Jones & Bartlett Learning
3.	Cybercrime and Society	Majid Yar	2nd	Majid Ya
4.	802.11 Wireless Networks	Matthew Fast		O'relly
Reference Book				
4	MariE-Helen Maras, "Computer Forensics: Cybercriminals, Laws, and Evidence", Jones & Bartlett Learning; 2nd Edition, 2014			
6.	Majid Yar, "Cybercrime and Society", SAGE Publications Ltd, Hardcover, 2nd Edition, 2013			
Online Resources				
7.	<a href="https://www.infosecinstitute.com/skills/learning-paths/computer-forensics/">https://www.infosecinstitute.com/skills/learning-paths/computer-forensics/</a>			
8.	<a href="https://www.edx.org/learn/computer-forensics">https://www.edx.org/learn/computer-forensics</a>			

**A. Course Outcome: -**

CO	Cognitive Abilities	Course Outcomes
CO – 01	Remember	Identify various malwares and understand the behavior of malwares in real world applications.
CO – 02	Understand	Understand Implementation of different malware analysis techniques.
CO – 03	Apply	Learn the purpose of malware analysis.
CO – 04	Analyze	Analyze the malware behavior in windows and android.
CO – 05	Evaluate	Identify the various tools for wireless network analysis.

**B. CO-PO-PSO Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	-	-	-	2	-	-	2	-	-	-	-	1	2	-	1
CO2	2	2	-	-	3	-	-	-	1	-	-	-	2	2	1	1
CO3	3	3	2	2	3	-	-	-	2	-	-	-	3	3	2	2
CO4	2	3	2	3	3	-	-	-	2	-	-	-	3	3	2	2
CO5	2	2	3	2	2	-	-	2	2	-	-	-	2	2	1	3
Wt. AVG	3.7	5.0	7.0	7.0	4.3	-	-	4.0	3.5	-	-	-	3.7	4.0	3.0	3.0

**C. LIST OF EXPERIMENTS:**

1	Analyze MITM attacks using Wireshark and perform ARP spoofing simulation.
2	Perform static malware analysis on a PE file using tools like PESTudio and VirusTotal.
3	Perform dynamic malware analysis using Cuckoo Sandbox or Any.run and generate behavior reports.
4	Implement Android malware analysis using MobSF (Mobile Security Framework).
5	Identify web vulnerabilities using OWASP ZAP or Burp Suite and generate security reports.
6	Perform reverse engineering on a Windows executable using Ghidra or IDA Free.
7	Collect volatile and non-volatile data for forensic analysis (e.g., using FTK Imager).
8	Analyze network behavior of malware samples using TCPDump and Wireshark.
9	Simulate a phishing attack and demonstrate email spoofing detection techniques.
10	Compare various malware detection techniques: signature-based vs heuristic-based vs behavior-based.
11	Detect unauthorized wireless access points using Kismet and Aircrack-ng.
12	Perform vulnerability scanning on Wi-Fi networks using tools like Airodump-ng and Reaver.

**D. RECOMMENDED STUDY MATERIAL**

S.No	Book	Author	Edition	Publication
1	Malware Forensics Field Guide for Linux Systems	Cameron H. Malin	2014	Elsevier
2	Mobile Malware Attacks and Defense	Ken Dunham, Saeed Abu-Nimeh	2009	Elsevier
3	<b>802.11 Wireless Networks</b>	Matthew Fast		O'relly
<b>Reference Book</b>				
1. ErciFiliol, Computer Viruses: from theory to applications, Springer, 2005.				
2. Designing and Deploying 802.11 Wireless Networks				
<b>Online Resources</b>				
1. <a href="https://www.cybrary.it/resources/study-guides/comptia-security-plus/">https://www.cybrary.it/resources/study-guides/comptia-security-plus/</a>				
2. <a href="https://www.tutorialspoint.com/wireless_security/index.htm">https://www.tutorialspoint.com/wireless_security/index.htm</a>				

**A. Course Outcomes: -**

CO	Cognitive Abilities	Students will be able to:
CO – 01	Remember	Recall the fundamental principles of DevSecOps, including its phases, benefits, and the concept of "shifting left" security. Identify key security controls and types of vulnerabilities relevant to the software development lifecycle (SDLC).
CO – 02	Understand	Explain the role of automation in DevSecOps and how it streamlines security processes. Describe the functionality and purpose of common security testing tools (e.g., SAST, DAST, SCA) at different stages of the CI/CD pipeline. Summarize best practices for secure coding and threat modeling in an agile environment.
CO – 03	Apply	Implement automated security testing tools (e.g., SAST, SCA) within a CI/CD pipeline to detect code vulnerabilities and insecure dependencies. Configure infrastructure as code (IaC) security checks (e.g., Terraform, Ansible) to ensure secure provisioning of cloud resources. Utilize container scanning tools to identify vulnerabilities in container images.
CO – 04	Analyze	Evaluate the output of various security scanning tools and prioritize vulnerabilities based on severity and potential impact. Analyze security vulnerabilities identified in code, configurations, and deployed applications to determine root causes. Compare different security automation strategies and their effectiveness within a DevSecOps framework.
CO – 05	Evaluate	Assess the security posture of an application or infrastructure at different stages of the SDLC using DevSecOps metrics and compliance standards. Propose and evaluate solutions to mitigate identified security risks and improve the overall security of the CI/CD pipeline. Critique existing DevSecOps implementations and suggest improvements based on best practices.

**B. CO-PO-PSO Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2		1								1	2	1		
CO2	3	3	2	2								1	3	2		
CO3	3	3	3	3	3	1			1			2	3	3	1	
CO4	2	3	3	3	2	2	1		2	1		2	3	3	2	1
CO5	2	2	3	3	2	2	1	1	2	1		3	3	3	2	1
<b>Wt. AV G</b>	<b>2.6</b>	<b>2.6</b>	<b>2.8</b>	<b>2.4</b>	<b>2.3</b>	<b>1.7</b>	<b>1.0</b>	<b>1.0</b>	<b>1.7</b>	<b>1.0</b>	<b>-</b>	<b>1.8</b>	<b>2.8</b>	<b>2.4</b>	<b>1.7</b>	<b>-</b>

**C. List Of Experiments**

S.No	Experiment
1	Setting Up a Basic CI/CD Pipeline with Automated Unit Testing and Deployment.
2	Integrating Static Application Security Testing (SAST) Tool (e.g., SonarQube, Bandit) into the CI/CD Pipeline.
3	Implementing Software Composition Analysis (SCA) Tool (e.g., OWASP Dependency-Check, Snyk) for Vulnerable Dependency Detection.
4	Automating Dynamic Application Security Testing (DAST) Tool (e.g., OWASP ZAP) against a Web Application.
5	Performing Container Image Vulnerability Scanning (e.g., Trivy, Anchore) in the CI/CD Pipeline.
6	Implementing Infrastructure as Code (IaC) Security Scans (e.g., Checkov, KICS) for Cloud Configuration Management.
7	Automating Secret Detection (e.g., GitLeaks, Trufflehog) in Code Repositories and CI/CD Pipelines.
8	Configuring Security Policy Enforcement using Policy-as-Code (e.g., OPA Gatekeeper, Sentinel) in

	Kubernetes or Cloud Environments.
9	Implementing Automated Compliance Checks and Reporting (e.g., OpenSCAP, InSpec).
10	Setting Up Runtime Security Monitoring (e.g., Sysdig Falco) for Containerized Applications.
11	Exploring Threat Modeling Techniques (e.g., STRIDE, OWASP Cornucopia) in an Agile Development Context.
12	Building a Comprehensive Security Dashboard to Visualize and Track Vulnerabilities Across the SDLC.

#### D. Recommended Study Material

S. No	Text Books:	Author	Edition	Publication
1	DevSecOps: Delivering Secure Software at Speed	Aditya Pratap Bhuyan	2024	Aditya Pratap Bhuyan
2	Practical Security Automation and Testing: Tools and Techniques for Automated Security Scanning and Testing in DevSecOps	Tony Hsiang-Chih Hsu	2019	Packt Publishing
3	Implementing DevSecOps Practices: Understand Application Security Testing and Secure Coding by Integrating SAST and DAST	Vandana Verma Sehgal	2023	Packt Publishing
4	The DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations	Gene Kim, Patrick Debois, John Willis, Jez Humble	Current	IT Revolution
<b>Reference Book</b>				
1	DevSecOps - Security Scanning Tools in Enterprise CI/CD Pipeline	KARTHIKEYAN RAMDASS DR. LALIT KUMAR	2025	DeepMisti Publication
2	Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation	Jez Humble and David Farley	Current	Addison-Wesley Professional
3	Agile Application Security: Enabling Security in a Continuous Delivery Pipeline	Laura Bell, Michael Brunton-Spall, Rich Smith, and Jim Bird	Current	O'Reilly Media
<b>Online Resources</b>				
1.	GitHub Actions Documentation / GitLab CI/CD Documentation - Official documentation for CI/CD platforms.			
2.	Medium articles on DevSecOps and Security Automation - Numerous articles and tutorials by practitioners.			
3	Vendor Documentation (e.g., Veracode, Checkmarx, Snyk) - Specific tool usage guides and best practices.			

**Minor Courses**  
**Professional Elective: Laborites**  
**(Artificial Intelligence & Machine  
Learning (SAS))**

**Batch: 2025-29**

**A. Course Outcomes: -**

CO	Cognitive Abilities	Students will be able to:
CO – 01	Remember	Recall the steps in the analytical lifecycle, SAS Viya environment, and terminology
CO – 02	Understand	Comprehend business problem-solving approach and data preparation
CO – 03	Apply	Prepare, explore, and transform data; apply ML algorithms like decision trees
CO – 04	Analyze	Perform feature selection, compare ML models, analyze their performance
CO – 05	Evaluate	Evaluate and select the best model for deployment, assess real-world performance

**B. CO-PO-PSO Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	1	-	-	-	-	-	-	-	-	3	2	-	-
CO2	3	3	2	2	1	-	-	-	-	-	-	-	3	2	-	-
CO3	2	2	3	3	3	1	-	-	-	-	-	-	3	3	-	-
CO4	2	3	3	3	3	1	-	-	1	1	-	-	3	3	-	-
CO5	2	2	3	3	3	2	-	-	-	-	-	-	3	3	-	-
Wt. AVG	2.4	2.4	2.4	2.4	2.5	1.3	-	-	1.0	1.0	-	-	3.0	2.6	-	-

**B. List of programs**

1	Discuss the problem of machine learning in business decision making.
2	Essentials of supervised prediction
3	Data exploration, Feature extraction
4	Input transformations
5	Feature selection
6	Variable clustering
7	Decision tree introduction
8	Tree structure model
9	Recursive partitioning, Pruning
10	Ensembles of trees
11	Neural Networks Introduction, Network architecture
12	Network Learning and Optimization
13	Support vector machine: Large-margin linear classifier
14	Methods of solution
15	Non linear classifier: Kernel Trick
16	Additional tools
17	Model assessment and Deployment: Model assessment and comparison
18	Model deployment

**C. Recommended Study Material**

S. No	Text Books:	Author	Edition	Publication
1.	<b>Virtualization Essentials Paperback</b>	<b>Matthew Portnoy</b>	<b>Latest</b>	<b>Wiley Publication</b>
2.	<b>VMware Cookbook Paperback</b>	<b>Troy- Shroff</b>	<b>Latest</b>	<b>O'Reilly</b>
Reference Book				
1.	<b>Nelson Ruest, Danielle Ruest, Virtualization, A Beginner's Guide, McGraw Hill, 2009</b>			
2.	<b>Cloud Computing: Concepts Technology &amp; Architecture By Thomes Erl</b>			
Online Resources				
1.	<b><a href="https://www.javatpoint.com/virtualization-in-cloud-computing">https://www.javatpoint.com/virtualization-in-cloud-computing</a></b>			
2.	<b><a href="https://www.tutorialspoint.com/virtualization2.0/virtualization2.0_tutorial.pdf">https://www.tutorialspoint.com/virtualization2.0/virtualization2.0_tutorial.pdf</a></b>			

**A. Course Outcomes: -**

CO	Cognitive Abilities	Students will be able to:
CO – 01	Remember	Understand the core concepts of neural networks and basic structures
CO – 02	Understand	Learn real-world practices and applications of neural networks
CO – 03	Apply	Adjust essential parameters of models to solve different business problems
CO – 04	Analyze	Build autoencoders and analyze the accuracy/efficiency of neural architectures
CO – 05	Evaluate	Perform intelligent hyperparameter tuning and evaluate model performance

**B. CO-PO-PSO Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	1	-	-	-	-	-	-	-	-	3	2	-	-
CO2	3	3	2	2	1	-	-	-	-	-	-	-	3	2	-	-
CO3	2	2	3	3	3	1	-	-	-	-	-	-	3	3	-	-
CO4	2	3	3	3	3	1	-	-	1	1	-	-	3	3	-	-
CO5	2	2	3	3	3	2	-	-	-	-	-	-	3	3	-	-
Wt. AVG	2.4	2.4	2.4	2.4	2.5	1.3	-	-	1.0	1.0	-	-	3.0	2.6	-	-

**B. LIST OF EXPERIMENTS:**

1	Programmatically build neural networks in SAS 9.4 and SAS Viya.
2	Modify neural networks' parameters for better performance.
3	Conduct automatic search for neural networks' hyperparameters through genetic algorithms.
4	Enhance data with autoencoders and synthetic observations.

**C. RECOMMENDED STUDY MATERIAL**

S.No	Text Books:	Author	Edition	Publication
1	Cloud Computing: Principles and Paradigms	RajkumarBuyya, James Broberg, Andrzej M. Goscinski		John Wiley and Sons Publications
2	Cloud Computing For Dummies	Wesley J. Chun, Prentice Hall	1999	McGraw Hill International Edition
<b>Reference Book</b>				
1	Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online – Michael Miller - Que 2008			

**A. Course Outcomes: -**

CO	Cognitive Abilities	Students will be able to:
CO – 01	Remember	Understand the fundamentals of R programming including data types, control structures, and functions.
CO – 02	Understand	Apply R programming techniques to manipulate and analyze various data structures such as vectors, lists, matrices, and data frames.
CO – 03	Apply	Import, clean, and preprocess datasets from different file formats using appropriate R packages.
CO – 04	Analyze	Create various data visualizations in R to explore and communicate data insights effectively.
CO – 05	Evaluate	Perform statistical analysis and build basic regression models using R for informed decision-making.

**B. CO-PO-PSO Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	1	1	-	-	-	-	-	-	-	3	2	-	-
CO2	3	3	2	2	2	-	-	-	-	-	-	-	3	2	-	-
CO3	2	2	3	3	3	1	-	-	-	-	-	-	3	3	-	-
CO4	2	3	3	3	3	1	-	-	1	1	-	-	3	3	-	-
CO5	2	3	3	3	3	2	-	-	-	1	-	-	3	3	-	-
Wt. AVG	2.4	2.6	2.6	2.4	2.4	1.3	-	-	1.0	1.0	-	-	3.0	2.6	-	-

**B. LIST OF EXPERIMENT:**

1	To install R and RStudio and execute basic R commands in the console and script editor.
2	To demonstrate the use of variables, various data types, and operators in R.
3	To implement conditional statements such as if, if-else, and switch in R.
4	To explore looping constructs such as for, while, and repeat in R.
5	To create user-defined functions and understand the scope of variables.
6	To create and manipulate vectors and lists in R.
7	To understand multi-dimensional data structures such as matrices, arrays, and data frames.
8	To read data from external sources and write processed data to files.
9	To perform basic data cleaning operations on real-world datasets.
10	To create basic charts and plots for data representation.
11	To perform statistical analysis and hypothesis testing.
12	To implement linear and multiple regression models and visualize time series data.

**C. RECOMMENDED STUDY MATERIAL**

S. No	Text Books:	Author	Edition	Publication
	Big Data Fundamentals	Thomas Erl, Wajid Khattak, and Paul Buhler	1st or 2nd Edition	Pearson, Latest Edition.
2.	An Introduction to Statistical Learning with Applications in R	Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani	-	Springer
<b>Reference Book</b>				
1.	"Introductory Statistics with R", P Dalgaard, Second edition.			
2.	"Beginning R-The statistical Programming language", Mark Gardner, John Wiley & sons 2012, Latest Edition.			
3.	"An Introduction to R", Notes on R: A Programming Environment for Data Analysis and Graphics. W. N. Venables,			

	D.M. Smith and the R Development Core Team. Version3.0.1 (2013-05-16). URL: <a href="https://cran.rproject.org/doc/manuals/r-release/R-intro.pdf">https://cran.rproject.org/doc/manuals/r-release/R-intro.pdf</a>
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<b>Online Resources</b>	
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1.	<a href="https://www.kaggle.com/">https://www.kaggle.com/</a>
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2.	<a href="https://www.datacamp.com/">https://www.datacamp.com/</a>
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3.	Data Mining with R” by Great Learning or Simply learn on Youtube
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4.	<a href="https://www.r-project.org/">https://www.r-project.org/</a>
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## A. Course Outcomes: -

CO	Cognitive Abilities	Students will be able to:
CO – 01	Remember	Automatically create and fit custom forecast models using structured analytic workflows or pipelines.
CO – 02	Understand	Visualize modeling data using attribute variables.
CO – 03	Apply	Refine forecast models to improve forecast accuracy.
CO – 04	Analyze	Apply overrides-generated forecasts.
CO – 05	Evaluate	Generate forecast data sets for deployment.

## B. CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	1	3	1	-	-	-	-	-	-	3	2	-	-
CO2	2	1	2	2	2	1	-	-	-	-	-	-	3	2	-	-
CO3	2	2	3	3	3	1	-	-	-	-	-	-	3	3	-	-
CO4	3	2	2	3	3	2	-	-	-	-	-	-	3	3	-	-
CO5	2	2	2	2	3	1	-	-	-	-	-	-	3	2	-	-
Wt. AVG	2.2	1.8	2.0	2.2	2.8	1.2	-	-	-	-	-	-	3.0	2.4	-	-

## B. LIST OF EXPERIMENTS

1	Introduction and Data Visualization: Creating a forecasting project and loading the data
2	Visualizing the modeling data using attribute variables
3	Pipeline Essentials: Basic modeling with pipelines
4	Pipeline templates and pipeline comparison
5	Accuracy statistics and forecast model selection
6	Families of models supported.
7	Hierarchical Forecasting
8	Time series data creation and forecast reconciliation
9	Combined models
10	Honest assessment
11	Post-forecasting Functionality: ▪ Overrides
12	Exporting generated tables
13	Adjustments to statistical forecasting
14	In-Line Code Access and Overview (Appendix): Code overview
15	Accommodating Event Variables in a Model Studio Project (Appendix)
16	Adding event variables in the TSMODEL procedure

## C. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
	The Complete Reference Linux		Seventh Edition Mc graw hill	Seventh Edition Mc graw hill
	Linux Bible	Christopher Negus	Kindle Edition	Wiley
<b>Reference Book</b>				
1.	Windows 10 Portable, Wiley, Paul Mac Fedrics.			
2.	Desktop OS for Expert, Sayan Banerjee and Swati Goel			
<b>Online Resources</b>				
1.	<a href="https://www.youtube.com/watch?v=BGjTboXjH28">https://www.youtube.com/watch?v=BGjTboXjH28</a>			
2.	<a href="https://www.youtube.com/watch?v=g5d0dfq_Ew8">https://www.youtube.com/watch?v=g5d0dfq_Ew8</a>			

## A. Course Outcomes: -

CO	Cognitive Abilities	Students will be able to:
CO – 01	Remember	Recall the syntax and fundamental functions of the gym library for environment interaction and identify basic components of RL algorithms.
CO – 02	Understand	Explain the procedural steps involved in implementing iterative value estimation for MDPs and articulate the update rules for model-free control algorithms (e.g., Q-Learning, SARSA).
CO – 03	Apply	Construct and execute Python code to implement classic Reinforcement Learning algorithms such as Value Iteration, Monte Carlo Prediction, Q-Learning, and SARSA for discrete environments.
CO – 04	Analyze	Compare and contrast the performance and convergence behavior of different model-free RL algorithms (e.g., Q-Learning vs. SARSA) on common tasks, based on empirical results from their implementations.
CO – 05	Evaluate	Assess the suitability and effectiveness of a chosen RL algorithm for a given simple problem, critically evaluating its limitations and potential for improvement based on practical experimentation.

## B. CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	1	-	-	-	-	-	-	-	-	-	1	-	3	-
CO2	3	3	2	1	2	-	-	-	-	-	-	-	1	-	1	-
CO3	2	3	1	-	-	-	-	-	-	-	-	-	3	-	2	-
CO4	1	1	1	-	-	-	-	-	-	-	-	-	1	-	1	-
CO5	1	1	1	1	-	-	-	-	-	-	-	-	1	-	1	-
WT. AVG	1.6	2	1.2	0.4	0.4	-	-	-	-	-	-	-	1.4	-	1.6	-

## C. List of Experiments: -

1	Interact with a Gym environment and observe states, actions, and rewards.
2	Implement Epsilon-Greedy strategy for a Multi-arm Bandit problem.
3	Perform Policy Evaluation on a small grid-world MDP.
4	Implement Value Iteration to find the optimal policy for a small grid-world MDP.
5	Estimate state-values using Monte Carlo Prediction in FrozenLake.
6	Implement and train a Q-Learning agent on a discrete Gym environment (e.g., FrozenLake/Taxi).
7	Implement and train a SARSA agent on a discrete Gym environment (e.g., FrozenLake/Taxi).
8	Apply image preprocessing (blurring, edge detection) and thresholding using OpenCV.
9	Develop an MLP model to classify the MNIST digits dataset.
10	Build and train a basic CNN model for image classification on CIFAR-10.
11	Analyze the data flow and key components of a Deep Q-Network (DQN) for visual input.
12	Implement a simple REINFORCE (Policy Gradient) agent for a basic control task (e.g., CartPole).

## D. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1	Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow	Aurelien Geron	Third Edition	O'Reilly
2	Grokking Deep Reinforcement Learning	Miguel Morales	Manning, 2017	Manning
<b>Reference Book</b>				
1.	Neural Networks and Deep Learning, Second Edition, Charu C Agarwal, Springer, 2023			
2.	Deep Learning (Adaptive Computation and Machine Learning series), Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press, 2016			

## A. Course Outcomes: -

CO	Cognitive Abilities	Students will be able to:
CO – 01	Remember	Use concepts in data visualization, such as types of charts, visualization techniques, and principles of effective visualization design.
CO – 02	Understand	Understand the significance of data visualization in exploring and communicating insights from data, including its role in identifying patterns, trends, and relationships.
CO – 03	Apply	Apply data visualization techniques using visualization tools like Tableau, matplotlib, ggplot, or D3.js to create visual representations of datasets.
CO – 04	Analyze	Analyze and interpret visualizations to extract meaningful insights from data, including identifying outliers, trends, and correlations.
CO – 05	Evaluate	Evaluate the effectiveness of different visualization types (e.g., bar charts, line charts, scatter plots) in representing specific types of data and conveying information to the audience.

## B. CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	-	1	2	-	3	-	1	-	1	-	1	1	3	2	2	-
CO2	-	1	2	-	3	-	1	-	1	-	1	1	3	2	2	-
CO3	-	1	2	-	2	-	1	-	1	-	1	1	3	2	2	-
CO4	-	1	2	-	2	-	1	-	1	-	1	1	3	2	2	-
CO5	-	1	2	-	2	-	1	-	1	-	1	1	3	2	2	-
WT. AVG		1	2		2.4		1		1		1	1	3	2	2	-

## C. List of Experiments: -

1	<p>Perform the Visualization of Spread sheet Models according to given requirement. For the given data set that contains immigration details to Canada from 1980 to 2013, Create an area plot for top 6 immigrant countries from 1990 to 2013 Create and year-wise immigrant bar chart from India to Canada during the period of 1980 to 2013. Create a box plot for Indian, Phillip in and China immigrants. Show the total no. of immigrants from India and France countries using Area Chart and Pie chart. Create a scatter Histogram for the immigrants from Fiji and Singapore in the year 2013.</p> <p>LinkforDataSet- <a href="https://www.un.org/en/development/desa/population/migration/data/empirical2/migrationflows.asp">https://www.un.org/en/development/desa/population/migration/data/empirical2/migrationflows.asp</a></p> <p>Visualize the given Placement Data Full Class dataset that contains details about Campus Recruitment using the below techniques for appropriate dimensions and differentiate between the two techniques: Histogram and Bar Chart [For histogram let no. of bins=10] Facet Plot and Pair Plot Area Chart and Pie Chart [For yes or no data]</p>
2	<p>RDBMS Connectivity using Python Find out output of the joint operation applied to the company database. Apply inner join type to the following queries; apart from this apply other joins type to the first question. List the name of all employees who works for the research department. For every project located at 'Stafford' list the project number, the controlling Departmentt number and Departmentt manages last name. Find the name of all employees who works on the projects controlled by Dno=4. Make the list of project numbers for projects that involve an employee whose last name is ' Jennifer' as a worker or as a manager of the dept that controls the project.</p>

	<p>List the name of the employees who have no dependents. List the name of manager that have at least one dependent.</p>																																																																																
3	<p>Visualization of Semi-Structured Data Create a dictionary for the below data and convert the data into JSON.</p> <table border="1"> <thead> <tr> <th>S.NO</th> <th>Name</th> <th>Department</th> <th>GPA</th> <th>Future Preference</th> </tr> </thead> <tbody> <tr><td>1</td><td>Amy</td><td>CSE</td><td>8.7</td><td>Placements</td></tr> <tr><td>2</td><td>Rebekah</td><td>ECE</td><td>9.2</td><td>Higher Education</td></tr> <tr><td>3</td><td>David</td><td>CSE</td><td>5.6</td><td>Higher Education</td></tr> <tr><td>4</td><td>Sophia</td><td>CSE</td><td>6.8</td><td>Placements</td></tr> <tr><td>5</td><td>Lucas</td><td>ECE</td><td>7.5</td><td>Placements</td></tr> <tr><td>6</td><td>Andrew</td><td>CSE</td><td>8.9</td><td>Higher Education</td></tr> <tr><td>7</td><td>Evan</td><td>CSE</td><td>7.9</td><td>Placements</td></tr> <tr><td>8</td><td>Rose</td><td>CSE</td><td>8.7</td><td>Higher Education</td></tr> <tr><td>9</td><td>Luis</td><td>ECE</td><td>7.2</td><td>Higher Education</td></tr> <tr><td>10</td><td>Blake</td><td>ECE</td><td>6.8</td><td>Higher Education</td></tr> <tr><td>11</td><td>Finn</td><td>CSE</td><td>7.2</td><td>Placements</td></tr> <tr><td>12</td><td>Alan</td><td>ECE</td><td>8.7</td><td>Placements</td></tr> <tr><td>13</td><td>Olivia</td><td>ECE</td><td>6.8</td><td>Higher Education</td></tr> <tr><td>14</td><td>Isabella</td><td>CSE</td><td>8.7</td><td>Placements</td></tr> <tr><td>15</td><td>Scarlett</td><td>ECE</td><td>6.8</td><td>Higher Education</td></tr> </tbody> </table> <p>using dump()method from JSON package.</p> <p>Plot a graph showing the difference in Future Preferences of the students. Visualize the student’s statistics based on the feature “Department”. Plot a pie chart for the feature GPA.</p> <p>For the below given data set which contains world population in json format: <a href="https://query.data.world/s/uvvfp4usm2q4mlapbqtoi2stgunwda">https://query.data.world/s/uvvfp4usm2q4mlapbqtoi2stgunwda</a></p> <p>Read the data using pandas in column orient. Using appropriate plotting technique visualize the given data on the basis of population feature.</p>	S.NO	Name	Department	GPA	Future Preference	1	Amy	CSE	8.7	Placements	2	Rebekah	ECE	9.2	Higher Education	3	David	CSE	5.6	Higher Education	4	Sophia	CSE	6.8	Placements	5	Lucas	ECE	7.5	Placements	6	Andrew	CSE	8.9	Higher Education	7	Evan	CSE	7.9	Placements	8	Rose	CSE	8.7	Higher Education	9	Luis	ECE	7.2	Higher Education	10	Blake	ECE	6.8	Higher Education	11	Finn	CSE	7.2	Placements	12	Alan	ECE	8.7	Placements	13	Olivia	ECE	6.8	Higher Education	14	Isabella	CSE	8.7	Placements	15	Scarlett	ECE	6.8	Higher Education
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4	<p>Introduction to Tableau and Aggregation Methods in Any Data Visualization tool of your choice. Connect the given Bus Safety dataset to Tableau and perform the below tasks on separate sheets. Go to meta-data of the data set and change the column name form ‘Date Of Incident’ to ‘Date’ and ‘Bus Garage’ to ‘Garage’. Visualize the no. of Incidents by different Operators and explore various possible charts. Show a pie chart depicting the age categories as Adult, Child, Elderly and Unknown and no. of incidents in each category. Show the statistics of Route No.’s in purple color Bar Chart. Create a chart for ‘Borough’ feature depicting the total count of each and then sort it in ascending order. Depict the no. of incidents under the eight Incident Event Types for each of the Boroughs in the form of horizontal bar chart.</p>																																																																																
5	<p>Visual Encodings and Basic Dash boards in Any Data Visualization tool of your choice</p> <p>For the given dataset FIFA.csv that contains data about various football players, perform the following tasks on separate sheets: After connecting the data use the data interpreter and clean the data. Create a horizontal bar chart to depict the International Reputation of various nations on an avg. Check if there is any relation between wage and position(left/right). If yes, describe the relation. Plot a bar chart against Avg. Heading Accuracy and Body Type. Find out which body type has highest and least accuracy. Create a yellow colored Tree Chart to depict the total penalties of each nation and thus determine the highest and lowest. Using the above sheets create a dashboard and write an analysis report of what insights can be drawn from this.</p>																																																																																
6	<p>Interactive Plots in Python Using the in-built “Car Crashes” dataset from seaborn library perform the below tasks in order to depict interactive plots. Create a sub-dataset df that contains 'total', 'speeding', 'alcohol' columns only. i. Visualize an interactive bar plot for df.</p>																																																																																

	<ul style="list-style-type: none"> <li>ii. Using bar iplot, display the mean of all columns in the original dataset.</li> <li>v. Visualize a scatter matrix plot for the dataset. (The scatter matrix plot is basically a set of all the scatter plots for numeric columns in your dataset)</li> <li>7. Depict an interactive box plot for df.</li> <li>i. Show a histogram plot for df interactively.</li> </ul>
7	<p>Hierarchical and Topographical Data Visualizations in Any Data Visualization tool of your choice.</p> <p>Using the in-built data set from following link : <a href="https://www.bls.gov/cpi/tables/relative-importance/home.htm#Archived%20Relative%20Importance%20Data">https://www.bls.gov/cpi/tables/relative-importance/home.htm#Archived%20Relative%20Importance%20Data</a> Find the suitable answer of following</p> <p>Develop a sunburst pie chart to visualize all items.          Create a tree map graph to display data in rectangular box          Display the data in hierarchical format using shankey diagram.</p>
8	<p>Calendar Heat maps Data Visualizations in Python</p> <p>Write a Pandas program to create a heat map (rectangular data as a color-encoded matrix) for comparison of the top 10 years in which the UFO was sighted vs each Month.          Load the dataset from “flight_dealy.csv” and create a heat map to show relationship between various fields of dataset.</p>
9	<p>Time Series Data Visualization in Python Collect the dataset from link  <a href="https://github.com/Neelu-Tiwari/dataset/blob/main/stock_data.csv">https://github.com/Neelu-Tiwari/dataset/blob/main/stock_data.csv</a> and perform the following task.          Plot the changes that occurred in data over time.          Create a bar plot of month data for 2016 and 2017.          Perform the more practices from  <a href="https://learnche.org/pid/data-visualization/data-visualization-exercises">https://learnche.org/pid/data-visualization/data-visualization-exercises</a>  <a href="https://www.r-exercises.com/2017/04/10/forecasting-time-series-exploration-exercises-part-1/">https://www.r-exercises.com/2017/04/10/forecasting-time-series-exploration-exercises-part-1/</a></p>
10	<p>Imagine that you work at one location of a retail department store chain. You're curious to see how the proportion of sales by product category at your particular store differs from the average of sales distribution numbers across all locations. Download the dataset from</p> <p><a href="https://docs.google.com/spreadsheets/d/1VDG-ZpkkRaAituejvzIJ1Ky24LMpQfTN/edit#gid=416232713">https://docs.google.com/spreadsheets/d/1VDG-ZpkkRaAituejvzIJ1Ky24LMpQfTN/edit#gid=416232713</a>.</p>
11	<p>Select a member of the MIT aesthetics and computation research group (<a href="http://acg.media.mit.edu/">http://acg.media.mit.edu/</a>). Briefly discuss that person’s work and provide a review of the potential for that technique to help in information visualization (amount of information communicated vs. amount of aesthetics).</p>
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#### D. RECOMMENDED STUDY MATERIAL

S. No				
1	Effective Data Storytelling: How to Drive Change with Data, Narrative, and Visuals	Brent Dykes	2018	
2	Effective Data Visualization: The Right Chart for the Right Data	Stephanie D.H. Evergreen	2021	Evergreen Data & Evaluation, LLC
<b>Reference Book</b>				
1.	"Information Dashboard Design: Displaying Data for At-a-glance Monitoring” by Stephen Few, O’Rellay			
2.	"The Accidental Analyst: Show Your Data Who’s Boss” by Eileen and Stephen McDaniel, O’Rellay			
<b>Online Resources</b>				
1	<a href="https://towardsdatascience.com/visualize-hierarchical-data-using-plotly-and-datapane-7e5abe2686e1">https://towardsdatascience.com/visualize-hierarchical-data-using-plotly-and-datapane-7e5abe2686e1</a>			
2	<a href="https://www.idvbook.com/index.html%3Fp=44.html">https://www.idvbook.com/index.html%3Fp=44.html</a>			

## A. Course Outcomes: -

CO	Cognitive Abilities	Students will be able to:
CO – 01	Remember	To Remember and describe the fundamental concepts of speech production mechanisms, speech signal processing, and spectral estimation techniques used in speech systems.
CO – 02	Understand	To understand cepstral analysis, feature extraction techniques (MFCC, LPCC), and recognition models (GMM, HMM) used in speech recognition systems.
CO – 03	Apply	To Apply principles of video formation, color perception, and camera models (Pinhole, CAHV) to analyze video input and camera motion.
CO – 04	Analyze	To Analyze various motion estimation methods including optical flow, block matching, and feature-based tracking for efficient video motion interpretation.
CO – 05	Evaluate	To evaluate different object tracking and segmentation approaches (e.g., blob tracking, Mean Shift, ASM) and assess their effectiveness for applications like video surveillance and compression.

## B. CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	2	2	0	0	0	0	1	0	2	3	1	1	-
CO2	2	3	1	2	3	0	0	0	0	0	0	2	3	1	2	-
CO3	3	2	2	2	3	0	1	1	1	2	1	3	2	3	2	-
CO4	3	3	2	3	3	0	2	1	0	2	2	3	3	2	2	-
CO5	3	2	2	3	3	1	2	0	1	3	2	3	2	2	2	-

## C. List of Experiments

<b>Experiment 1:</b>	<p><b>Load and Plot a Speech Signal</b></p> <p><b>Objective:</b> To load a speech signal and visualize its waveform.</p> <p><b>Tasks to be Done:</b></p> <ol style="list-style-type: none"> <li>1. Import librosa and matplotlib.pyplot.</li> <li>2. Load a built-in audio sample: y, sr = librosa.load(librosa.ex('trumpet'), sr=None)</li> <li>3. Plot the waveform using matplotlib.</li> <li>4. Print the duration and sampling rate.</li> </ol> <p><b>Expected Outcome:</b> Students will be able to load a speech/audio file, display its waveform, and understand basic signal characteristics.</p>
<b>Experiment 2:</b>	<p><b>Compute and Plot FFT of a Speech Signal</b></p> <p><b>Objective:</b> To compute and visualize the frequency components of a speech signal using FFT.</p> <p><b>Tasks to be Done:</b></p> <ol style="list-style-type: none"> <li>1. Use the same speech signal from Practical 1.</li> <li>2. Compute FFT using numpy.fft.fft().</li> <li>3. Compute frequency bins using numpy.fft.fftfreq().</li> <li>4. Plot the magnitude spectrum.</li> </ol> <p><b>Expected Outcome:</b> Students will see how time-domain signals are transformed into the frequency domain and identify prominent frequency components.</p>
<b>Experiment 3:</b>	<p><b>Extract MFCC Features from a Speech Signal</b></p> <p><b>Objective:</b> To extract Mel-Frequency Cepstral Coefficients (MFCC) from a speech signal for use in speech recognition.</p>

	<p><b>Tasks to be Done:</b></p> <ol style="list-style-type: none"> <li>1. Import librosa and matplotlib.pyplot.</li> <li>2. Load an example audio: y, sr = librosa.load(librosa.ex('trumpet'), sr=None)</li> <li>3. Extract MFCCs: mfcc = librosa.feature.mfcc(y=y, sr=sr, n_mfcc=13)</li> <li>4. Display MFCCs using a heatmap (librosa.display.specshow).</li> </ol> <p><b>Expected Outcome:</b> Students will see the MFCC feature matrix and understand how it summarizes speech signal characteristics in a form suitable for recognition tasks.</p>
<p><b>Experiment 4:</b></p>	<p><b>Compare Speech Segments Using DTW</b></p> <p><b>Objective:</b> To compare two short speech signals using Dynamic Time Warping (DTW).</p> <p><b>Tasks to be Done:</b></p> <ol style="list-style-type: none"> <li>1. Import librosa, scipy.spatial, and librosa.display.</li> <li>2. Load two different speech/audio samples (e.g., trumpet twice, with slicing to simulate slight variation).</li> <li>3. Extract MFCCs from both samples.</li> <li>4. Use librosa.sequence.dtw() to compute alignment cost.</li> <li>5. Plot the alignment path.</li> </ol> <p><b>Expected Outcome:</b> Students will understand how DTW handles time misalignment between two audio signals and see how similar signals are matched over time.</p>
<p><b>Experiment 5:</b></p>	<p><b>Load and Display Video Frames</b></p> <p><b>Objective:</b> To load a video file and display individual frames.</p> <p><b>Tasks to be Done:</b></p> <ol style="list-style-type: none"> <li>1. Import cv2 and matplotlib.pyplot.</li> <li>2. Use OpenCV to load a sample video (cv2.VideoCapture() with a local or default webcam video).</li> <li>3. Read and display the first 10 frames using cv2.imshow() or matplotlib.pyplot.imshow().</li> <li>4. Convert a frame to grayscale and display it.</li> </ol> <p><b>Expected Outcome:</b> Students will understand how video consists of multiple frames and how to extract and manipulate individual frames using Python.</p>
<p><b>Experiment 6:</b></p>	<p><b>Extract and Plot RGB Channels from a Video Frame</b></p> <p><b>Objective:</b> To analyze the color components (R, G, B) of a video frame.</p> <p><b>Tasks to be Done:</b></p> <ol style="list-style-type: none"> <li>1. Capture a single frame from a video using cv2.VideoCapture().</li> <li>2. Split the frame into R, G, and B channels using slicing or cv2.split().</li> <li>3. Display each channel as a grayscale image using matplotlib.pyplot.imshow() with cmap='gray'.</li> <li>4. Optionally, show histograms of pixel intensities for each channel.</li> </ol> <p><b>Expected Outcome:</b> Students will learn how color is represented in video frames and how to analyze and visualize the RGB components separately.</p>
<p><b>Experiment 7:</b></p>	<p><b>Estimate Motion Using Frame Differencing</b></p> <p><b>Objective:</b> To detect motion between consecutive video frames using simple frame differencing.</p> <p><b>Tasks to be Done:</b></p> <ol style="list-style-type: none"> <li>1. Import cv2 and matplotlib.pyplot.</li> <li>2. Load a video or capture from a webcam using cv2.VideoCapture().</li> <li>3. Read two consecutive frames and convert them to grayscale.</li> <li>4. Compute the absolute difference using cv2.absdiff().</li> <li>5. Display the difference frame as a motion map.</li> </ol> <p><b>Expected Outcome:</b> Students will observe how simple pixel-wise differencing detects motion regions between two frames.</p>
<p><b>Experiment 8:</b></p>	<p><b>Optical Flow Estimation Using Farneback Method</b></p>

	<p><b>Objective:</b> To compute and visualize dense optical flow between video frames using the Farneback algorithm.</p> <p><b>Tasks to be Done:</b></p> <ol style="list-style-type: none"> <li>1. Import cv2 and numpy.</li> <li>2. Capture two consecutive grayscale frames from a video.</li> <li>3. Use cv2.calcOpticalFlowFarneback() to estimate motion.</li> <li>4. Visualize the motion vectors using color encoding (e.g., HSV mapping).</li> </ol> <p><b>Expected Outcome:</b> Students will observe dense motion vectors and understand how optical flow estimates pixel-level motion.</p>
<b>Experiment 9:</b>	<p><b>Basic Object Tracking Using Color (Blob Tracking)</b></p> <p><b>Objective:</b> To track a moving colored object in a video using color-based blob detection.</p> <p><b>Tasks to be Done:</b></p> <ol style="list-style-type: none"> <li>1. Import cv2 and numpy.</li> <li>2. Capture video from webcam using cv2.VideoCapture().</li> <li>3. Convert each frame to HSV color space using cv2.cvtColor().</li> <li>4. Define a color range (e.g., red or blue), and create a mask using cv2.inRange().</li> <li>5. Use cv2.findContours() to detect and draw the object's outline.</li> <li>6. Display the original frame with tracking overlay.</li> </ol> <p><b>Expected Outcome:</b> Students will see how color segmentation can be used to detect and track an object in real time.</p>
<b>Experiment 10:</b>	<p><b>Video Shot Boundary Detection Using Histogram Differences</b></p> <p><b>Objective:</b> To detect shot boundaries in a video using histogram comparison between frames.</p> <p><b>Tasks to be Done:</b></p> <ol style="list-style-type: none"> <li>1. Import cv2, numpy, and matplotlib.pyplot.</li> <li>2. Read a video file and convert each frame to grayscale.</li> <li>3. Compute histogram for each frame using cv2.calcHist().</li> <li>4. Compare histograms of consecutive frames using correlation or Chi-square.</li> <li>5. Mark shot boundaries when difference exceeds a threshold.</li> </ol> <p><b>Expected Outcome:</b> Students will understand how histogram differences help detect scene transitions or shot boundaries in a video.</p>

#### D. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Fundamentals of Speech recognition	L. Rabiner and B. Juang	3rd	Prentice Hall signal processing series.
2.	Digital Video processing	A Murat Tekalp	2 <sup>nd</sup>	Prentice Hall.
<b>Reference Book</b>				
1.	"Speech and Audio Signal Processing", B.Gold and N. Morgan, Wiley.			
2.	"Digital image sequence processing, Compression, and analysis", Todd R. Reed, CRC Press			
3.	"Handbook of Image and Video processing", Al Bovik, Academic press, second Edition			
<b>Online Resources</b>				
1.	URL: <a href="https://www.geeksforgeeks.org">https://www.geeksforgeeks.org</a>			

**Minor Courses**  
**Professional Elective: Laborites**

**(Cloud and DevOps)**

**Batch: 2025-29**

## A. Course Outcomes: -

CO	Cognitive Abilities	Students will be able to:
CO – 01	Understand	Describe the fundamental concepts of virtualization, its history, terminologies, and compare with cloud computing.
CO – 02	Apply	Implement and configure various virtualization types and techniques including full, para, network, and storage virtualization.
CO – 03	Apply	Analyze and demonstrate the usage of virtualization platforms such as VMware vSphere, VirtualBox, and vCenter for managing virtual resources.
CO – 04	Applying	Deploy and evaluate container-based virtualization using Docker and Kubernetes for modern cloud-native environments.
CO – 05	Evaluate	Design and compare virtualization environments in public cloud platforms (AWS, Azure, GCP) and on-premise setups using case studies.

## B. CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	2	-	-	-	-	2	-	3	2	-	2	3
CO2	2	-	3	-	2	-	-	-	-	-	-	2	-	-	2	3
CO3	2	2	3	-	3	-	-	-	-	-	-	2	-	-	3	3
CO4	2	3	3	2	3	-	-	-	-	-	-	3	-	2	2	3
CO5	2	3	3	-	3	-	-	-	-	-	-	3	-	-	2	3

## C. List of Experiments: -

1	Install and configure VirtualBox and create VMs
2	Install and Configure VMware ESXi on a Bare Metal Machine
3	Compare Full vs. Para Virtualization using VirtualBox and KVM
4	Configure and Manage Storage Virtualization
5	Setup and Configure vCenter Server
6	Launch and Configure an EC2 Instance in AWS
7	Perform Run and Access EC2 instance on VirtualBox
8	Create and Manage Virtual Machines in Microsoft Azure
9	Install and manage Docker containers
10	Install and Configure Kubernetes
11	Compare On-Prem vs. Cloud Deployment
12	Perform Live Migration and Storage Migration in VMware vSphere

## D. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1	Mastering VMware vSphere 6.7	Martin Gavanda, Andrea Mauro	1st Edition	Packt Publishing
2	Virtualization Essentials	Matthew Portnoy	2nd Edition	Wiley
3	Docker Deep Dive	Nigel Poulton	3rd Edition	TechWorld with Nigel
Reference Book				
1	<a href="https://www.tutorialspoint.com/cloud_computing">https://www.tutorialspoint.com/cloud_computing</a>			
2.	<a href="https://www.geeksforgeeks.org/cloud-computing">https://www.geeksforgeeks.org/cloud-computing</a>			

**A. Course Outcomes: -**

CO	Cognitive Abilities	Students will be able to:
CO – 01	Understand	Understand the concepts of containerization and Docker architecture.
CO – 02	Apply	Apply the process of installing Docker and creating containerized applications.
CO – 03	Apply	Demonstrate Docker image creation, pushing to/pulling from Docker Hub.
CO – 04	Applying	Deploy and manage containers using Docker with static IP and migration techniques.
CO – 05	Evaluate	Evaluate the benefits and challenges of containerization in real-world environments.

**B. CO-PO-PSO Mapping**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	-	-	-	-	-	-	-	-	1	2	-	-	-
CO2	2	2	3	-	-	-	-	-	-	1	-	2	3	-	-	-
CO3	2	2	3	2	-	-	-	-	-	1	-	2	3	1	-	-
CO4	2	1	3	2	-	-	-	-	-	2	-	3	3	1	-	-
CO5	3	2	2	2	2	-	-	-	-	2	1	3	2	2	-	-
Wt. AVG	2.4	1.8	2.8	2.0	2.0	-	-	-	-	1.5	1.0	2.2	2.6	1.3	-	-

**C. List of Experiments: -**

1	Installation Docker on Ubuntu
2	Create an application in Docker
3	Push an image to Docker Hub
4	Fetch and run the image from Docker Hub
5	Creating first repository in Docker Hub using GUI
6	How to Push and Pull images from Docker Hub
7	Deploy the Containerization Process
8	Docker installation process in windows
9	Create a Docker image and run it as container
10	Create a repository on Docker Hub
11	How to provide the static IP to a Docker container
12	Migration of containers

**D. RECOMMENDED STUDY MATERIAL**

S. No	Text Books:	Author	Edition	Publication
1	CloudComputing: Concepts, Technology & Architecture	Zaigham Mahmood, Ricardo Puttini, and Thomas Erl	2013	Pearson Education
<b>Reference Book</b>				
1	Cloud Computing For Dummies" by Judith Hurwitz			
2.				
<b>Online Resources</b>				
1	<a href="https://www.geeksforgeeks.org/kubernetes-tutorial/">https://www.geeksforgeeks.org/kubernetes-tutorial/</a>			
2.	<a href="https://www.javatpoint.com/cloud-computing">https://www.javatpoint.com/cloud-computing</a>			

**A. Course Outcomes: -**

CO	Cognitive Abilities	Students will be able to:
CO – 01	Remember	Articulate the main concepts, key technologies, strengths and limitations of cloud computing.
CO – 02	Understand	Explain the key and enabling technologies that help in the development of cloud.
CO – 03	Apply	Make use of NIST cloud computing architecture to solve architecture design challenges
CO – 04	Analyze	Explain the core issues of cloud computing such as resource management and security.
CO – 05	Evaluate	Install and use current cloud technologies. Illustrate and choose the appropriate technologies, algorithms and approaches for implementation and use of cloud.

**B. LIST OF EXPERIMENTS**

1.	Setting Up and Securing an AWS Account Using IAM and Security Best Practices.
2.	Exploring AWS Global Infrastructure and Creating a Simple Web Application on AWS.
3.	Cost Management: Using AWS Billing Dashboard and TCO Calculator.
4.	Configuring a Virtual Private Cloud (VPC) and Implementing Security Groups, Designing and implementing a VPC with subnets, route tables, and Internet Gateways. Configuring security groups and Network Access Control Lists (NACLs).
5.	Deploying and Optimizing Amazon EC2 Instances.
6.	Creating a Lambda function to process data. Triggering Lambda functions with AWS services like S3 or DynamoDB. Or Building a Serverless Application with AWS Lambda and API Gateway.
7.	Setting up an Auto Scaling group and an Elastic Load Balancer (ELB). Configuring scaling policies and monitoring performance.
8.	Implementing Content Delivery Using Amazon CloudFront and Route 53.
9.	Setting up CloudWatch alarms and dashboards. Configuring logs for EC2 instances and other AWS services.
10.	Setting Up a Relational Database with Amazon RDS and Monitoring Performance, Creating and configuring an Amazon Relational Database Service (RDS) instance. Connecting to the database using a client.
11.	Managing Data Storage with AWS S3, EBS, and EFS. Hosting a static website on Amazon Simple Storage Service (S3), Configuring bucket policies and static website hosting.
12.	Implementing Backup and Recovery with AWS Backup.

**C. MAPPING MATRIX OF CO, PO, & PSO**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	-	-	-	-	2	1	1	-	-	-	-	1	2	2	-	-
CO2	-	-	-	-	2	1	1	-	-	-	-	1	2	2	-	-
CO3	-	-	-	-	3	2	2	1	-	-	-	1	2	3	-	-
CO4	-	-	-	-	2	1	1	-	-	-	-	1	2	2	-	-
CO5	-	-	-	-	3	2	2	1	-	-	-	1	2	3	-	-

**D. RECOMMENDED STUDY MATERIAL**

S. No	Text Books:	Author	Edition	Publication
1.	Cloud Computing: Principles and Paradigm	Rajkumar Buyya, James Broberg, Andrzej M. Goscinski		John Wiley and Sons Publications
2.	Cloud Computing For Dummies	Fern Halper, Robin Bloor		
<b>Reference Book</b>				
1.	Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online – Michael Miller - Que 2008			
2.	Cloud Computing: Web-Based Applications That Change the Way You Work by Micheal Miller			
<b>Online Resources</b>				
1.	<a href="https://www.tutorialspoint.com/amazon_web_services/index.html">https://www.tutorialspoint.com/amazon_web_services/index.html</a>			
2.	<a href="https://www.geeksforgeeks.org/aws-tutorial/">https://www.geeksforgeeks.org/aws-tutorial/</a>			

**A. Course Outcomes: -**

CO	Cognitive Abilities	Students will be able to:
CO – 01	Understand	Describe and apply each phase of the DevOps lifecycle using appropriate tools.
CO – 02	Apply	Use Git and GitHub for version control, branching, and source code collaboration.
CO – 03	Apply	Configure and use Jenkins to implement Continuous Integration (CI) pipelines.
CO – 04	Analyze	Build and deploy containerized applications using Docker and Dockerfile instructions.
CO – 05	Evaluate	Implement infrastructure monitoring using Prometheus and visualize metrics using Grafana.

**B. CO-PO-PSO Mapping**

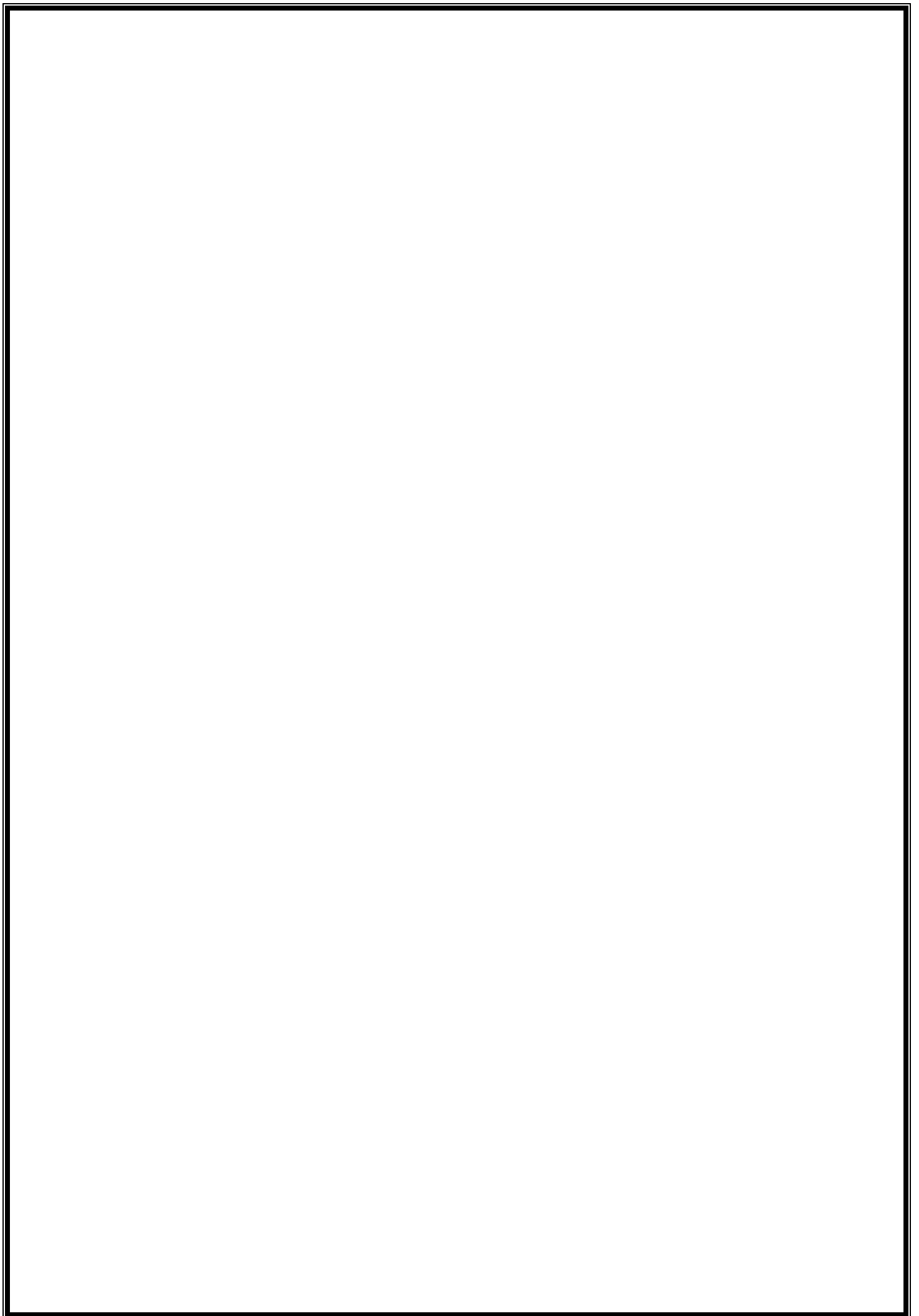
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	2	-	-	-	-	2	-	3	2	-	2	3
CO2	2	-	3	-	2	-	-	-	-	-	-	2	-	-	2	3
CO3	2	2	3	-	3	-	-	-	-	-	-	2	-	-	3	3
CO4	2	3	3	2	3	-	-	-	-	-	-	3	-	2	2	3
CO5	2	3	3	-	3	-	-	-	-	-	-	3	-	-	2	3
Wt. AVG	2.2	2.5	3.0	2.0	2.6	-	-	-	-	2.0	-	2.6	2.0	2.0	2.2	3.0

**C. List of Experiments: -**

1	Describe each phase of the DevOps lifecycle and give an example tool for each.
2	To understand Version Control System, install git and create a GitHub account.
3	Explore GIT hub and GIT Commands
4	Continuous Integration, install and configure Jenkins .
5	Demonstrate continuous integration and development using Jenkins .
6	To Build the pipeline of jobs using Jenkins.
7	Install Docker and execute docker commands to manage images and interact with containers.
8	To learn Dockerfile instructions, build an image for a sample web application using Dockerfile.
9	To install and Configure Pull based Software Configuration Management and provisioning tools using Puppet. /Ansible.
10	Create a Simple PlayBook in Ansible
11	Installation and configuration Prometheus
12	How to create Dashboards and Visuakization using Grafana .

**D. RECOMMENDED STUDY MATERIAL**

S. No	Text Books:	Author	Edition	Publication
1	Ansible for DevOps	Jeff Geerling	2nd Edition (2020)	Midwestern Mac
2	Learning Continuous Integration with Jenkins	John Arundel, James Turnbull	3rd Edition (2018)	Packt Publishing
3	Monitoring with Prometheus and Grafana	Nikhil Pathania	1st Edition (2017)	Packt Publishing
Reference Book				
1	Ansible for DevOps			
2.	Learning Continuous Integration with Jenkins			



**A. Course Outcomes: -**

CO	Cognitive Abilities	Students will be able to:
CO – 01	Understand	Demonstrate manual vs automated server configuration using shell scripting and DevOps tools.
CO – 02	Apply	Compare and implement push-based (Ansible) and pull-based (Puppet) automation mechanisms.
CO – 03	Apply	Develop and execute Infrastructure as Code (IaC) using Terraform and AWS CloudFormation.
CO – 04	Analyze	Install and configure Ansible and Puppet for software deployment and configuration management.
CO – 05	Evaluate	Monitor infrastructure performance and visualize metrics using Grafana dashboards.

**B. CO-PO-PSO Mapping**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	2	-	-	-	-	2	-	3	2	-	2	3
CO2	2	-	3	-	2	-	-	-	-	-	-	2	-	-	2	3
CO3	2	2	3	-	3	-	-	-	-	-	-	2	-	-	3	3
CO4	2	3	3	2	3	-	-	-	-	-	-	3	-	2	2	3
CO5	2	3	3	-	3	-	-	-	-	-	-	3	-	-	2	3

**C. List of Experiments: -**

1	Manual vs automated configuration (write shell script to configure Apache/Nginx).
2	Compare push-based (Ansible) and pull-based (Puppet) mechanisms.
3	Installation and setup ,Terraform CLI commands ( <b>init</b> , <b>plan</b> , <b>apply</b> , <b>destroy</b> )
4	Write a basic Terraform script .
5	Use AWS CloudFormation to set up a 2-tier architecture (optional with AWS Educate)
6	Install and configure Apache using Ansible.
7	Create a playbook to deploy a basic Python/NodeJS web app
8	Use Ansible roles to configure multiple services (e.g., Nginx + MySQL)
9	Install Puppet and configure a client-agent environment .
10	Write Puppet manifest to manage users, install packages.
11	Integrate Ansible with Jenkins pipeline to deploy an application.
12	Create and visualize dashboards in Grafana.

**D. RECOMMENDED STUDY MATERIAL**

S. No	Text Books:	Author	Edition	Publication
1	Ansible for DevOps	Jeff Geerling	2nd Edition (2020)	Midwestern Mac
2	Learning Continuous Integration with Jenkins	Nikhil Pathania	1st Edition (2017)	Packt Publishing
3	Monitoring with Prometheus and Grafana	James Turnbull	1st Edition (2021)	Turnbull Press
Reference Book				
1	_Ansible for DevOps Jeff Geerling 2nd Edition (2020) Midwestern Mac			
2.	Learning Continuous Integration with Jenkins Nikhil Pathania Packt Publishing			

**A. Course Outcomes: -**

CO	Cognitive Abilities	Students will be able to:
CO – 01	Understand	Secure Git and CI/CD pipelines using tools such as GitHub, Jenkins, and OWASP Dependency-Check.
CO – 02	Apply	Create and execute Ansible playbooks and Terraform configurations with embedded security and compliance policies.
CO – 03	Apply	Secure Docker and Kubernetes environments using RBAC, Pod Security Policies, and tools like Falco, Trivy, and Clair.
CO – 04	Analyze	Monitor infrastructure using Prometheus and Grafana and implement security event logging.
CO – 05	Evaluate	Deploy secure cloud infrastructure and demonstrate DevSecOps pipelines using AWS services.

**B. CO-PO-PSO Mapping**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	2	-	-	-	-	2	-	3	2	-	2	3
CO2	2	-	3	-	2	-	-	-	-	-	-	2	-	-	2	3
CO3	2	2	3	-	3	-	-	-	-	-	-	2	-	-	3	3
CO4	2	3	3	2	3	-	-	-	-	-	-	3	-	2	2	3
CO5	2	3	3	-	3	-	-	-	-	-	-	3	-	-	2	3

**C. List of Experiments: -**

1	Secure GitHub repository using branch protections and secrets scanning.
2	Implement SAST using SonarQube or CodeQL in CI pipeline.
3	Perform DAST scan using OWASP ZAP or Burp Suite.
4	Integrate Trivy or Clair to scan Docker images.
5	Write a Terraform script and validate with tfsec.
6	Configure Ansible with encrypted secrets (Ansible Vault).
7	Enforce RBAC in a Kubernetes cluster.
8	Use Falco to detect runtime container threats.
9	Build a Jenkins pipeline with security scanners.
10	Use Open Policy Agent to apply policy as code.
11	Deploy Prometheus and Grafana for security metrics.
12	Implement IAM policy for least privilege in AWS.

**D. RECOMMENDED STUDY MATERIAL**

S. No	Text Books:	Author	Edition	Publication
1	Securing DevOps	Julien Vehent,	1st Edition	Manning Publications
2	Hands-On Security in DevOps	Tony Hsiang-Chih Hsu	1st Edition	Packt Publishing
3	Infrastructure as Code	Kief Morris	2nd Edition	O'Reilly
Reference Book				
1	Securing DevOps Julien Vehent, 1st Edition			
2.	Infrastructure as Code Kief Morris 2nd Edition			

**A. Course Outcomes: -**

CO	Cognitive Abilities	Students will be able to:
CO – 01	Remember	Recall basic Linux commands and their functions.
CO – 02	Understand	Explain the purpose and functionality of different Linux commands
CO – 03	Apply	Execute Linux commands to perform specific tasks such as file manipulation, directory navigation, and process management
CO – 04	Analyze	Analyze complex shell scripts to understand their functionality and logic
CO – 05	Evaluate	Assess the efficiency and effectiveness of shell scripts in solving specific problems.

**B. MAPPING MATRIX OF CO, PO, & PSO**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	-	1	1	-	2	2	1	-	1	-	1	1	2	2	-	-
CO2	-	1	1	-	2	2	1	-	1	-	1	1	2	2	-	-
CO3	-	1	1		2	2	2	-	1	-	1	1	3	2	-	-
CO4	-	1	1	-	2	2	2	-	1	-	1	1	3	2	-	-
CO5	-	1	1	-	2	2	2	-	1	-	1	1	3	2	-	-

**C. List of Experiment**

1.	Analyze the Linux boot process by accessing and interpreting boot logs using journalctl. Identify the services that are failing during boot.
2.	Create and manage partitions using fdisk, then configure and extend a Logical Volume Manager (LVM) setup. Demonstrate adding space to an existing logical volume.
3.	Set up a static IP address using nmcli or netplan and verify the configuration with ping and traceroute.
4.	Install and configure a DHCP or DNS server. Demonstrate its working by connecting a client and validating the service.
5.	Write a shell script to back up a specific directory using rsync or tar, and schedule it to run daily using cron.
6.	Use awk, sed, and grep to filter, modify, and extract specific information from a system log file.
7.	Configure file and directory permissions using ACLs, Sticky Bits, SetUID, and SetGID. Demonstrate how these permissions restrict unauthorized access.
8.	Enable SELinux on a Linux system, configure it in enforcing mode, and demonstrate how it restricts unauthorized access to a specific service.
9.	Set up and run a virtual machine using KVM or VirtualBox. Compare resource usage and efficiency between a virtual machine and a Docker container running the same application.
10.	Launch an AWS EC2 instance using the CLI, install Apache, and configure a simple web server. Automate the deployment process using a Terraform script.

**D. RECOMMENDED STUDY MATERIAL**

S. No	Text Books:	Author	Edition	Publication
1.	RHCSA/RHCE Red Hat Linux Certification Study Guide Exams EX200 & EX300	Orsaria, Jang	McGraw-Hill Education	RHCSA/RHCE Red Hat Linux Certification Study Guide Exams EX200 & EX300
2.	Red Hat RHCSA/RHCE 7 Cert Guide: Red Hat Enterprise Linux 7(EX200 and EX300)	Sander Van Vugt	Phi Learning Pvt Ltd	Red Hat RHCSA/RHCE 7 Cert Guide: Red Hat Enterprise Linux 7(EX200 and EX300)
<b>Reference Book</b>				
1.	RHCSA/RHCE Red Hat Linux Certification Study Guide Exams EX200 & EX300			
2.	Red Hat RHCSA/RHCE 7 Cert Guide: Red Hat Enterprise Linux 7(EX200 and EX300)			
<b>Online Resources</b>				
1.	<a href="https://www.redhat.com/en/topics/linux/linux-server">https://www.redhat.com/en/topics/linux/linux-server</a>			
2.	<a href="https://www.geeksforgeeks.org/what-is-a-linux-server-and-why-use-it/">https://www.geeksforgeeks.org/what-is-a-linux-server-and-why-use-it/</a>			

**Minor Courses**  
**Professional Elective: Laborites**

**(Full Stack Development & Mobile  
Application)**

**Batch: 2025-29**

## A. COURSE OUTCOMES

CO	Cognitive Abilities	Students will be able to:
CO – 01	Remember	Recall fundamental Kotlin syntax, data types, and control structures.
CO – 02	Understand	Describe Android architecture, app lifecycle, and components.
CO – 03	Apply	Develop basic Android applications using Kotlin, layouts, and controls.
CO – 04	Analyze	Analyze code logic and structure using object-oriented concepts in Kotlin.
CO – 05	Evaluate	Assess the efficiency and effectiveness of shell scripts in solving specific problems.

## B. MAPPING MATRIX OF CO, PO, &amp; PSO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	2	-	-	-	-	-	-	-	2	2	-	-
CO2	2	3	2	-	2	-	-	-	-	-	-	-	2	2	-	-
CO3	2	-	3	2	3	-	-	-	2	-	-	-	3	2	-	-
CO4	2	3	3	3	2	-	-	-	1	-	-	-	3	2	-	-
CO5	3	-	3	2	3	-	-	-	3	-	2	2	3	2	-	-

## C. List Of Experiments:

1.	<p><b>Basic Kotlin Programs – Math &amp; Conditions</b></p> <ul style="list-style-type: none"> <li>Write a program to check Armstrong numbers between two integers.</li> <li>Find all roots of a quadratic equation.</li> </ul> <p>Check if an array contains a given value.</p>
2.	<p><b>Array and Time Calculation with Kotlin</b></p> <ul style="list-style-type: none"> <li>Sort a map by values using Kotlin.</li> <li>Convert between ArrayList and array.</li> </ul> <p>Calculate the difference between two time periods using a Kotlin class.</p>
3.	<p><b>Build Your First Android App – Basic Inputs</b></p> <ul style="list-style-type: none"> <li>Create an Android app that calculates factorial and square of an entered number using a button click.</li> <li>Add a clear button to reset input/output views.</li> <li>Create an app that reverses a string and checks if it's an Armstrong number.</li> </ul>
4.	<p><b>Tip Calculator App</b></p> <ul style="list-style-type: none"> <li>Build a tip calculator with EditText, RadioButtons, and a Switch.</li> <li>Display the tip amount using a TextView.</li> </ul> <p>Add a "Calculate" button to compute and display the tip.</p>
5.	<p><b>RecyclerView &amp; ListView Application</b></p> <p>Implement a basic Android application using RecyclerView and ListView.</p>
6.	<p><b>Contact Details App</b></p> <ul style="list-style-type: none"> <li>Create an app that takes contact information (phone, email).</li> </ul> <p>Add an icon that opens the dialer when clicked.</p>
7.	<p><b>Tabbed Activity with ViewPager</b></p> <ul style="list-style-type: none"> <li>Build a tabbed interface with 3 tabs.</li> </ul> <p>Each tab should include 2 buttons for navigation using ViewPager.</p>
8.	<p><b>Media Player App</b></p> <p>Create a media player in Android that can play, pause, and stop an audio or video file.</p>
9.	<p><b>Splash Screen with OnBoarding</b></p> <ul style="list-style-type: none"> <li>Design an app with onboarding and splash screen.</li> </ul> <p>Add functionality to change the background color every time the app is opened.</p>
10.	<p><b>Custom Domain-Based Project App</b></p> <ul style="list-style-type: none"> <li>Develop a fully functional app on a domain like education, healthcare, business, or e-commerce.</li> <li>Ensure the app has clean UI and integrates concepts from previous experiments.</li> </ul>

**A. Course Outcomes: -**

CO	Cognitive Abilities	Students will be able to:
CO – 01	Remember	To recall and apply basic JavaScript syntax, functions, and modern ES6+ features.
CO – 02	Understand	To explain core concepts of Node.js and utilize its built-in modules for backend development.
CO – 03	Apply	To build and test RESTful APIs using Express.js with routing and middleware.
CO – 04	Analyze	To analyze application requirements and design modular code for backend services.
CO – 05	Create	To design and develop a backend project using Express.js and MongoDB with full CRUD functionality.

**B. CO-PO-PSO Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	1	-	-	-	-	-	-	-	-	-	1	1	1	-
CO2	2	2	1	-	-	-	-	-	-	-	-	-	2	2	1	-
CO3	3	3	2	1	-	-	-	-	-	-	-	-	3	2	2	-
CO4	3	3	3	2	-	-	-	-	-	-	-	-	3	3	2	-
CO5	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3	-

**C. LIST OF EXPERIMENTS**

1	<b>Build a Simple Calculator Using JavaScript</b> <i>Objective:</i> To practice using JavaScript functions, variables, and modules by creating a basic command-line calculator that performs arithmetic operations.
2	<b>Create a Log File Writer with Node.js</b> <i>Objective:</i> To understand file system operations in Node.js by creating a tool that writes and appends logs to a file.
3	<b>Set Up a Basic Web Server in Node.js</b> <i>Objective:</i> To learn how to create a basic HTTP server using Node.js core modules and handle simple routes.
4	<b>Make a Custom Router Without Using Express</b> <i>Objective:</i> To manually implement URL routing using the built-in <code>http</code> module to understand how frameworks like Express work under the hood.
5	<b>Build an API That Returns JSON Data</b> <i>Objective:</i> To create an HTTP server that returns structured JSON data through a RESTful endpoint.
6	<b>Create a Student Record API Using Express (No Database)</b> <i>Objective:</i> To develop a simple RESTful API using Express.js to manage student data stored in memory (without database integration).
7	<b>Develop a To-Do List API with In-Memory Storage</b> <i>Objective:</i> To build a task manager API with full CRUD operations, using Express and storing data in a JavaScript array.
8	<b>Handle Contact Form Data Using Express</b> <i>Objective:</i> To receive and process form data from a frontend using Express and middleware for parsing incoming requests.
9	<b>Serve Static HTML Pages Using Express</b> <i>Objective:</i> To serve static web content such as HTML, CSS, and JavaScript files using the <code>express.static()</code> middleware.
10	<b>Build a Blog API Connected to MongoDB</b> <i>Objective:</i> To create a RESTful API for blog posts using Express and MongoDB with Mongoose for database operations.
11	<b>Create a User Signup API with Validation</b> <i>Objective:</i> To design an API for user registration that validates input data and stores it in a MongoDB database.
12	<b>Final Project: Student Management System Using Express and MongoDB</b> <i>Objective:</i> To develop a full-featured backend application with Express and MongoDB that handles student data with CRUD operations and a modular project structure.

**D. RECOMMENDED STUDY MATERIAL**

S. No	Text Books:	Author	Edition	Publication
1	Node.js Web Development	David Herron	5th Edition, 2020	Packt Publishing
2	Full Stack JavaScript Development with MEAN	Colin J. Ihrig, Adam Bretz	1st Edition, 2015	SitePoint
<b>Online Resources</b>				
1.	<a href="https://expressjs.com/">https://expressjs.com/</a>			
2.	<a href="https://www.freecodecamp.org/news/tag/nodejs/">https://www.freecodecamp.org/news/tag/nodejs/</a>			

## A Course Outcomes: -

CO	Cognitive Abilities	Students will be able to:
CO – 01	Remember	Learning PHP basics, syntax, data types
CO – 02	Understand	Understanding loops, array and string in PHP
CO – 03	Apply	Developing sessions in PHP using session management.
CO – 04	Analyze	Use of exception handling in PHP
CO – 05	Create	Solve various database tasks using the PHP language

## B. CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	-	-	-	-	2			3	2	-	-
CO2	3	3	-	2	-	-	-	-	-	2			3	2	-	-
CO3	2	3	3	2	3	1	-	2	2	3			3	2	2	3
CO4	3	3	3	3	3	2	-	2	2	3			3	3	3	3
CO5	2	3	3	3	3	2	2	2	3	3	-	-	3	3	3	3
Wt. AVG	2.6	2.8	3.0	2.5	3.0	1.7	2.0	2.0	2.3	2.6	-	-	3.0	2.4	2.7	3.0

## C. LIST OF EXPERIMENTS

1	Connect to MySQL Data Base: (a) Write PHP script to connect to a MySQL database using the MySQL extension
2	Create Database and table. (a) Write PHP Script to create a new data base and a table in MySQL
3	Insert Data into a table (a) Write a PHP script to insert data into a MySQL table.
4	Retrieve Data in a table (a) Write a PHP script to Retrieve data from a MySQL table.
5	Update Data in a table (b) Write a PHP script to Update data into MySQL table.
6	Delete Data from a table
7	Enhance previous JSP program to fetch data from database
8	Develop Rich Internet Applications to manage product and user details using struts and database
9	Develop Hibernate application to manage product details like insert, update, delete and display from database usingHQL
10	Develop Spring based dynamic web application to manage courses, students in a college environment using WebMVC framework and JDBC
11	Transfer a file from one system to another system by the network
12	Develop Chat Server using Java.

#### D. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1	Advanced Java Programming	B.Prasanalakshmi	1st	CH Publishers
2	Advanced Java Programming	Uttam K Roy	1st	Oxford University Press
3	Advanced Java Technology -A Conceptual Approach	A.A.Puntambekar	1st	Technical Publications
<b>Online Resources</b>				
1.	Advanced Java Coding Problems: Best Advanced Coding Problems with Explanation and Solutions, by Pratap Divyansh			
2.	Advanced Java Optimization Techniques, by Jason Arnold			


**A. COURSE OUTCOMES:**

CO	Bloom Level	Students will be able to:
CO – 01	Remember	Recall and understand the fundamental concepts of mobile application development, Android materials and Figma design materials
CO – 02	Understand	Understand the concepts of dart programming language in the development of mobile app using flutter.
CO – 03	Apply	Implement the App Navigation, layout creation and various Android APIs to learn all concept of flutter
CO – 04	Analyze	Analyse the working stateless and stateful widgets in Android Application.
CO – 05	Create	Design basic android applications with proper UI using Figma, VS code and Android Studio.

**B. CO-PO-PSO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	-	-	-	-	-	-	-	-	-	1	1	1	-
CO2	2	2	1	-	-	-	-	-	-	-	-	-	2	2	1	-
CO3	3	3	2	1	-	-	-	-	-	-	-	-	3	2	2	-
CO4	2	3	3	2	-	-	-	-	-	-	-	-	3	3	2	-
CO5	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3	-

**C. List of Experiment:**

1	Customize Shrine to reflect its brand using: <ul style="list-style-type: none"> <li>● Color</li> <li>● Typography</li> <li>● Elevation</li> <li>● Layout</li> </ul>
2	Design the Health Android App Layout in Figma/Android XD <div style="text-align: center;">  </div>
3	Create a Pizza Order Program. · Create a Small Overtime Payment Program
4	Creating a Simple Flutter App · Creating a simple widget to display “Hello POORNIMA!”
5	Create the Figma design on any specified topic from streams like, education, healthcare, business, e-commerce etc.
6	Embedd/Convert the figma design of the app designed in previous experiment to Android Studio
7	Create the full design layout by applying navigation and using all required flutter widgets for that specified app.
8	· Creating a Flutter App using BottomNavigationBar Navigation Technique. · Create a User Profile Interface using Firebase
9	· Perform the necessary backend implementation and database connectivity to the created application in unit-2.
10	· Perform testing and deployment of the application

**A. Course Outcomes: -**

CO	Cognitive Abilities	Students will be able to:
CO – 01	Remember	To recall JavaScript concepts and how they apply in frontend frameworks.
CO – 02	Understand	To explain core concepts of React.js and AngularJS.
CO – 03	Apply	To build interactive UI components using React.js and AngularJS.
CO – 04	Analyze	To analyze project requirements and apply relevant framework features.
CO – 05	Create	To design and develop full frontend projects using React.js and AngularJS.

**B. CO-PO-PSO Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	1	-	-	-	-	-	-	-	-	-	1	1	1	-
CO2	2	2	1	-	-	-	-	-	-	-	-	-	2	2	1	-
CO3	3	3	2	1	-	-	-	-	-	-	-	-	3	2	2	-
CO4	3	3	3	2	-	-	-	-	-	-	-	-	3	3	2	-
CO5	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3	-
Wt. AVG	2.4	2.4	2.0	2.0	-	-	-	-	-	-	-	-	2.4	2.2	1.8	-

**C. LIST OF EXPERIMENTS**

S. No.	Lab Project Title & Objective
1	<b>Build a Simple Calculator Using JavaScript</b> <b>Objective:</b> To practice using JavaScript functions, variables, and modules by creating a basic command-line calculator that performs arithmetic operations.
2	<b>To-Do List with Local Storage</b> <b>Objective:</b> To create a to-do list app with localStorage and basic JSON handling.
3	<b>React Counter App</b> <b>Objective:</b> To use React and useState to build a simple counter application.
4	<b>Dynamic Greeting App</b> <b>Objective:</b> To build a React component that greets users based on input using props and form handling.
5	<b>Product List Renderer</b> <b>Objective:</b> To render a list of products in React using reusable components and props.
6	<b>Simple Form Handling App</b> <b>Objective:</b> To create a form in React with input validation using useState.
7	<b>Multi-Page App using React Router</b> <b>Objective:</b> To develop a small React SPA with multiple pages using React Router.
8	<b>Theme Toggle with Context API</b> <b>Objective:</b> To implement a dark/light mode toggle using React's Context API.
9	<b>AngularJS Data Binding Demo</b> <b>Objective:</b> To explore AngularJS expressions, two-way data binding, and basic directives.

10	<b>Simple Shopping Cart</b> <b>Objective:</b> To use AngularJS directives and \$scope to create a functional shopping cart.
11	<b>AngularJS Form with Validation</b> <b>Objective:</b> To create and validate forms using AngularJS form controls and custom rules.
12	<b>Weather App using AngularJS &amp; Service</b> <b>Objective:</b> To fetch and display weather data using AngularJS services, AJAX, and routing.

#### D. RECOMMENDED STUDY MATERIAL

S. No.	Text Books	Author	Edition	Publication
1	React – Up and Running	Stoyan Stefanov	1st Edition, 2016	O’Reilly Media
2	AngularJS: Up and Running	Shyam Seshadri & Brad Green	1st Edition, 2014	O’Reilly Media
3	Pro React	Cassio de Sousa Antonio	–	Apress
Online Resources				
1.	<a href="https://reactjs.org">https://reactjs.org</a>			
2.	<a href="https://angularjs.org">https://angularjs.org</a>			
3.	<a href="https://www.w3schools.com/react/">https://www.w3schools.com/react/</a>			
4.	<a href="https://www.tutorialspoint.com/angularjs/">https://www.tutorialspoint.com/angularjs/</a>			

**A. Course Outcomes: -**

CO	Cognitive Abilities	Students will be able to:
CO – 01	Remember	To recall JavaScript concepts and how they apply in frontend frameworks.
CO – 02	Understand	To explain core concepts of React.js and AngularJS.
CO – 03	Apply	To build interactive UI components using React.js and AngularJS.
CO – 04	Analyze	To analyze project requirements and apply relevant framework features.
CO – 05	Create	To design and develop full frontend projects using React.js and AngularJS.

**B. CO-PO-PSO Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
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CO2	2	2	1	-	-	-	-	-	-	-	-	-	2	2	1	-
CO3	3	3	2	1	-	-	-	-	-	-	-	-	3	2	2	-
CO4	3	3	3	2	-	-	-	-	-	-	-	-	3	3	2	-
CO5	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3	-

**C. LIST OF EXPERIMENTS**

S. No	Lab Project Title	Objective
1	Build a Simple Calculator Using JavaScript	To practice using JavaScript functions, variables, and modules by creating a basic calculator.
2	To-Do List with Local Storage	To create a to-do list app with localStorage and basic JSON handling.
3	React Counter App	To use React and useState to build a simple counter application.
4	Dynamic Greeting App	To build a React component that greets users based on input using props and form handling.
5	Product List Renderer	To render a list of products in React using reusable components and props.
6	Simple Form Handling App	To create a form in React with input validation using useState.
7	Multi-Page App using React Router	To develop a small React SPA with multiple pages using React Router.
8	Theme Toggle with Context API	To implement a dark/light mode toggle using React's Context API.
9	AngularJS Data Binding Demo	To explore AngularJS expressions, two-way data binding, and basic directives.
10	Simple Shopping Cart	To use AngularJS directives and \$scope to create a functional shopping cart.
11	AngularJS Form with Validation	To create and validate forms using AngularJS form controls and custom rules.
12	Weather App using AngularJS & Service	To fetch and display weather data using AngularJS services, AJAX, and routing.

**D. RECOMMENDED STUDY MATERIAL**

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2	AngularJS: Up and Running	Shyam Seshadri & Brad Green	1st Edition, 2014	O'Reilly Media
3	Pro React	Cassio de Sousa Antonio	–	Apress
Online Resources				
1.	React Official Site			
2.	AngularJS Official Site			
3.	W3Schools React Tutorial			
4.	TutorialsPoint AngularJS			

**A. Course Outcomes: -**

CO	Cognitive Abilities	Students will be able to:
CO – 01	Understand/ Apply	Understand and implement Android networking components and monitor network states securely.
CO – 02	Apply	Apply secure storage techniques and manage sensitive data in Android applications.
CO – 03	Apply / Analyze	Implement secure communication practices and WebView configurations in Android apps.
CO – 04	Analyze / Evaluate	Analyze app permissions, rooting risks, and perform reverse engineering for security assessment.
CO – 05	Analyze, Apply, Evaluate	Identify and mitigate Android Application vulnerabilities through practical testing scenarios

**B. CO-PO-PSO Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	1	3	-	-	-	-	-	-	-	3	2	2	-
CO2	3	2	3	1	3	-	-	-	-	-	-	-	3	3	2	-
CO3	3	3	3	2	3	-	-	-	-	-	-	-	3	3	2	-
CO4	3	3	3	2	2	-	-	-	-	-	-	-	3	3	2	-
CO5	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3	-

**C. List of Experiments: -**

1	Create an Android app to check network connectivity status (Wi-Fi/Mobile Data/No Connection) and display appropriate messages.
2	Develop a simple app to retrieve device IP address, network type (Wi-Fi/Mobile) and statu
3	Create a simple app to save and retrieve data using SharedPreferences.
4	Scan and list available Wi-Fi networks on an Android device and identify their security types (open, WPA2, etc.)
5	Develop a simple Bluetooth pairing demo between two Android devices and observe permission requests.
6	Implement secure storage of sensitive data using EncryptedSharedPreferences.
7	Create a basic WebView app. Disable JavaScript and restrict URL loading to trusted domains only
8	Add HTTPS connection to a sample app using Retrofit or HttpURLConnection. Implement basic SSL pinning.
9	Check app permissions requested by an installed app using ADB and explain the difference between normal and dangerous permissions
10	Root an Android emulator and observe changes in app permissions or behaviors .
11	Use Apktool or Jadx to decompile a sample APK and locate the AndroidManifest.xml file. Identify declared permissions.
12	Simulate an insecure deep link in a test app and add validation to prevent unintended activity launching.

**D. RECOMMENDED STUDY MATERIAL**

S. No	Text Books:	Author	Edition	Publication
1	Android Security Internals: An In-Depth Guide to Android's Security Architecture	Nikolay Elenkov	1st	No Starch Press, 2015
2	Android Hacker's Handbook	Joshua J. Drake, Zach Lanier, Collin Mulliner, et al.	1st	Wiley, 2014
Reference Book				
1.	Learning Pentesting for Android Devices , Aditya Gupta, Packt Publishing ,2014			
2.	Android Malware and Analysis, Ken Dunham, CRC Press ,2018			

