# DOCTORAL PROGRAM

**COURSE WORK**

(Common for Engineering, Physics, Chemistry, Mathematics, Management candidates)

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject Name</th>
<th>Teaching Scheme (Hrs per week)</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Compulsory Subjects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PD101EN101</td>
<td>Research Methodology</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>PD101EN102</td>
<td>Seminar</td>
<td>4</td>
<td>4+2</td>
</tr>
<tr>
<td></td>
<td>Two credits separately allocated for review paper preparation and submission to standard journal.</td>
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<tr>
<td>PD101EN103</td>
<td>Mathematics for Research</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>PD101EN104</td>
<td>Area Specific Topics</td>
<td>4</td>
<td>4</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>16</strong></td>
<td><strong>20</strong></td>
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</tbody>
</table>

**Objective of Course Work:**

1. The objective of this course work is to familiarize the doctoral research candidates the process of research, Mathematical Concepts needed for research, Report Preparation & presentation, and the concepts needed from their own area of research.

2. To train them through practice in reference to reading, analyzing, summarizing a research paper, writing a review paper in their own area.

3. To get the work of exhaustive literature review done during the course work, so as to defend the problem statement in the final presentation of Thesis title while end term seminar.
POORNIMA UNIVERSITY

DETAILED SYLLABUS: Doctoral Program Course Work

I.1.1 Research Methodology Code: PD101EN101
4 Credits [LTP: 4-0-0]

A. OUTLINE OF THE COURSE

<table>
<thead>
<tr>
<th>Unit No.</th>
<th>Title of the unit</th>
<th>Minimum number of hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Overview of Research Methodology</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Data Collection &amp; Presentation</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Review of Basic Statistical Measures</td>
<td></td>
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<tr>
<td>4.</td>
<td>Design and Analysis of Experiments</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Attitude Measurement &amp; Scales</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Probability Distributions</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Testing Hypothesis I &amp; II</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Basic Multivariate Analysis</td>
<td></td>
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<tr>
<td>9.</td>
<td>Advance Multivariate Analysis</td>
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<tr>
<td>10.</td>
<td>Algorithmic Research</td>
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<tr>
<td>11.</td>
<td>Simulation</td>
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</tbody>
</table>

B. DETAILED SYLLABUS

<table>
<thead>
<tr>
<th>Unit</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Overview of Research Methodology</td>
</tr>
<tr>
<td></td>
<td>Introduction, Mathematical tools for analysis, Research problems in management, Types of research, Research Process</td>
</tr>
<tr>
<td>2.</td>
<td>Data Collection &amp; Presentation</td>
</tr>
<tr>
<td></td>
<td>Introduction, Primary data, Secondary data, Data Presentation</td>
</tr>
<tr>
<td>3.</td>
<td>Review of Basic Statistical Measures</td>
</tr>
<tr>
<td></td>
<td>Introduction, Measures of Central Tendencies, Measures of Variation, Measures of Skewness</td>
</tr>
<tr>
<td>4.</td>
<td>Design and Analysis of Experiments</td>
</tr>
<tr>
<td></td>
<td>Introduction, Analysis of Variance, Completely Randomized design, Randomized complete block design, Latin square design, Duncan's multiple Range Test, Functional design, second factorial experiment, Expected Mean Square</td>
</tr>
<tr>
<td>5.</td>
<td>Attitude Measurement &amp; Scales</td>
</tr>
<tr>
<td></td>
<td>Introduction, Measurement, Fundamentals of Data Collection Methods, Types of scales, Scales for Stimuli, Scaling Respondents</td>
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<tr>
<td>6.</td>
<td>Probability Distributions</td>
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<tr>
<td></td>
<td>Introduction, Approaches to Probability, Probability Distribution</td>
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<tr>
<td>7.</td>
<td>Testing Hypothesis I &amp; II</td>
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<tr>
<td></td>
<td>What is Hypothesis, Basic Concept of Hypothesis and Testing, Procedure, Flow Diagram, Measuring the Power of Test, Tests, Important parametric Tests, Hypothesis testing Means, differences, comparison, Proportion Testing, Differences, Important Non Parametric or Distribution Free Test, Relationship between Spearman's r's and Kendall's W, Characteristics</td>
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<tr>
<td>8.</td>
<td>Basic Multivariate Analysis</td>
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<tr>
<td></td>
<td>Introduction, Correlation analysis, Forecasting, Linear regression &amp; Time series</td>
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</table>
C. RECOMMENDED STUDY MATERIAL:

<table>
<thead>
<tr>
<th>S.No</th>
<th>Title of the Book</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Research Methodology</td>
<td>R. Panneerselvam, PHI</td>
</tr>
<tr>
<td>2.</td>
<td>Research Methodology: Methods and Trends</td>
<td>Dr. C. R. Kothari</td>
</tr>
<tr>
<td>3.</td>
<td>Research Methodology: A Step by Step Guide for Beginners</td>
<td>Ranjit Kumar</td>
</tr>
</tbody>
</table>

1.1.2 Seminar

Code: PD101EN102
4 Credits [LTP: 4-0-0]

C. OUTLINE OF THE COURSE

<table>
<thead>
<tr>
<th>Unit No.</th>
<th>Title of the unit</th>
<th>Minimum number of hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Formulating Problem Statement</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Literature survey</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>How to study a scientific paper</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Publishing a paper</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>How to present scientific paper</td>
<td></td>
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</tbody>
</table>

D. DETAILED SYLLABUS

<table>
<thead>
<tr>
<th>Unit</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Formulating Problem Statement</td>
</tr>
<tr>
<td></td>
<td>Overview of research process: Formulating the Research Problem, Extensive Literature Review, Developing the objectives, preparing the Research Design including Sample Design, Collecting the Data, Analysis of Data, Generalization and Interpretation, preparation of the Report or Presentation of Results, Formal write-ups of conclusions reached. Problem statement - Conditions and steps in selecting a research problem, Understanding the Key research area of interest, How to get new ideas (Criticizing a paper), Finding a good problem: Top-down and Bottom-up approach, Creative thinking techniques, Coming up with a problem statement Defining objectives - How to find objectives, characteristics of objectives</td>
</tr>
<tr>
<td>2.</td>
<td>Literature survey</td>
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<tr>
<td></td>
<td>Overview - What is literature survey, Functions of literature survey, maintaining a notebook, developing a Bibliography Methods of data collection - Observation, survey, contact methods, experimental, determining sample design Searching for publications - Publication databases, search engines and patent databases, Find some/all of the references for a given paper, including those that are not on the web Online tools - google, CiteSeer, ACM Digital Library, IEEE, The on-line Computer Science bibliography, Survey papers, Finding material not on the web, Searching patents</td>
</tr>
<tr>
<td>3.</td>
<td>How to study a scientific paper</td>
</tr>
</tbody>
</table>
4. **Publishing a paper**

- How to write scientific paper: Structure of a conference and journal paper, how (and How Not) to write a Good Systems Paper, Abstract writing, chapter writing, discussion, conclusion, references, bibliography, and In-class discussion of technical writing examples, Poster papers, review papers, how to organize thesis Project report.
- How to write a research proposal? How research is funded?
- Research ethics - Legal issues, copyright, plagiarism. General advice about writing technical papers in English
- Tips for writing correct English

5. **How to present scientific paper**

- Talk structure, basic presentations skills
- Documentation and presentation tools: LATEX, Microsoft office, PowerPoint and SLIHYY

### C. RECOMMENDED STUDY MATERIAL:

<table>
<thead>
<tr>
<th>S.No</th>
<th>Title of the Book</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>As discussed in the class</td>
<td></td>
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<tr>
<td>2.</td>
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<td>3.</td>
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</table>

1.1.1.3 **Mathematics for Research**

Code: PD101EN103

4 Credits [LTP: 4-0-0]

### A. CONTENTS

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<thead>
<tr>
<th>Unit</th>
<th>Contents</th>
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<tbody>
<tr>
<td></td>
<td>Candidate will have the option to select any five units from the following list of units</td>
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</tbody>
</table>

### B. DETAILED SYLLABUS

<table>
<thead>
<tr>
<th>Unit</th>
<th>Contents</th>
</tr>
</thead>
</table>
|      | **Unit 1 : Linear algebra**  
|      | Linear system solution: full and sparse matrices, least squares solution, Eigenvalues  
|      | Reference Books:  

|      | **Unit 2 : System of nonlinear equations**  
|      | Newton (and related) methods, Limiters  
|      | Reference Books:  

|      | **Unit 3 : Dynamical System**  
|      | Analytical and numerical solutions, Stability of numerical methods, Dynamical system Stability |
Reference Books:

Partial differential equations I
Elliptic systems, Solution methods, multi grid and other efficient algorithms
Reference Books:
1. Numerical Partial differential equations: finite difference methods, J WThomas, Springer

Unit 5: Partial differential equations II
Parabolic and Hyperbolic systems, 1-d and 2-d solution methods, stability analysis
Reference Books:

Unit 6: Complex Analysis
Integration in the complex plane, residues, improper integral evaluation
Reference Books:
1. Serge Lang, Complex Analysis, Springer Verlag

Unit 7: Transform Techniques
Laplace, Fourier transforms, FFT, z-transforms, Other linear transforms, Applications, Karhunen-Loeve transforms, System analysis in transform domain,
Reference Books:
2. L Debnath; Integral Transforms and their Applications CRC Press, Inc. 2nd Ed. R.

Unit 8: Optimisation
Linear systems with constraints, unconstrained nonlinear systems constrained nonlinear cases, Tabu Search, Simulated Annealing, Swarm Intelligence
Reference Books:

Unit 9: Stochastic Processes
Games theory, Probability, Reliability and Random numbers, CDF and PDF, Random processes, Moments, Models of random processes.
Reference Books:

Unit 10: Soft Computing
Genetic Algorithms, Fuzzy Logic, Neural Networks, Hyper Heuristics, Support Vector Machines
Reference Books:

Unit 11: Signal Detection and Estimation
Signal Detection and Estimation, Mathematical Modelling and analysis of various filters

Unit 12: Switching and Queuing Theory
Various models, Design requirements and issues, transmission techniques, media, switching theory, performance issues

Unit 13: Joint Time-Frequency Analysis
Wavelet transforms and its variants, analysis, limitations, applications, multi-resolution theory, Wigner-Vile distribution, Time series analysis and applications.

Unit 14: Computational Wave Theory
Maxwell equations, Poynting vector, wave types, interface conditions, orthogonality, hybrid computational methods, method of moments, low and high frequency applications

Unit 15: Finite Differences and Interpolation
Differences of polynomial, Factorial Notation, Newton's Interpolation Formulae, Interpolation with unequal
intervals, Numerical differentiation, Numerical integration.

**Reference Books:**

**Unit 16: Numerical Solutions of Ordinary Differential Equations**

**Reference Books:**
2. Introductory Methods of Numerical Analysis - S.S Sastry Prentice Hall of India

**Unit 17:**
Difference Equations, Solutions of difference equations. Finite difference approximations to partial derivatives. Finite difference method of finding solution of one dimensional heat equation, two dimensional heat equation and wave equation. Solutions of Laplace and Poisson equation.

**Reference Books:**

**Unit 18: Statistical Quality Control and Stochastic Processes**
Control charts: X Chart, R-Chart, P-chart and np charts etc. Markov process, Markov chain, Stochastic differential equations. Applications to physical problems.

**Reference Books:**
1. Advanced Methods of Mathematical Physics -by R.S. Kaushal and D. Paraskekar, Narosa Publishing House

**Unit 19: Matrices**

**Reference Books:**

**Unit-20: Analysis of Algorithms**

**Reference Books:**

**Unit-21: Randomized Algorithms**
Geometric algorithms and Linear Programming: Randomized incremental construction, Convex Hulls in the plane, Duality, Half-space intersections, Delaunay Triangulations, Trapezoidal Decompositions, Binary space partitions, random sampling, Linear Programming.

**Reference Books:**

**Unit-22: Graph Theory**
Graph as mathematical model, Planar and Dual Graphs, Vector Spaces of a Graph Matrix Representation of Graphs, Graph Coloring, Covering, and Partitioning, Directed Graphs, Enumeration of Graph, Graph Theoretic Algorithms and Computer Programs.
Reference Books:
1. G. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science" PHI Learning (2009)

Unit 23: Coding Theory
Uncertainty, acquisition of information, entropy, noiseless coding, noisy coding, cyclic redundancy checks, integers

Reference Books:

Unit 24: Mathematical Foundations of Computer Networks
Basic algorithms on directed graphs, weighted shortest paths, Networks and routing algebras - fixed-point equations, sequential algorithm to solve the fixed-point equations, generalized distance-vector and link-state routing protocols, applications to quality-of-service intra-domain routing and to policy-based inter-domain routing in the Internet, Network flows - flows and residual networks, Max-flow Min-cut theorem, Ford-Fulkerson method and Edmonds-Karp algorithm. Network calculus - Min-plus calculus; integrals and convolutions, Arrival curves and token buckets; service curves and schedulers, Applications to integrated and differentiated services in the Internet.

References:

Unit 25: Correlations and Regression
Auto correlation based on statistical methods, linear / Non-Linear regression analysis.

Unit 26: Geometrical Modeling
Measurements, properties and relationships of curves, surfaces and volumes, computer aided geometric design (CAGD), intersection algorithms and CAGD, real time algebraic surface modeling

A. CONTENTS

<table>
<thead>
<tr>
<th>Unit</th>
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<tbody>
<tr>
<td></td>
<td>Candidate will have the option to select any five units from the following list of units as per specialization or may submit any other relevant topic in coordination with the supervisor</td>
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</table>
B. COMPUTER SCIENCE

<table>
<thead>
<tr>
<th>Unit</th>
<th>Contents</th>
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</table>

**References**


**Unit 2: Compilers**

Introduction, types of Parsers, LL (k) and LALR (k) parsers, three address codes, Introduction to code generation, simple code generation algorithm, DAGs Introduction to Code Optimization, basic blocks and flow graphs, common subexpression elimination, loop optimization, loop invariant computations, dead code elimination, code movement

**Reference**


**Unit 3: Digital Image Processing**


**References**


**Unit 4: Wireless Technology**


**References**


**Unit 5: Network Security**

References

Unit-6: Artificial Intelligence


References

Unit-7: Language Translation

Language Processing: applications and key issues; lexicon and morphology; Phrase structure grammars and English syntax; Part of speech tagging; Syntactic parsing, top-down and bottom-up parsing strategies; Semantics, Word Sense Disambiguation, Semantic parsing; Information retrieval and Question answering; knowledge representation and reasoning, local discourse context and reference.

References

Unit-8: Machine Learning


References
2. Ethem Alpaydin, “Introduction to Machine Learning”, PHI

Unit-9: Graphics & Visualization


References

Unit-10: Advanced Algorithms and Applications

C. ELECTRICAL ENGINEERING

<table>
<thead>
<tr>
<th>Unit</th>
<th>Contents</th>
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</thead>
</table>
Unit 3: Control System Design
Design of linear and non-linear systems, continuous and discrete time, SISO and MIMO systems by state variable techniques. Advanced PID design techniques, Application of softwares: Simulink and CAD for control system design.

Reference Books:
3. ‘Control System Principles and Design’, M. Gopal.

Unit 4: Modeling of Dynamic Systems
Modeling and simulation techniques applied to dynamic systems covering physical systems such as electrical, mechanical, thermal, chemical, biomedical and biological.

Reference Books:

Unit 5: Renewable Energy Sources
Solar Photovoltaic, new organic photovoltaic materials and devices, Modeling and characterization of PV cells and modules, Grid integration of PV systems, Wind Energy systems, wind turbine Electrical generators and converters, Wind turbine system reliability, Wind resources and its characterization, grid integration of wind turbines and wind farms, Power quality and reliability issues related with wind farm interfaced to weak grid/fuel cells systems. Hybrid systems, standalone hybrid systems, other sustainable Energy sources such as biomass, tidal, wave, geothermal, small and micro hydel systems.

Reference Books:
1. Renewable Energy technologies; R. Ramesh, Narosa Publications.
2. Energy Technology: S. Rao, Paralkar.

Unit 6: Power Electronics and Drives
Modern power switching devices, Voltage source converter topologies, Multi pulse converters, Inverter, Multilevel Inverters and Chopper, Current source converters, Harmonics elimination schemes, Variable speed drives for various industrial applications, advanced control techniques (16 Hours)

Reference Books:
1. Power Electronics: M.H. Rashid (Prentice Hall India Pvt Ltd.)

Unit 7: Power system restructuring
Power tariff, pricing issues, market reforms and models, policies, methods of comparing investment options, Electricity market pricing and non pricing issues, spot pricing, reactive power pricing (10 Hours)

Reference Books:
2. ‘Regulation in infrastructure services: Progress and the way Forward’, TERI.
3. ‘Market operations in electric power systems forecasting, Scheduling and Risk Management’, Mohammad Shaheedur Rahman, Hatim, Zuri Li.

Unit 8: Numerical protection

PU/2012-13/COURSE WORK/SYLLABUS/SET/PHD
Numerical protection, numerical protection of transmission line, synchronous generator, power transformer, relay co-ordination (10 Hours)

Reference Books:
2. "Transmission network protection", Paitthakar, Marcel and Dekker, New York

Unit 9 : Power System Analysis
Synchronous machine modeling, excitation system modeling, transmission line modeling, analysis of single machine and multi machine, power system stabilizers, voltage stability, islanding (10 Hours)

Reference Books:
4. Power System operation and control :P.S.R Murthy

Unit 10 : Computer Applications in power system
Optimization techniques, classical techniques, single variable and multivariable optimization, Newton Raphson's method, Descart method, non linear programming, load flow under linear as well as non linear load connected to power system, motor starting analysis, symmetrical and un-symmetrical power system fault analysis, decoupled load flow, methods of optimal power flow (10 Hours)

Reference Books:

Unit 11: Power Quality
Power quality definitions as per IEEE Std. 1159, RMS Voltage variations, such as voltage sag, swell, under and over voltage, Flicker, its sources, effects on equipments and solutions, IEEE Std 1346, Waveform distortion, various factors governing waveform distortion, Harmonic sources, its effect on equipment, harmonic mitigation techniques K Rated transformer, series and parallel resonance, IEEE Std 519-1992, Power quality monitoring as per IEEE Std. 1159. Transients, impulsive and oscillatory transients, capacitor switching transient, Methods to control transient, TVSS,(10 Hours)

Reference Books:
1. IEEE std. 1159, IEEE Press, USA.
2. IEEE Std. 1346, IEEE Press, USA.
3. IEEE Std 519, IEEE Press, USA.

Unit 12: Grounding
Objectives of grounding, Factor affecting soil resistivity, single layer and multilayer homogeneous and heterogeneous soil modeling, Sub station grounding Design as per IEEE standard 80, Grounding of sensitive Electronic equipments as Per IEEE std. 1100, EMI and Electrostatic shielding (10 Hours)

Reference Books:
1. Power System Analysis, B.R.Gupta
2. IEEE Std. 80, IEEE Press, USA
3. IEEE Std. 1100, IEEE Press, USA.

Unit 13: Energy Management
Energy management and audit, Energy and mass balance, Energy modelling, Energy conservation
opportunities in Thermal, HVAC, Electrical, compressed air, Centrifugal pumps, Blowers, Waste heat recovery, CHP, Energy Efficient technologies, Energy conservation Building Codes (10 Hours)

Reference Books:

Unit 14: Condition Monitoring

Unit 15: Smart Grid
1. Formation of micro grids and interconnections to established grid.
2. Integration of wind, solar and other renewable generation into the present distribution.
3. Dispersed generation including captive power co-generation and mini-hydro.
4. Disaster and emergency management in case of disturbance in distribution.
5. Communication requirement protocols and standards.
7. Present status of micro grids in the world power system (10 Hours)

D. CHEMICAL ENGINEERING

Unit | Contents
--- | ---
1 | Advanced Biochemical Engineering
Various Applications Use of Microbes modeling of biochemical reaction and applications to scale up. Metabolic pathways and Bioreactor models
Reference Books:

2 | Advanced Polymer Engineering
Metalloene catalysis, Ziegler Natta Catalysis Mechanism and Products, Polymerization reactors.
Reference Books:

3 | Nanotechnology
Recent Approaches for synthesis, characterization of nanomaterials and Applications
Reference Books:
2. R. Kelsall, I. Hamley and M. Geoghegan (Eds.), “Nanoscale Science and Technology”, Wiley, 2005

4 | Separation Technology
Separation techniques using LEM, Ionic liquids, extractive separation reactive crystallization reactive separation and modeling.
Reference Books:
Unit 5: Environmental Engineering
Advance Oxidation processes. Water treatment and analysis. Emphasis on advance treatment techniques and reactors etc.

Reference Books:

Unit 6: Advance Modeling and Simulation
Multiscale simulations in materials, industrial flow modeling. Data driven modeling. Non-linear system dynamics

Reference Books:

Unit 7: Catalysis, reactor and reaction engineering
Heterogeneous reactor analysis and design Special reactors. Molecular catalysis. Solid catalyst, supported catalyst

Reference Books:

Unit 8: Advance Transport Phenomena

Reference Books:

Unit 9: Mass Transfer with Multiphase System
Diffusional mass transfer. Mass transfer with reaction in Fluid-Fluid- Solid system. Simultaneous absorption and Desorption with reaction. Mass transfer accompanied by General order irreversible and reversible reaction in gas – liquid and liquid- Liquid System.

Reference Books:
1. Gas liquid relation by Danekwerts P.V.
2. Heterogeneous Relation Analysis example and Relation design Vol: 2 John Wiley And Sons by Doraiswamy L.K. and M.M. Sharma

Unit 10 Advanced Process Control

Reference Books:

Unit 11 Advance Heat transfer

Reference Books:

NOTE: Other specializations shall be added as per requirements