UNIVERSITY OF PUNE

RULES & REGULATIONS, STRUCTURE and SYLLABUS

for

Ph.D. COURSE WORK

Under

FACULTY OF ENGINEERING
RULES & REGULATIONS

Appendix for Revised rules for Ph. D under Faculty of Engineering

The candidates who have registered for Ph.D. Program on or after 11\(^{th}\) July 2009 are governed by


Based on and adhering to this, University of Pune has formulated the Revised rules for Ph.D. and circulated vide circular no.406/2009 dated 29\(^{th}\) December 2009.

All the Procedures, rules and regulations regarding Short title, Applications, Commencement, Supervisor Eligibility Criterion, Procedure for Admission, Course work, Evaluation and Assessment methods etc. as laid down in these revised rules, are applicable to PhD Programs under Faculty of Engineering, University of Pune.

The following guidelines are a supplement to these rules and regulations; for only those sections, which require better and adequate comprehension.

1 - COURSE WORK:

<table>
<thead>
<tr>
<th>CODE</th>
<th>NAME OF COURSE</th>
<th>CONTACT HOURS</th>
<th>CONTINUOUS ASSESSMENT</th>
<th>END SEMESTER EXAM</th>
<th>TOTAL</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>700001</td>
<td>Research Methodology</td>
<td>5</td>
<td>50</td>
<td>100</td>
<td>150</td>
<td>5</td>
</tr>
<tr>
<td>700002</td>
<td>Seminar</td>
<td>10</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>5</td>
</tr>
<tr>
<td>700003</td>
<td>Faculty Specific Topics for Engineering Research</td>
<td>10</td>
<td>100</td>
<td>100</td>
<td>200</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Part-A (700003-A) Mathematics for Engineering Research</td>
<td></td>
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<tr>
<td></td>
<td>Part-B (700003-B) Branch Specific Topics</td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>25</td>
<td>200</td>
<td>250</td>
<td>450</td>
<td>20</td>
</tr>
<tr>
<td>CODE</td>
<td>Branch Specific Topics</td>
<td>CODE</td>
<td>Branch Specific Topics</td>
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</tr>
<tr>
<td>700003-B1</td>
<td>Advances in Civil Engineering</td>
<td>700003-B8</td>
<td>Advances in Chemical Engineering</td>
<td></td>
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<tr>
<td>700003-B2</td>
<td>Advances in Mechanical Engineering</td>
<td>700003-B9</td>
<td>Advances in Computer Engineering</td>
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<tr>
<td>700003-B3</td>
<td>Advances in Electrical Engineering</td>
<td>700003-B10</td>
<td>Advances in Production &amp; Industrial Engineering</td>
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<tr>
<td>700003-B4</td>
<td>Advances in Electro &amp; Tel Engineering</td>
<td>700003-B11</td>
<td>Advances in Petroleum &amp; Petro chemical. Engineering</td>
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<tr>
<td>700003-B5</td>
<td>Advances in Metallurgy Engineering</td>
<td>700003-B12</td>
<td>Advances in Architecture</td>
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<tr>
<td>700003-B6</td>
<td>Advances in Instrumentation Engg.</td>
<td>700003-B13</td>
<td>Advances in Information technology</td>
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<tr>
<td>700003-B7</td>
<td>Advances in Printing Engineering</td>
<td>700003-B14</td>
<td>Advances in Biotechnology</td>
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</tr>
</tbody>
</table>

**R-1.1**

After having been admitted, each Ph.D. student shall be required to undertake course work for a minimum period of one semester. The course work shall be treated as pre- Ph.D. preparation.

**R-1.2**

If found necessary, course work may be carried out by doctoral candidates in sister departments / institutes either within or outside the University for which due credit will be given to them.

**R-1.3**

The Ph.D. Course work for all branches under Faculty of Engineering shall be offered with credit system.

**R-1.4**

The total credit requirement for entire course work shall be of 20 credits. Students are required to earn these 20 credits in maximum three semesters.

**R-1.5**

The structure for Ph.D. course work for all branches under Faculty of Engineering shall be as given in Table- 1.

**R-1.6**

The course, Faculty Specific Topics for Engineering Research will consists of;

Part-A: Mathematics for Engineering Research, the contents of syllabus of which will be based on the advance topics from engineering mathematics. It will consist of minimum 15 units of 2 credits each.

Part-B: Branch Specific Topics, the contents of syllabus of which will be based on the advance topics/technology pertaining to the branch. It will consist of minimum of 10 units with 2 credits each.
The students shall require to appear to earn the credit for 2 units from Mathematics for Engineering Research and 3 units from Branch Specific Topics, related to their area of research, selected in consultation with the guide and approved by the head of research centre.

2 AWARD OF GRADE:

For each course, undertaken by the students, he/she shall be assigned a letter grade based on the total marks obtained by him/her in all the heads of examination of that course. The letter grades and the guidelines for conversion of marks to letter grades shall be as given in Table-2.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage of Marks obtained</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>50-100</td>
<td>Pass</td>
</tr>
<tr>
<td>F</td>
<td>Below 50</td>
<td>Fail</td>
</tr>
<tr>
<td>FX</td>
<td>-----------------</td>
<td>Detained, Repeat the course</td>
</tr>
<tr>
<td>II</td>
<td>-----------------</td>
<td>Incomplete-Absent for Exam but continue the course</td>
</tr>
</tbody>
</table>

R-2.1 P Grade

The grade ‘P’ is passing grade. The candidate acquiring ‘P’ grade in a course shall be declared to have passed that course.

R-2.2 F Grade

The grade ‘F’ shall be treated as failure grade. The candidate acquiring ‘F’ grade in a course shall be declared to have failed in that course. The student with F grade in any course shall have to pass the concerned course by re-appearing for the examination as and when it is conducted by the appropriate authority.

R-2.3 FX Grade

The grade ‘FX’ in a course is awarded by the research centre, if the student does not maintain the minimum attendance in the theory/class as prescribed by the University and/or his/her performance during the semester is not satisfactory.
R- 2.4 II Grade

Grade ‘II’ shall be awarded to a candidate in a course in which he has the minimum attendance as prescribed by the University and satisfactory in-semester performance but could not appear for the end semester examination. Such a student shall have to appear for the End Semester Examination as and when it is conducted by the authorities.

3 COURSE WORK ASSESSMENT:

The rules given below are specified for the examination scheme mentioned in typical Course Work Structure as given in Table-1.

R-3.1 CONTINUOUS ASSESSMENT:

The continuous assessment of all the courses of Ph.D. course work shall be done by concerned and appropriate faculty of the Research Centre.

R-3.1.1 Theory Courses:
The continuous assessment of theory course shall be evaluated on the basis of the class tests/assignments/case studies/quizzes. There shall be minimum two class tests/assignments/case studies/quizzes for each theory course. It shall be of minimum 25 marks. The marks obtained shall be displayed on the notice board within 10 days of conducting it.

R-3.1.2 Seminar:
The continuous assessment of seminar shall be based on the following heads;

<table>
<thead>
<tr>
<th>Head</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Performance of the student in the collection of the reference material and its understanding for seminar</td>
<td>40 Marks</td>
</tr>
<tr>
<td>b. Punctuality, Enthusiasm and aptitude of student in Preparing seminar / completing the report</td>
<td>10 Marks</td>
</tr>
</tbody>
</table>

3.2 END SEMESTER EXAMINATION (ESE)

R- 3.2.1

The End Semester Examination for the theory course shall be of 100 marks and three hours duration.

R-3.2.2

Grade II shall be awarded to a candidate in a course in which he/she could not appear for the end-semester examination. Such a student shall have to appear for the ESE as and when conducted by the appropriate authority.

R- 3.2.3
Research Methodology-
The Authority of the University of Pune will be responsible for paper setting, preparing the schedule of the examination, conducting the examination, appointment of examiners and assessment, awarding the marks for the ESE of the Course, Research Methodology.

R -3.2.4

Faculty Specific Topics for Engineering Research -
The concerned and appropriate faculty of the Research Centre. will be responsible for paper setting, preparing the schedule of the examination, conducting the examination, assessment, awarding the grades for the ESE of the Course, Faculty specific Topics.

R- 3.2.5

End semester presentation-
The Research Progress Monitoring Committee; duly constituted by the head of Research centre, shall review the End semester presentation and assign the marks based on the following heads

c. Content and Quality of the seminar 30 Marks
d. Presentation and Viva-Voce 20 Marks

The examiners will prepare the mark / grade sheet in the format as specified by the University of Pune, authenticate it, seal it, and shall submit it to the Head of the concern Research Center.

4. RULES OF EXAMINATIONS & PERFORMANCE REQUIREMENTS

R- 4.1
To pass the examination of a course/seminar, student should earn passing grade in the examination of that course/seminar.

R-4.2
For successful completion of the course work, student should pass in all the courses/ seminar of the course work.

5. RESULT:

Based on the performance of the candidate in the course work, the head of the research centre shall declare that the candidate has successfully completed the course work and accordingly inform University of Pune in due course of time.

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SYLLABUS
Ph.D. COURSEWORK UNDER FACULTY of ENGINEERING

700001: Research Methodology

Teaching Scheme: Contact Hours: 5 hrs/week
Credits: 5

Marking Scheme: Continuous Assessment: 50 Marks
End Semester Examination: 100 Marks

Objectives
- Learn to focus on a research problem using scientific methods
- Learn methods to devise and design an experimentation set-up
- Learn basic instrumentation and data collection methods
- Learn parameter estimation and related modelling methods

Unit 1: Research Problem
Meaning of research problem, Sources of research problem, Criteria / Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.

Unit 2: Basic instrumentation
Instrumentation schemes, Static and dynamic characteristics of instruments used in experimental set up, Performance under flow or motion conditions, Data collection using a digital computer system, Linear scaling for receiver and fidelity of instrument, Role of DSP is collected data contains noise.

Unit 3: Applied statistics
Regression analysis, Parameter estimation, Multivariate statistics, Principal component analysis, Moments and response curve methods, State vector machines and uncertainty analysis.

Unit 4: Modelling and prediction of performance
Setting up a computing model to predict performance of experimental system, Multi-scale modelling and verifying performance of process system, Nonlinear analysis of system and asymptotic analysis, Verifying if assumptions hold true for a given apparatus setup, Plotting family of performance curves to study trends and tendencies, Sensitivity theory and applications.

Unit 5: Developing a Research Proposal
Format of research proposal, Individual research proposal, Institutional proposal
Proposal of a student – a presentation and assessment by a review committee consisting of Guide and external expert only. Other faculty members may attend and give suggestions relevant to topic of research.
Reference Books:
1. ‘Research methodology: an introduction for science & engineering students’, by Stuart Melville and Wayne Goddard
2. ‘Research Methodology: An Introduction’ by Wayne Goddard and Stuart Melville
4. ‘Research Methodology: Methods and Trends’, by Dr. C. R. Kothari
5. ‘Operational Research’ by Dr. S.D. Sharma, Kedar Nath Ram Nath & co.
6. Software Engineering by Pressman

700002: Seminar

Teaching Scheme:  Marking Scheme:
Contact Hours: 5 hrs/week  Continuous Assessment: 50 Marks
Credits: 5  End Semester Examination: 50 Marks

Unit 1: Formulating Problem Statement
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

Unit 2: Literature survey
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

Unit 3: How to study a scientific paper
Summarizing paper – Reading abstracts and finding ideas, conclusion, Advantages of their approach, the drawbacks of the papers (What is lacking – can be found in the sections such as future work) Generalize results from a research paper to related research problems
Comparing the approach - Identify weaknesses and strengths in recent research articles in the subject
Unit 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

Unit 5: How to present scientific paper
Talk structure, basic presentations skills
Documentation and presentation tools – LATEX, Microsoft office, PowerPoint and SLITHY

Reference Books:
1. Lecture Notes and presentations

700003-A: Mathematics for Engineering Research

Note: Each Unit is of 2 credits. A candidate has to take any two units (4 credits)

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:

Unit 4: 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 W Thomas, 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-Viley 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:
   Students Edition
   Students Edition.

Unit 16: Numerical Solutions of Ordinary Differential Equations
Taylor Series Method, Euler’s method, Modified Euler’s method, Runge’s Method,
Runge Kutta method, Predictor -Corrector methods. Simultaneous first order differential
equations. Applications to Engineering problems.

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

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
2. Numerical Methods - by Dr.B.S.Grewal Khanna Publishers
   Students Edition.

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.Parashar,
   Narosa Publishing House
   Students Edition.
Unit 19: Matrices

Reference Books:
1. Applied Mathematics for Engineers and physicists by Pipes and Harvill International students edition,

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 Tringulations, 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 modelling

Assignments:
- Each unit will have at least 1 assignment.
- Programming assignments will be based on engineering problems
700003-B1: Advances in Civil Engineering

Note: Each Unit is of 2 credits. A candidate has to take any three units (6 credits)

STRUCTURAL ENGINEERING:

Unit 1
Three dimensional elasticity problems, Torsion of open section, Thermal Stresses, Fracture mechanics. Kirchoff and Mindlin theory of plates, higher order shear deformation theories, classical theories of skew plates, Shell surfaces, bending theory of shells.

Unit 2
Mechanics of modern materials, laminated composites, functionally graded materials. Application to plate and shell structures. Structural dynamics, Forced and Damped vibration, modal analysis, response spectra, seismic design of multistoried buildings, codal provisions.

Unit 3

Unit 4
Multi- variable and Multi-objective optimization. Non linear and non traditional techniques of optimization. Design for reliability, reliability based optimization. Stability Analysis: Beam column, buckling of frames. Lateral buckling of beams, torsional buckling, energy criterion and energy based methods, dynamic stability

Reference Books:

5. R.C. Roy - Structural Dynamics an Introduction to Computer Methods, John Wiley & Sons Publications
7. Ansel C. Ugural, Stresses in Plates and Shells, Mc Graw Hill
HYDRAULIC ENGINEERING:

Unit 5
Water resources systems analysis, design and management for water supply, irrigation, drainage, hydropower, food control, droughts. Surface and ground water hydrology, stochastic hydrology, physical and numerical modeling, use of finite difference, finite element and boundary element methods.

Unit 6
Instrumentation and monitoring of hydraulic systems, computer simulation and optimization of hydrosystems. Computational fluid dynamics, coastal hydrodynamics, watershed management, application of numerical methods.

Unit 7
Ground water systems planning and management, ground water pollution investigation. Hydroinformatics, multi criterion decision support system, applications of ANN and GA.

Unit 8
Hydraulics of spillways and energy dissipators, pressure fluctuations in hydraulic jump, static and dynamic uplift pressures in stilling basins. Remote sensing and GIS applications, Dam break analysis using softwares.

Reference Books:

1. Principles of water resources planning and management – Goodman
3. Computational fluid dynamics – Anderson
6. Hydraulics of spillways and energy dissipators – R. M. Khatsuria (Marcel Dekker Publisher, New York)
8. Hydrodynamics of coastal zones – Massel S.R.
17. Vallentine - Hydrodynamics
18. S. W. Yuan – Fluid Mechancis.

GEOTECHNICAL ENGINEERING:

Unit 9
Advanced Geotechnical Engineering
Stress distribution under earth embankments and evaluation of settlement profile. Field problems to monitor movement of slopes, foundations, etc.

Advanced Foundation Engineering
Foundations in difficult soils: expansive soils, chemically aggressive environment, soft soils,fill, regions of subsidence.

Unit 10
Rockmechanics and Tunelling
Deformation characteristics of rocks and its measurement. Instrumentation, Underground excavation and subsidence. Bearing capacity of homogeneous as well as discontinuous rocks.

Soil Dynamics and Geotechnical Earthquake Engineering
Soil behaviour under dynamic loads. Seismic response, strong ground motion, its parameters and their estimation, seismic hazard analysis, local site effects and design ground motion, seismic slope stability

Unit 11
Finite Element Methods in Geotechnical Engineering
Stress deformation analysis: One-, Two,Three-dimensional formulations; Discretization; Analysis of foundations, dams, underground structures and earth retaining structures.

Geoenvironmental Engineering
Landfills, in ash ponds and tailing ponds, and in rocks. Detection, control and remediation of subsurface contamination; Engineering properties and geotechnical reuse of waste.

**Unit 12**

**Soil Structure Interaction**


**Geotechnics for Infrastructure**

Exploration studies for different Infrastructure Projects, Investigation reports, Analysis and required measures.

**Reference Books:**

9. Karl Terzaghi (1954), Theoretical Soil Mechanics, Chapman and Hall,
10. Rock Mechanics in Engineering Practice: Stag and Zienkiewez, John Willey & Sons
12. London.

**ENVIRONMENTAL ENGINEERING:**

**Unit 13**

**Water Treatment**

Aeration, Sedimentation, Coagulation & flocculation, Filtration: Adsorption, adsorption, Ion Exchange Membrane Processes, RO, Ultrafiltration, Electrolyalisis, Disinfection

Wastewater Treatment

Unit 14 Air Quality Monitoring and Control Techniques:
Air pollutants: Sources, classification, Combustion Processes, pollutant emission, Effects on Health, vegetation, materials, atmosphere, Reactions of pollutants Scales of AP studies, effects as per scales, Air sampling, pollution measurement methods, Ambient air quality and emission standards, Air pollution indices, Air Act, legislation and regulations, Removal of gaseous pollutants. Particulate emission control; bioscrubers, biofilters, Indoor air quality
Models for Water and Air Quality

Unit 15 :Environmental Management and Impact Assessment
Environmental management, problems and strategies; Future strategies; multidisciplinary environmental strategies, Environmental impact assessment (EIA), Sustainable development (SD), initial environmental examination (IEE), environmental impact statement (EIS), environmental appraisal, environmental audit (EA); Environmental impact factors and areas of consideration, measurement of environmental impact,

Unit 16

Reference Books:
5. Wastewater Treatment and Reuse: Metcalf and Eddy.
6. Air Pollution: Stern
7. Wastewater Treatment for Pollution Control; Arceivala and DR. Asolekar
8. Industrial Wastewater Treatment: Nelson – Numero
9. Industrial Wastewater Treatment: Dr. A. D. Patwardhan

CONSTRUCTION MANAGEMENT :

Unit 17 : Essentials of Construction Management
CPM, PERT networks, Cost / Resource based networks, scheduling, monitoring and updating, resource planning and allocation, LOB, network crashing, time cost trade off.
Computer Application in Construction Management- Softwares for .Precedence network analysis, CPM, PERT, GERT, decision tree analysis,

Unit 18

Financial Aspects of Construction Projects

Risk Management
Introduction, Principles, types, origin, risk control, Use of mathematical models: Sensitivity Analysis, Break Even Analysis, Simulation Analysis, Decision Tree Analysis, Risk identification, analysis and mitigation of project risks, Role of Insurance in Risk Management.

Unit 19

Construction Techniques
Introduction to construction operations, erection work, automation processes and special Equipments for Infrastructure Projects- Dams, bridges, ports, harbours, flyovers
Recent trends in construction techniques

Material Management:
Material planning, accounting and material reconciliation. Systems of material classification. Deterministic and probabilistic models and applications, ABC analysis, replenishment and replacement policies, VED analysis, lead time demand, purchase planning, EOQ model. Wastage audit at site, Site waste material management plan. Computer applications based upon available softwares

Unit 20

Equipment management :
New trends and construction equipment of future. Planning and selection of equipments, for earthmoving, hauling, hoisting, conveying, pneumatic, pumping, aggregate production, concrete production, pile driving, tunneling and road construction applications. Equipment procurement, purchase, import of equipment, procedural formalities for Import

Operations Research in Construction-
Decision Theory, Game Theory, Linear Programming, Non linear programming

Reference Books-

1. Construction Engineering and Management by. S. Seetharaman, Umesh Publications, New Delhi
6. Operations Research- Hamdy A. Taha
7. Engineering Optimisation- S. S. Rao
TOWN & COUNTRY PLANNING

Unit 21
Spatial & Environmental Aspects of Planning-Environmental degradation and its impact, environmental impact assessments, principles of environmental approach to planning, Indicators of sustainability in planning & development of settlement, Environmental design w.r.t natural resource management. Environmental impacts of traffic; energy issues in transportation; transportation safety. Spatio-environmental Planning principles and techniques.

Unit 22
Transportation & Utility Services-Transportation systems; Land use-transportation inter-relationships; transportation planning process; Traffic management, Recent innovations in technologies and its probable impacts, Transport policies and evaluation of transportation proposals, Water supply systems, Waste water disposal systems & Solid wastes collection and disposal, Reuse and recycle Techniques, Planning for urban electrical distribution system and communication systems, Economic feasibility tests.

Unit 23
Social formation & Housing-Housing problems: Urbanization and Industrialization, Slums and squatters settlements - problems and possibilities, Residential layouts, housing densities, neighborhood unit, community facilities, Social aspects: built environment and human behavior, Evaluation of user's satisfaction, Finance for housing: priority in the national plans - role of public and private agencies, role of cooperatives and various institutions, Cost reduction techniques in housing, Housing norms and standards.
Rural & Urban Planning Decentralized planning: conceptual framework; Dimensions of District and Block planning : their spatial disparities and sectoral variations; identification of spatial units under decentralized planning, Infrastructure planning with application of forecasting techniques, Resource mobilization and credit planning; organizational aspects; participatory planning approach; training needs and plan execution, Rural development schemes and programs, Plan financing, monitoring and
evaluation of rural development schemes, Urban design: Design Survey, Modern Techniques, Issues in urban design; Principles of urban spatial organization; Conservation with historic preservation. Case studies from India and abroad, Urban renewal: Designing Central Business District (CBD) and Business Improvement District (BID), Growth and trends of metropolitan development, Components of a metropolitan plan, Multi-nuclei developments; hierarchy of urban centers and their functional linkages, Metropolitan region and problems, Case studies of metropolitan planning in India and abroad.

Unit 24
Remote Sensing and GIS in Planning & Disaster management - Aerial photography, Application of aerial photography in town planning studies, Satellite remote sensing, Application of remote sensing in regional studies, G.I.S applications in planning and its role in remote sensing, Disaster, Prevention, Preparedness (Warning), Relief
Quantitative Method in Planning - Survey, analysis and projections in City Planning; Ranking and Scaling; Applications of Probabilistic Modeling in City Planning; Applications of Queueing Theory in City Planning; Applications of Network Models in City Planning; Simulation in the Urban Context. Implementation Problems.

Reference Books:
5. K.A. Ramegowda, Urban and regional planning, University of Mysore
6. M/S DVan, The urban pattern, city planning and design.
7. Time saver standards for site planning, Mc Graw Hill Book company
8. John Rate life, An Introduction to town and country planning, London
10. Harvey M. Rubenstain, A Guide to site and Environmental planning, Newyork

TRANSPORTATION ENGINEERING

Unit 25
Regional analysis and development concepts, the role of transportation planning in the overall regional system, Methodology and models for regional transportation system, Planning and implementation framework, Introduction, Basic for traffic engineering, Planning and design of facilities, Travel forecasting principles and techniques, Design Hourly volumes and speed, Highway capacity and performance characteristics, Parking, simulation in Traffic engineering design.
Unit 26
Theory of uninterrupted and interrupted traffic flow, Traffic Planning Process, Demand Analysis, Transportation Economics, capacity & Delay analysis, The planning process, Sequential demand analysis Models of trip generation, distribution, traffic assignment, and modal split. Introduction to transportation systems, transportation innovations, social and economic impacts of transportation; Decision makers and their options, demand modeling and predictions; Modelling transportation technologies;

Unit 27
Analysis of network flows; Transportation network; Network theory, wardrops external principle of traffic assignments, evaluation of impacts; Basic physics of transportation; Concepts in transportation models and location models. Materials for road construction; Specifications and tests; Macadam construction, surfacing and surface treatment; Asphalt mix design pavement structure Sub grade evaluation; Construction and maintenance of concrete pavement, Construction of interlocking block pavements, Quality control tests; Construction of various types of joints. Types of pavement structures, Factors affecting design and performance of pavements, Estimation of layer thicknesses, Pavement drainage, Stresses and strains in flexible pavement, IRC method of pavement design, Stresses in rigid pavements: Types of stresses and causes; Introduction to Westergaard's equations for calculation of stresses in rigid pavement due to the influence of traffic and temperature; Considerations in rigid pavement analysis, EWL; wheel load stresses, warping stresses, frictional stresses, combined stresses.

Unit 28
Rigid pavement design: Design of cement concrete pavement for highways and runways; Design of joints, reinforcements, tie bars, dowel bars. IRC method of design; Design of continuously reinforced concrete pavements. Highway alignment study, controls for selection of Alignment, Engineering Surveys, Geometric design of highways: cross-sectional elements, horizontal and vertical alignments, Geometric Design of Intersections – rotaries, Safety; Characteristics and design considerations for freeways/expressways; At-grade intersections - types, design considerations; Grade separations and interchanges - structures, interchange types and general design considerations.

Reference Books:
Advances in Mechanical Engineering

Note: Each Unit is of 2 credits. A candidate has to take any three units (6 credits)

Unit 1: Convective Heat Transfer:
Fully developed flows, exact and similarity solutions, boiling and condensation, special topics

Reference Books:
2. T Cebeci, “Convective Heat Transfer”, Springer

Unit 2: Mass Transfer:
Mass transfer - 1, Droplet vaporization -1, Mass transfer-2, Droplet vaporization – 2, Mass transfer- 3 (Any two)

Reference Books:

Unit 3: Combustion:
Premixed and Diffusion flames

Reference Books

Unit 4: Computational Fluid Dynamics – I (CFD – I)
Finite volume algorithm, up-winding, Solution of pressure field on Cartesian meshes

Unit 5: Computational Fluid Dynamics – II (CFD-II)
Mesh generation techniques, Solution on Non-Cartesian meshes.

Reference Books (Common for both unit 4 and 5)
6. Date, A.W., “Introduction to Computational Fluid Dynamics”, Cambridge University Press, 2005

**Unit 6: Turbulence**
Governing equations, Free shear flows, Near wall behavior, Energy spectrum, Turbulence models

**Reference Books:**

**Unit 7: Vibrations**
Multi-degree freedom systems, Approximate and numerical methods, Continuous systems, Nonlinear systems

**Reference Books**

**Unit 8: Acoustics**
Wave propagation, generation/transmission of sound, noise control

**Reference Books**

**Unit 9: Fracture Mechanics**
Linear Elastic Fracture Mechanics, Elastic Plastic Fracture Mechanics, Fracture Mechanisms in Metals
Reference Books

Unit 10: Advanced Topics in Refrigeration and Cryogenics
Refrigeration applications in preservation of Food, transport by trucks and containers;
Railway cars; Marine Refrigeration; Fans and Blowers, Sound Control. Construction of psychrometric charts, enthalpy deviation curves (Any two)

Reference Books
1. ASHRAE HANDBOOKS (i) Fundamentals (ii) Refrigeration
3. Dossat R.J., Principles of Refrigeration, Pearson Education Asia

Unit 11: Advanced Theory of Elasticity (3-dimensional problems):
Theories of Stress and strain, Transformation of stress and strain, Linear stress-strain – temperature relations, Applications of energy methods, Torsion, Bending, Plates

Reference Books

Unit 12: Advanced gas dynamics:
Liberalized flow, Method of characteristics, Shock boundary layer interaction, Numerical methods

Reference Books

Unit 13: Robotics
Kinematics, Dynamics, Trajectory, Control

Reference Books

Unit 14: Advanced Topics in I C Engines:
Engine Emissions & Control, Engine Electronics, Modelling Real Engine Flow and Combustion Process, Fuel/Air Mixture Requirements (Any two)

Reference Books
4. SAE publications

Unit 15: Finite Element Methods
Thermal analysis (temperature effects), 2D, 3D elements, Contact analysis, Non-linear static analysis

Reference Books:

Unit 16: Micro Electro Mechanical Systems (MEMS)
From Microphysics to Macrophysics, Thermodynamics of Microstructures, Reliability of MEMS

Reference Books
4. Electronics cooling magazine issues from 1997 -2010
Unit 17: Bio-medical device design
Applications, FDA approval procedures, A Certification

Reference Books
1. Shieglely J.E., Machine design
2. Richard Fries and Paul King [www.crcpress.com]
3. Anatomy by Gray 1918
4. Pathology by Simpson
5. Principles of Orthopedic deformity correction - by Dror Paley [www.springer.com]
6. FDA procedures – Class notes

Unit 18:
Systems design for Cooling of Electronic Equipments Enclosure design, power packing factors, electronic packing

Reference Books

Unit 19: Reliability Engineering:
Reliability evaluation of complex systems, Safeties and certifications, Terro technological Aspects

Reference Books
1. M/c standard 8005

Unit 20: Turbo Machinery:
Analysis of flow, Design aspects, Cooling of turbo-machines, Special topics (Thermal and Hydro turbo machines)

Reference Books
5. Duncan Walker, “Torsional Vibration of Turbo-Machinery”,

Unit 21: Metal Forming:
Yield criteria, Slip line field theory,Temperature Field in Material.- Plastic and Visco-plastic behaviour of material, Surfaces of Discontinuity, Numerical Models of Plasticity.
Reference Books

Unit 22:
Metal Machining - Modelling and control of Chip Formation, Machining of hard materials and metal matrix reinforced composites, Characterization and surface integrity in hard machining, Modern concepts of machining

Reference Books

Unit 23: Modelling of Manufacturing Systems
Markov chains –Continuous and Discrete, Petri nets – Timed and Stochastic

Reference Books

Unit 24: Reverse Engineering :
Reverse engineering – Methodologies and Techniques, Hardware and software, Rapid prototyping –Relationship with reverse engineering

Reference Books

Unit 25: Advanced Machining Processes:
Hybrid electro-chemical processes, Hybrid thermal processes, Solid, liquid and powder based material addition processes (Analytical Study)
Reference Books

Unit 26: Manufacturing Systems:
Machine tool design, control, automation and analysis, Computerized process planning

Reference Books

Unit 27: High Integrity Die Casting
Vacuum die casting, Squeeze casting, Semi solid metal working, Design considerations for high integrity die Castings

Reference Books

Unit 28: Computational Welding Mechanics:
Models for welding heat sources, Thermal analysis of welds, Fracture Mechanics of welded structures

Reference Books

Unit 29: Composite Materials:
Elastic behavior of unidirectional and multi directional composites, Laminated composite beams and plates (Any one)

Reference Books
Note: Each Unit is of 2 credits. A candidate has to take any three units (6 credits)

Unit 1: Intelligent Control
Neural network architecture for modeling and Control, System identification and control, Fuzzy, Neuro-fuzzy, Typical applications of ANN, Classification, Clustering, Pattern Recognition, Different architectures of neural network, Learning algorithms, Knowledge based systems, Genetic algorithms.

Reference Books:

Unit 2: Multivariable and Optimal Control Systems
Introduction, general structure Examples, state space and transfer matrix forms; Controllability and observability, state Estimation, decoupling, model matching control, classical control extended to multivariable control system. Pontryagins minimum principle and its application to optimal control. Continuous and discrete time systems, linear regulator problem, minimum time optimal control, bang bang control.

Reference Books:
2. ‘Multivariable Control System’: W.M. Wonham.

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:
2. ‘Modeling and Identification of Control Systems’, M. Gopal

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 hydro systems.

Reference Books:
2. Energy Technology: S. Rao, Parulkar.

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.)
5. Practical Variable Speed Drives and Power Electronics : Malcolm Barnes, ELSEVIER Newnes Publications, Linacre House, Jordan Hill, Oxford OX2 8DP, 200 Wheeler Road, Burlington, MA 01803

**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 Shaedepur, Hatim, Zuri Li.

**Unit 8: Numerical protection**

Numerical protection, Numerical protection of transmission line, synchronous generator, power transformer, relay co-ordination. (10 Hours)

**Reference Books:**


**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, Descent 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**

Reference Books:
1. IEEE recommended Practice for Energy Management in Industrial and commercial facilities, IEEE Std 739-1995

Unit 14: Condition Monitoring
Condition monitoring of transformer, soild, liquid and gaseous phase monitoring, SFRA techniques, On line off site condition monitoring of transformer, residual life assessment of transformer, Noninvasive testing on transformer for condition assessment, Condition monitoring of OLTC, Condition monitoring of induction motor by MCSA, rotor and bearing fault analysis of induction motor, condition monitoring of cables and switch gears.

Unit 15: Smart Grid
1. Formation of microgrids 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-hydel.
4. Disaster and emergency management in case of disturbance in distribution.
5. Communication requirement protocols and standards.
6. Development of microgrid management software
7. Present status of microgrids in the world power system (10 Hours)
700003-B4: Advances in E and TC/ Electronics Engineering

Note: Each Unit is of 2 credits. A candidate has to take any three units (6 credits)

Unit 1: Microelectronics and VLSI
Microelectronic devices, characteristics, mathematical modeling, performance parameters, design aspects, parasitics, integration issues, layout rules, optimization techniques.

Unit 2: RFIC Design
RF Amplifiers, characteristics, mathematical models, power relations, stability considerations, stability circles, unconditional stability, stabilization methods, designs, circles, circles.

Unit 3: Mixed Signal Analysis
Signal integrity, techniques, equivalent models, characteristics, limitations, mixed signal processing, simulation, physical parameters.

Unit 4: RF Systems
The techniques of RF amplifier, mixer and local oscillator designs, Advanced YIG and narrow band filters, amplifiers, Transmission line design, Design challenges in satellite frequency bands.

Unit 5: Microwave and Antennae
Microwave sources, Passive devices, MMIC, MMIC fabrication techniques, Thick and Thin film technologies and materials, Microstrips, Microwave antennae.

Unit 6: Coding and Modulation Techniques in Communication
Digital communication system architectures, Source coding, Channel coding, Performance measures of communication systems, PLD based system implementations and related issues.

Unit 7: Communication Network
Various IEEE standards, Performance issues, Trade-offs, Network architectures, Security algorithms with their performance measures.

Unit 8: Wireless & Broadband Communication
IEEE/ITU/ ETSI communication standards and specifications, various trade-offs in functionality, implementation, Transmitter/Receiver architectures and related issues, Wireless embedded approach, Antennae and front end design issues.

Unit 9: Advanced Topics in Signal Processing
Modeling different Signals and systems, various transforms, System design and Implementation issues, DSP architectures and related issues, Evaluation parameters for the various applications.
Unit 10: Image Processing & Pattern Recognition
Image representation formats, noise, processing techniques, Performance measures, various algorithms, Pattern classifications and recognition techniques, Biometrics.

Unit 11: Speech Processing
Speech recognition and synthesis techniques, modeling the speech signal, various algorithms, trade-offs and implementation issues.

Unit 12: Processor Architectures
Design philosophy of RISC, CISC, Multi-core, Various processor architectures, Design of microcontroller CPU.

Unit 13: Programmable Architectures and Memories
HDL programming, PLDs, floating point arithmetic, multipliers, modeling a sequential machine, Barrel shifter, HDL models for memories and buses.

Unit 14: System on Chip and MEMs
Chip architecture, Clock & power related issues, SRC, DRC, I/O architectures, Wire parasitic, Design validation, MEMs.

Unit 15: Modern Control Theory
Control mechanisms and their modeling, Implementation aspects and related trade-offs, various applications, Selection criteria’s of control systems for various applications, Performance evaluation techniques.

Unit 16: Human Machine Interface
Different techniques used for HMI, Algorithms, Related issues and constraints, Performance issues, Applications.

Unit 17: Machine Vision
Human vision, Expert systems, Algorithms, Implementation issues and trade offs, Performance measures and analysis.

Unit 18: Biomedical Engineering
Biomedical Signals, Biomedical Systems, Analysis, Implementation issues, Performance measures.

Unit 19: Nano Technology
Present devices and materials, Advance materials such as Carbon nano tubes etc., advance devices, constraints, applications, Trade offs.

Reference Books:
700003-B5: Advances in Metallurgical Engineering

Note: Each Unit is of 2 credits. A candidate has to take any three units (6 credits)

Unit 1: Characterization and testing of Materials

X-ray Diffraction (XRD), Determination of lattice parameters, Applications of XRD to metallurgical problems, Scanning electron microscope (SEM), Wavelength dispersive X-ray (WDX) and Energy dispersive X-ray (EDX) spectroscopy, Transmission electron microscope (TEM), selected area diffraction, techniques of specimen preparation, Scanning-Tunneling Microscope (STM) and Atomic Force Microscope (AFM); Thermal analysis:- TGA, DTA/DSC, Dilatometer; UTM, Impact test, Fatigue test, Hardness, Creep, and Fracture Toughness.

Unit 2: Advanced Powder Metallurgy

Conventional and modern methods, Blending techniques. Powder characterization techniques, Powder compaction processes, Theories of sintering and its mechanism, Sintering furnaces and atmospheres, applications of P/M processes for tools, creep resistant alloys and bearing materials.

Unit 3: Nanomaterials & Nanotechnology

Top down and bottom up approaches, classification of nanomaterials, carbon nanotube (CNT), particulate reinforced metal/ceramic/polymer nanocomposites, Characterization of nanomaterials, Applications of nanotechnology in medicine, automobile sector, metallurgical, civil, computer and electronics field; Pros and cons of nanotechnology.

Unit 4: Electronic Materials

Dielectric properties, Polarization mechanism, Frequency and Temperature effects, Electrical breakdown, Classification of ferroelectric materials, Piezoelectricity, Capacitor dielectric materials, Insulating materials and Pyroelectric materials, ceramic composites as capacitors and sensors.

Unit 5: Diffusion and Kinetics

Unit 6: Advanced Composites

Introduction to advanced composites, Classifications of composites, role of interfaces, types of reinforcements, methods of fabricating metal matrix composite (MMC), polymer matrix composite (PMC) and ceramic matrix composite (CMC), Their properties and applications.

Unit 7: Iron and Steel Making

Iron making, Blast furnace, Raw materials, Pig iron, Reduction reaction, Steel making, Refractories, Scrap, Fluxes, Sponge Iron production, Electric Furnace, Ladle Metallurgy, Principle of Steel making and Refining Technology, Gases removal, De-oxidation of Steel and Non-Metallic inclusions, Role of Slag Composition on Quality of Steel, Processes-AOD, VOD& VD. Continuous Casting processes, Defects in Cast Product, Electromagnetic Stirring (EMS) for Quality improvement.

Unit 8: High Temperature Corrosion


Unit 9: Casting and Materials Joining


Unit 10: Advanced Thermodynamics of Materials

Reference Books:

5. High Temperature Oxidation of Metals and Alloys –by N. Birks and Meir
6. Fundamentals of Corrosion- Scully
8. R.C.Buchanan –Ceramic materials for Electronics, Marcel Dekker Inc. 1986
9. Steel Making – V. Kudrin, Mir. Publisher
10. Introduction to Modern Steel Making- Dr.R.H.Tupkari, Khanna Publishers
11. Electrometallurgy-I - By Edneral
12. Continuous Casting of Steel – By Irving W.R.,
18. Nanomaterials: An introduction to synthesis, properties and applications, Editor-Dieter Vollath, Wiley-CVH.
700003-B6: Advances in Instrumentation and Control

Note: Each Unit is of 2 credits. A candidate has to take any three units (6 credits)

Unit 1: Process Optimization
Multivariable optimization, linear programming, quadratic programming, integer programming, sequential quadratic programming, global optimization, geometric programming and dynamic programming.

Unit 2: Dynamical System Design and Analysis
Development of system models using lumped and distributed parameter techniques, numerical analysis and simulation, experiment design, case studies.

Unit 3: Instrument and System Design
Need analysis, shielding, cabling, electromagnetic interference (EMI), electromagnetic compatibility, electrostatic discharge, different kind of noise and their reduction techniques.

Unit 4: Biomedical Instrumentation
Physiological measurements, non-invasive measurement techniques, biomedical signal analysis, modeling of physiological systems.

Unit 5: Intelligent Sensors
Consideration for sensor design, smart materials and their characterisation, features of intelligent sensors, testing and validation, case studies.

Unit 6: Digital Control
Digital systems and signal analysis, control system design, stability improvement by state feedback, digital controller tuning.

Unit 7: Advanced Process Control
System identification, multivariable control system design of linear, bilinear, mixed-integer and nonlinear systems, optimal control, model-based predictive control, adaptive control.

Unit 8: Soft Computing
Fuzzy logic, neural network, support vector machines, genetic algorithms.

Unit 9: Embedded System Design
Embedded system design concepts, memory management, I/O management, analog and digital sensors interfacing, actuator interfacing, final state machine design, design tools.

Unit 10: Photonic instrumentation
Laser instrumentation, Fiber Optic instrumentation, Advanced optical sensors.
Unit 11: Advanced analytical instrumentation
Advanced techniques in analytical instrumentation.

Reference Books:
700003-B7: Advances in Printing Engineering

Note: Each Unit is of 2 credits. A candidate has to take any three units (6 credits)

Instructions:
- Select one unit from first five units

Unit 1. Flexography:
Anilox generation and Cell Geometry; Parameters affecting ink transfer; Doctor Blades

Unit 2. Gravure:
Cylinder engraving techniques; Parameters affecting printability; Cell Geometry

Unit 3. Offset Lithography:
Ink and water emulsification; Parameters affecting dot reproduction; Coating materials for plate

Unit 4. Screen Printing:
Mesh Geometry; Parameters affecting Ink transfer, Ink metering technique

Unit 5. Non-impact Printing:
Piezo crystals; Electrostatic forces; Acoustic pulse generation; Magnetic forces

Unit 6. Surface Properties:
Surface tension and energy; Surface physical properties and treatments; Stresses in substrate, coatings and ink film

Unit 7. Physical and Chemical Interactions:
Chemical interactions required for printing inks and image carriers; Chemical and surface interaction

Unit 8. Liquid Properties:
Colloidal Systems; Newtonian and Non-Newtonian Liquids; Polar nature of liquids; Rheology

Unit 9. Liquids:
Wetting liquids and non-wetting liquids; Contact, wetting and equilibrium dynamics of printing inks on porous and non-porous substrates with 2D and 3D approach

Unit 10. Physical Properties:
Particle size; Phase separation of polymers; Pigment aspect ratio; Color shifting properties of particles
Unit 11. Materials 1:
Solvents; Biodegradable polymers; Nano pigments for ink and substrate

Unit 12. Materials 2:
Elastomers in printing; Printing process metallurgy; Material strength

Unit 13. Color:
N-colors; Color Inconstancy; Metamerism; Color Vision

Unit 14. Substrate:
Water absorption rate; Substrate and ink interaction; Di-electric and electric properties, Surface Imperfections

Unit 15. Chemicals:
Oxidizers and Reducers; Catalysts; Thermo and photo sensitive chemicals and reactions in printing

Unit 16. Light and Heat:
Photochemical reaction; Laser systems and their designing parameters for imaging and engraving

Unit 17. Drying:
Ink drying/curing and related calculations; Calculating dryer temperatures; Solvent absorption, evaporation and calculating rate; Effect of pH on drying of ink

Unit 18. Screening:
Screening, dot forming and color separation; Physical and Chemical factors governing line resolution; Relation between angular resolution, dot and viewing conditions

References:
3. Herbert Holik (Ed.), Handbook of Paper and Board, WILEY-VCH GmbH & Co. KGaA


700003-B8: Advances in Chemical Engineering

Note: Each Unit is of 2 credits. A candidate has to take any three units (6 credits)

Unit 1: Advance Biochemical Engineering
Various Applications Use of Microbes modeling of biochemical reaction and applications to scale up. Metabolic pathways and Bioreactor models

Reference Books:

Unit 2: Advance Polymer Engineering
Metallocene catalysis, Ziegler Natta Catalysis Mechanism and Products, Polymerization reactors.

Reference Books:

Unit 3: Nanotechnology
Recent Approaches for synthesis, characterization of nanomaterials and Applications

Reference Books:
1. Introduction to NanoScience, CRC Press G. Louis Hornyak, Joydeep Dutta, Harry F. Tibbals and Anil K. Rao,
2. R. Kelsall, I. Hamley and M. Geoghegan (Eds.), “Nanoscale Science and Technology”,
3. Wiley, 2005

Unit 4 : Separation Technology
Separation techniques using LEM, Ionic liquids, extractive separation reactive crystallization reactive separation and modeling

Reference Books:
3. Oxford University Press,

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 Danckwerts 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
Modeling of a few complicated systems, State space and transfer function matrix models, Stability criterion of transferfunction matrix models, Development of empirical model from process data, Identifying Discrete-Time models from experimental data.

Reference Books:


Unit 11 Advance Heat transfer
Forced convection Inside Tubes & Ducts, Forced Convection over Exterior Surfaces, Heat transfer coefficients in laminar and turbulent flow, Heat Transfer with phase change Heat transfer in Two and three phase system Heat transfer by combined conduction, convection and Radiation

Reference Books:

700003-B9: Advances in Computer Engineering

Note: Each Unit is of 2 credits. A candidate has to take any three units (6 credits)

Unit 1: Natural Language Processing

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.
WSN: Design issues, System Architecture, Sensor Network OS Tiny OS, Nes C Language, Distributed data processing, Synchronization and localization, Communication and routing, Security issues, services and applications
Mobile Ad-hoc Networks: Location Management Schemes, Routing.
GSM and satellite Communication: Architecture, hand-off and power management.
Wireless Network Standards & Protocols: 802.11.X, 802.16.x, 802.15.X, Comparison 802.11a, 11b, 11g, Challenges for MAC, DCF and PCF, WEP & EAP
QoS in wireless Network: Parameters Throughput or bandwidth, Delay or latency
Delay variation (delay jitter), Loss or error rate

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
References

Unit-11: Data warehousing and Mining
Data Mining Tasks, Data Warehouse (Multidimensional Data Model, Data Warehouse Architecture, Implementation), Data Warehousing to Data Mining, Data Preprocessing: Why Preprocessing, Cleaning, Integration, Transformation, Reduction, Discretization, Concept Hierarchy Generation, Descriptive Statistical Measures, Classification: Decision Trees, Model Over fitting, Bayesian Classification, Rule-based classification, Nearest Neighbor Classifier, Classification by Back-propagation, Support vector machines, Association Rule Based, Other Classification Methods, Prediction, Classifier Accuracy, Cluster Analysis: K-means, Agglomerative Hierarchical Clustering, DBSCAN, Association Rules: Apriori algorithm, FP-growth algorithm, Advanced techniques, Data Mining software and applications: Text mining (extracting attributes/keywords, structural approaches - parsing, soft parsing, Bayesian approach to classifying text), Web mining (classifying web pages, extracting knowledge from the web), Data Mining software and applications

Reference
2. Margaret H. Dunham, “Data Mining Introductory and Advanced Topics”, Prentice Hall

Unit-12: Parallel and Distributed Systems
Terminology of Parallel and Distributed Computing, Parallel and Distributed Architectures, Parallel Performance, Shared Memory and Threads, Parallel Algorithms, Message Passing, Distributed Systems, Distributed Coordination, Distributed File Systems, Distributed Shared Memory, Cloud Computing, Computational Grids and Applications

References
700003-B10: Advances in Production & Industrial Engineering

Note: Each Unit is of 2 credits. A candidate has to take any three units (6 credits)

Unit 1: Quantitative Techniques

Reference Books


Unit 2: Robotics And Automation

Reference Books


Unit 3: Facility Planning
Site selection theories, Physical facilities – Algorithm, Automated Guided Vehicles (AGV’s), Material handling systems – Conveyor design., Deterministic models - single and multi facility location models, Job Allocation problems - quadratic assignment problems, Warehouse layout models, plant location problems

Reference Books

1. Facilities Planning, Thompkins, J A and White, J. A.
2. Facility layout and Location. Francis, R.L. and White, J. A

Unit 4: Production Systems
Reference Books
3. Handbook of MRP II and JIT-John Petroff-Prentice hall

Unit 5: Reliability / Maintenance
Fault Tree Analysis & Event Tree Analysis, Accelerated reliability testing, Nonparametric reliability evaluation, Failure Modes Effects Analysis & Failure Modes Effects and Criticality Analysis, HASS, HALT, reliability evaluation of complex system, Evaluation of system reliability, maintainability and availability, AGREE, ARINC, Mean & Median statistical methods, Fair & Kim’s Algorithm.

Reference Books
5. A.K. Gupta: Reliability Engineering & Terotechnology Mc Millan (I) Ltd.

Unit 6: Work Study & Ergonomics
Time & Motion Study, PMTS, Anthropometry, Critical analysis of work design criteria, Man - machine learning phenomenon, Bio – dynamics analysis, Job evaluation and merit rating.

Reference Books

Unit 7: Advanced Machine Tool Design
Design of elements like Bed, Columns, Guideways, Design of Guides using FEA, Lumped parametric method, Design of spindles based on deformation and rigidity, Reliability based design, static and dynamic rigidity, stability analysis, Vibrational study - Microdisplacement and error analysis Modular Concept in Machine tool structure.
Reference Books

5. NC Machine tools – S.J. Martin, ELBS.

Unit 8: Advanced Machining / Non conventional Machining

Theory and Numerical analysis of abrasive jet machine, Abrasive flow machining, Ultrasonic machining, Electrical Discharge Machining(EDM), Electro Chemical Machining, Electro Chemical Discharge Machining(ECDM), Vibro ECDM, Dry and Near dry EDM, thermal Energy Methods material pressing, LASER machining, Electron Beam Machining, Plasma arc machining, Physical vapour deposition and chemical vapour deposition, high energy rate forming and Electroforming.

Reference Books

2. The MEMS handbook, CRC Press, 2001

Unit 9: Metrology and Quality Control

Error due to Numerical Interpolation, displacement measurement technique, Error types and their evaluation, Image processing and its applications in metrology, Laser trackers, micro and nanometrology, Process capability- Process Capability Index, Advanced dimensional chain and tolerance stacking, Global management or six sigma management, methods of improving accuracy and surface finish. Quality Control, Statistical Quality Control, Quality assurance systems

Reference Books

1. Precision Engineering in Manufacturing , R.L. Murthy
2. Metrology, R.K. Jain
3. Engineering Metrology, I.C. Gupta

Unit 10: Theory of plasticity, Metal forming

Analysis in drawing and extrusion of metals, theory and practice of Bulk forming processes, Plastic deformation in forging, rolling, Extrusion and Drawing process, Sheet
metal forming. Theory of plastic deformation – Yield criteria - Work of plastic deformation

Analysis of forming processes - Energy slab method- open die forging, plate drawing, Flat rolling, - Other methods of analysis like FEM, Upper and lower bound solution methods – slip line field.

Review of stress –strain relations, Yield criteria, plastic anisotropy, forming limits and material models , Viscoplasticity, Solutions to metal forming problems.

**Reference Books**

2. Metal Forming - Process and analysis – by B. Avitzur, Tata Mcgraw Hill

**Unit 11: Tribology**

Triboenvironment, contact theory of surface, Ergodicity and Stationarity of surface, Contact phenomenon & contact deformation of the surface, Parameters affecting friction and wear, Adhesive, Abrasive, Erosive wear, Dry friction, boundary friction, semi liquid and liquid friction under lubrication, Use of solid lubricants in extrusion and metal cutting, method of testing and Characterization of lubrication.

**Reference Books**

**700003-B11: Advances in Petroleum and Petrochemical Engineering**

**Note:** Each Unit is of 2 credits. A candidate has to take any **three units** (6 credits)

**Unit 1: Advanced Transport Phenomena**

**Unit 2: Reservoir simulation**
Generalized approach, model formulation, history matching, up scaling, streamline simulation, simulation of geomechanics, Pressure/Volume/Temperature (PVT) Treatment, high performance computing, well modeling, thermodynamic characterization.

**Unit 3: Production optimization**
Integrated production systems, reservoir inflow characterization and modeling tools, multiphase flow modeling in wellbore, risers and flow lines, Diagnosis of systems performance. Production Allocation, Linking the reservoir; the near-wellbore, the wellbore and the surface facilities. Planning short, medium and long-term optimization of field management

**Unit 4: Emerging Drilling Technologies**
Materials, Microsystems, real time drilling and communications, advanced designs in bit technology and mud motors, advances in mud and solids control technology, advances in measurement while drilling (MWD) and other drilling technology, drilling optimization methods

**Unit 5: Enhanced Oil Recovery**
Fluid flow in permeable media, mass conservation, energy equations, and momentum equations. Phase behavior, fluid properties, displacement efficiencies, volumetric sweep efficiency. Principal secondary and tertiary recovery mechanisms and Advances.

**Unit 6: Unconventional Hydrocarbon Energy sources**
Heavy and extra heavy oil, tight gas reservoirs, CBM, GTL, Shale gas and Gas Hydrates

**Unit 7: Intelligent systems in oilfield development**
Real options theory, decision support methods, fuzzy logic, Real Option Value Calculation by Monte Carlo Simulation and , Approximation by Fuzzy Numbers and Genetic Algorithms, Analysis of Alternatives for Oil Field Development under Uncertainty, high performance processing

**Unit 8 Carbon capture and sequestration**
Greenhouse gas effect, Carbon Sequestration and management, Global and fossil fuel carbon cycles, sequestration of carbon dioxide in geological formations, advanced biological processes, materials, advanced chemical approaches to sequestration, system
technology platforms and technologies, engineering system components, science and technology capabilities.

Unit 9: Artificial Intelligence Techniques
Artificial Neural Network, Fuzzy Logic, Evolutionary Algorithm, Their applications in petroleum and petrochemical engineering

Unit 10: Numerical Methods
Numerical Solution of system of stiff / non-stiff Ordinary Differential Equations and Partial Differential Equations with boundary conditions