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 11th July 2009 are governed by

UGC (MINIMUM STANDARDS AND PROCEDURE FOR AWARD OF M.Phil/Ph.D. DEGREE), REGULATION, 2009 PUBLISHED IN THE GAZETTE OF INDIA, DATED 11TH July, 2009.

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 29th 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- 1

STRUCTURE FOR Ph.D. COURSE WORK (common for all branches)

CODE	NAME OF COURSE	CONTACT HOURS	EXAMINATION SCHEME			CREDITS
			CONTINUOUS ASSESSMENT	END SEMESTER EXAM	TOTAL	
700001	**Research Methodology**	**5**	**50**	**100**	**150**	**5**
700002	**Seminar**	**10**	**50**	**50**	**100**	**5**
700003	**Faculty Specific Topics for Engineering Research** **Part-A** (700003-A) Mathematics for Engineering Research **Part-B** (700003-B) Branch Specific Topics	**10**	**100**	**100**	**200**	**10**
Total		**25**	**200**	**250**	**450**	**20**

CODE	Branch Specific Topics		CODE	Branch Specific Topics
700003-B1	Advances in Civil Engineering		700003-B8	Advances in Chemical Engineering
700003-B2	Advances in Mechanical Engineering		700003-B9	Advances in Computer Engineering
700003-B3	Advances in Electrical Engineering		700003-B10	Advances in Production & Industrial Engineering
700003-B4	Advances in Electro & Tel Engineering		700003-B11	Advances in Petroleum & Petro chemical. Engineering
700003-B5	Advances in Metallurgy Engineering		700003-B12	Advances in Architecture
700003-B6	Advances in Instrumentation Engg.		700003-B13	Advances in Information technology
700003-B7	Advances in Printing Engineering		700003-B14	Advances in Biotechnology

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 -2

Grade	Percentage of Marks obtained	Remarks
P	**50-100**	**Pass**
F	**Below 50**	**Fail**
FX	**----------**	**Detained, Repeat the course**
II	**----------**	**Incomplete-Absent for Exam but continue the course**

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;

	Head	**Marks**
a.	Performance of the student in the collection of the reference material and its understanding for seminar	40 Marks
b.	Punctuality, Enthusiasm and aptitude of student in Preparing seminar / completing the report	10 Marks

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; duely 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.

SYLLABUS

Ph.D. COURSEWORK UNDER FACULTY of ENGINEERING

700001: Research Methodology

Teaching Scheme: **Marking Scheme:**
Contact Hours: 5 hrs/week **Continuous Assessment: 50 Marks**
Credits: 5 **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
3. 'Research Methodology: A Step by Step Guide for Beginners', by Ranjit Kumar, 2nd Edition
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:
1. I. S. Sokolnikiff, "Mathematical Methods of Physics and Engineering", McGraw Hill
2. Murray R. Spiegel, "Advanced Mathematics for engineers and scientist", Schaum's out line series, McGraw Hill Intl Co., New Delhi.

Unit 2 : System of nonlinear equations
Newton (and related) methods, Limiters

Reference Books:
1. I. S. Sokolnikiff, "Mathematical Methods of Physics and Engineering", McGraw Hill
2. Murray R. Spiegel, 'Advanced Mathematics for engineers and scientist', Schaum's out line series, McGraw Hill International Book Co., New Delhi.

Unit 3: Dynamical System
Analytical and numerical solutions, Stability of numerical methods, Dynamical system stability

Reference Books:
1. I. S. Sokolnikiff, "Mathematical Methods of Physics and Engineering", McGraw Hill
2. Erwin Kreyszig, 'Advanced Engineering Mathematics', John Wiley and sons Inc., 8th Edition, 2003.

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
2. Mathematical Methods of Physics and Engineering, I. S. Sokolnikiff, McGraw Hill

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

Reference Books:
1. I. S. Sokolnikiff, "Mathematical Methods of Physics and Engineering", McGraw Hill
2. J W Thomas, "Numerical Partial differential equations: finite difference methods", Springer

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:
1. N. Sneddon: The use of Integral Transform, McGraw Hill, New York 1972.
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:

1. Jorge Nocedal and Stephen Wright; Numerical Optimization, Springer, 2nd edition, (2006)
2. S. S. Rao; Engineering Optimization: Theory and Practice, Wiley, 4th edition, (2009)

Unit 9: Stochastic Processes

Games theory, Probability, Reliability and Random numbers, CDF and PDF, Random processes, Moments, Models of random processes.

Reference Books:

1. Kishor S. Trivedi, Probability and Statistic with Reliability, Queuing and computer Science Applications, Prentice-Hall of India.

Unit 10: Soft Computing

Genetic Algorithms, Fuzzy Logic, Neural Networks, Hyper Heuristics, Support Vector Machines

Reference Books:

1. Jorge Nocedal and Stephen Wright, "Numerical Optimization", Springer, 2nd edition, (2006)
2. S. S. Rao, "Engineering Optimization: Theory and Practice", Wiley, 4th edition, (2009)
3. Edmund Burke and Graham Kendall (Ed.), "Search Methodologies: Introductory tutorials in optimization and decision support systems", Springer, 2005.

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:

1. Higher Engineering Mathematics.-by Dr B.S Grewal, Khanna Publishers.
2. Advanced Engineering Mathematics. - by C.Ray Wylie, L.C.Burret International Students Edition
3. Advanced Engineering Mathematics. -by Erwin Kreyszig, 8th Edition Wilay 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:

1. Numerical methods for Engineers, S.C Chapra, R.P.Canale 3rd Edition Mc Graw Hill Publishers.
2. Introductory Methods of Numerical Analysis - S.S Sastry Prentice Hall of India
3. Numerical Methods, Balguruswamy, Tata. Mc Graw Hill
4. Numerical Solutions of Partial Differential Equations, K. W. Morton, and D. F. 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

1. Numerical methods for Engineers-by S.C Chapra, R.P.Canale 3rd Edition Mc Graw Hill Publishers.
2. Numerical Methods - by Dr.B.S.Grewal Khanna Publishers
3. Advanced Engineering Mathematics. -by Erwin Kreyszig, 8th Edition Wilay Students Edition.

Unit 18: .Statistical Quality Control and Stochastic Processes

Control charts: $\tilde{X}$ 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
2. Advanced Engineering Mathematics. -by Erwin Kreyszig, 8th Edition Wiley Students Edition.

Unit 19: Matrices

Definitions of various types of matrices, Elementary matrix transformations linear transformation formations .Orthogonal trans formation. Eigen values and Eigen vectors. Problems orizing from Markov's stochastic process. Numerical method for finding Eigen value and Eigen vectors and applications to mass spring problems and coupled masses. Applications of matrices for finite element methods.

Reference Books:

1. Applied Mathematics for Engineers and physicists by Pipes and Harvill International students edition.
2. The finite Element method 3rd edition , -by O.C.Zienkiewicz, Tata Mc Graw Hill
3. Advanced Engineering Mathematics. -by Erwin Kreyszig, 8th Edition, Wilay Students Edition.

Unit-20: Analysis of Algorithms

Algorith Analysis, Proof Techniques, Asymptotics, Recurrences, algorithmic strategies, Parallel Algorithms, Amortized Analysis, Integer and Polynomial Arithmetic, Pattern-Matching Algorithms, NP-Complete Problems, Some Provably Intractable Problems, Lower Bound on Numbers of Arithmetic Operations, **empirical algorithmics**

Reference Books:

1. Holger H. Hoos & Thomas Stützle, Morgan Kaufmann, "Design & Analysis of Computer Algorithms- Stochastic Local Search Foundations and Applications", Elsevier, 2004

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:

1. Rajiv Motwani, Prabhakar Raghavan, "Randomized Algorithms", Cambridge University Press

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)
2. Harray Frank,"Graph Theory", Narosa Book Distributors Private Ltd (2001**)**

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

Reference Books:
1. Paul Garrett, "The mathematics of coding theory – information, compression, Error correction and finite fields", Pearson Education, 2005

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:

1. Thomas Cormen, Charles Leiserson, Ronald Rivest, and Clifford Stein. *Introduction to algorithms*, 2th edition. The MIT Press 2001 [Chapter VI]
2. Jorgen Bang-Jensen and Gregory Gutin. *Digraphs: theory, algorithms and applications*. Springer, 2002 [Section 7.3 and 9.5]
3. J. L. Sobrinho, An algebraic theory of dynamic network routing, *IEEE/ACM Transactions on Networking*, 13(5), October 2005.
4. Jean-Yves Le Boudec and Patrick Thiran. *Network calculus*. Springer, 2006. [Chapter 1, 2, and 3]
5. Cheng-Shang Chang. *Performance guarantees in communication networks*. Springer 2000 [Chapter 1 and 2]

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
Finite Element Method, 2D and 3D applications in plane and three dimensional elasticity problems. Analysis of plate and shell structures. Applications using proper software.Nonlinear analysis of structural elements. Material and geometric nonlinearity. Applications for beam, plates and shells.

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:

1. Timoshenko and Goodier - Theory of Elasticity, McGraw-Hill Publications
2. S. Crandall, N. Dahl and T. Lardner - Mechanics of Solids, McGraw Hill Publications
3. Anil K Chopra – Dynamics of Structures Theory and Applications to Earthquake Engineering, Prentice-Hall Publications
4. R.W Clough and J Penzin – Dynamics of Structures, McGraw Hill Publications
5. R.C. Roy - Structural Dynamics an Introduction to Computer Methods, John Wiley & Sons Publications
6. S. Timoshenko and W. Krieger, Theory of Plates and Shells, Mc Graw Hill.
7. Ansel C. Ugural, Stresses in Plates and Shells, Mc Graw Hill
8. Chandrashekhara K., Analysis of Plates, New Age International Edition
9. J.N. Reddy – An Introduction to the finite element method – Tata McGraw Hill Publishing Co. Ltd

10. C.S. Krishnamoorthy – Finite Element Analysis – Theory & Programming - Tata McGraw Hill Publishing Co. Ltd
11. Zienkiewicz & Taylor - The Finite Element Method 4th Edition – Vol – I & II – McGraw Hill International Edition
12. Robert D. Cook, D.S. Malkus, M.E. Plesha – Concepts & Applications of Finite Element Analysis – John Wiley & Sons.
13. Timoshenko S.P. and and Gere J.M., Theory of Elastic Stability, Mc Graw Hill,
14. Ashwini Kumar, Stability of Structures , Allied Publishers Ltd
15. R. Ranganathan, Reliability Analysis and Design of Structures, Mc Graw Hill.
16. M.Sathyamoorthy, 'Nonlinear Analysis of Structures', CRC Press, New York
17. S.S.Rao, 'Engineering Optimisation- Theory and Practice', New Age International.
18. U. Kirsch, 'Optimum structural design',McGraw –Hill, New York

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
2. Applied hydrology – Linsley Kolhar and Paulhas (McGraw Hill)
3. Computational fluid dynamics – Anderson
4. Neural network fundamentals with graphs, algorithms, applications – Bose N.K. and Liang P (McGraw Hill)
5. Practical handbook of GA applications, Vol I – L. Chambers (CRC Press)

6. Hydraulics of spillways and energy dissipators – R. M. Khatsuria (Marcel Dekker Publisher, New York)
7. Energy dissipators and hydraulic jump – W. H. Hager (Kluwer academic publishers, Netherland)
8. Hydrodynamics of coastal zones – Massel S.R.
9. Ground water systems planning management – Robert WillisHager, W.H. (1992). "Energy dissipators and hydraulic jump". Kluwer academic publishers, Netherland.
10. Hager, W.H., Bremen, R. (1989). "Classical hydraulic jump : post jump depths". *J. Hydr. Res.*,27(5), 565-581.
11. Jeppson, R.W. (1970). "Graphical solution to hydraulic jump". *J. Hydr. Engg., ASCE*, 96(1), 103-108.
12. Khatsuria R. M. (2005). "Chapter 20- Hydraulic jump stilling basins". Hydraulics of spillwaysand energy dissipators. Marcel Dekker Publisher, New York.
13. Fox and McDonald, " Introduction to fluid Mechanics", John Wiley
14. R. H. F. Rao, " Fluid Dynamics", Charles E Morn'll Books Inc. 1967
15. I. H. Shames, "Mechanics of Fluids", McGraw Hill, 1962
16. Y. L. Steeter, "Fluid Dynamics", McGraw Hill, 1948
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

Elastic and plastic analysis of stress distribution on yielding bases. Analysis of conduits. Interaction analysis of piles and pile groups. Elastic continuum and elastoplastic analysis of piles, Non-linear load-deflection response.

Geotechnics for Infrastructure

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

Reference Books:

1. Aki K and Richards P G (2002), Quantitative Seismology, University Science Books
2. Bowles J E (1996), Foundation Analysis and Design, McGraw Hill.
3. Das B M (1997), Advanced Soil Mechanics, Taylor and Francis.
4. Das B M (1993), Principles of Soil Dynamics, Brooks/Cole
5. Coduto D P (2001), Foundation Design: Principles and Practices, Prentice -Hall
6. Kaniraj S R (1988), Design Aids in Soil Mechanics and Foundation Engineering, Tata McGraw Hill
7. Poulos H G and Davis E H (1980), Pile Foundation Analysis and Design, John Wiley and Sons
8. Koerner R M (1997), Designing with Geosynthetics, Prentice Hall
9. Karl Terzaghi (1954), Theoretical Soil Mechanics, Chapman and Hall,.
10. Rock Mechanics in Engineering Practice: Stag and Zienkiewez, John Willey & Sons
11. J.C. Jagger and N.G.W. Cook(1971), Fundamentals of Rock Mechanics, Methuen and Co.,
12. London.
13. Sarsby R (2000), Environmental Geotechnics, Thomas Telford
14. Hsai-Yang Fang, Introduction to Environmental Geotechnology, CRC Press.
15. Kramer S L (1996), Geotechnical Earthquake Engineering, Prentice Hall
16. Prakash Shamsher and Puri V K (1988), Foundations for Machines; Analysis and Design, John Wiley and Sons
17. Wolf J P (1985), Dynamic Soil-Structure Interaction, Prentice-Hall

ENVIRONMEMTAL ENGINEERING:

Unit 13

Water Treatment

Water Quality: Requirement, Standards, Stream & Effluent standards. Water quality indices. Water purification, physical, chemical processes. Unit operations, unit processes.

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

Wastewater Treatment

Waste waters-Sources, nature, characteristics, Analysis:- BOD progression & its formulations, Fundamentals of Process Kinetics, Zero order, First order, Second order Reactions, Different Reactors based on type of flow, Design of W/W treatment systems-Primary, secondary and tertiary; ASP, Nitrification-denitrification, Ponds and aerated Lagoons, Attached Growth Biological Treatment Systems: TF, RBC, Activated Biofilters etc., Expanded /fluidized bed reactors, USAB, Expanded granular bed reactors,. Sludge Digestion: anaerobic and aerobic, Waste water reclamation and reuse, Effluent disposal.

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

Introduction to Mathematical Models: Modelling approaches to water quality - classification and considerations in selecting models, Model requirements and limitations. D.O. Models for Streams: DO model for streams,Streeter - Phelps model - oxygen 'sag' curve, Benthal oxygen demand, Study of Mathematical Models, Models for Estuary and Lakes, Air quality models : Gaussian dispersion model, Regional air quality models

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,

SWM:Waste Management -Sources, Classifications, Characteristics, Generations, Onsite Handling and Storage, Collection, Transfer Recycling and Disposal Techniques of Municipal Solid Waste (MSW), Economic Evaluation of the Systems. Hospital Waste Management.

Unit 16

Remote Sensing, GIS and GPS Techniques and their applications in Environmental Studies. Softwares in Environmental Engineering.Pollutant Transport Mechanisms and Modelling, Hazardous Waste Management, Waste Minimisation Techniques, Environmental Risk Management

Reference Books:

1.Manual on water supply and Treatment ", CPHEEO, Ministry of Urban Development, GOI, New Delhi, 1999.

2. Manual on Sewerage and Sewage Development ", CPHEEO, Ministry of Urban Development, GOI, New Delhi, 1993.
3. B.A. Hauser, " Practical Hydraulics Hand Book ", Lewis Publishers, New York,1991.
4. M.J. Hammer, " Water and Wastewater Technology ", Regents/Prentice Hall, NewJersey, 1991.
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
10 Kiely, G., Environmental Engineering. McGraw Hill, 1996. ISBN: 007091272
11. Wanielista, M., Kersten, R., and R. Eaglin.. Hydrology: Water Quantity and Quality Control. Wiley Interscience, 1996. ISBN: 0471072591
12. Zipparro, V.J., Davis' Handbook of Applied Hydraulics Fourth Edition. McGraw Hill, 1993. ISBN: 0070730024
13. Franzini, J., Freyberg, D., Linsley, R., and G. Tchobanoglous, Water ResourcesEngineering. McGraw Hill, 1991. ISBN: 0070380104 14
14 Reed, S.C. and Crites, R.W., Natural Systems for Waste Management and Treatment. McGraw Hill, 1996. ISBN: 0071346627
15 Eckenfelder, W.W. (Jr)., Industrial Water Pollution Control, (2nd Ed). McGraw-Hill, 1989. ISBN: 007018903X.
16 Guyer, H.H., Industrial Processes and Waste Stream Management.Wiley Interscience, 1998. ISBN: 0471299847.
17 Bishop, P., Pollution Prevention: Fundamentals and Practice. McGraw Hill, 2000. ISBN: 0073661473
18 American Water Works Association, Water Treatment Plant Design, (3rd Ed.). McGraw-Hill, 1997. ISBN: 0070016437.
19 American Water Works Association, Water Quality and Treatment: A Handbook of Community Water Supplies. McGraw Hill, 1998. ISBN: 0070015406
20 Kawamura, S., Integrated Design and Operation of Water Treatment Facilities**.** Wiley and Sons, 2000. ISBN: 0471350931
21 Nyer, E.K., Groundwater Treatment Technology, (2nd Ed.). Wiley Interscience, 1992. ISBN: 0471284149**.**

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 tread off..

Computer Application in Construction Management- Softwares for .Precedence network analysis, CPM, ,PERT, GERT, decision tree analysis,

Unit 18

Financial Aspects of Construction Projects

Means of Finance, Working Capital Requirements, Project Cash Flow Projections and Statements, Project Balance Sheet, Profit Loss Account Statements, Concept of Debt Equity Ratio, Tax – Need and types

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 specialEquipments for Infrastrucure 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, tunnelingand 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
2. Total Project Managemtn- the Indian Context by P. K. Joy Macmillan India Ltd. Financial Managemnt by Prasanna Chandra, Tata Mc Graw Hill Publicaitons
3. Construction Project Management-Planning, Scheduling and Controlling by K. K. Chitkara, Tata McGraw Hill Publishing Company, New Delhi
4. Materials Management – Gopalkrishnan and Sunderasan, Prentice Hall Publications
5. Construction Planning, Methods & Equipment: Puerifoy – Tata McGraw Hill
6. Operations Research- Hamdy A. Taha
7. Engineering Optimisation- S. S. Rao

TOWN & COUNTRY PLANNING

Unit 21

Historic Development & Planning Theory-Origin ,evolution and contemporary developments in planning.,Formation of metropolitan areas &impacts of Industrial Revolution,Socio-economic & technological,impacts of growth of population; rural-urban migration,Characteristics of the urban environment: Land uses, physical structure ,The interim and comprehensive plans: Structure Plan, Master Plan, Zonal Development Plan - their purpose and contents,Surveys, analyses and design methods and practices in comprehensive planning,Residential Areas : Neighborhood and Sector Planning, Planning of New Towns in India and abroad.

Spatial & Environmental Aspects of Planning-Environmental degradation and its impact,environmental impact assessments ,principles of environmental approach to planning. Indicators of sustainabity 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.

Planning Administration & Professional Practices-Planning legislation ,Constitutional basis and provisions relating to land, Evolution of planning laws,Land Acquisition Act of India, MRTP Act 1966,UDPFI Guidelines (implications of 73rd and 74th amendment of the constitution),EPA, Conservation of natural resources, Conservation and Management of Ancient Monuments and Archaeological sites and ruins., Land Development Control,Urban Arts Commission Act, Transportation, Landscape, Housing and slum clearance legislation. ,Role in interdisciplinary groups

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 :

1. K.S.Rangwala and P.S.Rangwala,. "Town Planning ",Charotar Publishing House,15th Edition,1999.
2. Michael Hord, R. Remote sensing methods and application, John Wiley and Sons, New York, 1986.
3. National Building Code of India- Part-III.
4. Municipal and Panchayat bye-laws, CMDA Rules and Corporation bye-laws.
5. KA. 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
9. The art of home landscaping – Mc Graw Hill Book company
10. Harvey M. Rubenstain ,A Guide to site and Environmental planning, Newyork
11. The Small Town Planning Handbook by: Thomas L. Daniels, John W. Keller, Mark B. Lapping.

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; Asphal 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:

1. D. Salvo Perspectives in Regional Transportation Planning, Laxington Books, USA, 1974.
2. Mishra ,Sundaram and Prakash Rao, Regional Development Planning in India, Vikas Publishing House Pvt. Ltd., 1974.
3. G.J. Pingnataro, Principles of Traffic Engineering, Mc Graw-Hill, 1970.

4. Wohl and Martin, Traffic System Analysis for Engineering and Planners, Mc Graw Hill, 1983.
5. Ronald D. Drew, Traffic Flow Theory, Mc Graw Hill, 1964.
6. Manheim, Analysis of Transportation Systems, MIT, USA, 1980.
7. R.G. Weilson, Entropy in Urban and Regional Transportation, McGraw-Hill, 1980.
8. Miller and Mayor, Decision Analysis and Decision Making Oriented Urban Transportation, McGraw-Hill, 1984.
9. Hails, J.R. Ed., Applied Geomorphology and Engineering, Downden, Hutchinson and Ross, Stroundsburg, 1976.
10. Coats, D.R. Ed., Environmental Geomorphology and Landscape Conservation, Vols. II and III Dowen, Hutchinson and Ross, Stroudsburg, 1973.
11. Yoder and Witzech, Pavement Design, McGraw-Hill, 1982.
12. Sharma and Sharma, Principles and Practice of Highway Engg., Asia Publishing House, 1980.
13. Teng, Functional Designing of Pavements, Mc Graw - Hill, 1980.
14. Asce Journal papers.

700003-B2: 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:
1. W.M Kays and M.E. Crawford, "Convective Heat and Mass Transfer", McGraw Hill Intl.
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:
1. W.M Kays and M.E. Crawford, "Convective Heat and Mass Transfer", McGraw Hill Intl.
2. D. Brian Spalding, "Combustion and mass Transfer', 1st edition, Pergamon Press, 1979

Unit 3: Combustion:
Premixed and Diffusion flames

Reference Books
1. Kenneth K.Kuo, " Principles of Combustion", John Wiley and sons. Inc, 2005
2. Irvin Glassman, "Combustion", Academic Press, 1987
3. Turns,S.R., "An Introduction to Combustion, Concepts and Applications", Mc-Graw Hill, 2000
4. Williams,F.A., "Combustion Theory" The Benjamin and Cummings Publishing Company Inc.,1985
5. Law,C.K., "Combustion Physics", Cambridge University Press,2006

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*)
1. Wesseling P, "Principles of Computational fluid dynamics", Springer
2. Ferziger J.H., "Computational methods for fluid dynamics", Springer

3. Anderson, J.D. ”Computational Fluid Dynamics: The Basics with Applications”, McGraw Hill, 1995
4. Ferziger,J.H. and Peric,M., “Computational Methods for Fluid Dynamics”, Springer, 1999
5. Patankar,S.V., “Numerical Heat Transfer and Fluid Flow”, Narosa Publishing House, USA, 1980
6. Date,A.W., “Introduction to Computational Fluid Dynamics”, Cambridge University Press, 2005
7. Wilcox,D.C., “Turbulence Modelling for CFD”, DCW Industries Inc., 1994
8. Chunng,T.J., “Computational Fluid Dynamics”, Cambridge University Press, 2002
9. Thompson,J.F., Warsi,Z.U.A. and C.W. Mastin, “Numerical Grid Generation-Foundations and Applications” North Holland, 1985

Unit 6: Turbulence

Governing equations, Free shear flows, Near wall behavior, Energy spectrum, Turbulence models

Reference Books:

1. Stephen B. Pope, “Turbulent flows”, Cambridge Univ. Press
2. Hinze J.O., “Turbulence”, McGraw Hill

Unit 7: Vibrations

Multi-degree freedom systems, Approximate and numerical methods, Continuous systems, Nonlinear systems

Reference Books

1. Balakumar Balachandran and Edward Magrab, “Vibrations”, Thomson Brooks/Cole, 2004.
2. Kelly S.G., “Mechanical vibrations”, McGraw-Hill, 2007

Unit 8: Acoustics

Wave propagation, generation/transmission of sound, noise control

Reference Books

1. Kinsler, Frey and Coppens, “Fundamentals of Acoustics”, John Wiley & Sons
2. Allan D Pierce, “Acoustics: An Introduction to its Physical Principles and Applications”, Acoustical Society of Amer, 1989.

Unit 9: Fracture Mechanics

Linear Elastic Fracture Mechanics,Elastic Plastic Fracture Mechanics, Fracture Mechanisms in Metals

Reference Books

1. T L Anderson, Fracture Mechanics- Fundamentals and Applications, CRC Publishers, 2nd edition, 1995
2. Ashok Saxena, Nonlinear Fracture Mechanics for Engineers, CRC Publications
3. Hertzberg R.W., Deformation and Fracture Mechanics of Engineering Materials, Wiley, 4th edition, 1996.

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
2. Threlkeld J.L., "Thermal Environmental Engineering", Prentice Hall
3. Dossat R.J., Principles of Refrigeration, Pearson Education Asia
4. Handbook of air-conditioning system design, Carrier Incorporation,McGraw Hill Book Co., U.S.A.
5. Hainer R.W. 'Control Systems for Heating, Ventilation and Air – Conditioning', Van Nastrand Reinhold Co., New York, 1984.

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

1. Boresi A.D., Schmidt R.J, and Sidebottom O.M, "Advanced Mechanics of Materials", Wiley
2. Richard Budynas, "Advanced strength of applied stress analysis", McGraw Hill
3. Cook R.D., Young W.C., "Advanced Mechanics of Materials", Prentice Hall
4. Timoshenko and Goodier, "Theory of Elasticity", McGraw-Hill Publications
5. Ugural and Fenster, "Advanced Strength and Applied Elasticity", 4th Ed., Prentice Hall, PTR, 2003.
6. Srinath L.S, "Advanced Mechanics of Solids", Tata Mc-Graw Hill, New Delhi, 2003.

Unit 12: Advanced gas dynamics:

Liberalized flow, Method of characteristics, Shock boundary layer interaction, Numerical methods

Reference Books

1. Anderson J.A., "Compressible Flow", McGraw Hill.
2. Shapiro A.H., "Dynamics and Thermodynamics of Compressible Fluid Flow", MIT Press

3. Zucker R. D. and Biblarz Oscar, "Introduction to Gas Dynamics", John Wiley and Sons. Inc., Second Edition, 2002

Unit 13: Robotics
Kinematics, Dynamics, Trajectory, Control

Reference Books
1. John J Craig, "Introduction to Robotics – Mechanics and Control", Prentice Hall, 3rd Edition, 2004.
2. Fu K.S., Gonzales R.C., and Lee C.S.G., "Robotics: Control, Sensing, Vision and Intelligence, Tata Mc-Graw Hill, 2008.

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
1. Charles Fayette Taylor, "The Internal Combustion Engine in Theory and Practice", Vol. I & II, The MIT Press.
2. John B Heywood, "Internal Combustion Engine Fundamentals", McGraw Hill International Edition, 1998.
3. Makartchouk, A., "Diesel Engine Engineering: Thermodynamics, Dynamics, Design, and Control". New York, and Basel: Marcel Dekker, Inc., 2002.
4. SAE publications
5. Blair, G., "The Basic Design of Two-Stroke Engines", Warrendale, PA: Society of Automotive Engineers, 1990.
6. Owen, K., and Coley.T., "Automotive Fuels Handbook". Warrendale, PA: Society of Automotive Engineers, 1990.

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

Reference Books:
1. Bathe K J "Finite Element Procedures", Cambridge, MA 2007
2. Sequerlind L J, "Finite Element Analysis", Wiley, 2nd edition, 1984
3. Reddy J.N., "An Introduction to Finite Element Method", McGraw Hill

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

Reference Books
1. Balian Roger, "From Microphysics to Macrophysics",1st edition, Springer, 2006.
2. Thermodynamics of Microstructures, ASM International, 2008
3. Younes Shabany, "Heat transfer Thermal Management of electronics", CRC Press.
4. Electronics cooling magazine issues from 1997 -2010

Unit 17: Bio-medical device design
Applications, FDA approval procedures, A Certification

Reference Books
1. Shiegly 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
1. Faghri Amir, "Heat Pipe Science and Technology", Taylor & Francis, 1995.
2. Dunn and Reay, "Heat Pipes", Pergamon, 4th Edition,
3. Kaveh Azar, "Thermal Measurements in Electronic Cooling", CRC Press, 1997.

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

Reference Books
1. M/c standard 8005
2. Kapur K.C., and Lamberson L.R., "Reliability in Engineering Design", Wiley India Pvt. Ltd., 2009.

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

Reference Books
1. Lakshminarayana B., "Fluid Dynamics and Heat Transfer of Turbo Machinery", Wiley – Interscience, 1995.
2. Rangwala A.S., "Turbo-Machinery Dynamics", McGraw Hill,
3. Earl Logan, Jr, Ramendra Roy, "Handbook of Turbo Machinery", 2nd Edition (Mechanical Engineering, No. 158)
4. Rama S.R. Gorla, "Turbo Machinery: Design and Theory", Marcell Dekker
5. Duncan Walker, "Torsional Vibration of Turbo-Machinery",
6. R. I. Lewis, "Turbo machinery Performance Analysis"

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

1. Sluzalec and Andrzej, “Theory of Metal Forming Plasticity - Classical and Advanced Topics” Springer Publications
2. Avitzur B., “Metal Forming - Process and analysis” Tata Mc-Graw Hill
3. Mielnik E.M., “Metal working science and Engineering”, Mc-Graw Hill. Inc

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

1. Milton C Shaw, “Metal Cutting Principles” 2nd Edition, Oxford series in Advanced Manufacturing.
2. Paulo Davim (Ed.), “Machining – Fundamentals and Advances” Springer-Verlag, London, 2008.
3. Childs Thomas, Maekawa K., Obikawa T., and Yamane Y., “Metal machining – Theory and Applications” John Wiley & Sons, New York, 2000

Unit 23: Modelling of Manufacturing Systems

Markov chains –Continuous and Discrete, Petri nets – Timed and Stochastic

Reference Books

1. Viswanadham, N and Narahari, Y. “Performance Modelling of Automated Manufacturing Systems”, Prentice Hall of India, New Delhi, 2000
2. Hruz B. and Zhou M.C., “Modelling and Control of Discrete Event Dynamic Systems”, Springer, London, 2007.
3. Curry G., Feldman R.M., “Manufacturing Systems Modelling and Analysis”, Springer-Verlag, Heidelberg, 2009.

Unit 24: Reverse Engineering :

Reverse engineering – Methodologies and Techniques, Hardware and software, Rapid prototyping –Relationship with reverse engineering

Reference Books

1. Vinesh Raja and Kiran J Fernandes, “Reverse Engineering – An Industrial perspective”, Springer, London, 2008
2. Pham D and Dimov S, “Rapid manufacturing - The technologies and applications of rapid prototyping and rapid tooling. Springer-Verlag, London, 2001.

Unit 25: Advanced Machining Processes:

Hybrid electro-chemical processes, Hybrid thermal processes, Solid, liquid and powder based material addition processes (Analytical Study)

Reference Books

1. Hassan El-Hofy, "Advanced Machining Processes – Non Traditional and Hybrid Machining Processes", Mc-Graw Hill, London, 2005
2. Brown J., "Advanced Machining Technology Handbook", Mc-Graw Hill, New York, 1998

Unit 26: Manufacturing Systems:

Machine tool design, control, automation and analysis, Computerized process planning

Reference Books

1. George Chryssolouris, "Manufacturing Systems: Theory and
2. Practice", 2nd Edition, Springer, New York, 2006.
3. Chang T.C., "Expert Process Planning for Manufacturing", Addison – Wesley, MA, 1990
4. Slocum A.H., "Precision Machine Design", SME, Prentice-Hall Inc, 1992.

Unit 27: High Integrity Die Casting

Vacuum die casting, Squeeze casting, Semi solid metal working, Design considerations for high integrity die Castings

Reference Books

1. Edward J Vinarcik, "High Integrity Die Casting Processes", John Wiley & Sons Inc., New York, 2003.
2. Campbell John, "Castings", Butterworth – Heinemann, 2000.

Unit 28: Computational Welding Mechanics:

Models for welding heat sources, Thermal analysis of welds, Fracture Mechanics of welded structures

Reference Books

1. Goldak J.A., and Akhlaghi M., "Computational Welding Mechanics", Springer, New York, 2005.
2. Radaj D., "Heat Effects on Welding: Temperature field. Residual stress and Distortion", Springer, 1992.

Unit 29: Composite Materials:

Elastic behavior of unidirectional and multi directional composites, Laminated composite beams and plates (Any one)

Reference Books

1. Isaac and Daniel M., "Engineering Mechanics of Composite Materials", Oxford University Press, 1994.
2. Jones R.M., "Mechanics of Composite Materials", McGraw Hill, New York, 1975
3. Calcote L.R., "Analysis of Laminated Composite Structures", Van Nostrand Rainfold, New York, 1969

700003-B3: Advances in Electrical Engineering

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:

1. Simon Haykin, 'Neural Networks: A Compressive Foundation', Second Edition, Person Education.
2. Zimmermann, H.J, 'Fuzzy Set Theory and its Applications', Second Edition, Kluwer Academic Publishers.
3. M. Ganesh, 'Introduction to fuzzy sets and fuzzy Logic', Prentice Hall India.
4. Mohamed H. Hassoun, 'Fundamentals of Artificial Neural Network', Prentice Hall India.
5. Jacek Zurada, 'Introduction to Artificial Neural Network', Jaico Publishing House India.

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:

1. 'Linear Multivariable Control Systems', Y. S. Apte, New Age International Publications.
2. 'Multivariable Control System': W.M. Wonham.
3. 3. 'Optimal Control: An Introduction' O Kirk, Prentice Hall.
4. 'Multivariable Feedback Control', S.Skogestad, I.Postlethwaite,
5. John Wiley and Sons, 2005

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:

1. 'Control System Design', G.C.Godwin, S.F.Graebe, M.E.Salgada, Prentice Hall of India .

2. ‘Control System Design Guide: A practical Guide’, George Eills, Academic Press(3rd Edition).
3. ‘Control System Principles and Design’, M.Gopal.
4. ‘Control System Engineering’, Norman S.Nise, Willey (Third Edition)

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:

1. ‘System modeling and response: Theoretical and Experimental Approaches’, Ernst O.Dobling, John Wiley and Sons , 1980.
2. ‘Modeling and Identification of Control Systems’,M.Gopal
3. ‘Modeling and Simulation of Dynamic Systems’, Robert Woods, Kent L. Lawrence, Prentice Hall.

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 gird.fuel cells systems. Hybrid systems, standalone hybrid systems, other sustainable Energy sources such as biomass, tidal, wave, geothermal, small and mirco hydel systems.

Reference Books:

1. Renewable Energy technologies: R.Ramesh, Narosa Publications .
2. Energy Technology: S.Rao, Parulkar.
3. Non-Conventional Energy Systems: Mittal , Wheeler Publication
4. Wind and solar Systems by Mukund Patel , CRC press.
5. Solar Photovoltaic for terrestrials, Tapan Bhattacharya.
6. Wind Energy Technology: Njenkins, John Wiley Sons.
7. Grid integration of wind Energy conversion Systems: Siegfried, Wiley Publications , John Wiley and Sons.

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.)
2. Power Electronics Handbook : M.H.Rashid, Academic Press Series in Engineering.
3. First Course in Power Electronics : Ned Mohan, MNPERE publications.
4. Electric Drives:Ion Boldea, Sayd Nasar ,CRC Press, Boca Raton London New York Washington, D.C.

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:

1. Sally Hunt, 'Making competition work in Electricity' , 2002 John Wiley Inc.
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:

1. 'Digital protection' , L.P. Singh , New Age International (P) ltd. Publishers, New Delhi. ,
2. 'Transmission network protection', Paithankar , Marcel and Dekker , New York
3. 'Fundamental of power system protection', Paithankar and Bhide , Prentice hall of India Pvt.Ltd. New Delhi.
4. 'Protective relaying for power system II' , Stanley Horowitz , IEEE press , 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:

1. Power system dynamics :K.R.Padiyar , B.S.Publications.
2. Power system Control and Stability :Vol.I, Anderson & Foud , IEEE Press New York.
3. Power system Dynamics and Control :Kundur , IEEE Press New York.
4. 4 .Power System operation and control :P.S.R Murthy
5. Power System stability : E.W.Kimbark, IEEE Press , N.Y.Vol.3
6. Power system control and stability , Vol.1 , Anderson and Foud , IEEE Press New York.
7. Power System Voltage Stability :C.W.Taylor, McGraw Hill International student Edition .

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:

1. Computer Aided Applications in power system operation and Analysis: R.N.Dhar, Tata Mc-Graw Hills , New Delhi.
2. 2.Computer techniques in power system Analysis: M.A.Pai, Tata Mc Graw Hills , New Delhi.
3. Optimization Techniques: S.S Rao , Wiely Eastern Ltd., New Delhi .
4. Electrical Energy System Theory: An Introduction , Olle Elgred, TMH Publishing Company , New Delhi.

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.
4. Understanding power quality Problems , Voltage Sag and interruptions :M.H.Bollen ,IEEE Press , 2000 , Series on Power Engineering.
5. Electrical power System Quality :Dugan, Mar F.McGranghan.MC Graw Hill Publication.
6. Power System Quality assessment :J.Arrillaga. M.R. Watson, S.Chan, John Wiley and Sons.

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 modeling , 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:

1. IEEE recommended Practice for Energy Managent in Industrial and commercial facilities , IEEE Std 739 -1995
2. Energy Efficiency in Electrical utilities , Guide Book for National Examination for Energy Managers and Energy Auditors , BEE, New Delhi.
3. Energy Efficiency in Thermal utilities , Guide Book for National Examination for Energy Managers and Energy Auditors , BEE, New Delhi.
4. Energy performance assessment for equipment and utility systems , Guide Book for National Examination for Energy Managers and Energy Auditors , BEE, New Delhi.
5. Hand book on Energy Management and Audit , TERI , New Delhi.

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-hydal.
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:

1. M.J. Roberts, "Signals and Systems", Tata McGraw Hill Publications, 2003.

2. M. Burns, “Introduction to Mixed Signal IC Test and Measurement”, Oxford University Press Publications, New York.
3. Xilinx, “The Programmable Logic Data Book”, Xilinx, California.
4. Hu, Yu Hen, “Handbook of Neural Network Signal Processing”, CRC Press Publications.
5. Yacoub M.D., “Wireless Technology”, CRC Press Publications.
6. Gold B., “Speech and Audio Signal Processing”, John Wiley Publications.
7. Kuo B.C., “Digital Control System”, Sounders College Publications, New York.
8. Comer “Digital Logic and State Machine Design”, Sounders College Publications, New York.
9. Prokis J.G., “Digital Signal Processing”, PHI Publications.
10. Alley, Charles L, “Micro Electronics”, McGraw Hill Publications.
11. Ha, Tri T., “Digital Satellite Communication”, McGraw Hill Publications.
12. Peebles, “Probability and Random Signals”, McGraw Hill Publications.
13. Balanis, “Antenna Theory analysis and Design”, John Wiley Publications.
14. Gray R.P.,” Analysis and Design of Analog ICs”, John Wiley Publications.
15. Tompkins J.W., “Biomedical Digital Signal Processors”, PHI Publications.
16. Collin E.R., “Foundations for Microwave Engineering”, McGraw Hill Publications.
17. Freeman R.L., “Radio System Design for Telecommunication”, John Wiley Publications.
18. Kronsjo L., “Advances in Parallel Algorithm”, Blackwell Scientific Publication, London.
19. Xavier, Eugune S.P., “Statistical Theory of Communication”, New Age International Publication.
20. Baker R.J., “CMOS: Circuit Design, Layout and Simulation”, IEEE Press Publication.
21. McGillen C.D., “Continuous and Discrete Signal and System Analysis”, Oxford University Press.
22. Russ J.C., “The Image Processing Handbook”, CRC Press Publications.
23. Franssila S., “Introduction to Micro fabrication”, John Wiley Publications.
24. Park J., “Practical Embedded Controllers”, Elsevier Publications, Amsterdam.
25. Kabatiansky G., “Error Correcting Coding and Security for Data Network”, John Wiley Publications.
26. Lee K., “Semiconductor Device Modeling For VLSI”, PHI Publications.
27. Maxfield C.M., “The Design Warriors Guide to FPGA”, Elsevier Publications, Amsterdam.
28. ***Carsten Steger, Markus Ulrich, Christian Wiedemann, “***Machine ***Vision Algorithms and Applications”,*** Wiley-VCH, Weinheim Publications.
29. Pires, J. Norberto, “Human Machine Interface for Industrial Robotic Cells”, Springer Publications.

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

Introduction, Fick's Law of diffusion, factors affecting diffusion, Mechanism of diffusion, methods of evaluation of diffusion coefficient, Kirkendall effect, diffusion in thin films and multilayers. Problems related to diffusions. Order of reactions, absolute reaction rate theory, nucleation and growth in homogeneous and heterogeneous reactions, nucleation problems in solid phases.

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

Introduction to high Temperature corrosion & oxidation of Metals and Alloys, Thermodynamics & Ellingham diagram, vapour species diagram, Isothermal stability diagram, Rate Laws, Kinetics and Mechanics. Wagner's parabolic law of Oxidation. Role of Diffusion and Defect structure of oxides in Oxidation, multiple scale formation & cracking. Hot Corrosion, Corrosion in Mixed Gaseous Environment. Prevention of Corrosion, Inhibition, Metallic and Ceramic Paints, Coatings, Special Treatment. High temperature materials.

Unit 9 : Casting and Materials Joining

Casting processes, Solidification medium, Constitutional super cooling, Feeder design and performance, Defects in castings and remedial measures, Fusion welding, Solid-liquid joining, Solid state joining, Heat flow analysis, Weld metal microstructure, Heat Affected Zone, Properties of welded zones, Defects and remedies in welded zones, Dissimilar metal joining, Joining processes selection, applications of joining processes.

Unit 10 : Advanced Thermodynamics of Materials

First law and second law of thermodynamics, Heat capacity, Enthalpy, Heat of reactions, Hess's law, Kirchoff's equation, Third law of thermodynamics, Temperature dependence of heat capacity. Concept of equilibrium, Free energy as criterion for equilibrium and its applications to processing of materials. Gibbs-Duhem equations. Free energy-temperature diagrams, oxygen potential. Binary phase diagrams, Free energy versus compositions in binary systems.

Reference Books:

1. William F. Smith - Foundation of Materials Science and Engineering, Mc Graw-Hill International Edition, 2nd Edition, 1993.
2. S. O. Kasap - Principles of Electronic Materials and Devices, Tata Mc Graw-Hill Publication, 2nd Edition, 2002.
3. Buschow K.H.J. (Ed.), Handbook of Magnetic Materials, Amsterdam : Elsevier
4. Electronic Materials Handbook, ASM International, Materials Park, 1989
5. High Temperature Oxidation of Metals and Alloys –by N.Birks and Meir
6. Fundamentals of Corrosion- Scully
7. W.D.kingery, H.A.Bowen and D.R.Uhlman-Introduction to ceramics –2nd Edition, John Wiley, New York1976
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.,
13. B.D. Cullity, Elements of X-ray Diffraction (For X-rays), 3rd ed., Prentice-Hall, Upper Saddle River 2001
14. L.E. Murr, Electron and Ion Microscopy and Microanalysis, Marcel Dekker, 1991.
15. K.K. Chawla, Composite Materials- Science & Engg., Springer-Verlag, NY, 1987.
16. Clyne & Withers, An Introduction to Metal matrix composites, Cambridge Uni. Press, 1993.
17. Suresh S., Martensen, Needleman, Fundamentals of Metal Matrix Composites, Butterworth-Heinmann, 1993.
18. Nanomaterials: An introduction to synthesis, properties and applications, Editor-Dieter Vollath, Wiley-CVH.
19. Nanoscale Materials in Chemistry, Editor: Kenneth J. Klabunde, Publisher-Wiley-Interscience.

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 feed- back, 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:

1. Vaidyeswaran Rajaraman; Computer oriented numerical methods, Prentice-Hall of India, 2nd edition, (1980)
2. Jorge Nocedal and Stephen Wright; Numerical Optimization, Springer, 2nd edition, (2006)
3. S. S. Rao; Engineering Optimization: Theory and Practice, Wiley, 4th edition, (2009)
4. Ian T. Cameron, Katalin Hangos, John Perkins, George Stephanopoulos; Process Modelling and Model Analysis, Academic Press, 1st edition, (2001) Sabrie Soloman; Sensors handbook, McGraw Hill, (1999) J. Fraden; Handbook of modern sensors; physics, design and application, Springer, 3rd edition, (2004)
5. R. Frank; Understanding smart sensors, Artech house, (1996)
6. Frank Vahid and Tony D. Givargis; Embedded System Design: A Unified Hard-ware/Software Introduction, Wiley, (2001)
7. Joseph D. Bronzino; The Biomedical Engineering Handbook, CRC Press, 3rd edition,(2006)
8. Henry Ott; Electromagnetic Compatibility Engineering, Wiley, 1st Edition, (2009)
9. Dale E. Seborg, Duncan A. Mellichamp, Thomas F. Edgar, Francis J. Doyle III; Process Dynamics and Control, John Wiley and Sons, 3rd edition, (2010)
10. F. Gregg Shinskey; Process Control Systems: Application, Design, and Tuning, McGraw-Hill Professional, 4th Edition, (1996)
11. B. Wayne Bequette; Process Control: Modeling, Design and Simulation, Prentice Hall, (2003) 2

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:

1. Shlomo Magdassi (Ed.), The Chemistry of Inkjet Inks, World Scientific Publishing Co. Pte. Ltd., 2010

2. Eric R.Lee, Microdrop Generation, CRC Press, 2003

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

4. D. H. Everett, F. R. S., Basic Principles of Colloid Science, Royal Society of Chemistry

5. Gravure Process and Technology, Gravure Education Foundation and Gravure Association of America, 2003.

6. Flexography-Principles and Practices, Volume 1-6, FFTA, 5th Edition, 1999.

7. H. Kipphan, Handbook of Print Media, ISBN: 3-540-67326-1 Springer-Verlag Berlin Heidelberg, 2001

8. E. A. Apps, Printing Ink Technology, Leonard Hill Ltd., 1958.

9. A. S. Athayle, Plastics in Packaging, Tata McGrawHill Publication, 1992.

10. A. S. Athayle, Plastics in Flexible Packaging, Multi-Tech Publishing, 1992.

11. James P. Cassey, Pulp and Paper-Chemistry & Chemical Technology, Inter Science Publication, 1960.

12. Brett, G, Digital Prepress Technologies, Leatherhead: Pira International, 2001.

13. Martin, G., Non-impact Printing, Leatherhead: Pira International, 1993.

14. Dr. Abhay Sharma, Understanding Color Management, Thomson Delmar Learning, 2003.

15. Aaron L. Brody, Kenneth S. Marsh, Encyclopedia of Packaging Technology, A Wiley-Interscience Publication, 2nd Edition, 1997.

16. Dr. Nelson R. Eldered, What Printer Should Know About Ink, GATF Press Pittsburgh, 2001.

17. Laden P. O, Chemistry & Technology of Water based Inks, Blackie Academic & Professional - Imprint of Chapmall Hall, 1st Edition, 1997.

18. Chris H. Williams; Printing Ink Technology, Pira International, 2001.

19. Hans Kuhn, Horst-Dieter Försterling, David Hennessey Waldeck, Principles of Physical Chemistry, Wiley Publications, 2009.

20. Orazio Svelto, Principles of Lasers 5th Edition, Spinger, 2009.

21. Nicholas P. Cheremisinoff, Elastomer Technology Handbook

22. Anil K. Bhowmick, Howard L. Stephens, Handbook of Elastomers 2nd Edition, 2001.

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:

1. Biochemical Engineering fundamentals, by James, E.Bailey and David F Ollis, II Edition, 1986. McGraw-Hill Internal Edition.
2. Fogler, H. Scott. Elements of Chemical Reaction Engineering, 3rd Ed. Prentice Hall (1999).

Unit 2: Advance Polymer Engineering

Metallocene catalysis, Ziegler Natta Catalysis Mechanism and Products, Polymerization reactors.

Reference Books:

1. Handbook of Polymer reaction Engineering"**,** Thierry Meyer (Editor), Jos Keurentjes (Editor), Wiley, New York, April 2005.
2. George Odian Principles of Polymerization Wiley-Interscience; 4 edition 2004

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:

1. Phillip C. Wankat, "Separation Process Engineering", Prentice Hall PTR, 2006.
2. Roger G. Harrison, Paul W. Todd, Scott R., "Bioseparations Science and Engineering",
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:

1. S.J.Arceivala, wastewater treatment and disposal, marcel dekker 1981.

2. Metcalf and Eddy, wastewater engineering, treatment, disposal and Reuse, Inc. Third
3. edition McGraw – hill 1991.

Unit 6 : Advance Modeling and Simulation

Multiscale simulations in materials, Industrial flow modeling, Data driven modeling, Non-linear system dynamics

Reference Books:

1. C. L. Smith, R. N. Pike & P. W. Murill, Formulation optimization of Mathematical
   International text, Pensylvania (1970) 2)W. L. Luyben, Process Modeling Simulation and Controls for Chemical Engineers, Mc.Graw Hill Book Co.

Unit 7 : Catalysis, reactor and reaction engineering

Heterogeneous reactor analysis and design Special reactors, Molecular catalysis, Solid catalyst, supported catalyst

Reference Books:

1. Fogler, H. Scott. Elements of Chemical Reaction Engineering, 3rd Ed. Prentice Hall (1999). 2) Froment, Gilbert F. and Bischoff, Kenneth B. Chemical Reactor Analysis and Design, 2nd Ed.Wiley (1990).

Unit 8 : Advance Transport Phenomena

Boundary conditions. Macroscopic balances. Governing equations of heat transfer: Energy balance, Governing equations of mass transfer: Species mass balance, Constitutive equations, Simultaneous heat and mass transfer

Reference Books:

1. Bird, R.B., Stewart, W.E. and Lightfoot E.N., Transport Phenomena, Second edition, John Wiley and Sons, 2002.
2. Deen W. M., Analysis of transport phenomena, Oxford University Press, 1998.

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
3. 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:

1. Seborg, Edgar, Mellichamp, Process Dynamics and control John Willey, 2nd Edn., 2004.
2. Willis Harmon Ray, Babatunde Ayodeji Ogunnaike. "Process Dynamics, Modeling, and Control", Oxford University Press, 1994.

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:

1. Frank Kreith & Mark S. Bohn Principles of Heat Transfer, 6^{th} Edition, Asian Books Private Limited, 2001
2. Ghoshdastidar, P. S. Heat Transfer, Oxford University Press, 2004.

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

Introduction to Natural Language Understanding, An Outline of English Syntax, Grammars and Parsing, Grammars for Natural Language, Toward Efficient Parsing, Ambiguity Resolution: Statistical Methods, Linking Syntax and Semantics, Ambiguity Resolution, Scoping and the Interpretation of Noun Phrases.

References

1. James Allen, "Natural Language Understanding", Pearson Education, 2nd Edition
2. Akshar Bharati, Vineet Chaitanya, Rajiv Sangal, "Natural Language Processing- A Paninian Perspective", PHI
3. Christopher D. Manning and Hinrich Schütze. 1999. Foundations of Statistical Natural Language Processing. MIT Press.

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

1. Alfred V. Aho, Ravi Shethi, Jeffrey D Ullman,"Compilers- principle, techniques and tools", Pearson Education, 2006
2. V Raghvan,"Principles of Compiler Design",Tata McGraw Hill,,2010

Unit-3: Digital Image Processing

Digital image fundamentals: image digitization, sampling and quantization, image resolution, color perception & processing, image processing: pixel based transformation, geometric transformation, local processing restoration, binary image processing: thresholding, runlength encoding, distance transforms, medial axis transforms, morphological operations, region segmentation & representation: split & merge algorithm, region growing, image filtering histogram modification, linear and Gaussian filters, contours , digital curves, polyline splitting, Hop_ Along algorithm, Conic & Splines Hough transform, Fourier description, textures: statistical syntactic and model based methods, Texture image analysis, image transforms :Fourier, Hadamard, discrete cosine, wavelets and other orthogonal transforms, compression image (predictive compression methods, vector quantization, hierarchical & progressive methods, JPEG & MPEG), Motion picture analysis.

References:

1. Rafael C Gonzalez, Richard E Woods, "Digital Image Processing", Prentice Hall Publisher, 2008, 3rd Edition
2. William K Pratt, "Digital Image Processing", John Willey (2001)
3. Millman Sonka, Vaclav hlavac, Roger Boyle, Broos/colic,"Image Processing Analysis and Machine Vision", Thompson Learning (1999).
4. A.K. Jain, "Fundamentals of Digital Image Processing", PHI, New Delhi (1995)

5. Chanda Dutta Magundar,"Digital Image Processing and Applications", PHI, 2000

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

1. Holger Kars," Protocols and architectures for WSN" , Wiely publication.
2. M Jochen Schiller, "Mobile communication", Person Publication.
3. Mathew Gast, "802.11 wireless Networks the definitive guide", O'Reilly.

Unit-5: Network Security

Network threats and attacks, Security Services, Number Theory Concepts, Cryptographic algorithms, Network Security Protocols, System Security, Security research in wired, wireless and ubiquitous networks, Security Standards and RFCs

References

1. William Stallings, "Cryptography and Network Security", Fourth Edition,Pearson Education 2007.
2. Behrouz A. Forouzan, "Cryptography & Network Security", TMH 2007.
3. Robert Bragg, Mark Rhodes, "Network Security: The complete reference", TMH

Unit-6: Artificial Intelligence

AI problems, AI intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation. Searching: Searching for solutions, uniformed search strategies, Heuristic functions. Constrain satisfaction problems: Game Playing Alpha-Beta pruning, Evaluation functions, cutting of search, Knowledge Representation & Reasons logical Agents, logic, propositional logic, Resolution patterns in propositional logic, Resolution, Forward & Backward Chaining, Planning – Classical planning problem, Language of planning problems, Expressiveness and extension, planning with state.

References

1. Stuart Russel,Peter Norvig, "Artificial Intelligence – A Modern Approach", Second Edition, PHI/Pearson Education.
2. Patrick Henry Winston, "Artificial Intelligence", 3rd Edition, Pearson Education.

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

1. Christopher D. Manning and Hinrich Schütze, "Foundations of Statistical Natural Language Processing", MIT Press,1999.
2. James Allen, "Natural Language Understanding", Pearson Education, 2nd Edition

Unit-8: Machine Learning

Designing a Learning system, Learning Process, Learning methods, Forms of learning, Induction learning, Learning with complex data, learning with Hidden variables, Parametric-Nonparametric methods, Multivariate methods, Feature extraction, clustering, Decision tree, Artificial Neural networks, Self Organization Map, Regression, Radial Basis Function networks, Function Approximation, Hopfield models Evaluating Hypotheses, Computational Learning theory, Instance based learning, rule based learning, Analytical Learning, Reinforcement learning, Hidden Markov Models, Probability, classification, Linear Discrimination.

References

1. Simon Hhaykin, "Neural networks - A comprehensive foundations", Pearson Education 2nd Edition 2004.
2. Ethem Alpaydin, "Introduction to Machine Learning", PHI
3. Tom Mitchell, "Machine Learning", MGH

Unit-9: Graphics & Visualization

Picture analysis, Modeling: 2D, 3D Geometric modeling and transformations, projections, Clipping, curves and fractals. Illumination models and Rendering: Light, Ambient Light, Diffuse reflection, Specular reflection, Shading algorithms, Color models, Ray tracing, Texture mapping. Scientific Visualization: Methods of Scientific Exploration, Data Aspects and Transformations, Time-Tested Principles for Good Visual Plots, Tone Mapping, Matters of Perception, Visualizing Multidimensional Data, Scalar Data Visualization, Vector Data Visualization. Graphics User Interfaces, image manipulation and storage, advanced modeling techniques.

References

1. Peter Shirley, Ashikhmin Gleicher et. al.,"Fundamentals of Computer Graphics", A. K. Peters Ltd., 2005
2. Hearn and Baker,"Computer Graphics", PHI
3. Van Dan Feiner, Hughes, Foley, "Computer Graphics: Principles and Practice", PHI

Unit-10: Advanced Algorithms and Applications

Problem solving, Probabilistic analysis and randomized algorithms, Perfect Hashing, The Floyd-Warshall algorithm, Johnson's algorithm for sparse graphs, NP-hard problems, Approximation algorithms, Online algorithms and competitive analysis. Linear-Programming Algorithms: Structure of Optima, Interior Point. Computational geometry: convex hull. Random Walks and Markov chains

References

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein**,** "Introduction to Algorithms," Third Edition PHI 2010.

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

1. J. Han and M. Kamber, "Data Mining- Concepts and Techniques", 2nd Edition, Morgan Kaufmann, 2006.
2. M argaret H. Dunham," Data Mining Introductory and Advanced Topics", Prentice Hall
3. P. Tan, M. Steinbach and V.,Kumar, "Introduction to Data Mining", Addison Wesley, 2006.

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

1. G Coulouris, J Dollimore and T Kindberg, "Distributed Systems Concepts and Design", Third Edition, Pearson Education.
2. Kai Hwang, Faye A.Brigs, "Computer Architecture and Parallel Processing", Mc Graw Hill

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

Optimization techniques, Simulation Using Software, Non-linear Programming, Goal Programming, Inventory Management , Supply Chain Management, Project Management, Resource Optimization.

Reference Books

1. Gupta P. K. and Hira D. S. : Operations Research, S Chand & Company Ltd.
2. Sharma J. K. : Mathematical Models in Operations Research, Tata McGraw – Hill Publishing Company Limited.
3. Sharma S. D., Kedar Nath : Operations Research, Ram Nath & Co.
4. R. Panneerselvam : Operations Research, Prentice Hall of India Pvt. Ltd

Unit 2 : Robotics And Automation

CAD / CAM, Rapid Prototyping, Flexible Manufacturing Systems And Group Technology (MICLASS, OPTIZ), Cell Formation in GT. Analysis of Vision System, online Inspection through Vision System, Design of Grippers, various sensors in robotics, Robot kinematics and dynamics, Trajectory Planning in robotics, Avoiding obstacles by robot.

Reference Books

1. Robotics Technology and Flexible Automation – S.R. Deb Tata McGraw Hill.
2. Robotics for Engineers – Yoram Koren, Tata McGraw Hill.
3. Industrial Robotics – Groover, Weiss, Tata McGraw Hill.
4. Robotics – Control, Sensing, Vision and Intelligence – K. S. Fu, R. C. Gonzalez, C. S. G. Lee, McGraw Hill Int.
5. Robotics and Image Processing by P.A. Janakiraman, Tata McGraw Hill 1995

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. Francies, R.L. and White, J. A
3. Plant Layout and Material handling James M Apple,2"d Edition., John, Wiely and Sail.

Unit 4 :Production Systems

Markov chain analysis, Discrete Time Markov Chain, Assembly line balancing, Petri Nets, Generalized Stochastic PetriNets, Stochastic of manufacturing Systems, Economic analysis, Materials Management, Operations Management.

Reference Books

1. Production Flow Analysis for Planning Group Technology – John L. Burbridge
2. Just in Time – David Hutchins-Gower Publishing ISBN-0566077981
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

1. Concepts in Reliability in Engineering – L. S. Srinath, Affiliated East West Press.
2. Reliability in Engineering Design – K. C. Kapur and L. R. Lumbersome, Willey.
3. System reliability-Modelling and Evaluation – C. Singh and R. Billinton, Hutchinson.
4. Terotechnology: Reliability Engineering and Maintenance Management - B Bhadury and S.K. Basu, Asian Reference Books , New Delhi 2002.
5. A.K. Gupta: Reliability Engineering & Terotechnology Mc Millan (I) Ltd.
6. Terotechnology & Reliability Engineering: A. K. Gupta, McMillan Co.
7. Maintenance, Replacement & Reliability: A. K. S. Jardine, HMSO, London.

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

1. Human Factors in Design and Manufacturing-Mark S.Sanders, Ernest. J. McCORMICK.
2. Works Organisation and Management: Basu S.K., Sahoo K.C., and Datta N.K., Oxford-IBH, 3rd Edn., 1997.
3. Human Engineering- Guide to Equipment design C.T.Morgan, J.S.Cook, A. Chapnis and M.W.Land: McGraw Hill, N.Y, 1963.
4. Barnes, "Motion and Time Study", Wiley International.

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

1. Design of Machine Tools – Latest Edn. – S. K. Basu and D. K. Pal, Oxford – IBH.
2. Computer Numerical Control Machines – B. Leatham and Jones.
3. Computer Control in Manufacturing – Yoram Koren, Tata McGrew Hill.
4. Numerical Control and Computer Aided Manufacturing – Kundra, Rao and Tiwari, Tata McGraw Hill.
5. NC Machine tools – S.J. Martin, ELBS.
6. Principles of Machine Tools – A. Bhattacharya and G.C. Sen, New Central Book Agency, Calcutta.
7. Machine Tool Design – N. K. Mehta, Tata McGraw Hill.

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

1. MEMS & Microsystem: Design & Manufacture by Tai ran Hsu, Tata McGraw Hill Publisher, 2002.
2. The MEMS handbook, CRC Press, 2001
3. Microsensors, MEMS and smart Devices by Julian W. Gardner & Vijay K. Varadan, John Wiley & Sons, 2001.
4. 'Nanotechnology' by Nario Taniguchi, , Oxford University Press, 1996.

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

1. Theory of Metal Forming Plasticity - Classical and Advanced Topics by Sluzalec, Andrzej , Springer Publications
2. Metal Forming - Process and analysis – by B. Avitzur, Tata Mcgraw Hill
3. Metal working science and Engineering by E.M. Mielnik , McGraw Hill. Inc.
4. Theory of plasticity "-Chakrabarthy J.,- McGraw Hill Co, 1987.
5. Metal forming Mechanics and Metallurgy – Hofsord W.F. and Caddell R.M. – Prentice Hall, Eaglewood, cliffs, 1993
6. Theory of Metal Forming Plasticity - Classical and Advanced Topics by Sluzalec, Andrzej , Springer Publications

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

1. Fundamentals of Tribology – S.K.Basu, B.B. Ahuja and S.N. Sengupta, PHI
2. Friction, lubrication, wear- vol I,II and III-Kragelsky.
3. Tribology of bearings – B.C. Mujumdar.
4. Tribology – A System Approach – H.Czichos and Elsevies.
5. Friction and Wear of Materials –E. Rabinowics, Wiley N.Y.

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

Navier Stokes equations in Heat, Mass and Momentum Transport. Modeling of heterogeneous systems of practical interest in Navier Stokes framework. Solution of model equations.

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