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M.Tech – SE

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY::PUTTUR
(AUTONOMOUS)
Department of Civil Engineering

M.Tech. (Civil Engineering)
Specialization: Structural Engineering

I M.Tech - I Semester

S No.	Course Code	Course Name	L	T	P/ Drg	C
1	19HS0823	Research Methodology and IPR	2	-	-	2
2	19CE1001	Advanced Structural Analysis	3	-	-	3
3	19CE1002	Advanced Solid Mechanics	3	-	-	3
4	**Programme Elective (PE) – I**					
	19CE1008	Theory of Thin Plates and Shells	3	-	-	3
	19CE1009	Theory and Applications of Cement Composites				
	19CE1010	Theory of Structural Stability				
5	**Programme Elective (PE) – II**					
	19HS0837	Analytical and Numerical Methods for Structural Engineering	3	-	-	3
	19CE1011	Structural Health Monitoring				
	19CE1012	Structural Optimization				
6	19CE1003	Structural Design Lab	-	-	4	2
7	19CE1004	Advanced Concrete Lab	-	-	4	2
Audit Course – I						
8	19HS0818	English for Research Paper Writing	2	-	-	-
Contact periods / week			16	-	8	**18**
			Total/Week		**24**	

I M.Tech - II Semester

No.	Course Code	Course Name	L	T	P/ Drg	C
1	19CE1005	FEM in Structural Engineering	3	-	-	3
2	19CE1006	Structural Dynamics	3	-	-	3
3	**Programme Elective (PE) – III**					
	19CE1013	Advanced Steel Design	3	-	-	3
	19CE1014	Design of Formwork				
	19CE1015	Design of High-Rise Structures				
	19CE1016	Design of Masonry Structures				
4	**Programme Elective (PE) – IV**					
	19CE1017	Design of Advanced Concrete Structures	3	-	-	3
	19CE1018	Advanced Design of Foundations				
	19CE1019	Soil Structure Interaction				
	19CE1020	Design of Industrial Structure				
5	19CE1007	Model Testing Lab	-	-	4	2
6	19HS0838	Numerical Analysis Lab	-	-	4	2
7	19CE1025	Mini Project	-	-	4	2
Audit Course – II						
8	19HS0829	Constitution of India	2	-	-	-
Contact periods / week			14	-	12	**18**
			Total/Week **26**			

L – Lecture hour; T – Tutorial; Drg – Drawing; P - Practical; C – Credits.

II YEAR – I SEMESTER

S No.	COURSE CODE	SUBJECT	L	T	P/ Drg	C
1	**Professional Elective Course (PEC) – V**		3	-	-	3
	19CE1021	Design of Prestressed Concrete Structures				
	19CE1022	Analysis of Laminated Composite Plates				
	19CE1023	Fracture Mechanics of Concrete Structures				
	19CE1024	Design of Plates and Shells				
2	**Open Elective Course**		3	-	-	3
	19HS0824	Business Analytics				
	19ME3121	Industrial Safety				
	19ME3021	Advances in Operations Research				
	19ME3022	Composite Materials				
	19EE2128	Waste to Energy				
3	19CE1026	Dissertation Phase – I	-	-	20	10
Contact Periods / Week			6	-	20	**16**
			Total/Week **26**			

L – Lecture hour; T – Tutorial; Drg – Drawing; P - Practical; C – Credits

II YEAR – II SEMESTER

S No.	COURSE CODE	SUBJECT	L	T	P/ Drg	C
1	19CE1027	Dissertation Phase – II	-	-	32	16
Contact Periods / Week			**-**	**-**	32	**16**
			Total/Week **32**			

Note:

- L – Lecture hour; T – Tutorial; Drg – Drawing; P Practical; C – Credits.
- **Total credits:** 18+18+16+16**=68**

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I M.Tech – I Sem.

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(19HS0823) RESEARCH METHODOLOGY AND IPR

COURSE OBJECTIVES

At the end of this course, students will be able to:

1. *Understand some basic concepts of research and its methodologies*
2. *Identify appropriate research topics*
3. *Enrich knowledge to their research field*
4. *Process for filing Patent*

COURSE OUTCOMES

1. *Recognize appropriate research problem, errors in selecting a research problem, Scope and objectives of research*
2. *Critically assess research methods pertinent to technology innovation research*
3. *Identify, explain, compare, and prepare the key elements of a research proposal/report*
4. *Skill to understand the need of intellectual property rights, IPR protection to inventors*
5. *Develop procedural knowledge to Legal System and solving the problem relating to intellectual property rights for further research work and investment in R & D*

UNIT – I

Research: 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 - Approaches of investigation of solutions for research problem - data collection, analysis, interpretation - Necessary instrumentations

UNIT – II

Literature survey in Research: Effective literature studies approaches - analysis - Plagiarism - Research ethics

UNIT – III

Project Report: Effective technical writing - how to write report – Paper - Developing a Research Proposal - Format of research proposal - A presentation and assessment by a review committee

UNIT – IV

Intellectual Property Rights: Nature of Intellectual Property – Patents, Designs, Trade and Copyrights - Process of Patenting and Development - Technological research, innovation, patenting, development - International Scenario - International cooperation on Intellectual Property - Procedure for grants of patents - Patenting under PCT

UNIT – V

Patent Rights: Scope of Patent Rights - Licensing and transfer of technology –Patent information and databases - Geographical Indications - New Developments in IPR - Administration of Patent System - New developments in IPR - IPR of Biological Systems, Computer Software - Traditional knowledge, Case Studies - IPR and IITs

TEXT BOOKS

1. CR Kothari, "*Research Methodology: Methods and Techniques*" 3rd Edition, New Age International (P) Limited, Publishers, 2013
2. Neeraj Pandey & Khushdeep Dharani, "*Intellectual Property Rights*" Eastern Economy Edition, PHI Learning Private Limited

REFERENCES

1. John W. Creswell, "Research Design – Qualitative, Quantitative and Mixed Methods Approaches" 4th Edition, SAGE Publications, New Delhi 2014
2. Ranjit Kumar, 4th Edition, "*Research Methodology: A Step by Step Guide for beginners*" SAGE Publications, New Delhi, 2014.
3. Ramakrishna B & Anil Kumar H.S "*Fundamentals of Intellectual Property Rights- for students, Industrialist and Patent Lawyers*", First Published, Notion Press, Chennai, 2017.
4. Ahuja VK, "*Intellectual Property Rights in India*", Second Edition, Mittal Books India, 2015.
5. KC Kankanala, AK Narasani & V Radhakrishnan, "*Indian Patent Law and Practice*", Oxford India Paperbacks, Edition, 2012.

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(19CE1001) ADVANCED STRUCTURAL ANALYSIS

COURSE OBJECTIVES

1. *Student shall learn analysis of continuous beam, portal frames, pin jointed structures*
2. *By Flexibility and Stiffness matrix methods.*
3. *Formation of global Stiffness matrix from local Stiffness matrix and equation solving Techniques.*

COURSE OUTCOMES

After completion of this course, the student shall understand

1. *Analysis of continuous beam by stiffness & flexibility matrix methods*
2. *Analysis of Rigid Jointed frames by Stiffness & flexibility matrix methods*
3. *Analysis of Pin Jointed Structures by Stiffness & Flexibility matrix methods*
4. *Formation global & element stiffness matrix, direct stiffness method*
5. *Equation solution Techniques*

UNIT-I

Indeterminacy: Determination of static and kinematic indeterminacies of two, dimensional and three-dimensional portal frames, Pin-jointed trusses and hybrid frames, Coordinate systems, Structural idealization.

UNIT-II

Introduction to Matrix Methods of Analysis: Flexibility and stiffness matrices, Force displacement relationships for axial force, couple, torsional moments, Stiffness method of analysis and flexibility method of analysis.

UNIT-III

Analysis of Continuous Beams: Stiffness method and flexibility method of analysis, Continuous beams of two and three spans with different end conditions.

Analysis of Two-Dimensional Pin Jointed Trusses: Stiffness and flexibility methods, Computation of joint displacement and member forces.

UNIT-IV

Analysis of Two - Dimensional Portal Frames: Stiffness and flexibility method of analysis of 2-D portal frames with different end conditions - Plotting of bending moment diagrams.

UNIT-V

Solution Techniques: Solution of system of linear algebraic equations, direct inversion method, Gauss elimination method, Cholesky method, Banded equation solvers, Frontal solution technique.

TEXT BOOKS

1. Basic Structural Analysis, C. S. Reddy, 3rd edition, Tata McGraw-Hill Education Private Limited, New Delhi.
2. Structural Analysis (A Matrix Approach), 2nd edition, G.S. Pandit, S.P. Gupta, Tata McGraw-Hill Education Private Limited, New Delhi.

REFERENCES

1. Structural Analysis, 3rd edition, R.C. Coates, M.G. Coutie, F.K. Kong, Van Nostrand Reinhold publishers.
2. Matrix Structural Analysis, 2nd edition, William McGuire, Richard H. Gallagher, Ronald D. Ziemian, Create Space Independent Publishing Platform.
3. Theory of Matrix Structural Analysis, J. S. Prezemieniecki, Dover Publications.
4. Structural Analysis, 8th edition, R.C. Hibbeler, Pearson Prentice Hall.
5. Matrix Structural Analysis, John L Meek, Tata McGraw-Hill Education Private Limited, New Delhi.

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(19CE1002) ADVANCED SOLID MECHANICS

COURSE OBJECTIVES

1. *Student shall learn about plane stress and plane strain analysis*
2. *Analysis of Stress and strain in three dimensions and torsion of Prismatic bars*

COURSE OUTCOMES

After completion of this course, the student shall understand

1. *Two dimensional analysis of stress and strain*
2. *Three dimensional analysis of stress and strain*

UNIT-I

Introduction: Elasticity, Notation for forces and stresses, Components of stress, Components of strain, Hooke's law.

Plane Stress and Plane Strain Analysis: Plane stress, plane strain, Differential equations of equilibrium, Boundary conditions, Compatibility equations, Stress function.

UNIT-II

Two Dimensional Problems in Rectangular Coordinates: Solution by polynomials, Saint Venant's principle, Determination of displacements, Bending of simple beams, Application of Fourier series for two dimensional problems, Gravity loading.

UNIT-III

Two Dimensional Problems in Polar Coordinates: General Equation in polar co-ordinates, Stress distribution symmetrical about an axis, Pure bending of curved bars, Strain components in polar coordinates, Displacements for symmetrical stress distributions, Simple problems.

UNIT-IV

Analysis Of Stress and Strain in Three Dimensions: Introduction, Principal stresses, Stress ellipsoid and stress-director surface, Determination of the principal stresses, Determination of the maximum shearing stress, Homogeneous deformation, Principal axes of strain, Rotation, Differential equations of equilibrium, Conditions of compatibility, Determination of displacements, Equations of equilibrium in terms of displacements.

UNIT-V

Torsion of Prismatic Bars: Torsion of prismatic bars – Elliptical cross section – Other elementary solutions – Membrane analogy – Torsion of rectangular bars.

TEXT BOOKS

1. Theory of Elasticity, S.P. Timoshenko, G.N. Goodier, Tata McGraw-Hill Education Private Limited, New Delhi.
2. Theory of Elasticity and Plasticity, Dr. Sadhu Singh, 4th edition, Khanna Publications.

REFERENCES

1. Mechanics of materials, 2nd edition, E. P. Popov, Prentice Hall publications.
2. Elasticity Theory, Applications and Numerics, 3rd edition, Martin H. Sadd, Elsevier publications, Academic Press, India.
3. Introduction to Theory of Elasticity, R.J. Atkin, N. Fox, Reprint of the Longman Group Ltd., London, 1980 edition.

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(19CE1008) THEORY OF THIN PLATES AND SHELLS

COURSE OBJECTIVES

This subject is taught to impart knowledge about the behaviour of plates and shells.

COURSE OUTCOMES

1. *Analyze the plates using Navier's and Levy's method*
2. *Analyze the circular, rectangular and square plates by finite difference method*
3. *Design the curved shells and roofs*
4. *Design the various folded plate structures*

UNIT-I

Laterally loaded thin plates – Differential equation – Boundary conditions. Bending of – Simply supported rectangular plates – Navier's solution and Levy's method – Rectangular plates with various edge condition

UNIT-II

Symmetrical bending of circular plates – Finite difference method for analysis of square and rectangular plates.

UNIT-III

Types of shells – Structural action – Membrane theory – Limitations – Beam method of analysis.

UNIT-IV

Analysis and design of doubly curved shells – Elliptic paraboloid - Conoid and hyperbolic paraboloid roofs - Spherical Shells.

UNIT-V

Folded plate structures – Structural behaviour – Various types – Design of folded plates - Reinforced detailing.

TEXT BOOKS

1. Design and construction of concrete shell roofs, 1st edition, G.S. Ramaswamy, CBS Publishers and distributors
2. Design of Reinforced Concrete Shells and Folded Plates, P.C. Varghese, Eastern Economy Edition, PHI Learning Pvt. Ltd., New Delhi.

REFERENCES

1. Theory of Plates and Shells, 2nd edition, S. Timoshenko, S. Woinowsk Tata Mc Graw-Hill Publishing Company Limited, New Delhi.
2. Theory and Design of Concrete Shells,Chatterjee, Binoy Kumar, Oxford and IBNew Delhi.
3. Analysis of Thin concrete Shells, K. Chandrasekhara, Oxford and IBH, Kolkata, 1971.
4. ASCE Manual of Engineering Practice No. 31, Design of Cylindrical Concrete Shell Roofs, ASC, New York.

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PROGRAMME ELECTIVE (PE) – I
(19CE1009) THEORY AND APPLICATIONS OF CEMENT COMPOSITES

COURSE OBJECTIVES
This subject is taught to impart knowledge about the applications of cement composite

COURSE OUTCOMES
1. *Formulate constitutive behaviour of composite materials – Ferrocement, SIFCON and Fibre Reinforced Concrete*
2. *Mechanical properties of cement composites*
3. *Admixtures and special uses of cements.*
4. *X-ray diffraction and SEM analysis of materials.*

UNIT-I
Cement Composites: Types of Cement Composites, Terminology, Constituent Materials and their Properties, Construction Techniques for Fibre Reinforced Concrete - Ferro cement, SIFCON, Polymer Concretes, Preparation of Reinforcement, Casting and Curing.

UNIT-II
Mechanical Properties of Cement Composites: Behaviour of Ferro cement, Fibre Reinforced Concrete in Tension, Compression, Flexure, Shear, Fatigue and Impact, Durability and Corrosion.

UNIT-III
Analysis and Design of Cement Composite Structural Elements: Ferro cement, SIFCON and Fibre Reinforced Concrete.

UNIT-IV
Admixtures and Special Uses of Cements: Organic retarders and accelerators, Air-entraining agents and grinding aids, water reduces and super plastic very high strength cement-based materials

UNIT-V
X-Ray Diffraction and SEM Analysis of Materials: Fundamental principles of X-ray Diffraction and SEM analysis. X-ray Diffraction of cement, composite and other admixture waste materials.

TEXTBOOKS
1. Mechanics of Composite Materials, Jones R. M 2nd Ed., Taylor and Francis,BSP Books, 1998. Ferro cement – Theory and Applications, Pama R. P., IFIC, 1980.
2. New Concrete Materials, Swamy R.N., 1st Ed., Blackie, Academic and Professional, Chapman & Hall, 1983.
3. Taylor, H.F.W (1997). Cement Chemistry, Thomas telford, 2nd Edition, New York.
4. Natural Resources Canada and Forintek Canada Corp., Building Materials in the context of sustainable Development, Summary report and research guidelines *(Ottawa : Forintek Canada Corp., 1994)
5. M.R.Rixom, Chemical Admixtures for concrete (New York: E&F.N.Spon., 1986).
6. H.P.Klug and L.E. Alexander, X-ray diffraction Procedures for Polycrystalline abd Amorphous Materials, John Wiley, New York (1974).

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PROGRAMME ELECTIVE (PE) – I
(19CE1010)THEORY OF STRUCTURAL STABILITY

COURSE OBJECTIVES

1. *Beam columns with different loads, elastic and inelastic buckling of bars, mathematical treatment of stability problems, torsional buckling of thin walled bars*
2. *Lateral buckling of rectangular cross-sectional beams and buckling of rectangular plates.*

COURSE OUTCOMES

The student shall be able to

1. *Analyze elastic and inelastic buckling of bars*
2. *Understand the various numerical methods for treatment of stability problems and buckling of rectangular cross-sectional beams and plates*

UNIT-I

Beam Columns: Differential equation for beam columns, Beam column with concentrated loads, Continuous lateral load, Couples, Beam column with built in ends, Continuous beams with axial load.

UNIT-II

Elastic Buckling of Bars: Elastic buckling of straight columns, Effect of shear stress on buckling, Eccentrically and laterally loaded columns, Energy methods, buckling of a bar on elastic foundation, buckling of bar with intermediate compressive forces and distributed axial loads, buckling of bars with change in cross section, Effect of shear force on critical Load-Built up columns.

UNIT-III

Inelastic Buckling: Buckling of straight bars, double modulus theory and Tangent modulus theory.
Mathematical Treatment of Stability Problems: Buckling problem, Orthogonality Relation-Ritz method, Timoshenko method and Galerkin's method.

UNIT-IV

Torsional Buckling: Pure torsion of thin walled bar of open cross section, Non-uniform torsion of thin walled bars of open cross section, Torsional buckling, Buckling by Torsion and Flexure.

UNIT-V

Lateral Buckling of Simply Supported Beams: Beams of rectangular cross section subjected to pure bending.
Buckling of Simply Supported Rectangular Plates: Derivation of equation of plate subjected to constant compression in two directions and one direction.

TEXT BOOKS

1. Theory of Elastic Stability, 2nd edition, Stephen P. Timoshenko & James M. Gere, Dover Publications.
2. Principles of Structural Stability Theory (Prentice-Hall Civil Engineering and Engineering Mechanic Series), Alexander Chajes, Prentice Hall Publications, 1974.

REFERENCES

1. Structural Stability Theory and Implementation, Reprint Edition of 1987, Wai-Fan Chen, E.M. Lui, PTI Prentice Hall Private Limited.
2. Theory of Beam Columns, Vol I&II, 2nd edition, Atsuta, Chen W.F., Tata McGraw-Hill Education Private Limited, New Delhi.
3. Introduction to the Elastic Stability of Structures (Prentice-Hall Civil Engineering and Engineering Mechanic Series), 1st edition, Smites, George, Prentice Hall Publishers.
4. Guide to Stability Design Criteria for Metallic Structures, 6th edition, Ronald D. Ziemian, Wiley Publications

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M.Tech – SE

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I M. TECH - I SEM. (SE)

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PROFESSIONAL ELECTIVE COURSE (PEC) – II

(19HS0837) ANALYTICAL AND NUMERICAL METHODS FOR STRUCTURAL ENGINEERING

Course Objectives:

- *To train the students thoroughly in Mathematical concepts of Interpolation, Curve fitting,Numerical Differentiation and Integration and their applications*
- *To prepare students for lifelong learning and successful careers using mathematical concepts of Interpolation, Curve fitting, Numerical solution of ordinary differential equations and their applications*
- *To develop the skill pertinent to the practice of the mathematical concepts including the students' abilities to formulate and modeling the problems, to think creatively and to synthesize information*

Course Outcomes:

At the end of the course, students would be expected to:

- *Have acquired ability to participate effectively in group discussions*
- *Have developed ability in writing in various contexts*
- *Have acquired a proper level of competence for employability*
- *Have acquired computational skills to solve real world problems in engineering*

UNIT-I

Introduction to Numerical Methods: Why study numerical methods. Sources of error in numerical solutions: truncation error, round off error. Order of accuracy - Taylor series expansion**Direct Solution of Linear systems:** Gauss elimination, Gauss Jordan elimination. Pivoting, inaccuracies due to pivoting. Factorization, Cholesky decomposition. Diagonal dominance, condition number, ill conditioned matrices, singularity and singular value decomposition. Bandedmatrices, storage schemes for banded matrices, skyline solver.

UNIT-II

Iterative solution of Linear systems: Jacobi iteration. Gauss Seidel iteration. Convergence criteria.

Direct Solution of Non-Linear systems: Newton Raphson iterations to find roots of a 1D nonlinear equation. Generalization to multiple dimensions. Newton Iterations, Quasi Newton iterations. Local and global minimum, rates of convergence, convergence criteria.

UNIT-III

Partial Differential Equations: Introduction to partial differential equations. Definitions & classifications of first and second order equations. Examples of analytical solutions. Method of characteristics.

Numerical Differentiation:

Difference operators (forward, backward and central difference). Stability and accuracy of solutions. Application of finite difference operators to solve initial and boundary value problems.**UNIT -IV**

Introduction to the Finite Element Method as a method to solve partial differential equations: Strong form of the differential equation. Weak form. Galerkin method: the finite element approximation. Interpolation functions: smoothness, continuity, completeness, Lagrange polynomials. Numerical quadrature: Trapezoidal rule, Simpsons rule, Gauss quadrature**.**

UNIT - V

Numerical integration of time dependent partial differential equations:

Parabolic equations: algorithms - stability, consistency and convergence, Lax equivalence theorem. Hyperbolic equations: algorithms - Newmark's method, stability and accuracy, convergence, multistep methods. Types of integral equations. Fredholm integral equations of the first and second kind. Fredholm's Alternative theorem. Collocation and Galerkin methods for solving integral equations.

Text books:

1. Higher Engineering Mathematics, B.S. Grewal, Khanna publishers.
2. Advanced Engineering Mathematics, Peter V.O' Neil, CENGAGE publisher.
3. Concepts and Applications of Finite Element Analysis, 4th edition, Robert D. Cook, JohnWiley and sons Inc., New York.

Reference Books:

1. An Introduction to Numerical Analysis, Atkinson K.E., J. Wiley and Sons, 1989.
2. Theory and Problems of Numerical Analysis, Scheid F, McGraw Hill Book Company,(Shaum Series), 1988.
3. Introductory Methods of Numerical Analysis, Sastry S. S, Prentice Hall of India, 1998.

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PROGRAMME ELECTIVE (PE) – II
(19CE1011) STRUCTURAL HEALTH MONITORING

COURSE OBJECTIVES

This subject is taught to impart knowledge about the Structural Health Monitoring Concepts.

COURSE OUTCOMES:

At the end of the course, students will be able to

1. *Diagnosis the distress in the structure understanding the causes and factors.*
2. *Assess the health of structure using static field methods.*
3. *Assess the health of structure using dynamic field tests.*
4. *Suggest repairs and rehabilitation measures of the structure.*

UNIT-I

Structural Health: Factors affecting Health of Structures, Causes of Distress, Regular Maintenance.

UNIT-II

Structural Health Monitoring: Concepts, Various Measures, Structural Safety in Alteration.
Structural Audit: Assessment of Health of Structure, Collapse and Investigation Management, SHM Procedures.

UNIT-III

Static Field Testing: Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement.

UNIT-IV

Dynamic Field Testing: Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Hardware for Remote Data Acquisition Systems, Remote Structural Health Monitoring.

UNIT-V

Introduction To Repairs And Rehabilitations of Structures: Case Studies (Site Visits), piezo–electric materials and other smart materials, electro–mechanical impedance (EMI) technique, adaptations of EMI technique.

TEXTBOOKS

1. An Introduction to Numerical Analysis, Atkinson K.E., J. Wiley and Sons, 1989.
2. Theory and Problems of Numerical Analysis, Scheid F, McGraw Hill Book Company, (Shaum Series), 1988.
3. Introductory Methods of Numerical Analysis, Sastry S. S, Prentice Hall of India, 1998.

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PROGRAMME ELECTIVE (PE) – II
(19CE1012) STRUCTURAL OPTIMIZATION

COURSE OBJECTIVES

This subject is taught to impart knowledge about the structural optimization

COURSE OUTCOMES

At the end of the course, students will be able to

1. *Use Variational principle for optimization*
2. *Apply optimization techniques to structural steel and concrete members.*
3. *Design using frequency constraint.*

UNIT-I

Introduction: Simultaneous Failure Mode and Design, Classical External Problems.

UNIT-II

Calculus of Variation: Variational Principles with Constraints, linear programming, Integer Programming, Nonlinear Programming, Dynamic Programming,

UNIT-III

Geometric Programming and Stochastic Programming.

UNIT-IV

Applications: Structural Steel and Concrete Members, Trusses and Frames.

UNIT-V

Design: Frequency Constraint, Design of Layouts.

TEXTBOOKS

1. Elements of Structural Optimization, Haftka, Raphael T., Gürdal, Zafer, Springer.
2. Variational methods for Structural optimization, Cherkaev Andrej, Springer

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(19CE1003) STRUCTURAL DESIGN LAB

COURSE OBJECTIVES

The objective of Structural Design laboratory is to understand the Design and Detail all the Structural Components of Frame Buildings.

COURSE OUTCOMES

At the end of the course, students will be able to

1. *Design and Detail all the Structural Components of Frame Buildings.*
2. *Design and Detail complete Multi-Storey Frame Buildings.*

LIST OF EXPERIMENTS:

Design and detailed drawing of complete G+ 3 structures by individual student using latest relevant IS codes.

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(19CE1004) ADVANCED CONCRETE LAB

COURSE OBJECTIVES

The objective of concrete laboratory is to determine the strength characteristics of reinforced cement concrete and conducting NDT.

COURSE OUTCOMES

At the end of the course, students will be able to

1. *Design high grade concrete and study the parameters affecting its performance.*
2. *Conduct Non Destructive Tests on existing concrete structures.*
3. *Apply engineering principles to understand behaviour of structural/ elements.*

LIST OF EXPERIMENTS/ASSINMENTS

1. Study of stress-strain curve of high strength concrete, Correlation between cube strength, cylinder strength, split tensile strength and modulus of rupture.
2. Effect of cyclic loading on steel.
3. Non-Destructive testing of existing concrete members.
4. Behaviour of Beams under flexure, Shear and Torsion.

REFERENCES

1. Properties of Concrete, Neville A. M., 5th Edition, Prentice Hall, 2012.
   Concrete Technology, Shetty M. S., S. Chand and Co., 2006.

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(19HS0818) ENGLISH FOR RESEARCH PAPER WRITING

COURSE OBJECTIVES*:*

Students will be able to:

1. *Understand that how to improve your writing skills and level of readability.*
2. *Learn about what to write in each section.*
3. *Understand the skills needed when writing a Title.*
4. *Ensure the good quality of paper at very first-time submission.*

UNIT - I

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

UNIT - II

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts and Introduction.

UNIT - III

Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check.

UNIT - IV

Key skills needed when writing a Title, key skills needed when writing abstract, key skills needed when writing an Introduction, skills when writing a Review of the Literature.

UNIT - V

Skills needed when writing the Methods, skills needed when writing the Results, skills needed when writing the Discussion, skills needed when writing the Conclusions.

TEXTBOOKS

1. Goldbort R (2006) Writing for Science, Yale University Press.
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's Books.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht. Heidelberg London, 2011.

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(19CE1005) FEM IN STRUCTURAL ENGINEERING

COURSE OBJECTIVES

The Student shall learn the concepts of FEM, Discretization, and Rayleigh Ritz method of functional approximation. Principles of Elasticity, 1-D, 2-D, 3-D FEM, isoperimetric formulation and finite element analysis of plates.

COURSE OUTCOMES

After completion of this course, the student shall understand

1. *The history of FEM, methods of functional approximation*
2. *Principles of Elasticity, isoperimetric formulation*
3. *Finite element analysis of plates*

UNIT-I

Introduction: Concepts of FEM, Steps involved Merits and demerits, Energy principles, Discretization, Rayleigh Ritz method of functional approximation.

Principles of Elasticity: Stress equations, Strain displacement relationships in matrix form, Plane stress, plane strain and axi-symmetric bodies of revolution with axi-symmetric loading.

UNIT-II

One-Dimensional FEM: Stiffness matrix for beam and bar Elements-Shape functions for 1-D elements, Static condensation of global stiffness matrix, Solution, Initial strain and temperature effects.

UNIT-III

Two-Dimensional FEM: Different types of elements for plane stress and plane strain analysis, Displacement models, generalized coordinates, Shape functions, Convergent and compatibility requirements, Geometric invariance, Natural coordinate system, Area and volume coordinates, Generation of element stiffness and nodal load matrices, Static condensation.

UNIT-IV

Isoperimetric Formulation: Concept, Different isoperimetric elements for 2-D analysis, Formulation of 4-noded and 8-noded isoperimetric quadrilateral elements, Lagrangian elements - Serendipity elements.

Axi-Symmetric Analysis: Bodies of revolution, Axi-symmetric modeling, Strain displacement relationship, Formulation of axi-symmetric elements.

UNIT-V

Three-Dimensional FEM: Different 3-D elements, 3-D strain, displacement relationship, Formation of hexahedral and isoperimetric solid element.

TEXT BOOKS

1. Finite Element Analysis –Theory & Programming, 2nd edition, C.S. Krishna Murthy, Tata Mc Graw-Hill Education Private Limited, New Delhi.
2. Introduction to Finite Element Method, 4th edition, Tirupati Chandrupatla, Ashok D. Belegundu, Prentice Hall Publications

REFERENCES

1. Concepts and Applications of Finite Element Analysis, 4th edition, Robert D. Cook, John Wiley and sons Inc., New York.
2. An Introduction to Finite Element Method, 3rd edition, J.N. Reddy, Tata Mc Graw-Hill Publishing Company Limited, New Delhi.
3. Finite Element Procedures, 2nd edition, Klaus-Jurgen Bathe, Prentice Hall.
4. Finite Element Analysis (Theory and Programming), 2nd edition, C.S. Krishnamurthy, Tata Mc Graw-Hill Publishing Company Limited, New Delhi.

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(19CE1006) STRUCTURAL DYNAMICS

COURSE OBJECTIVES

1. *Student shall learn about introduction to structural dynamics-single and multi-degree of freedom systems*
2. *To understand Free and Forced vibrations, Practical vibration analysis*

COURSE OUTCOMES

After completion of this course, the student shall understand the concepts OD

1. *Structural dynamics-single and multi-degree of freedom systems*
2. *Free and Forced vibrations*
3. *Practical Vibration analysis*

UNIT-I

Introduction to Structural Dynamics: Introduction - Elements of a vibratory system, Degrees of freedom, Continuous systems, lumped mass idealization, Oscillatory motion, Simple harmonic motion, Fundamental objective of dynamic analysis, Types of prescribed loading, Methods of discretization, Formulation of the equations of motion for single degree of freedom (SDOF) systems,

UNIT-II

Single Degree of Freedom System: Solutions of the equation of motion, free vibration response, Undamped and damped, Critical damping, Logarithmic decrement, Forced vibrations of SDOF systems, Harmonic excitation, Dynamic magnification factor, Bandwidth. Response to harmonic, periodic, impulsive and general dynamic loading, Duhamel integral.

UNIT-III

Multi Degree of Freedom System: Selection of the degree of freedom, Evaluation of structural property matrices, Formulation of MDOF equations of motion, Undamped free vibrations, Solution of Eigen value problem for natural frequencies and mode shapes, Analysis of dynamic response, Normal coordinates, Uncoupled equations of motion, Orthogonal properties of normal modes, Mode superposition procedure.

UNIT-IV

Continuous System: Introduction –Flexural vibrations of beams- Elementary Case- Equation of motion –Analysis of Undamped free shapes of simple beams with different end conditions-principles of application to continuous beams.

UNIT-V

Practical Vibration Analysis: Stodola method, Fundamental mode analysis, Analysis of second and higher modes, Holzer method - Basic procedure, Transfer matrix procedure.

TEXT BOOKS

1. Dynamics of Structures, 2nd edition, Clough and Penzium, Tata McGraw-Hill Education Private Limited, New Delhi.
2. Structural Dynamics (Theory and Computation), 3nd edition, Mario Paz, Springer publications.

REFERENCES

1. Dynamics of structures (Theory and Applications to Earthquake Engineering), Anil K Chopra, 4th edition, Pearson Education, New Delhi.
2. Elements of Mechanical Vibrations, R.N. Iyengar, I.K. International Publishing House.
3. Dynamics of Structures, 3rd edition, Jagmohan L. Humar, CRC Press (Taylor and French Group).
4. Engineering Vibrations, 2nd edition, William J. Bottega, CRC Press (Taylor and French Group).

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PROGRAMME ELECTIVE (PE) – III
(19CE1013) ADVANCED STEEL DESIGN

COURSE OBJECTIVES

Student shall learn about

1. *Design of Light Gauge compression members and beams*
2. *Analysis and design of Transmission Towers*
3. *Plastic analysis and design of continuous beams, Portal frames*
4. *Limit State Design of steel Tension members and laterally restrained beams.*

COURSE OUTCOMES

After completion of this course, the student shall be able to

1. *Design light Gauge steel compression and Flexural members*
2. *Analyze and design Transmission towers*
3. *Analyze and design continuous beams and portal frames using plastic theory*
4. *Design steel Tension members and laterally restrained beams using limit state method*

UNIT-I

Light Gauge Steel Structures: Light gauge steel, Types of sections, Specifications, Permissible stresses.

Compression Members: Local buckling of elements, Stiffened compression elements, Computation of permissible stresses, Design of columns.

Flexural Members: Bending Deflection, Local buckling of compression elements, laterally supported and unsupported beams, Computation of permissible stresses, Design of beams, Connections, Various methods, Welding.

UNIT-II

Transmission Line Towers: Introduction, Types of towers, Tower configuration, Loads, Analysis and design of self-supporting simple towers.

Plastic Design: Analysis and design of continuous beams, Portal frames (up to two bay two storey) and single span gable frames.

UNIT-III

Limit State Design: Introduction, Characteristic strength, Characteristic load, Partial safety factor, Limit stat

UNIT-IV

Design of Tension Members: Introduction, Types of tension members, Types of sections, Slenderness ratio, Net area of cross section, Design of tension members, Lug angles.

UNIT-V

Design of Beams: Introduction, Effective length of compression flange, Design of laterally restrained beams and unrestrained beams.

TEXT BOOKS

1. Design of Steel Structures, 3rd edition, S.K. Duggal, Tata McGraw-Hill Education Private Limited, New Delhi.
2. Design of Steel Structures, 2nd edition, N Subramanian, Oxford Higher Education, New Delhi.
3. Comprehensive Design of Steel Structures, 2nd edition, B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, Laxmi Publications Private Limited, New Delhi.

REFERENCES

1. Design of Steel Structures, K.S. Sai Ram, Dorling Kindersley(India), Pvt. Ltd, Pearson Education in South Asia.
2. Design of Steel Structures, L.S. Negi, 2nd edition, Tata McGraw-Hill Education Private Limited, New Delhi.
3. (ISI)-No.6, Structural Engineers Handbook, Bureau of Indian Standard. Design of Steel Structures, 6th edition, Arya and Ajmani, New Chand Publishers of collapse in flexure and shear, Limit state of serviceability.

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PROGRAMME ELECTIVE (PE) – III
(19CE1014) DESIGN OF FORMWORK

COURSE OBJECTIVES

1. *Designing formwork for foundations, wall, column, beam, and slab elements,*
2. *Planning and estimation of the cost of formwork and scaffolding for various applications*

COURSE OUTCOMES

1. *Select proper formwork, accessories and material.*
2. *Design the form work for Beams, Slabs, columns, Walls and Foundations.*
3. *Design the form work for Special Structures.*
4. *Understand the working of flying formwork.*

UNIT-I

Introduction: Requirements and Selection of Formwork.
Formwork Materials: Timber, Plywood, Steel, Aluminium, Plastic, and Accessories. Horizontal and Vertical Formwork Supports.

UNIT-II

Formwork Design: Concepts, Formwork Systems and Design for Foundations, Walls, Columns, Slab and Beams.

UNIT-III

Formwork Design for Special Structures: Shells, Domes, Folded Plates, Overhead Water Tanks, Natural Draft Cooling Tower, Bridges.

UNIT-IV

Flying Formwork: Table Form, Tunnel Form, Slip Form, Formwork for Precast Concrete, Formwork Management Issues –Pre- and Post-Award.

UNIT-V

Formwork Failures: Causes and Case studies in Formwork Failure, Formwork Issues in Multi-Story Building Construction.

TEXT BOOKS

1. Formwork for Concrete Structures, Kumar Neeraj Jha, Tata McGraw Hill Education, 2012. IS 14687: 1999, False work for Concrete Structures - Guidelines, BIS.
2. Formwork for Concrete Structures, Peurifoy, Mc Graw Hill India, 2015.

REFERENCES

1. Formwork for Concrete Structures Mary Krumboltz Hurd – 2005
2. Formwork for Concrete Structures Garold (Gary) D. Oberlender, Robert L. Peurifoy – 2010

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PROGRAMME ELECTIVE (PE) – III
(19CE1015) DESIGN OF HIGH RISE STRUCTURES

COURSE OBJECTIVES

Student shall learn about the High Rise structures i.e., Tower, Chimney, Tall Building, .etc.

COURSE OUTCOMES

1. *Analyze design and detail Transmission/ TV tower, Mast and Trestles with different loading conditions.*
2. *Analyses design and detail the RC and Steel Chimney.*
3. *Analyses design and detail the tall buildings subjected to different loading conditions using relevant codes.*
4. *Analysis and design of dynamic approach OF STRUCTURAL DESIGN USING is Code provisions.*

UNIT-I

Design of Transmission/ TV Tower, **Mast and Trestles**: Configuration, bracing system, analysis and design for vertical transverse and longitudinal loads.

UNIT-II

Analysis and Design of RC and Steel Chimney: Foundation design for varied soil strata.

UNIT-III

Tall Buildings: Structural Concept, Configurations, various systems, Wind and Seismic loads,

UNIT-IV

Dynamic approach, structural design considerations and IS code provisions. Firefighting design provisions.

UNIT-V

Application of software in analysis and design

TEXT BOOKS

1. Design Of High Rise Structures : Steel, Concrete, And Composite Systems - Bungale S. Taranath - 2016
2. Design Of High Rise Structures -Feng Fu – 2018
3. Design of High Rise Structures -Harry G. Poulos - 2017
4. Design Of High Rise Structures -- Analysis And Design Of RC And Steel Chimney Dr. B.C. Punmia, Ashok Kr. Jain, Arun Kr. Jain - 1992

REFERENCES

1. Structural Design of Multi-storied Buildings, Varyani U. H., 2nd Ed., South Asian Publishers, New Delhi, 2002.
2. Structural Analysis and Design of Tall Buildings, Taranath B. S., Mc Graw Hill, 1988.

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PROGRAMME ELECTIVE (PE) – III
(19CE1016) DESIGN OF MASONRY STRUCTURES

COURSE OBJECTIVES

Student shall learn About the Masonry Materials, Masonry Design Approaches, flexural Strength of Reinforced Masonry Members, and Prestressed Masonry …etc.

COURSE OUTCOMES*:*

1. *Understand the masonry design approaches.*
2. *Analyses Reinforced Masonry Members.*
3. *Determine interactions between members.*
4. *Determine shear strength and ductility of Reinforced Masonry members*
5. *Check the stability of wall*
6. *Perform elastic and in elastic analysis of masonry walls.*

UNIT-I

INTRODUCTION: Historical Perspective, Masonry Materials, Masonry Design Approaches, Overview of Load Conditions, Compression Behaviour of Masonry, Masonry Wall Configurations, Distribution of Lateral Forces.

UNIT-II

Flexural Strength of Reinforced Masonry Members: In plane and Out-of-plane loading.

UNIT-III

Interactions: Structural Wall, Columns and Pilasters, Retaining Wall, Pier and Foundation. Shear strength and Ductility of Reinforced Masonry Members.

UNIT-IV

Prestressed Masonry: Stability of Walls, Coupling of Masonry Walls, Openings, Columns, Beams.

UNIT-V

Elastic and Inelastic Analysis: Modelling Techniques, Static Push over Analysis and use of Capacity Design Spectra.

TEXT BOOKS

1. Design of Masonry Structures A.W. Hendry, B.P. Sinha, S.R. Davies – 2003
2. Design of Masonry Structures Narendra Taly
3. Design of Masonry Structures James Ambrose – 1997
4. Design of Masonry Structures Dr.P.Purushothamaraj and Dr.V.Ramaswamy

REFERENCES

1. Design of Reinforced Masonry Structures, Narendra Taly, ICC, 2nd Edn,
2. Masonry Structures: Behavior and Design, Hamid Ahmad A. and Drysdale Robert G., 1994.
3. Mechanics of Masonry Structures, Editor: Maurizio Angelillo, 2014.
4. Earthquake-resistant Design of Masonry Buildings,Toma evi Miha, Imperial College Press, 1999.

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PROGRAMME ELECTIVE (PE) – III
(19CE1017) DESIGN OF ADVANCED CONCRETE STRUCTURES

COURSE OBJECTIVES

Student shall learn about the estimation of crack width, Redistribution of moments in Reinforced concrete beams, design of deep beams, ribbed (voided) slabs, grid floors, flat slabs, plain concrete wall and shear wall using IS 456-2000.

COURSE OUTCOMES

After completion of this course, the student shall able to (as per 13456 2000),

1. *Estimation of crack width and Redistribution of moments in Reinforced concrete beam.*
2. *Design of deep beams, ribbed (voided) slabs.*
3. *Design of Grid floors, flat slabs.*
4. *Design of plain concrete walls.*
5. *Design of shear walls.*

UNIT-I

Estimation of Crack Width and Redistribution of Moments in Reinforced Concrete Beams: Limit State of cracking, Cracking in R.C. members, Causes, mechanism and effects of cracking, Classification and effect of cracks, Factors affecting crack width in beams, Calculation of crack width, Empirical method, Estimation of crack width in beams by IS 456, Shrinkage and thermal cracking, Redistribution of moments in a fixed beam and a two-span continuous beam, Advantages and disadvantages of moment redistribution, Moment-Curvature relation of reinforced concrete sections.

UNIT-II

Design of Deep Beams and Corbels: Steps of designing deep beams by IS 456, Detailing of deep beams, Design of corbels.

UNIT-III

Design of Ribbed (Voided) Slabs: Analysis of the ribbed slabs for moment and shears, Design for shear, Deflections, Arrangement of reinforcements.

UNIT-IV

Design of Grid Floors: Introduction, Design of grid floors by IS Code method.

Design of Flat Slabs: Introduction, Advantages and disadvantages of flat slabs, Design of flat slabs using direct design method and equivalent frame method, Design for interior panel.

UNIT-V

Design of Plain Concrete Walls: Braced and unbraced walls, Eccentricities of vertical loads, Empirical design method (walls carrying axial load), Design of wall for In-plane horizontal forces.

Design of Shear Walls: Classification of shear walls, Loads in shear walls, Design of rectangular and flanged shear walls, Moment of resistance of rectangular shear walls.

TEXT BOOKS

1. Advanced Reinforced Concrete Design, 2nd edition, P.C. Varghese, Prentice-Hall of India, Private Ltd., New Delhi.
2. Advanced Reinforced Concrete Design-SI Units, N. Krishna Raju, 3rd edition, CBS Publications, New Delhi.
3. Advanced R.C.C. Design (R.C.C., Vol. II), S.S. Bhavikatti, 3rd edition New Age International Publishers Pvt. Ltd., New Delhi.

REFERENCES

1. Illustrated Design of Reinforced Concrete Buildings, 4th edition, Dr. V.L. Shah and Dr. S.R. Kharve, Structures Publications, Pune.
2. Reinforced Concrete Design, S. Unnikrishn Pillai and Devdas Menon, 3nd edition, Tata McGraw-Hill Education Private Limited, New Delhi.
3. Reinforced Concrete. Vol.II, (Advanced Reinforced Concrete), 7th edition, H.J. Shah, Charotar Publishing House Pvt. Ltd., Anand

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PROGRAMME ELECTIVE (PE) – III
(19CE1018) ADVANCED DESIGN OF FOUNDATIONS

COURSE OBJECTIVES

Student shall learn about the planning of soil exploration, shallow foundations, pile foundations & coffer dams

COURSE OUTCOMES

At the end of the course, students will be able to

1. *Decide the suitability of soil strata for different projects.*
2. *Design shallow foundations deciding the bearing capacity of soil.*
3. *Analyze and design the pile foundation.*
4. *Understand analysis methods for well foundation*

UNIT-I

Planning of Soil Exploration: for Different Projects, Methods of Subsurface Exploration, methods of Borings along with Various Penetration Tests.

UNIT-II

Shallow Foundations: Requirements for Satisfactory Performance of Foundations, Methods of Estimating Bearing Capacity, Settlements of Footings and Rafts, Proportioning of Foundations using Field Test Data, Pressure - Settlement Characteristics from Constitutive Laws.

Pile Foundations: Methods of Estimating Load Transfer of Piles, Settlements of Pile Foundations, Pile Group Capacity and Settlement, Laterally Loaded Piles, Pile Load Tests, Analytical Estimation of Load- Settlement Behaviour of Piles, Proportioning of Pile Foundations, Lateral and Uplift Capacity of Piles.

UNIT-III

Well Foundation: IS and IRC Code Provisions, Elastic Theory and Ultimate Resistance Methods.

UNIT-IV

Tunnels and Arching in Soils, Pressure Computations around Tunnels.
Open Cuts, Sheeting and Bracing Systems in Shallow and Deep Open Cuts in Different Soil Types.

UNIT-V

Coffer Dams: Various Types, Analysis and Design, Foundations under uplifting loads, Soil-structure interaction

TEXT BOOKS

1. Design of foundation system, N.P. Kurian, Narosa Publishing House
2. Foundation Analysis and Design, J. E. Bowles, Tata McGraw Hill New York
3. Analysis and Design of Substructures, Sawmi Saran, Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.

REFERENCES

1. Bowles. J.E., Foundation Analysis and Design, Tata McGraw-Hill International Edition, 5th Edn, 1997.
2. Das B.M., Shallow Foundations: Bearing capacity and settlement, CRC Press, 1999.
3. Tomlinson M.J., Pile design and construction Practice, Chapman and Hall Publication, 1994.
4. Poulos, H. G. and Davis, F. H., “Pile Foundation Analysis and Design”, Wiley and Sons. 1980

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PROGRAMME ELECTIVE (PE) – III
(19CE1019) SOIL STRUCTURE INTERACTION

COURSE OBJECTIVES

Student shall learn about the planning of foundation design, subsoil characteristics, linear and non-linear stress-strain characteristics

COURSE OUTCOMES

At the end of the course, students will be able to

1. *Understand soil structure interaction concept and complexities involved.*
2. *Evaluate soil structure interaction for different types of structure under various conditions of loading and subsoil characteristics.*
3. *Prepare comprehensive design oriented computer programs for interaction problems based on theory of sub grade reaction such as beams, footings, rafts etc.*
4. *Analyze different types of frame structure founded on stratified natural deposits with linear and non-linear stress-strain characteristics*
5. *Evaluate action of group of piles considering stress-strain characteristics of real soils.*

UNIT-I

Critical Study of Conventional Methods of Foundation Design, Nature and Complexities of Soil Structure Interaction.

UNIT-II

Application of Advanced Techniques of Analysis such as FEM and Finite Difference Method. Relaxation and Interaction for the Evaluation of Soil Structure Interaction for Different Types of Structure under various Conditions of Loading and Subsoil Characteristics.

UNIT-III

Preparation of Comprehensive Design Oriented Computer Programs for Specific Problems, Interaction Problems based on Theory of Sub Grade Reaction Such as Beams, Footings, Rafts Etc

UNIT-IV

Analysis of Different Types of Frame Structures Founded on Stratified Natural Deposits with Linear and Non-Linear Stress-Strain Characteristics.

UNIT-V

Determination of Pile Capacities and Negative Skin Friction, Action of Group of Piles Considering Stress-Strain Characteristics of Real Soils, Anchor Piles and Determination of Pullout Resistance

TEXT BOOKS

1. Analytical and Computer Methods in Foundation, Bowels J.E.,Mc Graw Hill Book Co., New York, 1974.
2. Numerical Methods in Geotechnical Engineering, Desai C.S. and Christian J.T., McGraw Hill Book Co., New York.

3. Soil Structure Interaction - The real behaviour of structures, Institution of Structural Engineers. Elastic Analysis of Soil Foundation Interaction, Developments in Geotechnical Engg. Vol-17

REFERENCES

1. Elsevier Scientific Publishing Company.
2. Elastic Analysis of Soil-Foundation Interaction, Selvadurai A.P.S., Elsevier Scientific Publishing Company.
3. Analysis & Design of substructures, Swami Saran, Oxford & IBH Publishing Co. Pvt. Ltd. Design of Foundation System- Principles & Practices, Kurian N. P., Narosa Publishing

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PROGRAMME ELECTIVE (PE) – III
(19CE1020) DESIGN OF INDUSTRIAL STRUCTURES

COURSE OBJECTIVES

Student shall learn about the Industrial structures i.e., Chimneys, Water tanks, Silos, Bunkers, Grid floors…etc.

COURSE OUTCOMES

1. *Explain various types of industrial structures and its design methodologies*
2. *Design bunkers, silo.*
3. *Design chimney and towers.*
4. *Design various industrial floors.*

UNIT-I

Chimneys – Introduction, dimensions of steel stacks, chimney lining, breech openings and access ladder, loading and load combinations, design considerations, stability consideration, design of base plate, design of foundation bolts, design of foundation.

UNIT-II

Water Tanks – Design of rectangular riveted steel water tank – Tee covers – Plates – Stays – Longitudinal and transverse beams –Design of staging – Base plates – Foundation and anchor bolts.

UNIT-III

Design of Pressed Steel Water Tank – Design of stays – Joints – Design of hemispherical bottom water tank – side plates – Bottom plates – joints – Ring girder –Design of staging and foundation.

UNIT-IV

Design for Material Storage - Stand pipes – Jessen & Rankine's theories – design of silos – design of bunkers

UNIT-V

Design of Industrial Floors - Ground floor – Pavement design – Mezzanine floors – Gratings – chequered plates – composite deck slab

TEXT BOOKS

1. A.R. Santhakumar and S.S. Murthy, 'Transmision Line Structures', Tata McGraw-Hill, 1992.
2. Dr. K. Rajagopalan, 'Storage Structures', Routledge, 2004.

REFERENCES

1. S.N. Manohar, Tall Chimneys, 'Design and Construction', Tata McGraw-Hill, 1985.
2. Design of Steel Structure, Punmia B. C., Jain Ashok Kr., Jain Arun Kr., 2nd Ed., Lakshmi Publishers

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(19CE1007) MODEL TESTING LAB

COURSE OBJECTIVES

Student shall learn about the Static testing of plates, shells, and frames models.

COURSE OUTCOMES

At the end of the course, students will be able to

1. *Understand the response of structures.*
2. *Prepare the models.*
3. *Conduct model testing for static loading*
4. *Conduct model testing for free and forced vibrations*

SYLLABUS CONTENT:

Response of structures and its elements against extreme loading events. Model Testing: Static - testing of plates, shells, and frames models.

MODEL TESTING: Free and forced vibrations, Evaluation of dynamic modulus. Beam vibrations, Vibration isolation, Shear wall building model, Time and frequency-domain study, Vibration Characteristics of RC Beams using Piezoelectric Sensors etc

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M.Tech – SE

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I M.Tech - II Sem

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(19HS0829) CONSTITUTION OF INDIA

COURSE OBJECTIVES

1. *To know the premises informing the twin themes of liberty and freedom from a civil rights perspective*.
2. *To address the growth of Indian opinion regarding modern Indian intellectuals constitutional role*
3. *To address entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism*.
4. *To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution*
5. *To acquire knowledge for various competitive examinations*

COURSE OUTCOMES

Student undergoing this course can

1. *Explain the key concepts of political economy*
2. *Analyse the significant developments in the political ideologies*
3. *Describe the salient features of the constitution of India interpret, integrate and critically*
4. *Analyse the political economy of Indian international relations and gain knowledge in Judiciary system*
5. *Apply their knowledge and skills acquired to write various competitive examinations*

UNIT-I

Introduction to the Constitution

UNIT-II

Historical Perspective of the Constitution of India- Salient features and characteristics of the Constitution of India

UNIT-III

Scheme of the fundamental rights-The scheme of the Fundamental Duties and its legal status-The Directive Principles of State Policy – Its importance and implementation

UNIT-IV

Parliamentary Form of Government in India – Powers and Functions-The President of India - Status and Powers -The historical perspectives of the constitutional amendments in India-Judiciary system - Powers and Functions

UNIT-V

Local Self Government – Constitutional Scheme in India - Election Commission: Role and Functions

TEXT BOOKS

1. Government of India Ministry of Law and Justice (Legislative Department), *The Constitution of India, 1950 (Bare Act)* Government Publication, 2015.
2. Dr. S. N. Busi, *Dr. B. R. Ambedkar framing of Indian Constitution*, 1st Edition, Government Publication 2015.

REFERENCES

1. M. P.Jain, *Indian Constitution Law*, Lexis Nexis 7th Edition, 2014.
2. D.D. Basu, *Introduction to the Constitution of India*, Lexis Nexis, 2015
3. P.M.Bakshi, *Constitution of India* Universal Law Publishing, 15th

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II M. TECH - I SEM. (SE)

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PROFESSIONAL ELECTIVE COURSE (PEC) – V

(19CE1021) DESIGN OF PRESTRESSED CONCRETE STRUCTURES

COURSE OBJECTIVES

1. *Student shall learn about Losses of prestress, Analysis and design of sections for flexure and shear, Bond and anchorage*
2. *To understand deflections of prestressed concrete beams, Circular prestressing*
3. *Analysis and design of statically indeterminate structures*

COURSE OUTCOMES (COs)

On successful completion of this course, the student will be able to

1. *Discuss about the historical development and its principles of prestressed concrete*
2. *Analyze the methods of prestressing and its losses*
3. *Predict the deflection and its importance in Prestressed concrete*
4. *Define flexural, shear & torsional resistance in prestressed concrete*
5. *Discuss and analyze composite members in prestressed concrete*
6. *Analysis and design of statically indeterminate beams*

UNIT- I

Introduction: Historic development – Terminology- General principles of prestressing, pretensioning and post tensioning –Advantages and Applications of prestressed concrete **Methods of Prestressing:** Tensioning devices -Methods and Systems of Prestressing– Analysis of post tensioning - Different systems of prestressing like Hoyer System, Magnel System Freyssinet system and Gifford – Udall System

UNIT- II

Losses of Prestress: Estimation of the loss of prestress due to various causes like elastic shortening of concrete, Creep of concrete - Shrinkage of concrete, Relaxation of stress in steel, Slip in anchorage, friction etc.

UNIT -III

Deflections of Prestressed Concrete Members: Importance of control of deflections- factors influencing deflections- Short term deflections of un cracked member – Prediction of long term deflections -Cracked members

UNIT- IV

Flexural, Shear & Torsional Resistance of Concrete Members: Types of flexural failure Strain compatibility method– Code procedures - Shear and principal stresses – Prestressed concrete members in torsion – Design of sections for flexure, Axial Tension, Compression and bending, shear, Bond – Introduction to Limit state Design of Prestressed concrete for flexure.

UNIT -V

Composite sections: Analysis for stresses- Differential shrinkage- Flexural and Shear strength of composite sections

Statically Indeterminate Structures: Advantages and disadvantages of continuity - Layouts for continuous beams -Primary and secondary moments - Elastic analysis of continuous prestressed members - Concordant cable profile - Design of continuous beams

TEXTBOOKS

1. N Krishna Raju, *Prestressed Concrete* 4th edition , McGraw-Hill Education Private Limited, New Delhi,2008
2. S. Ramamrutham, *Design of Reinforced Concrete Structures*, Dhanpat Rai Publishing ,2010

REFERENCES

1. T.Y. Lin, Ned H. Burns, *Design of Prestressed Concrete Structures*, 3rd edition,John Willey and Sons ,2019
2. N. Rajagopalan, *Prestressed Concrete*, 2nd edition, Narosa Book Distributors,2018
3. Arthur H. Nilson, *Design of Prestressed Concrete*, 2nd edition, Wiley Publications,1997

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M.Tech-SE

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY: PUTTUR

(AUTONOMOUS)

II M. TECH - I SEM. (SE)

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PROFESSIONAL ELECTIVE COURSE (PEC) – V
(19CE1022) ANALYSIS OF LAMINATED COMPOSITE PLATES

COURSE OBJECTIVES

Students should able to Learn the Composite plates in engineering structure continues to increase dramatically, and there have been equally significant advances in modeling for general and composite materials and structures in particular

1. *To impart knowledge on the behavior of plates and to analyze the problems pertaining to beams on elastic foundation*
2. *To introduce the finite element method and their applications*
3. *To study the various numerical methods for the stress analysis*

COURSE OUTCOMES (COs)

On successful completion of this course, the student will be able to

1. *Analyze the rectangular composite plates using the analytical solutions*
2. *Analyze the composite plates using advanced finite element method*
3. *Precise the various numerical methods for the stress analysis*
4. *Analyze the discretion of classical plates theory by using spatial approximations*
5. *Develop the finite element method by stiffness matrix & Numerical integration*
6. *Analyze the computation of stresses by using rectangular laminated plates*

UNIT-I

Introduction: Displacement Field Approximations for Classical Laminated Plate Theory (CLPT) and First Order Shear Deformation Theory (FSDT), Analytical Solutions for Bending of Rectangular Laminated Plates using CLPT

UNIT-II

Governing Equations: Navier Solutions of Cross – Ply and Angle – Ply Laminated Simply-Supported Plates, Determination of Stresses - Levy Solutions for Plates with Other Boundary Conditions

UNIT-III

Finite Element Models of the Classical Plate Theory (CLPT) – Weak Forms – Spatial Approximations – Semi discrete Finite Element Model – Quadrilateral Elements and Numerical Integration – Finite Element Solutions for Bending of Rectangular Laminated Plates using CLPT

UNIT-IV

Introduction to Finite Element Method, Rectangular Elements, Formation of Stiffness Matrix, Formation of Load Vector, Numerical Integration, Post Computation of Stresses

UNIT-V

Finite Element Solutions for Bending of Rectangular Laminated Plates using FSDT. Finite Element Model, Co-Element Formulation, Post Computation of Stresses

TEXT BOOKS

1. Mechanics of Laminated Composites Plates and Shells, Reddy J. N., CRC Press
2. Ye Jianqiao, Laminated Composite Plates and Shell

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PROFESSIONAL ELECTIVE COURSE (PEC) – V

(19CE1023) FRACTURE MECHANICS OF CONCRETE STRUCTURES

COURSE OBJECTIVES

1. *To understand the basic parameters involved in Fracture Mechanics*
2. *To understand the mechanisms and types of Fracture*
3. *To study the theories underlying Fracture analysis of structures*
4. *To study the models pertaining to Fracture analysis of structures*

COURSE OUTCOMES (COs)

On successful completion of this course, the student will be able to

1. *Describe the Basics Concepts of Fracture Mechanics &its Mechanism*
2. *Identify and classify cracking of concrete structures based on fracture mechanics.*
3. *Perform Stresses at Crack Tip and different Criteria involved*
4. *Explain the fatigue and fatigue crack grow rate*
5. *Describe the basic concepts of CTOD and COD*
6. *Explain the fracture resistance of materials*

UNIT-I

Fracture Mechanics Principles: Introduction, Mechanisms of Fracture, a crack in structure, the Griffith's criterion, modern design – strengths, stiffness and toughness. Stress intensity approach

UNIT-II

Stress Analysis for Members with Cracks: Linear elastic fracture mechanics, Crack tip stress and deformations, Relation between stress intensity factor and fracture toughness, Stress intensity-based solutions. Crack tip plastic zone estimation, Plane stress and plane strain concepts. The Dugdale approach, the thickness effect

UNIT-III

Elastic – Plastic Fracture Mechanics: Introduction, Elasto–plastic factor criteria, crack resistance curve, J-integral, Crack opening displacement, crack tip opening displacement. Importance of R-curve in fracture mechanics, experimental determination of J-integral, COD and CTOD

UNIT-IV

Fatigue and Fatigue Crack Growth Rate: Fatigue loading, various stages of crack propagation, the load spectrum, approximation of the stress spectrum, the crack growth integration, fatigue crack growth laws

UNIT-V

Fracture Resistance of Materials: Fracture criteria, fatigue cracking criteria, effect of alloying and second phase particles, effect of processing and anisotropy, effect of temperature, closure

TEXT BOOKS

1. David Broek – Sijthoff & Noordhoff – Alphen aan den Rijn ,*Elementary engineering fracture mechanics* – Netherlands
2. Suri C. T. and Jin Z.H., *Fracture Mechanics* ,1st Edition, Elsevier Academic Press,2012

REFERENCES

1. Fracture mechanics – applications to concrete – Edited by Victor, C.Li, & Z.P.Bazant– ACI SP118.
2. Valliappan S. "Continuum Mechanics Fundamentals" (1982), Oxford IBH, N D. New Delhi
3. Venkataraman and Patel “Structural Mechanics with introduction to Elasticity and Plasticity” – McGraw Hill,1990
4. Shanes – “Introduction to Solid Mechanics – II Edition, PH,1989
5. Fracture mechanics of concrete structures – Theory and applications – Rilem Report – Edited by L. Elfgreen – Chapman and Hall – 1989

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PROFESSIONAL ELECTIVE COURSE (PEC) – V
(19CE1024) DESIGN OF PLATES AND SHELLS

COURSE OBJECTIVES

To understand the principals involved in the analysis and design of plates and shells

1. *Understand various types of spatial structures*
2. *Analyze spatial structures by various methods*
3. *Apply knowledge of analytical solution in problem solving*
4. *Design and detailing of spatial structures*

COURSE OUTCOMES (COs)

On successful completion of this course, the student will be able to

1. *Analyze and design thin plates with defection*
2. *Analyze and design of laterally loaded, uniformly loaded circular plates*
3. *Analyze and design thin shells using approximate solutions*
4. *Analyze different types of plates (rectangular and circular) under different boundary connections by various classical methods and approximate methods*
5. *Analyze and design of prismatic folded plate system*
6. *Analyze and design of doubly curved shells*

UNIT I

Thin Plates with Small Deflection: Laterally loaded thin plates – governing differential equations - Simply supported and fixed boundary conditions

UNIT II

Design of Circular Plates: Symmetrical bending of Circular plates - Differential equation for symmetricalbendingoflaterallyloadedcircularplates-uniformlyloadedcircularplates-Circular plates with circular hole at center - circular plate concentrically loaded

UNIT III

Thin Shells: Geometry of shells - Detailing of Reinforcement in shells - edge beams and transfer beam Structural actions - Membrane theory

UNIT IV

Design of Shells: Cylindrical shells - Design of spherical dome –Folded plate structures - Design of folded plates

UNIT V

Design of Doubly Curved Shells: Analysis and design of doubly curved shells – Elliptic paraboloid - Conoid and hyperbolic paraboloid roofs

TEXT BOOKS

1. Timoshenko and Woinowsky-Krieger S., *Theory of Plates and Shells,*, Tata McGraw Hill Edition, 2010
2. G.S. Ramaswamy, *Design and Construction of Shell Structures*, CBS Publishers, New Delhi,1996

REFERENCES

1. Jawad Maan H., *Design of Plate and Shell Structures,* Springer Science
2. Szllard, R. *Theory of Analysis of Plates,* Prentice HallInc
3. K Chandrashekhara, "*Analysis of thin concrete shells*", New Age International,1995
4. Billington D. P., *Thin Shell Concrete Structures,* McGraw-Hill, 1995

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OPEN ELECTIVE COURSE – I

(19HS0824) BUSINESS ANALYTICS

COURSE OBJECTIVES

1. *Understand the concepts and methods of business analytics.*
2. *To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.*
3. *Identify the management related issues and processes to resolve*
4. *Understand the significance of forecasting models helpful in decision making*
5. *To become familiar with processes needed to develop, report, and analyze business data.*

COURSE OUTCOMES (COs)

On successful completion of course student will be able to

1. *Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.*
2. *Design alternatives to solve business problems utilizing quantitative analysis, critical thinking and sound ethical decision making.*
3. *Summarize, process and transform data for obtaining meaningful conclusions*
4. *Interpret data using latest data analytics tools to address organisational problems*
5. *Organize and critically apply the concepts and methods of business analytics*
6. *Assess decision problems and build models for creating solutions using business analytical tools.*

UNIT I

Business analytics: Overview of Business analytics - Scope of Business analytics - Business Analytics Process - Relationship of Business Analytics Process and organisation - competitive advantages of Business Analytics - Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

UNIT II

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data - simple Linear Regression - Important Resources - Business Analytics Personnel - Data and models for Business analytics - problem solving - Visualizing and Exploring Data, Business Analytics Technology.

UNIT III

Organization Structures of Business analytics: Team management - Management Issues - Designing Information Policy – Outsourcing - Ensuring Data Quality - Measuring contribution of Business analytics - Managing Changes - Descriptive Analytics - predictive analytics - predicative Modelling - Predictive analytics analysis - Data Mining - Data Mining Methodologies - Prescriptive analytics and its step in the business analytics Process - Prescriptive Modelling - nonlinear Optimization.

UNIT IV

Forecasting Techniques: Qualitative and Judgmental Forecasting - Statistical Forecasting Models - Forecasting Models for Stationary Time Series - Forecasting Models for Time Series with a Linear Trend - Forecasting Time Series with Seasonality - Regression Forecasting with Casual Variables - Selecting Appropriate Forecasting Models - Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform - New-Product Development Model - Newsvendor Model - Overbooking Model - Cash Budget Model.

UNIT V

Decision Analysis: Formulating Decision Problems - Decision Strategies with the Outcome Probabilities - Decision Trees - The Value of Information - Utility and Decision Making - Recent Trends in Embedded and collaborative business intelligence - Visual data recovery - Data Storytelling and Data journalism.

TEXT BOOKS:

1. *Business Analytics: Data analysis & Decision making*, S. Christian Albright, Cengage Learning
2. *Essentials of Business Analytics*, Jeffery Camm, & others, Cengage Learning

REFERENCES:

1. *Business analytics Principles, Concepts, and Applications*, Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press
2. *Business Analytics* James Evans, Pearsons Education.
3. *Data mining for business analytics: Concepts, Techniques and Applications*, Galit Shmueli, Peter C. Bruce, Inbal Yahav, Nitin R. Patel, Kenneth C. Lichtendahl Jr., WILEY

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OPEN ELECTIVE COURSE – I

(19ME3121) INDUSTRIAL SAFETY

COURSE OBJECTIVES

1. *Learn about Mechanical and electrical hazards.*
2. *Understand the Fundamentals of Maintenance Engineering.*
3. *Identify the importance of Wear, Corrosion and their prevention.*
4. *Explain the Fault Tracing concept of various instruments used.*
5. *Know the terms Periodic and preventive maintenance.*

COURSE OUTCOMES

On successful completion of this course the student will be able to

1. *Explain the Points of factories act 1948 for health and safety.*
2. *Define the term Cost & its relation with replacement economy.*
3. Recognize the Concept of Wear, Corrosion and its Prevention methods
4. Understand the Concept of sequence of fault finding activities and the importance of decisiontree
5. *Elaborate the importance of scheduled preventive maintenance of mechanical and electrical equipment.*
6. *Distinguish between Periodic and Preventive maintenance of equipment's.*

UNIT-I

Industrial Safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and fire fighting, equipment and methods.

UNIT-II

Fundamentals Of Maintenance Engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT-III

Wear And Corrosion And Their Prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT-IV

Fault Tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT-V

Periodic And Preventive Maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

TEXT BOOKS

1. Higgins & Morrow, *Maintenance Engineering Handbook,* Da Information Services.
2. H. P. Garg, *Maintenance Engineering,* S. Chand and Company.

REFERENCES

1. Audels, *Pump-hydraulic Compressors,* Mcgrew Hill Publication.
2. Winterkorn, *Foundation Engineering Handbook,* Chapman& Hall London.

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OPEN ELECTIVE COURSE – I

(19ME3021) ADVANCES IN OPERATIONS RESEARCH

COURSE OBJECTIVES

1. *Enumerate the fundamentals of Linear Programming.*
2. *Learn classical optimization techniques.*
3. *Develop the best strategy of Game and identifying the Queuing theory.*
4. *Understand about sequence and optimum Duration of the Project.*
5. *Develop the importance of Replacement models and Inventory control.*
6. *Identify the critical path of the project for optimum project duration.*

COURSE OUTCOMES

1. *On successful Completion of this course the student will be able to*
2. *Create mathematical models of the real time situations.*
3. *Implement Transportation and Assignment problems to solve in real time industry*
4. *Choose the best strategy of Game and capable of identifying the suitable queuing Theory*
5. *Enumerate fundamental techniques and apply it to solve various optimization areas*
6. *Investigate, study, Apply knowledge in Replacement models and Inventory Control Models*
7. *Understand the Inventory control Models*

UNIT-I

Introduction to OR and Linear Programming: OR definition–Types of Operations Research models; Linear Programming- Problem Formulation, Graphical Method, Simplex Method, Big-M Method, Degeneracy – Problems.

UNIT-II

Transportation Problem: Formulation; Initial Basic Feasible Solution-North-West Corner Rule, Least Cost Method, Vogel's Approximation Method Modified Distribution (MODI) Method, Unbalanced Transportation-Problem.

Assignment Problem: Formulation, Optimal Solution -Traveling Salesman problem.

UNIT-III

Game Theory: Introduction – Minimax (Maximin) Criterion and Optimal Strategy, Saddle Point, Solution of Games with Pure Strategy and Mixed Strategies – 2 X 2 Games –Dominance Principle.

Queuing Theory: Introduction to queuing system–Service Channel, Arrival Pattern, Size of Population, Service Pattern, Queue Discipline, Customer Behavior, Probability Distribution-Birth & Death Process, Simple Problems on Single Service channel only.

UNIT-IV

Sequencing: Terminology - Johnson's Algorithm for n-jobs x 2 Machines and n-jobs x 3 machines models - Problems

PERT & CPM: Introduction, Difference between PERT and CPM, Terminology- Activities, Events, Predecessor, Early Start, Early Finish, Late Start & Late Finish Times, Earliest Occurrence and Latest Occurrence of the Event, Total Float, Free Float, Independent Float; CPM- Deterministic Model; PERT- Probabilistic Model, Critical Path, Optimal Project Duration, Least Possible Project Duration- Problems.

UNIT-V

Replacement: Failure Mechanism of Items**,** Types of Replacements- Individual Replacement policy, Group Replacement policy, Replacement of items fail suddenly – problems

Inventory: Necessity for maintaining inventory, inventory costs, classification of fixed order quantity inventory models, selective inventory management techniques.

TEXT BOOKS

1. S D. SHARMA *Operations Research,* KNRN Publications, 17th Edition, 2015.
2. Hamdy A Taha, *Operations Research,* Pearson Publications, 9th Edition, 2015.

REFERENCES

1. Manohar Mahajan, *Operations Research,* Dhanpat Rai&Co, 2016.
2. Er. Premkumar Guptha & Dr.D.S.Hira, *Operations Research*, Schandpublications, 2012.
3. R Panneerselvam, *Operations Research,* PHI, 2nd Edition, 2012.

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OPEN ELECTIVE COURSE – I

(19ME3022) COMPOSITE MATERIALS

COURSE OBJECTIVES

The objective of the course is to

1. *Understand the mechanical behavior of composite materials.*
2. *Get an overview of the methods of manufacturing composite materials.*
3. *Know the fundamentals of composite materials.*
4. *Understand the fabrication and process of composites.*
5. *Recognize the applications of composite materials.*
6. *Understand the mechanics of composites in the manufacturing process.*

COURSE OUTCOMES

On successful Completion of this course the student will be able to

1. *Explain the Fundamental concept of composite materials.*
2. *Classify different types of composite materials.*
3. *Describe the Fabrication and processing of composite materials.*
4. *Illustrate the Methods of preparation of Metal matrix Composites and polymer matrix composites*
5. *Discuss about the Mechanical behavior of composite materials.*
6. *Explain the application of composite materials.*

UNIT-I

Introduction To Composites: Fundamentals of composites – need– enhancement of properties – classifications –Introduction to Reinforcement composites–types, Applications- Fiber production techniques for glass, carbon and ceramic fibers –Resin materials-Types.

UNIT-II

Polymer Matrix Composites: Fabrication of PMC's ,Fabrication of Fibers, Plastic Fiber Forms, Pre-pregs, Molding Compounds-Processes, Lay-Ups, Filament Winding, Pultrusion, and Recycling-Matrix – Reinforcement Interface, Wettability.

UNIT-III

MMC&CMC: Fabrication of MMC'S, Liquid Infiltration- Casting, Solid State Processes-Diffusion Bonding &In Situ Technique- Fabrication of CMC's, Hot-Pressing, Infiltration, In Situ Chemical reaction Techniques. CVD & CVI, Sol-gel, Carbon Carbon composites.

UNIT-IV

Mechanics of Composites: Basic assumptions of laminated anisotropic plates, symmetric laminates, angle ply laminates, cross ply laminates, laminate structural moduli, evaluation of lamina properties, determination of lamina stresses, maximum stress and strain criteria, Von -Mises Yield criterion for isotropic materials, generalized Hill's criterion for anisotropic materials, Tsai-Hill's criterion for composites, prediction of laminate failure, thermal analysis of composite laminates

UNIT-V

Applications Of Composites: Applications of advanced composite materials- Environmental effects in Composites, Green composites, Synthesis and Properties of Nano composites. Surface Composites & Surface metal matrix composites: Need, Synthesis, Properties and applications.

TEXT BOOKS

1. Mathews F. L. and Rawlings R. D., *Composite Materials: Engineering and Science*, Chapman and Hall, London, England, 1st Edition, 1994.
2. Chawla K. K., *Composite materials*, Springer – Verlag, 2nd Edition, 1998.

REFERENCES

1. Clyne, T. W. and Withers, P. J., *Introduction to Metal Matrix Composites*, Cambridge University Press, 1993.
2. Strong, A.B., *Fundamentals of Composite Manufacturing*, SME, 2nd Edition, 1989.
3. Sharma, S.C., *Composite materials*, Narosa Publications, 4th Edition, 2000

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OPEN ELECTIVE COURSE – I
(19EE2128) WASTE TO ENERGY

COURSE OBJECTIVES

1. *To learn different types of waste materials available for energy conversion*
2. *To understand Pyrolytic oil and gases*
3. *To introduce gasification methods for biomass*
4. *To learn concepts of biomass resources, combustion types and biogas plant technology*

COURSE OUTCOMES (COs)

On successful completion of this course, the student will be able to

1. *Analyse agro based, forest residue and industrial waste conversion processes.*
2. *Manufacture of Pyrolytic oils and gases*
3. *Manufacture of charcoal, yields and applications*
4. *Understand various types of gasifiers operation*
5. *Understand inclined and fluidized bed combustors operation*
6. *Understand types of biogas plants and biomass energy programme in India*

UNIT- I

Introduction to Energy from waste: Classification of waste as fuel –Agro based- Forest residue- Industrial waste- MSW- conversion devices- Incinerators- Gasifiers-Digestors

UNIT- II

Bio-mass Pyrolysis: Pyrolysis- Types- Slow-Fast- Manufacture of Charcoal- methods- yields and application. Manufacture of Pyrolytic oils and gases – yields and applications

UNIT- III

Biomass Gasification: Gasifiers- Fixed bed system- Downdraft and Updraft gasifiers- Fluidized bed gasifiers- construction and operation- Gasifier burner arrangement for thermal heating

UNIT- IV

Biomass Combustion: Biomass stoves- Types- Inclined combustors- Fluidized bed combustors- construction and operation of above biomass combustors

UNIT- V

Properties of Biogas: Biogas plant Technology and status – Biomass resources and their classification- Biomass conversion processes- thermo chemical conversion –Direct Combustion- Biomass gasification- Pyrolysis and liquefaction – bio-chemical conversion- anaerobic digestion- Types of biogas plants- applications-Biomass Energy Programme in India

TEXT BOOKS

1. Non-Conventional Energy- Desai Ashok V. Wiley Eastern Ltd 1990
2. Biogas Technology – A Practical Hand Book – Khandelwal K.C. and Mahdi SS, Vol I &II. Tata McGraw Hill Publishing Co Ltd.,1983

REFERENCES

1. Food, Feed and Fuel from Biomass – Challal D.S., IBH Publishing Co Pvt Ltd.,1991
2. Non-conventional Energy Sources- GD Roy, Khanna Publishers, 6th Edition
3. Biomass & Bioenergy – KhahidRehmanHekeem, Mohammad Jawald., Umar Rashid- SpringerInternational Publishing Ltd