

GANDHI INSTITUTE OF TECHNOLOGY AND MANAGEMENT (GITAM)

(Deemed to be University)

VISAKHAPATNAM * HYDERABAD * BENGALURU

Accredited by NAAC with A⁺⁺ Grade

GITAM School of Technology



SYLLABUS

2 Year Postgraduate Programme

PCIVL01: M. Tech. Structural Engineering

w.e.f. 2023-24 admitted batch

(Updated on 31st July 2023)

GANDHI INSTITUTE OF TECHNOLOGY AND MANAGEMENT



Vision

To become a global leader in higher education.

Mission

To impart futuristic and comprehensive education of global standards with a high sense of discipline and social relevance in a serene and invigorating environment.

Quality Policy

To achieve global standards and excellence in teaching, research, and consultancy by creating an environment in which the faculty and students share a passion for creating, sharing and applying knowledge to continuously improve the quality of education.

GITAM School of Technology

Vision

To become a global leader in holistic engineering education and research

Mission

1. To impart a strong academic foundation and practical education through a flexible curriculum, state of the art infrastructure, and best learning resources
2. To actively pursue academic and collaborative research with industries and research institutions, both in India and abroad
3. To build a congenial and innovative eco system by enabling the latest technologies, thus helping the students, to solve the challenges of societal importance
4. To provide our students with the appropriate leadership, management, communication skills and professional ethics for career success and to continuously impact the global lives

M.Tech. in Structural Engineering
Department of Civil Engineering
Effective from academic year 2023-24 admitted batch

Semester I

S. No	Course Code	Course Name	Category	L	T	P	C
1.	19ECE701	Theory of Elasticity	PC	3	0	0	3
2.	19ECE703	Finite Element Method	PC	3	0	0	3
3.	19ECE705	Structural Dynamics	PC	3	0	0	3
4.	19ECE7XX	Program Elective I	PE	3	0	0	3
5.	19ECE7XX	Program Elective II	PE	3	0	0	3
6.	19EMC741	Research Methodology and IPR	MC	2	0	0	2
7.	19ECE721	Computer Applications in Structural Engineering	PC	0	0	4	2
8.	19ECE725	Finite Element Method Laboratory	PC	0	0	4	2
9.	19EAC7XX	Audit Course I	AC	2	0	0	0
Total				21			

Semester II

S. No	Course No	Course Name	Category	L	T	P	C
1.	19ECE702	Advanced Reinforced Concrete Design	PC	3	0	0	3
2.	19ECE704	Structural Reliability	PC	3	0	0	3
3.	19ECE7XX	Program Elective III	PE	3	0	0	3
4.	19ECE7XX	Program Elective IV	PE	3	0	0	3
5.	19EOE7XX	Open Elective	OE	3	0	0	3
6.	19ECE722	Computational Methods in Structural Engineering Laboratory	PC	0	0	4	2
7.	19ECE726	Advanced Concrete Laboratory	PC	0	0	4	2
8.	19ECE792	Technical Seminar	PC	0	0	4	2
9.	19EAC7XX	Audit Course II	AC	2	0	0	0
10.	HSMCH102	Universal Human Values: Understanding Harmony	MC	2	1	0	3
Total				24			

Semester III

S. No	Course No	Course Name	Category	L	T	P	C
1.	19ECE891	Project Work I	PW			26	13
Total				13			

Semester IV

S. No	Course No	Course Name	Category	L	T	P	C
1	19ECE892	Project Work II	PW			26	13
Total				13			

M.Tech. in Structural Engineering**Number of Credits**

Semester	I	II	III	IV	Total
Credits	21	24	13	13	71

AUDIT COURSES I and II

S.No	Course Code	Course Title	Category	L	T	P	C
1	19EAC741	English For Research Paper Writing	AC	2	0	0	0
2	19EAC742	Disaster Management	AC	2	0	0	0
3	19EAC743	Sanskrit for Technical Knowledge	AC	2	0	0	0
4	19EAC744	Value Education	AC	2	0	0	0
5	19EAC745	Constitution of India	AC	2	0	0	0
6	19EAC746	Pedagogy Studies	AC	2	0	0	0
7	19EAC747	Stress Management by Yoga	AC	2	0	0	0
8	19EAC748	Personality Development through Life Enlightenment Skills	AC	2	0	0	0
9	19EAC750	Developing Soft Skills And Personality	AC	3	0	0	0

OPEN ELECTIVES

S.No	Course Code	Course Title	Category	L	T	P	C
1	19EOE742	Business Analytics	OE	3	0	0	3
2	19EOE744	Industrial Safety	OE	3	0	0	3
3	19EOE746	Operations Research	OE	3	0	0	3
4	19EOE748	Cost Management of Engineering Projects	OE	3	0	0	3
5	19EOE752	Waste to Energy	OE	3	0	0	3
6	19EOE754	Green Buildings	OE	3	0	0	3

M.Tech. in Structural Engineering**PROGRAM ELECTIVES****Program Elective I**

S. No	Course Code	Course Title	Category	L	T	P	C
1	19ECE741	Advanced Structural Analysis	PE	3	0	0	3
2	19ECE743	Theory of Plates and Shells	PE	3	0	0	3
3	19ECE745	Theory of Structural Stability	PE	3	0	0	3

Program Elective II

S. No	Course Code	Course Title	Category	L	T	P	C
1	19ECE751	Foundations for Dynamic Loading	PE	3	0	0	3
2	19ECE753	Bridge Engineering	PE	3	0	0	3
3	19ECE755	Advanced Steel Design	PE	3	0	0	3
4	19ECE757	Prestressed Concrete	PE	3	0	0	3

Program Elective III

S. No	Course Code	Course Title	Category	L	T	P	C
1	19ECE742	Disaster Management and Preparedness	PE	3	0	0	3
2	19ECE744	Comprehensive Disaster Risk Management	PE	3	0	0	3
3	19ECE746	Urban Disaster Mitigation Engineering	PE	3	0	0	3
4	19ECE748	Wind Analysis and Design of Tall Structures	PE	3	0	0	3
5	19ECE750	Infrastructure Planning	PE	3	0	0	3
6	19ECE760	Infrastructure Finance, Valuation, and Contracts	PE	3	0	0	3

Program Elective IV

S. No	Course Code	Course Title	Category	L	T	P	C
1	19ECE752	Fire Resistant Design of Structures	PE	3	0	0	3
2	19ECE754	Hydraulic Structures	PE	3	0	0	3
3	19ECE756	Earthquake Engineering	PE	3	0	0	3
4	19ECE758	Nonlinear Continuum Mechanics	PE	3	0	0	3

19ECE701: THEORY OF ELASTICITY**L T P C****3 0 0 3**

***Theory of elasticity** is the branch of Solid Mechanics which deals with the stress and displacements in elastic solids produced by external forces or changes in temperature. In this course the student will be able to study deformation and stresses developed in the material caused by external forces. The linear theory of elasticity views a structure as built of infinitesimal elements, which are solved by using concepts of physics and mathematical application.*

Course Objectives

- Explain plane stress and plane strain relation.
- Determine stresses and strains by using different methods.
- Solve stress strain problems in polar coordinates.
- Evaluate stresses and strains for 3D body.
- Apply optics law to determine stresses and strains.

Unit I**8L**

Introduction : Components of stress, components of strain, Hookes law, Plane stress and plane strain, Stress at a point, Differential Equations of equilibrium, Boundary conditions, Compatibility equations, stress function.

Learning outcomes:

After completion of this unit, the student will be able to

1. Understand basic definitions and concepts of stress, strain and equilibrium equations(L2)
2. Identifying state of stresses in a material at a particular location (L3).

Unit II**8L**

Two Dimensional Problems in Rectangular Coordinates: Solution by polynomials, Saint Venant's principle, determination of displacements, bending of cantilever loaded at the end, bending of a beam subjected to uniform load.

Learning outcomes:

After completion of this unit, the student will be able to

1. Find solutions for two dimensional coordinates(L1)
2. Formulations and solution strategies of various boundary value problems((L5)

Unit III**8L**

Two Dimensional Problems in Polar Coordinates: Basic equations, Biharmonic equation for axis symmetry, pure bending of curved bars- exact analysis, thick cylinder, rotating disks.

Learning outcomes:

After completion of this unit, the student will be able to

1. Understand biharmonic equations to solving irregular two-dimensional problems.(L2)
2. Find state of stresses in Polar Coordinates (L1)
3. Identify state of stresses in thick cylinder, rotating disks (L3)

Unit IV**8L**

General theorems: Differential equations of equilibrium – conditions of compatibility, Analysis of

stress and strain in Three Dimensions: Introduction - Principal stresses - Determination of principal stress – Stress invariants – Determination of Maximum shearing stress.

Learning outcomes:

After completion of this unit, the student will be able to

1. Understand state of stresses for three dimensional bodies.(L2)
2. Find solutions for three dimensional coordinates(L1)
3. Formulations and solution strategies of various boundary value problems for three dimensional bodies ((L5)

Unit V

10L

Torsion: Torsion of straight bars – Elliptic cross section – Membrane analogy torsion of bar of narrow rectangular cross section.

Learning outcomes:

After completion of this unit, the student will be able to

1. Understand basic definitions and concepts of torsion stresses (L2)
2. Find Membrane analogy torsion of bar of narrow rectangular cross section (L3).

Text Book(s):

1. Timoshenko, Goodier, Theory of Elasticity, 3/e, McGraw Hill Company, 2010.
2. Sadhu Singh, Theory of Elasticity, 11/e, Khanna publication, 2015.

References

1. C. T. Wang, Applied Elasticity, McGraw Hill, 1963.
2. J. P. Den Hartog, Advanced Strength of Materials, Dover Publications, 1988.

Course Outcomes

- Relate plane stress and plane strain.(L1)
- Evaluate stresses and strains by using different methods.(L5)
- Determine stress strain problems in polar coordinates.(L5)
- Solve stresses and strains for 3D body.(L6)
- Estimate stresses and strains by applying optics law.(L5)

19ECE703: FINITE ELEMENT METHOD**L T P C****3 0 0 3**

The Finite Element Method (FEM) is an approximation method for solving problems which can easily be expressed using differential equations. This course is designed to provide deep insights into the applications of FEM in solving problems involving structural engineering.

Course Objectives:

- To demonstrate the history and need of FEM.
- To illustrate the mathematical basis for formulation of FEM.
- To extend the idea of FEM as applied to 1D analysis.
- To discuss the formulation of 2D elements.
- To outline the formulation of 3D tetrahedral elements.

Unit I**8L**

Introduction: History and need of FEM, Steps in FEM, Equations of equilibrium, boundary conditions, constitutive relationship.

Learning Outcomes:

Post completion of the unit the student will be able to:

- *Explain the history of FEM. (L2)*
- *Relate the various steps involved in FEM. (L2)*
- *Illustrate the basic concepts of solid mechanics. (L2)*

Unit II**8L**

Formulation of FEA: Coordinate system (local & global), weighted integral & weak formulation, requirements on representation of element behaviour functions, types of errors.

Learning Outcomes:

Post completion of the unit the student will be able to:

- *Build the weak form for the differential equation. (L3)*
- *Understand the global and local coordinates (L2)*
- *Classify the various errors involved in FEM. (L2)*

Unit III**8L**

One Dimensional Analysis: Bar element, derivation of stiffness matrix, assembly of stiffness matrix, boundary conditions – analysis of trusses under axial forces only.

Learning Outcomes:

Post completion of the unit the student will be able to:

- *Build the global stiffness matrix for a truss. (L3)*
- *Apply the various boundary conditions to the matrix equations (L3)*
- *Solve problems on trusses of different geometry & various loading. (L3)*

Unit IV**8L**

Two Dimensional Analysis: Various element shapes, triangular element formulation, discretisation of a structure, inter connections at nodes of displacement models, inter element connectivity, isoparametric formulation.

Learning Outcomes:

Post completion of the unit the student will be able to:

- *Formulate the matrix equations for 2-D Finite Elements. (L6)*
- *Apply the various boundary conditions to the matrix equations (L3)*
- *Outline the interconnectivity of elements (L2)*
- *Build the isoparametric formulation for 2-D elements . (L6)*

Unit V

10L

Three-Dimensional Analysis: Various elements used; tetrahedral element formulation, mesh refinement vs higher order element,

Learning Outcomes:

Post completion of the unit the student will be able to:

- *Formulate the matrix equations for 3-D Finite Elements. (L6)*
- *Apply the various boundary conditions to the matrix equations (L3)*
- *Build the isoparametric formulation for 3-D elements . (L6)*

Text Book(s):

1. Tirupathi R. Chandrupatla, Ashok D. Belegundu ,Introduction to Finite Elements in Engineering, , Pearson Education India; 4th edition (2015).
2. J. N. Reddy, An Introduction to the Finite Element Method, 3/e, McGraw-Hill, New York (2005).
3. C. S. Krishnamoorthy, Finite Element Analysis: Theory and Programming, , Tata McGraw-Hill Education (1994).

References:

1. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, Concepts and Applications of Finite Elements Analysis, 4th Edition (2001).
2. J.F.Abel, C.S.Desai, Introduction to the FEM, CBS Publishers (2005).
3. Reger. T. Fenner, Finite Element Method for Engineers, The Macmillan Ltd., London, 2nd Edition (2013).
4. Bathe, Klaus Jorgen & Wilson, Edward.L ,Finite Element Procedures, 4th Edition, Prentice Hall (2016).

Course Outcomes:

- To explain the significance of FEM.(L2)
- To infer the mathematical background of FEM.(L2)
- To assess the idea of FEM as applied to 1D analysis.(L5)
- To deduce the formulation of 2D elements. (L5)
- To rule on the formulation of 3D tetrahedral elements.(L5)

19ECE705: STRUCTURAL DYNAMICS**L T P C****3 0 0 3**

Structural dynamics, is a type of structural analysis which covers the behaviour of a structure subjected to dynamic. Any structure can be subjected to dynamic loading. The prerequisite for this course would be Mathematics and Structural Analysis and Design of Reinforced Concrete Structures. The student will be able to develop and solve equation of motion for SDOF subjected to free and forced vibrations for Single Degree of Freedom Systems, Distributed Mass Systems, Lumped Mass Systems and Multiple Degree of Freedom Systems. This course is prerequisite for Earthquake Engineering Course .

Course Objectives

- To demonstrate the principles and methods of dynamic analysis of structures
- Illustrate dynamics response of single degree freedom system using fundamental theory and equation of motion
- Interpret methods to analyze structures subjected to any kind of dynamic excitation and computing quantities like displacements, forces, stresses etc.
- Analyze and study dynamics response of Multi degree freedom system using fundamental theory and equation of motion
- Develop modal equations for damped and undamped systems.

Unit I**8L**

Free Vibration: Undamped Single-Degree-of-Freedom System: Degrees of Freedom, Undamped system, Springs in Parallel or Series, Newton's Law of Motion, Free Body Diagram, Solution of the Differential Equation of Motion, Frequency and Period, Amplitude of Motion.

Damped Single-Degree-of-Freedom System: Viscous Damping, Equation of Motion, Critically Damped System, Overdamped System, Underdamped System, Logarithmic Decrement.

Learning Outcomes:

After completion of Module I, the student will be able to

- **Relate** the structural idealizations studied to the properties of real structures **(L1)**
- **Define** generalized degrees of freedom for single and multi degree of freedom systems **(L1)**
- **Apply** knowledge of mathematics, science and engineering by developing the equation of motion for SDOF for free vibrations **(L3)**
- **Solve equation of motion** for free vibration for damped and undamped SDOF system **(L6)**
- **Demonstrate** logarithmic decrement from free vibrations of SDOF **(L2)**

Unit II**8L**

Response of One-Degree-of-Freedom System to Harmonic Loading: Harmonic Excitation: Undamped System, Harmonic Excitation: Damped System.

Response to General Dynamic Loading: Response to impulse loading: General nature of impulsive loading, sinewave impulse, Rectangular impulse, square pulse of finite duration, triangular impulse, response to general force pulse, greens function, Duhamel's Integral-Undamped System, Duhamel's Integral-Damped System

Learning Outcomes:

After completion of Module II, the student will be able to

- **Apply** knowledge of mathematics, science and engineering by developing the equation of motion for SDOF for forced vibrations **(L3)**
- **Solve** equation of motion for various forced vibration for undamped and damped SDOF system **(L6)**

- **Determine** the response to forced vibration using Duhamel's Integral for SDOF (L5)

Unit III

8L

Structures with distributed mass and load: Introduction, free vibration, frequency and motions of SSB, cantilever beam, fixed beam, propped cantilever beam, forced vibration of beams, Beams, with variable cross section and mass.

Learning Outcomes:

After completion of Module III, the student will be able to

- **Apply** knowledge of mathematics, science and engineering by developing the equation of motion for various beams for free and forced vibrations (L3)
- **Solve** equation of motion for free and forced vibration (L6)

Unit IV

8L

Lumped mass MDOF systems: Determination of natural frequencies, Stiffness Method, Flexibility Method, Stodola-Vianelle method, Rayleigh method, Modified Rayleigh-Ritz method; multistory rigid frames subjected to lateral loads, damping in multi degree systems.

Learning Outcomes:

After completion of Module IV, the student will be able to

- **Determine** the natural frequencies for lumped mass systems using various techniques (L5)
- **Determine** the damping for lumped mass systems using various techniques (L5)
- **Identify** the dynamic response of Lumped mass MDOF systems. (L3)

Unit V

10L

Natural Vibration Frequencies and Modes: Systems without damping, Normal Vibration Frequencies and Modes, Modal and Spectral Matrices, Orthogonality of Modes, Interpretation of Modal Orthogonality, Normalization of Modes, Modal Expansion of displacements.

Free Vibration Response: Solution of Free Vibration Equations: Undamped Systems, Free Vibration of Systems with damping. **Modal Analysis:** Modal Equations for undamped systems, Modal Equations for damped Systems, Displacement Response, Element Forces

- **Determine** the natural frequencies and natural modes of vibration of a structure for MDOF systems (L5)
- **Evaluate** free vibration response of undamped and damped systems for MDOF systems. (L5)
- **Develop** the classical modal analysis procedure to obtain the response of MDOF systems. (L3)

Text Book(s):

1. John M. Biggs, Introduction to Structural Dynamics, 1/e, McGraw Hill Inc, 2014.
2. Mario Paz, William Leigh, Structural Dynamics, 5/e, Springer, 2006.

References:

1. Anil K. Chopra, Dynamics of Structures, Theory and Applications to Earthquake Engineering, 4/e, Prentice Hall of India, 2011.
2. A.Ghali, A.M.Neville, Tom G. Brown, Structural Analysis: A Unified classical & Matrix Approach, 6/e, CRC Press, 2009.
3. Jai Krishna, Chandrasekharan, and Saritha Prakasham, Elements of Earthquake Engineering, 2/e, South Asian Publishers, 2000.

Course Outcomes

After completion of the course, the students will

- Identify vibration analysis of systems/structures with different degrees of freedom.(L3)
- Analyze lumped mass systems for their dynamic behavior.(L4)
- Explain the equation of motion, dynamic response of single, and multi degree-of-freedom system.(L5)
- Summarize the solution techniques for dynamics of Multi-degree freedom systems.(L2)
- Apply structural dynamics theory to earthquake analysis, response, and design of structures.(L3)

19ECE721: COMPUTER APPLICATIONS IN STRUCTURAL ENGINEERING**L T P C****0 0 4 2**

The prerequisite for this course would be Structural Analysis, Water Resources Engineering and Project Planning and Management. The student gets familiarity in i) analysis and design of RCC and steel Structures using STAAD Pro., ii) design water distribution network using EPANET, iii) schedule and plan a project using Construction Management principles, and iv) reading of spatial data using GIS. The use of software increases the accuracy in analysis and reduces the time to complete the given practical problem.

Course Objectives

- Demonstrate the design of reinforced concrete structural elements.
- Explain earthquake resistant design
- Explain analysis of a building for wind loading.
- Demonstrate the method of analysis of truss.

List of Experiments

1. Design of reinforced concrete beam (singly/doubly)
2. Design of reinforced concrete column subjected to biaxial bending
3. Design of reinforced concrete slab (One way/Two-way)
4. Design of reinforced concrete retaining wall (cantilever type)
5. Design of reinforced concrete shear wall
6. Lateral forces on a building due to an earthquake using equivalent static method
7. Lateral forces on a building due to wind
8. Analysis of rigid jointed plane frames
9. Analysis of simply supported/cantilever beam
10. Analysis of plane truss

References:

1. T.S Sarma, Staad Pro V8i for Beginners, Notion Press; 1 edition (2014).
2. Sham Tickoo, Learning Bentley Staad.Pro V8i for Structural Analysis, Dreamtech press (2015).
3. Technical Reference Manual for Staad, Bentley.

Course Outcomes

- Analyze and design the structural components like beams, slabs, columns, retaining wall and shear wall. (L4)
- Analyze for earthquake loading & wind loading of framed buildings. (L4)
- Analyze and design pin jointed, rigid jointed plane structures. (L4)

19ECE725: FINITE ELEMENT METHOD LABORATORY**L T P C****0 0 4 2**

This laboratory shall expose the learner to the applications of Finite Element Method in a computational framework. The learner will be familiarised with a GUI based modelling approach for analysing solids and simulate their response to various loads.

Course objectives

- Build familiarity with GUI based FE analysis
- Construct models for analysis
- Evaluate and visualize the philosophy of FEM.

List of Experiments

1. Analysis of a one dimensional bar.
2. Analysis of a two dimensional beam.
3. Modeling and analysis of two dimensional truss.
4. Analysis of a two dimensional frame.
5. Analysis of Plate with a Hole under
 - a. Uniform Pressure at hole.
 - b. Uniaxial Extension.
 - c. Biaxial Extension.
 - d. Simple Shear.
6. Axisymmetric problem.
7. Analysis of a three dimensional bicycle bracket.
8. Analysis of three dimensional curved beams.
9. Analysis of plates with material and geometric non linearity.

References:

1. Guangming Zhang, Engineering Analysis with Pro/Mechanica and ANSYS, College House Enterprises, ISBN: 978-1935673033, 2017.
2. Sham Tickoo, Finite Element Analysis with ANSYS Workbench, BPB Publications, ISBN 978-8194401810, 2019.

Course outcomes

Post completion of the course learners will be able to

1. Build models in a FEA based application software (L6).
2. Analyse models under various loads and boundary conditions (L4).
3. Interpret the results from FEA based analysis of bodies (L5).

19ECE702: ADVANCED REINFORCED CONCRETE DESIGN**L T P C.****3 0 0 3**

The prerequisite for this course would be Design of Reinforced Concrete Structures. Design of few regular structures are covered in this course. The use of working stress method for achieving crack control design is explained. The popularity of flat slab design in modern construction is also discussed. Importance of fire resistance design of structures, introduction to earthquake loading and ductile detailing of beams as per codal provisions is summarized.

Course Objectives:

- To summarize the importance of limit state of serviceability.
- To outline the design knowledge of flat slabs.
- To develop an understanding of the codal provisions of fire and design of concrete beam members subjected to fire.
- To explain the definition of Earthquake forces and Structural Responses.
- To develop an understanding of the codal provisions of ductile detailing of frames

Unit I**8L**

Deflection of Reinforced Concrete Beams and Slabs: Introduction, Short-term deflection of beams and slabs, deflection due to imposed loads, short-term deflection of beams due to applied loads, Calculation of deflection by IS 456. Estimation of Crack width in Reinforced Concrete Members: Introduction, Factors affecting crack width in beams, Calculation of crack width, simple empirical method, estimation of crack width in beams by IS 456.

Learning Outcomes:

After completion of this unit, the student will be able to

- distinguish between long term and short term deflection in beams (L4)
- evaluate the short term deflection of beam using IS code method(L5)
- evaluate the long term deflection of beam using IS code method(L5)
- estimate the crack width in beams using IS code method (L5)

Unit II**8L**

Design of Flat Slabs: Direct Design Method – Distribution of Moments in column strips and middle strip – moment and shear transfer from slabs to columns – shear in flat slabs – check for one way shear – Introduction to equivalent frame method. Limitation of direct design method – Distribution of moments in column strips and middle strip.

Learning Outcomes:

After completion of this unit, the student will be able to

- illustrate the different components of flat slabs (L2)
- outline the distribution of moments in column and middle strips (L2)
- design a flat slab for a panel using direct design method (L6)
- perceive the limitations of direct design method of flat slab (L5)

Unit III**8L**

Design of Reinforced Concrete Members for Fire Resistance: Introduction, ISO 834 standard heating conditions, grading or classifications, effect of high temperature on steel and concrete, effect of high temperatures on different types of structural members, fire resistance by structural detailing from tabulated data, analytical determination of the ultimate bending moment, capacity of reinforced concrete beams under fire, other considerations.

Learning Outcomes:

After completion of this unit, the student will be able to

- categorize the various approaches in analysis for elevated temperature structures (L4)
- assess the effect of high temperature on steel and concrete materials (L5)
- examine the effect of high temperature on different types of structural members(L4)
- evaluate the capacity of RCC beam when exposed to fire(L5)

Unit IV**8L**

Earthquake Forces and Structural Responses: Introduction, Bureau of Indian Standards for earthquake design, Earthquake magnitude and intensity, Historical development, Basic seismic coefficient and seismic zone factors, determination of design forces, Choice of method for multi-storeyed buildings, Difference between wind and earthquake forces, Partial safety factors for design, Distribution of seismic forces, Analysis of structures other than buildings.

Learning Outcomes:

After completion of this unit, the student will be able to

- summarize terminology related to earthquake (L2)
- classify different seismic waves (L2)
- distinguish between earthquake magnitude and intensity (L4)
- distinguish between wind and earthquake forces (L4)
- evaluate the earthquake forces for multi-storied structures(L5)

Unit V**10L**

Ductile detailing, Increased values of seismic effect for vertical and horizontal projections, proposed changes in IS 1893 (Fifth revision). Ductile Detailing of Frames for Seismic Forces: Introduction, General principles, Factors that increase ductility, Specifications for material for ductility, ductile detailing of beams – Requirements.

Learning Outcomes:

After completion of this unit, the student will be able to

- apply the concept of ductile detailing in RC beams (L3)
- select the reinforcement detailing in beams to meet the ductility principles as per code (L5)
- examine the factors that increase the ductility in beams (L4)
- identify the specifications for materials for ductility (L3)

Text Book(s):

1. P. C. Varghese, Advanced Reinforced Concrete Design, 2/e, Prentice Hall of India, 2011.
2. Ashok K. Jain, Reinforced Concrete, 7/e, Nem Chand and Bros., 2012.

References:

1. Park, Paulay, “Reinforced Concrete Structures”, Wiley, 2009.

Course Outcomes:

At the end of the course the student will be able to

- estimate the deflection and crack width of beams and slabs (L5)
- analyze and design the Flat Slabs (L4)
- analyze and design concrete members subjected to fire (L4)
- examine the structures for earthquake forces (L4)
- apply codal provisions for ductile detailing of flexural members (L3)

19ECE704: STRUCTURAL RELIABILITY**L T P C****3 0 0 3**

Reliability is the science of determining the probability of safety of a system under design conditions within a prescribed lifetime. This course aims to expose the learner to the various mathematical techniques adopted to determine the reliability of structural systems.

Course Objectives:

- Outline various concepts of structural safety.
- To identify various resistance distributions and parameters .
- To illustrate the philosophy of structural reliability.
- To organize the ideas of level 2 reliability methods.
- To introduce the ideas of reliability based design.

Unit I**8L**

Concepts of Structural Safety: General, Design methods. Basic Statistics: Introduction, Data reduction, Histograms, Sample correlation. Probability Theory: Introduction, Random events, Random variables, Functions of random variables, Moments and expectation, common probability distribution, Extremal distribution.

Learning Outcomes:

Post completion of the unit the student will be able to:

- *Explain the basic statistical techniques required for reliability. (L2)*
- *Relate the functions of random variables. (L2)*
- *Illustrate the various kinds of distribution of variables. (L2)*

Unit II**8L**

Resistance Distributions and Parameters: Introduction, Statistics of properties of concrete. Statistics of properties of steel, Statistics of strength of bricks and mortar, dimensional variations, characterization of variables, Allowable stresses based on specified reliability.

Learning Outcomes:

Post completion of the unit the student will be able to:

- *Analyse the statistical properties of construction materials. (L4)*
- *Understand the characterization of variables. (L2)*
- *Analyse the allowable stresses using reliability. (L4)*

Unit III**8L**

Basic Structural Reliability: Introduction, Computation of Structural reliability. Monte Carlo Study of Structural Safety: General, Monte Carlo method, Applications.

Learning Outcomes:

Post completion of the unit the student will be able to:

- *Evaluate the structural reliability of structural systems. (L5)*
- *Apply Monte Carlo simulation techniques to determine reliability of systems.(L3)*
- *Evaluate the safety of a structural system. (L5)*

Unit IV**8L**

Level 2 Reliability Methods: Introduction, Basic variables and failure surface, First-order second-moment methods (FOSM).

Learning Outcomes:

Post completion of the unit the student will be able to:

- *Formulate the failure equation for structural systems. (L6)*
- *Interpret the concept of FOSM (L2)*
- *Apply FOSM to determine structural reliability.(L3)*

Unit V**10L**

Reliability Based Design: Introduction, Determination of partial safety factors, Safety checking formats, Development of reliability based design criteria, Optimal safety factors, Summary of results of study for Indian standard – RCC Design.

Learning Outcomes:

Post completion of the unit the student will be able to:

- *Formulate the safety checking formats. (L6)*
- *Develop reliability based design criteria (L3)*
- *Agree with the Indian Standards for RCC designs with concepts of structural reliability. (L5)*

Text Book(s):

1. R. Ranganathan, Structural Reliability Analysis and Design, Jaico Publishing House, 2006.
2. R.E. Melchers, Structural Reliability – Analysis & Prediction, 2/e, Wiley – Blackwell, 1999.

References:

1. Maurice Lemaire, Structural Reliability, Wiley (2009).
2. Dan M. Frangopol, Mitsuo Kawatani & Chul-Woo Kim, Reliability and Optimization of Structural Systems, Taylor & Francis (2006).

Course Outcomes:

- To identify the concepts of probability as applied to structural safety.(L2)
- To justify the use of resistance distributions and parameters.(L2)
- To appraise the basic concepts of structural reliability.(L5)
- To evaluate the advantage of using level2 reliability methods.(L5)
- To build the ideas of reliability based design.(L5)

19ECE722: COMPUTATIONAL METHODS IN STRUCTURAL ENGINEERING LABORATORY

L T P C**0 0 4 2**

MATrix LABoratory (MATLAB) is an advanced tool used to solve scientific problems. This laboratory will expose the learners to the commonly used computational techniques and code it in MATLAB to provide a realistic insight into the techniques.

Course Objectives:

- To develop MATLAB codes for solution of simultaneous linear equations.
- To construct codes for 1D Finite Element problems.
- To identify methods to code for numerical integration techniques & statistical methods.
- To model finite difference methods.

List of experiments

1. Formulate set of simultaneous equations and solutions for the analysis of continuous beam using MATLAB (Gauss elimination).
2. Developing a computer program for the analysis of continuous beam and solving the unknowns using Gauss-Seidal method (maximum 9 unknowns).
3. Solution of Plane Stress and Plane Strain problems in MATLAB.
4. Solving 1D Finite Element Problems and plotting shape functions.
5. Estimation of volume of earthwork using numerical integration techniques.
6. Forecasting of water requirement using MATLAB.
7. Determination of mean, standard deviation of a given sample of concrete strengths and developing correlation between cube strengths and cylinder strengths.
8. Forecasting global temperature and analyzing climate change.
9. Solution of beam problems using Finite Difference Techniques.

References:

1. Rudra Pratap, Getting Started with MATLAB: A Quick Introduction for Scientists & Engineers, Oxford University Press (2010).
2. Amos Gilat, MATLAB: An Introduction with Applications, 4ed Paperback (2012).

Online Reference:

1. MATLAB Documentation. <https://in.mathworks.com/help/matlab/>

Course outcomes:

- To build MATLAB codes for solution of simultaneous linear equations.(L6)
- To create 1D Finite Element problems in a computational scheme.(L6)
- To design codes for numerical integration techniques & statistical methods.(L6)
- To propose computational techniques for solving monte carlo and finite difference methods.(L6)

19ECE726: ADVANCED CONCRETE LABORATORY**L T P C****0 0 4 2**

This laboratory shall expose the learner to the various non destructive testing methods to assess the compressive strength of concrete. In addition the lab shall aim to analyse the response of RC beams and columns under various loading conditions

Course Objectives

- Determine mechanical properties of Plain Cement Concrete.
- Evaluate strength of concrete using NDT Methods.
- Demonstrate performance of structural members.

List of Experiments

1. Assessment of compressive strengths by Rebound hammer test
2. Calibration of Rebound hammer for compressive strength
3. Assessment of compressive strengths by UPV
4. Calibration of UPV for compressive strength
5. Rapid Estimation of compressive strength of concrete using Accelerated curing tank
6. Study on Behavior of a RC beam using loading frame
7. Study on behavior of RC column using loading frame
8. Split tensile test on a cylindrical concrete specimen
9. Stress-strain curve for concrete
10. Fatigue test on mild steel specimen

References:

1. Indian Standard, Non Destructive Testing of Concrete-Methods of Test, IS 13311 (Part 1 & 2), 1992.
2. Indian Standard, Methods of test for strength of concrete, IS 516-1959 (2006).

Course outcomes

- Evaluate mechanical properties of Plain Cement Concrete.(L5)
- Determine strength of concrete using NDT Methods. (L5)
- Interpret and analyze performance of structural members. (L5)

19ECE792: TECHNICAL SEMINAR**L T P C****0 0 4 2**

Scope & Overview: Students are expected to identify a research problem/case study from any domain of Structural Engineering/Disaster management to carry out a reconnaissance research on the topic and suggest innovative solutions for the same. It is advisable for students to choose a topic of interest to be continued as M.Tech Project in the 3rd & 4th Semester. The guidelines to carry out the research shall include the following:

1. Literature Review
2. Identification of Gap
3. Objectives and Expected Outcomes
4. Methodology / Innovative solution

Each student has to prepare a power point presentation on a selected technical topic with a novelty and get it evaluated by the faculty assigned for this purpose.

19ECE741: ADVANCED STRUCTURAL ANALYSIS**L T P C****3 0 0 3**

Structural Analysis deals with the analysis of the response of a structure under various loading conditions. This course is designed to expose the learner towards various advanced methods adapted for analysis of structures.

Course Objectives:

- To illustrate the basic concepts of structural analysis
- To analyse indeterminate structures using moment distribution method
- To analyse the indeterminate structures using flexibility matrix method
- To analyse the indeterminate structures using stiffness matrix method
- To analyse a multistoreyed frame using approximate methods

Unit I**8L**

Basic Concepts of Structural Analysis: Introduction- Classification of structures- Equations Of static equilibrium- Internal forces- Degree of Static Indeterminacy- Degree of Kinematic Indeterminacy- Stability.

Learning Outcomes:

Post completion of the unit the student will be able to:

- *Classify the various types of structures. (L2)*
- *Relate the various equations of equilibrium. (L2)*
- *Illustrate the basic concepts static & kinematic indeterminacy. (L2)*

Unit II**8L**

Analysis of indeterminate structures by Moment Distribution Method: Introduction-continuous beams-bents-rectangular portals-portals with inclined legs-2 Bay 2 storey portal frames.

Learning Outcomes:

Post completion of the unit the student will be able to:

- *Build the moment distribution table. (L3)*
- *Understand the procedure of determination of reactions using moment distribution method. (L2)*
- *Analyse the sway for frames. (L4)*

Unit III**8L**

Flexibility Method: Introduction-Method of consistent Deformation-Application of flexibility method to pin jointed frames (Max 12 Members)- Analysis of rigid portal frames (2 by 2 storey).

Learning Outcomes:

Post completion of the unit the student will be able to:

- *Build the flexibility matrix equations. (L3)*
- *Analyse pin jointed frames using flexibility method. (L4)*
- *Solve problems on rigid portal frames using flexibility method. (L3)*

Unit IV**8L**

Stiffness Method: Introduction-Relation between slope deflection method and stiffness method- Stiffness method of analysis-Choice between flexibility and stiffness methods-Displacement and forces in members of indeterminate structures (having a redundancy not more than 3) by stiffness method.

Learning Outcomes:

Post completion of the unit the student will be able to:

- *Formulate the stiffness matrix equations. (L6)*
- *Apply the stiffness method for various structures.(L3)*
- *Outline the need of stiffness method. (L2)*

Unit V**10L**

Approximate methods of analysis: Analysis of multi-storeyed frames by portal method, points of inflection method, substitute frame method.

Learning Outcomes:

Post completion of the unit the student will be able to:

- *Analyse a multi storeyed frame using portal method. (L4)*
- *Analyse a structure using points of inflection method. (L4)*
- *Analyse a multi storeyed frame using substitute frame method. (L4)*

Text book(s):

1. V.N. Vazirani, M.N Ratwani, Advanced Theory Of Structures and Matrix Method, Khanna Publishers, 2002
2. William Weaver, J.R, James M. Gere, Matrix Analysis Of Framed Structures, 2/e, Van Nostrand Publisher, 2012.

References:

1. Structural Analysis-A Matrix Approach -G.S Pandit and S.P Gupta, Volume II, Mc Graw Hill Education Private Limited
2. Advanced Structural Analysis by Ashok. K. Jain, Nem Chand Brothers, Second Edition-2006

Course Outcomes :

By the end of the course student will be able to :

- Apply basic concepts of structural analysis for analysing beams and trusses (L3)
- Analyse indeterminate structures using moment distribution method (L4)
- Analyse the indeterminate structures using flexibility matrix method.(L4)
- Analyse the indeterminate structures using stiffness matrix method. (L4)
- Analyse a multistoreyed frame using approximate methods. (L4)

19ECE743: THEORY OF PLATES AND SHELLS**L T P C****3 0 0 3**

The prerequisite for this course would be Engineering Mechanics, Mathematics and Advanced Mechanics of Solids. Derivation of differential equations for analysis of rectangular plates with different edge conditions and various loadings is explained. The expression for deformation due to loadings in rectangular plate is derived. Analysis of thin shell structures for inplane membrane forces using membrane theory is discussed.

Course objectives

- Analyze rectangular plates with different support conditions.
- Demonstrate pure bending of plates.
- Apply different solutions to plate problems.
- Classify shells with geometry.
- Analyze different types of shells using membrane theory.

Unit I**8L**

Bending of Long Rectangular Plates to a Cylindrical Surface: Differential equation for cylindrical bending of plates – Uniformly loaded rectangular plates with simple supported edges and with built in edges.

Learning Outcomes:

After completion of this unit, the student will be able to

- develop governing differential equation for cylindrical bending of plates (L6)
- Determine the deflection equation for simply supported rectangular plate with udl (L5)
- Determine the deflection equation for rectangular plate with built in edges with udl (L5)

Unit II**8L**

Pure bending of plates: slope & Curvature of bent plates – Relations between bending moments and curvature in pure bending of plates. Symmetrical bending of circular plates: Differential equation for symmetrical bending of laterally loaded circular plates, uniformly loaded circular plates.

Learning Outcomes:

After completion of this unit, the student will be able to

- explain pure bending in plates (L5)
- develop expression for stresses in circular plates for different loadings(L6)
- develop equation for deflection in circular plates for different loadings(L6)

Unit III**8L**

Simply supported rectangular plates under sinusoidal loading – Navier's solution of simply supported plates, further applications of Navier's solutions, simply supported rectangular plates under hydrostatic pressure, Levy's solution for uniformly distributed load.

Learning Outcomes:

After completion of this unit, the student will be able to

- determine deflection of simply supported plate with udl using Navier solution (L5)
- determine deflection of simply supported plate with udl using Levy's solution(L5)
- develop expression for moment and shear for simply supported rectangular plate under hydrostatic pressure(L6)

Unit IV**8L**

Membrane analysis: Shells of revolution (axi-symmetrical loading), Spherical shells, Conical Shells, Elliptical shell of revolution. Torus, Hyperboloid of revolution of one sheet, shells of uniform strength membrane deformation.

Learning Outcomes:

After completion of this unit, the student will be able to

- define shell geometry(L1)
- classify shells based on curvature (L2)
- demonstrate different shells of revolution under axi-symmetrical loading (L2)
- apply membrane theory for analysis of shells(L3)

Unit V**10L**

Membrane analysis of shells of translation, circular cylinder, Parabola, Cycloid, Catenary and Membrane deformations.

Learning Outcomes:

After completion of this unit, the student will be able to

- explain the behaviour of different shells of revolution (L5)
- determine the membrane forces in shells (L5)
- develop equation for membrane deformation (L6)

Text Book(s):

1. S. Timoshenko, Wernowsky Krieger, "Theory of Plates and Shells", 2/e, McGraw Hill Education, 2010.
2. G.S.Ramaswamy, "Design and Construction of Concrete Shells", Wiley Online Library, 2005.

References:

1. Flugge, "Stresses in Shells", Springer – Verlag, 2013.
2. P.C. Varghese, Design of Reinforced Concrete Shells and Folded Plates, Prentice Hall India Learning Private Limited, 2010.

Course outcomes

After completion of the course students will be able to

- Evaluate bending moment of plates (L5)
- Analyze circular plates with symmetrical bending (L4)
- Solve rectangular plate problem using different solutions(L6)
- Compare and list different types of shells (L2)
- Develop basic membrane equations for analysis of shell(L6)

19ECE745: THEORY OF STRUCTURAL STABILITY**L T P C****3 0 0 3**

Prerequisite to this course is mechanics and structural analysis. Branch of Structural statics that deals with the character of the response is called stability or instability of structures. Stability of structures or structural elements is an important phase of structural analysis, and consequently, they affect structural stability.

Course Objectives

- Determine critical buckling load carrying capacity of columns using different concepts.
- Analyse beam columns.
- Evaluate critical buckling load carrying capacity of columns using approximate methods.
- Find out critical buckling load on frames.
- Apply different methods to evaluate buckling of plates

Unit I**8L**

Buckling of Columns: Method of neutral equilibrium, Critical load of the Euler column, Linear column theory - An Eigen value problem, Effective length concept, effect of shear stress on buckling, eccentrically loaded columns, Inelastic buckling of columns, Double modulus theory, Tangent modulus theory, Shanley theory of inelastic column behaviour.

Learning Outcomes:

After completion of Module, the student will be able to

- **Determine** the buckling loads for simple columns by analytical solution (**L5**)
- **Infer** the concept of effective length and its use in design (**L2**)
- **Interpret** the behaviour of lateral buckling in beams (**L2**)

Unit II**8L**

Beam columns (Beam columns with concentrated lateral load, distributed, load end moment only couple).

- **Summarise** the behaviour of beam columns (**L2**)
- **Analyze** beam columns for various loads (**L4**)

Unit III**8L**

Approximate methods of analysis: Conservation of energy principles; calculation of critical loads using approximate deflection curve; Principle of stationery potential energy, Raleigh – Ritz method, Buckling load of column with variable cross section, Galerkin's method; stiffness method; effect of axial load on bending stiffness – slope deflection equations, Buckling of column loaded along the length using energy methods.

- **Estimate** the critical loads on columns (**L5**)
- **Determine** the buckling load of column (**L2**)
- **Evaluate** the effect of axial load on bending stiffness (**L5**)

Unit IV**8L**

Buckling of Frames: Modes of Bucking, Critical load of simple frame using neutral equilibrium, Slope deflection equations and matrix analysis.

- **Summarise** the different modes of buckling (**L2**)
- **Determine** the critical load for buckling in frames (**L2**)

Unit V**10L**

Buckling of Plates: Differential equation, Strain energy of bending, Critical load, Finite difference approach inelastic buckling of plates.

Analysis of lateral buckling of plates and shells

- **Determine** the critical load for buckling in plates (**L2**)
- **Interpret** the behaviour of lateral buckling in plates and shells (**L2**)

Text Book(s):

1. Alexander Chajes, “Principles of Structural Stability Theory”, Prentice Hall, 1993.
2. Timoshenko, Gere, “Theory of Elastic Stability”, 2/e, Dover Publication, 2009.

References:

1. Wai-Kai Chen, E. M. Lui, Structural Stability: Theory and Implementation, PTR Prentice Hall(1987)

Course Outcomes

- Evaluate critical buckling load carrying capacity of columns using different concepts(L5)
- Formulate analysis parameters beam columns.(L6)
- Estimate critical buckling load carrying capacity of columns using approximate methods.(L5)
- Determines critical buckling load on frames.(L5)
- Find out buckling of plates by applying different methods.(L1)

19ECE751: FOUNDATIONS FOR DYNAMIC LOADING**L T P C****3 0 0 3**

Preamble: *This course mainly deals with the behavior and properties / response of foundation soil as material subjected to the dynamic or cyclic time dependent loading. It also discuss about different elements in soil dynamics. The concepts of Fundamentals of vibration and analysis, wave propagation through soils during earthquakes, dynamic soil properties , iquefaction of soils under dynamic loads and soil damping were very much essential in the design earthquake or dynamic load sensitive structures. Basics of design principles of machine foundations were also covered in this course.*

COURSE OBJECTIVES:

- 1) **To familiarize** the students with fundamentals of vibrations and damping
- 2) **To study** wave propagation theory and characteristics of seismic/elastic waves.
- 3) **To impart** the knowledge on dynamic properties of soil
- 4) **To demonstrate** liquefaction concepts and its mitigation measures.
- 5) **To acquaint** the design requirements of various foundations subjected to dynamic loading.

UNIT- I**8 Hours**

Elements of Soil Dynamics: Free and forced vibrations with and without damping for single degree of freedom, Natural frequency of foundation soil system – Barken, Pressure bulb concept, Pauw's analogy. Dynamic Magnification factor and logarithm of Decrement.

Learning Outcomes: Students will be able to

- **Explain** the Free and forced vibrations with and without damping for single degree of freedom(L2)
- **Demonstrate** the concepts of various Natural frequency of foundation soil system (L2)
- **Determine** Dynamic Magnification factor and logarithm of Decrement (L5)

UNIT- II**8 Hours**

Wave Propagation: Waves in elastic half space, and characteristics of classification of seismic/elastic waves. Measurement of Shear wave velocity, SASW (Spectral Analysis of Surface Waves) Technique. Vibration Isolation, types, methods and material characteristics pertains to isolation and vibration control. Base Isolation Concepts.

Learning Outcomes: Students will be able to

- **Explain** the characteristics of waves in elastic half space (L2)
- **Classify** seismic and elastic waves (L2)
- **Measure** Shear wave velocity (L5)
- **Demonstrate** Vibration Isolation, types, methods and material characteristics pertains to isolation and vibration control (L2)

UNIT- III**8 Hours**

Elastic Properties of Soil: Determination of Dynamic characteristics of soil by Field and laboratory methods, Stress-Strain characteristics of soil under dynamic loads, Damping properties. Seismic zone map of India. Bearing capacity of soil under dynamic loads by pseudo static analysis.

Learning Outcomes: Students will be able to

- **Determine** the dynamic characteristics of soil by Field and laboratory methods (L5)
- **Inter** the Stress-Strain characteristics of soil under dynamic loads (L2)
- **Analyze** the Seismic zone map of India (L4)
- **Estimate** the bearing capacity of soil under dynamic loads by pseudo static analysis – (L5)

UNIT- IV

8 Hours

Liquefaction and Ground Improvement: Mechanism, conditions vulnerable to liquefaction, Estimation of liquefaction potential in the field, Determination of FOS against liquefaction, CRR, CSR. Factors affecting liquefaction, Anti liquefaction measures, Ground improvement in cohesion less soils – dynamic compaction, Vibroflotation, blasting etc.

Learning Outcomes: Students will be able to

- **Demonstrate** the mechanism, conditions vulnerable to liquefaction, Estimation of liquefaction (L2)
- **Estimate** the liquefaction potential in the field (L5)
- **Determine** the against liquefaction, CRR, CSR (L5)
- **Relate** the factors affecting liquefaction, Anti liquefaction measures (L2)
- **Identify** the Ground improvement techniques for cohesion less soils (L3)

UNIT- V

10 Hours

Foundations: Foundation types and classification, Resonance and its effect, General requirements of machine foundations considering practical point of view. Design Principles, Special foundations for high speed/impact machines.

Learning Outcomes: Students will be able to

- **Classify** the foundation types (L2)
- **Analyze** the effect of Resonance on foundations (L4)
- **Relate** the general requirements of machine foundations considering practical point of view (L2)
- **Design** special foundations for high speed/impact machines (L6)

Text Book(s):

1. Swami Saran, Soil Dynamics & Machine Foundations, 3/e, Galgotia Publications Pvt. Ltd., 2016.
2. Shamsheer Prakash, Soil Dynamics, 3/e, JohnWiley, 2000.

References:

1. Srinivasulu P. and Vydyanathan, Handbook of Machine Foundations, 1/e, Tata McGrawHill Education Pvt. Ltd., 2017.
2. Haussmann, Engineering Principles of Ground Modification, McGrawHill Publications, 2013.
3. Steven L Kramer, Geotechnical Earthquake Engineering, Pearson Education Limited, 1 edition, 2003.

COURSE OUTCOMES:

The student will be able to

1. **Demonstrate** various basic concepts related to vibrations and damping in soil (L2)
2. **Explain** the characteristics of seismic waves and measurement of Shear wave velocity (L2)

3. **Determine** dynamic properties of soil and bearing capacity of soil under dynamic loads (L5)
4. **Explain** the liquefaction mechanism and counter liquefaction measures to be adopted (L2)
5. **Apply** the design principles for foundations subjected to dynamic loading (L3)

19ECE753: BRIDGE ENGINEERING**L T P C****3 0 0 3**

This course enables the student to understand the behaviour and design of bridges. The prerequisite for this course would be Design of Reinforced Concrete Structures and Design of Steel Structures. Fundamental concepts of load transfer and types of loading on bridges are covered. The design of superstructure for both Reinforced Concrete and steel bridges and superstructure is explained. The importance of providing bearings in bridges is justified.

Course Objectives

- Explain basic concepts related to construction of bridges.
- Classify R.C.C. bridges and design culvert and T-beam bridge.
- List design principles of different steel bridges.
- Design substructure of bridge.
- Classify different bearings.

Unit I**8L**

Introduction and Investigation for Bridges: Components Of a Bridge, Classification, Standard Specifications, Need for Investigation, Selection of Bridge Site, Preliminary Data to be Collected, Preliminary Drawings, Determination of Design Discharge, Economical Span, Location of Piers And Abutments, Vertical Clearance Above HFL, Scour Depth, Choice of Bridge Type, Importance of Proper Investigation.

Learning Outcomes:

After completion of this unit, the student will be able to

- discuss basic definitions, types and components of bridges(L6)
- select suitable geographical location and functionality of a bridge(L3)
- examine the preliminary data collected for design of bridge (L4)

Unit II**8L**

Design Consideration of RCC bridges: Various types of bridges (brief description of each type), Design of R.C.C. Culverts (Class 70R loading) and T-Beam Bridges.

Learning Outcomes:

After completion of this unit, the student will be able to

- categorize different types of bridges (L4)
- identify different types of wheel loads acting on bridge deck slab (L3)
- estimate maximum live load bending moment by effective width method (L6)
- design of RCC Slab bridge(L6)
- design of T-beam bridge (L6)

Unit III**8L**

Design Consideration of steel bridges: Various types of steel bridges (brief description of each type), Design of welded plate girder bridge. Design Principles of box girder bridges.

Learning Outcomes:

After completion of this unit, the student will be able to

- illustrate different types of steel bridge (L2)
- design a welded plater girder bridge (L6)

- demonstrate the design principles for box girder bridge (L2)

Unit IV**8L**

Sub Structure for Bridges: Pier and Abutments Caps; Materials for Piers and Abutments, Design of Pier, Design of Abutment, Backfill behind Abutment, Approach Slab.

Learning Outcomes:

After completion of this unit, the student will be able to

- discuss the subsurface investigations required for bridge design (L6)
- analyse the forces in pier design(L4)
- examine the stability of abutment(L4)
- design of approach slab (L6)

Unit V**10L**

Bridge Bearings: General features, types of bearings, design of elastomeric pad bearing.

Learning Outcomes:

After completion of this unit, the student will be able to

- summarize different types of bearing (L2)
- justify the purpose of using bearings (L5)
- design of elastomeric pad bearing (L6)

Text Book(s):

1. D. Johnson Victor, Essentials of Bridge Engineering, 6/e, Oxford and IBH Publishing, 2007.
2. Krishna Raju N., "Design of Bridges", 4th Edition, Oxford & IBH Publishing, 2010.

References:

1. Jagadish. T.R, Jayaram. M.A, "Design of Bridge Structures", 2/e, Prentice Hall of India, 2009.
2. Ponnuswamy.S, Bridge Engineering, 2/e, Tata McGraw Hill Education, 2008.

Course Outcomes

After completion of the course the students will be able to

- Relate basic concepts for construction of bridges (L1)
- Design of a culvert and T-beam bridge (L6)
- Summarize design principles of different steel bridges (L2)
- Analyse and design the substructure for bridge (L4)
- Compare functionality of different bearings (L2)

19ECE755: ADVANCED STEEL DESIGN**L T P C****3 0 0 3**

Prerequisite to this course is design of steel structures. This course deals with the design of Light gauge steel structures, railway steel bridges, composite members and the Gantry girders.

Course Objectives

- To explain the properties of light gauge steel and design various structural elements.
- To identify loads acting on a steel bridges and design a plate girder bridge
- To illustrate behavior of composite members
- To explain the structural behavior of Composite Compression Members and slabs
- To study the Design of Gantry Girder.

Unit I**8L**

Light gauge steel structures: Local buckling of thin sections, Post packing of thin elements, Light gauge steel columns and compression members, Form factor for columns and compression members, Stiffened compression elements, Multiple stiffened compression elements, Unstiffened compression elements effective length of light gauge steel compression members, Basic design stress, Allowable design stress, Light gauge steel beams, Laterally supported light gauge steel beams web crippling. Allowable design stress in beams, Beams subjected to combined axial end bending stress, connections.

Learning Outcomes

After completion of Module I, students will be able to

- **Classify** various types of light gauge sections (L2)
- **Design** beams and columns using Light Gauge Steel sections (L6)

Unit II**10L**

Steel Bridges: Introduction, classification of steel bridges, Loads: Live load for Railway, Highway and combined rail cum road bridges, Impact effect, wind load, lateral force (racking force), longitudinal forces, centrifugal forces, seismic forces, temperature effects. Plate girder bridges: Introduction, types, general arrangement, wind load effects, analysis and design of Deck type plate girder bridge for railways, analysis and design of Half-through plate girder bridge for railways, analysis and design of Through type plate girder bridge for railways

Learning Outcomes

After completion of Module II, students will be able to

- **Classify** various types of steel bridges (L2)
- **Determine** the load on railway bridges (L5)
- **Design** various types of plate girder railway bridges (L6)

Unit III**8L**

Introduction to composite design – shear connectors – types of shear connectors – degrees of shear connections – partial and full shear connections – composite sections under positive bending – negative bending – propped conditions – un-propped conditions – deflection of composite beams.

Learning Outcomes

After completion of Module III, students will be able to

- **Determine** the types of shear connections (L5)
- **Classify** various types of shear connectors (L2)
- **Design** composite beams for various conditions (L6)

Unit IV**8L**

Introduction – Composite slabs – profiled sheeting – sheeting parallel to span – sheeting perpendicular to span - Types of Composite columns – design of encased columns – design of in-filled columns – axial, uni-axial and bi-axially loaded columns.

Learning Outcomes

After completion of Module IV, students will be able to

- **Design** various Composite slabs (L6)
- **Explain** the behaviour of profiled sheeting along and perpendicular to span (L4)
- **Distinguish** various types of Composite Columns (L4)
- **Design** various Composite Columns (L6)

Unit V**8L**

Gantry Girder: Introduction - loading consideration and maximum load effect - selection of gantry girder – design of gantry girders for primary loads only.

Learning Outcomes

After completion of Module V, students will be able to

- **Interpret** loadings to be considered as per standards (L2)
- **Categorize** the critical section to be considered in design (L4)
- **Design** the gantry girder (L6)

Text Book(s):

1. S.K. Duggal, Limit State, Design of Steel Structures, Tata McGraw Hill, 2014.
2. N. Subramanyam, Design of Steel Structures, 1/e, Oxford University Press, 2008

References:

1. R.P. Johnson, “Composite Structures of Steel & Concrete”, Blackwell Scientific publications, UK, 1994.
2. Rama Chandra and Gehlot, V. (2007), Design of Steel Structures Vol. 1 and II, Standard Publication, New Delhi.
3. Punmia, B.C., Jain, A.K. and Jain, A.K. (2015), Comprehensive Design of Steel Structures, Laxmi Publications, New Delhi.

Course Outcomes

By the end of the course the student will be able to:

- Choose appropriate Light Gauge Steel Sections for flexural and compression members (L6)
- Design a plate girder bridge (L6)
- Design of shear connectors (L6)
- Design of composite slabs (L6)
- Design of Gantry Girder (L6)

19ECE757: PRESTRESSED CONCRETE**L T P C****3 0 0 3**

The prerequisite for this course would be Design of Reinforced Concrete Structures. The basic concepts of prestressing, various prestressing systems, analysis of stresses, losses of prestress and design for flexure are explained. The student acquires knowledge about design of a structural member using Indian Standard code. Prestressed concrete is often preferred in construction of bridges, buildings, sanitary, hydraulic, highway, nuclear and marine structures.

Course objectives

- Classify and compare different prestressing methods.
- Determine flexural strength using different methods.
- Evaluate various losses in prestressed concrete members.
- Design prestressed concrete members for flexure.
- Discuss stress distribution in end block.

Unit I**8L**

Introduction and Systems of prestressing

Introduction: Basic concepts of prestressing, Historical Development, Need for high strength steel and concrete, Terminology, Advantages of prestressed concrete, Applications of prestressed concrete. Systems of prestressing: Classification of prestressed concrete. Pre tensioning techniques - long line system (Hoyer system), post - tensioning Techniques (a) Fressinet system and (b) Gifford Udall system.

Learning Outcomes:

After completion of this unit, the student will be able to

- illustrate the development of prestressed concrete (L2)
- define various terminologies (L1)
- compare between different prestressing systems (L4)
- classify methods of prestressing (L2)

Unit II**8L**

Analysis of prestress and Bending stresses:

Basic assumptions, Analysis of prestress, Resultant stresses at a section, Pressure line or thrust line and internal resisting couple, Concept of load balancing, Stresses in tendons, Cracking moment.

Learning Outcomes:

After completion of this unit, the student will be able to

- outline basic assumptions in prestressed concrete members (L2)
- evaluate the resultant stresses at a section (L5)
- determine the location of thrust line (L5)
- discuss load balancing concept (L6)

Unit III**10L**

Losses of Prestress:

Nature of losses of Prestress, Loss due to elastic deformation of concrete, Loss due to shrinkage of concrete, Loss of prestress due to creep of concrete, Loss of prestress due to relaxation of stress in steel, Loss of prestress due to friction, Loss due to Anchorage slip, Total losses allowed for in design.

Learning Outcomes:

After completion of this unit, the student will be able to

- demonstrate various losses in prestressed concrete members (L2)
- distinguish between various losses in prestressed concrete members (L4)
- determine various losses in prestressed concrete members (L5)

Unit IV

8L

Design of prestressed concrete sections: Design of sections for flexure.

Learning Outcomes:

After completion of this unit, the student will be able to

- design the cross section of the beam (L6)
- determine the profile of cable and its eccentricity (L5)
- evaluate the maximum horizontal spacing of cables (L5)

Unit V

8L

Anchorage zone stresses in post-tensioned members:

Introduction, Stress distribution in end block, Investigations on anchorage zone stresses, comparative analysis, Anchorage zone reinforcement.

Learning Outcomes:

After completion of this unit, the student will be able to

- explain the stress developed in anchorage zone of post tensioned members (L5)
- develop stress distribution diagram in end blocks (L6)
- design of anchorage reinforcement (L6)

Text Book(s):

1. N. Krishna Raju, Prestressed concrete, 4/e, Tata McGraw Hill, 2018.
2. G.S. Pandit, Prestressed concrete, CBS Publishers, 2016.

References:

1. P. Dayaratnam, Prestressed Concrete Structures, Oxford and IBH Publishing Company, 2014.
2. T.Y. Lin, H. Ned, Burhns, Design of Prestressed Concrete Structures, 3/e, John Wiley and Sons, 2010.
3. H. Arthur, Nilson, Design of prestressed concrete, Wiley India Pvt.ltd, 2011.
4. J.R. Libby, Modern Prestressed concrete, CBS Publishers, 2007.

Course Outcomes

- distinguish between different prestressing methods. (L4)
- evaluate flexural strength of prestressed concrete beams(L5)
- estimate various losses in prestressed concrete members(L5)
- design prestressed concrete members(L6)
- construct stress distribution diagram in end block(L6)

19ECE742: DISASTER MANAGEMENT AND PREPAREDNESS**L T P C****3 0 0 3**

This course is intended to provide fundamental understanding of different aspects of Disaster Management. It will expose the students to the concept and functions of Disaster Management and to build competencies of Disaster Management professionals and development practitioners for effective supporting environment as put by the government in legislative manner. It would also provide basic knowledge, skills pertaining to Planning, Organizing and Decision-making process for Disaster Risk Reduction.

Course Objectives:

To develop ability to

- Define various terms related to disaster management (DM), Explain DM cycle, Classify Disasters.
- Outline vulnerability of profile of India, disaster risk reduction (DRR).
- Explain the significance of regulations of DM.
- Understand the significance of disaster resistant construction.
- Interpret the landslide hazard in India.

Unit I**8L**

Concept of Disaster Management: Terminology of Disaster Management (DM), Classification of Disasters, Disaster Management Cycle, urban disasters.

Learning Outcomes:

By the end of this unit, the student will be able to

- Define various terms related to disaster management (L-1).
- Explain DM cycle (L-2).
- Classify Disasters (L-2).
- Identify the causes of urban disasters (L-3).

Unit II**8L**

Overview of disaster scenario in India: Vulnerability of profile of India with respect to various disasters, vulnerability mapping, approaches to disaster risk reduction (DRR), Components of disaster relief.

Learning Outcomes:

By the end of this unit, the student will be able to

- Explicate the vulnerability profile and vulnerability mapping of India (L-2).
- Explain the approaches to DRR (L-2).
- Outline the components of disaster relief (L-2).

Unit III**8L**

Regulations of Disaster Management: Disaster Management Act 2005, National Policy on Disaster Management 2009, National Disaster Management Plan 2016, Organizational structure of disaster mitigation agencies at various levels.

Learning Outcomes:

By the end of this unit, the student will be able to

- Explicate various acts and policies related to DM (L-2).
- Explain the organizational structure of disaster mitigation agencies at various levels (L-2).

Unit IV**10L**

Disaster Resistant Construction: Seismic response of R.C frames, buildings with soft first storey, lateral strength of masonry walls, cyclone resistant house for coastal areas, response of buried steel pipelines carrying water subjected to earthquake ground motion.

Learning Outcomes:

By the end of this unit, the student will be able to

- Identify the salient features of disaster resistant construction (L-3).

Unit V**8L**

Landslide Hazard in India: Landslide Hazard Zonation (LHZ) mapping, Casual factors of Landslides, geo-environmental problems associated with the occurrence of landslides, landslide hazard in the Himalayas.

Learning Outcomes:

By the end of this unit, the student will be able to

- Explain the use of LHZ in management of Landslide hazards (L-2).
- Identify geo-environmental problems associated with landslides (particularly in the Himalayas) (L-3).

Text Book(s):

1. N. G. Dhawan and A. S. Khan, Disaster Management and Preparedness, 1/e, CBS Publication, 2014.
2. R. K. Dave, Disaster Management in India: Challenges and Strategies, Prowess Publishing, 2018.

References:

1. M. M. Sulphey, Disaster Management, 1/e, Prentice Hall of India, 2016.
2. M. Pandey, Disaster Management, 1/e, Wiley India, 2014.
3. R. B. Singh, Natural Hazards and Disaster Management: Vulnerability and Mitigation, Rawat Publications, 2006.

Course Outcomes

By the end of this course, the student will be able to

- Explain DM cycle (L-2).
- Compare vulnerability of profile of India with respect to various disasters (L-2).
- Illustrate the organizations structure of disaster mitigation agencies (L-2).
- Identify the salient features of disaster resistant construction (L-3).
- Identify geo-environmental problems associated with landslides (particularly in the Himalayas) (L-3).

19ECE744: COMPREHENSIVE DISASTER RISK MANAGEMENT**L T P C****3 0 0 3**

This is an introductory course which gives an overview of the major disaster risk management issues. It provides an awareness of the growing risk of natural disasters and the risk reduction. The course reviews the hazard mapping, disaster management cycle, stake holder analysis and international legislation. It also demonstrates the role of national and local actors in the processes related to risk assessment.

Course Objectives:

To develop ability to

- Understand hazard and risk management.
- Outline the various components of the disaster management cycle.
- Explain the significance of stakeholder analysis.
- Understand the significance of Disaster Risk Reduction.
- Understand the significance of International Legislation.

Unit I**8L**

Hazard Mapping and Risk Management: Terminology of Disaster Risk Management (DRM), hazard mapping, multi-hazard mapping - sources of hazard information, role of GIS, limitations, overlay hazard mapping, interpretation of hazard information, scale and coverage, types of symbols, emergency preparedness planning, hazard vulnerability assessment (HVA), risk assessment.

Learning Outcomes:

- To list out terminology of disaster risk management (L1)
- To demonstrate hazard mapping (L2)
- To assess the risk of hazard (L5)

Unit II**8L**

Components of Disaster Management Cycle: Disaster prevention, mitigation - Pre-Disaster Mitigation Efforts, preparedness - Education, Outreach and Training, Business Continuity & Emergency Management Planning, disaster response - Immediate Response to Stakeholders Establish Business Recovery Center and relief, recovery - Post-Disaster Economic Recovery Plan.

Learning Outcomes:

- To summarize disaster prevention (L2)
- To demonstrate the preparedness (L2)
- To demonstrate emergency management planning (L2)

Unit III**8L**

Stakeholder Analysis: Multi-stakeholder approach, advocacy coalition framework (ACF), subsystem boundaries, belief systems, key actors.

Disaster Communication: Communication as a key to resilience, communication technologies, Policy and Institutional Framework for Emergency Communications.

Learning Outcomes:

- To list out various communication technologies (L1)
- To examine policy and institutional framework for emergency Communications (L4)

- To summarize various types of stake holder analysis (L2)

Unit IV**10L**

Disaster Risk Reduction (DRR): Mobilization and allocation of resources in DRR, Strategies to Strengthen DRR.

Disaster and Crisis counselling: Resources for disaster and crisis counselling, mainstreaming disaster risk reduction into development efforts, developing potential for posttraumatic growth, focus on victims' strengths, wellness and capacity for positive change, building coping capacity.

Learning Outcomes:

- To list out strategies to strengthen DRR (L1)
- To list out resources for disaster and crisis counseling (L1)
- To develop potential for posttraumatic growth (L6)

Unit V**8L**

International Legislation: International Policies, regulations, Acts related to Disaster Management in some of the most severely disaster prone countries.

Learning Outcomes:

- To demonstrate international policies (L2)
- To demonstrate regulations (L2)
- To summarize acts related to disaster management (L2)

Text Book(s):

1. N. G. Dhawan, A. S. Khan, Disaster Management and Preparedness, 1/e, CBS Publication, 2014.
2. R. K. Dave, Disaster Management in India: Challenges and Strategies, Prowess Publishing, 2018.

References:

1. M. M. Sulphery, Disaster Management, 1/e, PHI Learning, 2016.
2. M. Pandey, Disaster Management, 1/e, Wiley India, 2014.
3. R. B. Singh, Natural Hazards and Disaster Management: Vulnerability and Mitigation, Rawat Publications, 2006.

Course Outcomes

- Understand hazard mapping and risk management (L-2).
- Explain DM cycle (L-2).
- Identify measures of disaster communication (L-3).
- Identify the salient features of disaster resistant construction (L-3).
- Illustrate the organizations structure of disaster mitigation agencies. (L-3).

19ECE746: URBAN DISASTER MITIGATION ENGINEERING**L T P C****3 0 0 3**

The natural disaster to urban areas is becoming complex and difficult to predict and so the risk of the disaster has also risen. Therefore, it is necessary to understand the integrated disaster mitigation measures before the disaster, immediately after the disaster, and long after the disaster. This course provides knowledge on critical Issues in urban disaster management, functioning of various disaster management authorities, disaster risk mitigation measures in Indian cities, disaster resilient infrastructure.

Course Objectives:

To develop ability to

- Understand urban disasters
- Outline the critical issues in urban disaster management.
- Explain the functioning of various urban disaster management authorities.
- Understand the urban disaster risk mitigation measure sin Indian cities.
- Understand the various methods to develop disaster resilient infrastructure.

Unit I**8L**

Introduction to Urban Disasters: Features of urban systems, role of urbanization in the occurrence of disaster events, urban disaster management, disaster response in a rapidly changing urban environment, urban disaster risk reduction (UDRR), and learnings from recent urban disasters.

Learning Outcomes:

- To examine features of urban systems (L4)
- To summarize urban disaster management (L2)
- To assess urban disaster risk reduction (L5)

Unit II**8L**

Critical Issues in Urban Disaster Management: Implications of urban disasters, urban security issues, sociotechnical challenges, disaster management in megacities, consequences of climate change, upgrading urban disaster preparedness, development of novel risk-management strategies, comprehensive approach to UDRR.

Learning Outcomes:

- To outline urban security (L2)
- To summarize disaster management in megacities (L2)
- To develop novel risk-management (L3)

Unit III**8L**

Functioning of various Disaster Management Authorities: Organizational structure of Disaster Management agencies in India, Japan, Indonesia, Nepal, USA – roles and responsibilities at various levels.

Learning Outcomes:

- To summarize organizational structure of disaster management agencies in India (L2)
- To summarize organizational structure of disaster management agencies in Japan, Indonesia, Nepal, USA (L2)

- To list out roles and responsibilities (L1)

Unit IV**8L**

Disaster Risk Mitigation Measures in Indian Cities: Advanced early warning systems, multi-disciplinary and multi-sectoral approach in urban disaster risk management, incorporation of UDRR measures in the developmental plans and strategies, institutional and policy mechanisms for carrying out response, relief and rehabilitation activities, human resource development.

Learning Outcomes:

- To list out advanced early warning systems (L1)
- To apply UDRR measures in the developmental plans and strategies (L3)
- To outline relief and rehabilitation activities (L2)

Unit V**10L**

Disaster Resilient Infrastructure: Sendai Framework for Disaster Risk Reduction, necessity of creating disaster resilient infrastructure - good practices, development of risk assessment methodologies, risk metrics and indicators of sustainability for different infrastructure classes, issues of standards, design and regulation for infrastructure development, operations and maintenance, financing for disaster resilient infrastructure.

Learning Outcomes:

- To assess the need for creating disaster resilient infrastructure (L5)
- To outline good practices (L2)
- To understand maintenance for disaster resilient infrastructure (L2)

Text Book(s):

1. N. G. Dhawan and A. S. Khan, Disaster Management and Preparedness, 1/e, CBS Publication, 2014.
2. R. K. Dave, Disaster Management in India: Challenges and Strategies, Prowess Publishing, 2018.

References:

1. M. M. Sulphey, Disaster Management, 1/e, PHI Learning, 2016.
2. M. Pandey, Disaster Management, 1/e, Wiley India, 2014.
3. R. B. Singh, Natural Hazards and Disaster Management: Vulnerability and Mitigation, Rawat Publications, 2006.

Online Resources:

1. Online Courses on Disaster Management, National Institute of Disaster Management in partnership with the World Bank (GFDRR), Washington. <https://nidm.gov.in/online.asp>
2. Disaster Management, Swayam,
3. MHRD, AICTE. <https://swayam.gov.in/courses/4983-disaster-management>
4. Disaster Risk Reduction and Management, ReliefWeb, UNOCHA. <https://reliefweb.int/training/2455444/free-online-course-disaster-risk-reduction-and-management>

Course Outcomes

- Understand the concept of urban disasters (L-2).
- Explain the critical issues in urban disaster mitigation and management (L-2).
- Identify the various national and international disaster management authorities (L-3).

- Illustrate the Disaster Risk Mitigation Measures in Indian Cities. (L-3).
- Identify the salient features of disaster resistant construction (L-3).

19ECE748: WIND ANALYSIS AND DESIGN OF TALL STRUCTURES**L T P C****3 0 0 3**

To study the behaviour, analysis and design of tall structures. At the end of this course the student should have understood the problems associated with large heights of structures with respect to loads (wind and earthquake and deflections of the structure). This course also familiarizes the students with design of industrial structures like Towers, steel and R.C.C Chimneys.

Course Objectives

- To **estimate** the wind load on structures based on relevant standards .
- To **infer** the behavior of shear wall .
- To **Interpret** the various loads acting on towers and their effect on the design of towers.
- To **explain** the structural behavior of RCC & Steel Chimneys due to Wind Loading.

Unit I**8L**

Introduction: Basic wind speed, Design wind speed, Design wind pressure, offshore wind velocity, Wind pressures and forces in buildings/ structures. External pressures coefficients for various roofs, Dynamic effects. Design of Tall Buildings: Analysis of tall building for lateral loads, cantilever method, Portal method, Factor method;

Learning outcomes:

After completion of this unit, the student will be able to

1. Estimate wind force on a structure based using relevant standards (L5).
2. Calculate dynamic wind forces(L6).
3. Analyse tall buildings using different methods (L4)

Unit II**8L**

Design of shear wall: Introduction, Types of shear walls, behaviour of cantilever walls with rectangular cross section, Flange cantilever shear walls, Moment – Axial load interaction for shear wall section, Interaction of shear walls and Rigid jointed frames, Shear walls with openings, Coupled shear walls.

Learning outcomes:

After completion of this unit, the student will be able to

1. Understand different types of shear walls and its use in structures(L2).
2. Analysis and Design a shear wall(L4)

Unit III**10L**

Design of Steel Towers: Introduction, Loads on towers, Analysis of towers, Masts, Stresses in towers due to vertical loads and horizontal loads, Design of members in towers, Design of foundations.

Learning outcomes:

After completion of this unit, the student will be able to

1. Understand different types of loads acting on towers(L2).
2. Analysis of towers, Masts (L4)
3. Identify Stresses developed in towers due to vertical and horizontal loads(L3)
4. Design of individual members in tower by relevant standards(L6).
5. Design a tower and its foundation((L6)

Unit IV**8L**

Design of Chimneys (RCC): Introduction, Wind pressure, Stresses in chimney shaft due to self- weight and wind, Stress in horizontal reinforcement due to wind shear, Stresses due to temperature difference. Design of RC chimney.

Learning outcomes:

After completion of this unit, the student will be able to

1. Calculate wind pressure acting on Chimneys(L5)
2. Calculate stresses due to self-weight, wind and temperature (L5).
2. Analysis and Design a R.C.C Chimneys(L4).

Unit V**8L**

Design of steel chimneys: Introduction, Types of chimneys, Forces acting on steel chimneys, design of various components, Stability of steel chimney.

Learning outcomes:

After completion of this unit, the student will be able to

1. Understand different types of steel chimneys (L2).
2. Calculate forces acting on chimney due to various components (L5).
2. Analysis and Design a Steel Chimneys (L4).

Text Book(s):

1. Ramachandra, “Design of Steel Structures”, Vol – 2, 9/e, Scientific Publishers, 2010.
2. R. Park, T. Paulay, “Reinforced Concrete Structures”, John Wiley and Sons, 2009.

References:

1. B. C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, “Reinforced Concrete Structures”, 7/e, Laxmi Publications, 2015.
2. S. N. Manohar, “Tall Chimneys”, Tata Mc Graw Hill Publishers, 1985.

Course Outcomes

By the end of the course the student will be able to:

- Determine the wind load on structures based on relevant standards (L5)
- Design of shear wall (L6)
- Infer the various loads acting on towers and their effect on the design of towers (L3)
- Design of Steel & RCC Chimney (L6)

19ECE750: INFRASTRUCTURE PLANNING

LTPC

3 0 0 3

This course attempts to introduce students to 'real world' risks and challenges in managing infrastructure. After a brief introduction to the infrastructure planning process as well as the state of infrastructure across sectors in India, we systematically look at various processes and evaluations that undergird infrastructure projects and their planning. We then look at a variety of real-world case studies and novel solutions or fixes that can help us execute infrastructure projects better. The course also involves one or more guest lectures to ensure that what is being discussed is practically applicable. The students would be made industry ready with relevance to construction organisations such as L&T, GMR Infra, consulting firms such as PwC, Deloitte, Quasi-Government Bodies etc., or can become planning and management consultants.

Course Educational Objectives:

1. To familiarise the students with the concepts of the infrastructure and its planning activities.
2. To emphasise the Indian infrastructure development and equip abilities to select the best alternative by using scientific methodologies.
3. To enable the student to understand the economic evaluation of infrastructure projects
4. To enable the student to understand the financial evaluation of infrastructure projects
5. To equip the student to make the infrastructure planning process and decision-making with the use of real project analysis cases

UNIT 1	Introduction to Infrastructure Planning	7 Hours
---------------	--	----------------

Definitions of infrastructure; Economic multiplier effects of infrastructure; Typical infrastructure planning steps; Planning and appraisal of major infrastructure projects; Screening of project ideas; Life cycle analysis;

UNIT 2	Infrastructure Scenario in India and Alternative Selection	8 Hours
---------------	---	----------------

The Infrastructure Scenario in India, Urban Infrastructure in India, The Power Sector in India, The Water Sector in India, Transportation Infrastructure, Telecommunications sector in India, Rural Infrastructure in India, Road Infrastructure, Development in India, Rural Road Development in India - Opportunities and Challenges, Key Issues - Sector-wise;

Multi-criteria analysis for comparison of infrastructure alternatives;

UNIT 3	Economic Analysis	8 Hours
---------------	--------------------------	----------------

Economic Analysis – Concepts and Applications, Principles of methodologies for economic analysis of public works, Social welfare function, indifference curves and trade-offs, Demand curves and price elasticities; Benefit-cost ratio and internal rate of return; Shadow pricing; Accounting for risk and uncertainty;

UNIT 4**Financial Evaluation****8 Hours**

Financial Evaluation - Time value of money, Investment criteria, Project cash flows – elements and basic principles of estimation, Financial estimates and projections, Cost of capital, Rate of return;

UNIT 5**Project Analysis and Student Case Studies****8 Hours**

Project risk analysis; Political and social perspectives of infrastructure planning;

Case studies from developed and developing countries of notable megaprojects, smart city projects, major urban infrastructure projects etc. Student presentations on hypothetical case studies (or) with problem-based learning methodology

Textbooks:

1. Goodman, A., & Hastak, M. 2015. *Infrastructure Planning, Engineering, and Economics* (2nd ed.). New York: McGraw Hill Professional and ASCE Press.
2. J. Parkin and D. Sharma, *Infrastructure planning*, Thomas Telford, London, 1999.

References:

1. P. Chandra, *Projects: Planning, analysis, selection, financing, implementation, and review*, Tata McGraw-Hill, New Delhi, 2009.
2. J. D. Finnerty, *Project financing - Asset-based financial engineering*, John Wiley & Sons, New York, 1996.
3. L. Squire and H. G. van der Tak, *Economic analysis of projects*, John Hopkins University Press, London, 1975.
4. T. J. Webster, *Managerial economics: Theory and practices*, Elsevier, New Delhi, 2003.

Course Further Reading:

1. Haldea, G. 2011. *Infrastructure at crossroads: The challenges of governance*. Oxford University Press.

Course Outcomes:

1. At the end of unit 1, the student will be able to understand and identify the various kinds of infrastructure projects, the key requirements, and the planning steps.
2. At the end of unit 2, the student realises the infrastructure demand-supply gap in India concerning all major sectors of infrastructure and applies scientific tools to identify the best alternative among available options
3. At the end of unit 3, the student performs economic analysis and develops economic models for any infrastructure project
4. At the end of unit 4, the student can design financial evaluations and develop financial models for a given infrastructure project.
5. At the end of unit 5, the student will be able to understand, assimilate, and deploy infrastructure planning concepts and methodologies to real projects/contexts.

CO-PO Mapping:

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

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

19ECE760: INFRASTRUCTURE FINANCE, VALUATION, AND CONTRACTS**L T P C****3 0 0 3**

This course has three-pronged objectives. The first and main objective of the course is to provide an understanding and appreciation of a financing technique that is widely used to finance infrastructure projects today. This course will provide exposure to this innovative financing method - Project Finance, and its applicability and utility across industries. The objective of this course is to give exposure to the world of project finance with particular reference to PPPs in infrastructure.

The course also provides students with the concepts such as valuation, various types of construction contracts, claims and disputes. The course uses real case studies to illustrate the concepts, use guest lectures when relevant and encourages student case study presentations at the end of the course.

Course Objectives:

1. To familiarise the students with the concepts of infrastructure development and its funding.
2. To emphasise the project financing model of infrastructure development to equip the analysis of private financing of public infrastructure projects.
3. To enable the student to how to evaluate the existing construction assets.
4. To enable the student to understand different types of contracts used in major infrastructure projects across the globe.
5. To equip the student to understand various kinds of claims and disputes to know the solutions of various kind of construction projects so as to apply to real project analysis cases.

UNIT 1	Introduction to Infrastructure Finance	7 Hours
---------------	---	----------------

Introduction to infrastructure financing; Means of financing – public finance and private finance; Procurement of infrastructure projects through Public Private Partnership route – Types of PPP models, Contractual structure of PPP projects, Value for money evaluation, Lifecycle of PPP projects, PPP procurement process;

UNIT 2	Project Finance	8 Hours
---------------	------------------------	----------------

Financing infrastructure projects with private capital - Introduction to project finance concept, Analysing project viability, designing security arrangements, Structuring the project, Preparing project financing plan;

UNIT 3	Valuation	8 Hours
---------------	------------------	----------------

Property Appraisal, Valuation and its importance, Direct Capital Valuation Method, Land and building method, Development Valuation of Properties, Income method of Valuation, Profit Method of Valuation, Investment Method of Valuation, Valuation of Residential Property, Valuation for Taxation or Rating, Valuation for Compulsory Purchase.

UNIT 4	Contracts	8 Hours
---------------	------------------	----------------

Standard forms of contracts used in India and abroad; Owner- construction contractor prime contract, labour agreements; purchase order and subcontract agreements; contracts, agreements, bonds, bids and proposals; contract changes - pre and post-award; delays,

suspensions, and terminations; common rules of contract interpretation; Problems in the operation of contracts, Enforcement of contracts, Incentive mechanism in contracts.

UNIT 5**Claims and Disputes and Student Case Studies****8 Hours**

Claims and disputes, Claim process, Dispute resolutions, Arbitration settlements, Litigation on contracts, Case studies on arbitration and litigations in contracts.

Case studies from developed and developing countries & Student presentations on various case studies

Textbooks:**Infrastructure Finance**

1. E.R. Yescombe, Principles of Project Finance, Academic Press, 2002.
2. Akintoye, M. Beck and C. Hardcastle, Public-Private Partnerships - Managing risks and opportunities, Oxford: Blackwell Science Limited, 2003.

Valuation

3. Rangawala. 2015. Valuation of Real Properties Charotar Publishing House; 10th edition, 978-9385039010

Contracts

4. Hughes, W., Champion, R., & Murdoch, J. 2015. Construction Contracts: Law and Management (5th ed.). Oxon: Routledge.
5. D.S. Berrie and B.C. Paulson, Professional Construction Management including C.M., Design Construct And General Contracting, Third edition, McGraw Hill International edition, 1992.
6. Various National Codes/Legislations/Standards

References:

1. J. D. Finnerty, Project Financing - Asset-Based Financial Engineering. New York: John Wiley & Sons, Inc, 1996.
2. T. Merna and C. Njiru, Financing Infrastructure Projects, Thomas Telford, 2002.
3. P. K. Nevitt, and F. J. Fabozzi, Project Financing, Euromoney Books, 7th Ed., 2000.
4. G. Raghuram, R. Jain, S. Sinha, P. Pangotra, and S. Morris, Infrastructure Development and Financing: Towards a Public-Private Partnership, MacMillan, 2000.
5. R. Tinsley, Project Finance in Asia Pacific: Practical Case Studies, Euromoney Books, 2002.
6. UNIDO, Guidelines for Infrastructure Development through Build-Operate-Transfer (BOT) Projects, UNIDO, Vienna, 1996.
7. Walker, and A.J. Smith, Privatised Infrastructure: the Build Operate Transfer Approach, Thomas Telford, 1995.
8. L. Squire and H.G. Van der Tak, Economic Analysis of Projects, John Hopkins University Press, 1975.

Course Outcomes:

1. At the end of unit 1, the student will be able to understand the concepts of funding infrastructure projects
2. At the end of unit 2, the student realises and will be applied project finance concepts with an understanding to develop financial models for projects.

3. At the end of unit 3, the student performs valuation of projects with standard methods
4. At the end of unit 4, the student can design or suggest suitable contracts for a given scope of work.
5. At the end of unit 5, the student will be able to understanding and apply claims and disputes to devise strategies that prevent disputes.

19ECE752: FIRE RESISTANT DESIGN OF STRUCTURES**L T P C****3 0 0 3**

The prerequisite for this course would be design of Reinforced concrete and Steel Structures. The learner will familiarize with different properties of materials for fire resistance. It deals with the design of assemblies, steel and RCC buildings exposed to fire. The learner will gain knowledge in estimating the fire resistance ratings of various components of the building. This course gives confidence for the learners to design the structures with significant fire resistance.

Course Objectives

- Explain basic properties of materials for fire resistant design
- Design of structural assemblies exposed to fire
- Design of steel buildings exposed to fire
- Evaluation of fire resistance rating of materials
- Design of concrete members exposed to fire

Unit I**8L**

Materials Properties in fire, Classification systems for high temperature concretes. Design of Structures at normal temperatures – Loads, Structural analysis, Material Properties, Probability of failures. Design of structures under fire conditions – Design equate loads for fire design, structural analysis.

Learning Outcomes

- To illustrate the properties of materials in fire (L2)
- To demonstrate design of structures at normal temperatures (L2)
- To explain probabilities of failures (L5)

Unit II**8L**

Design structural assemblies exposed to fire – Frames – Redundancy – Disproportionate collapse – continuity – plastic design.

Learning Outcomes

- To design structural assemblies exposed to fire (L6)
- To demonstrate the redundancy (L2)
- To illustrate plastic design (L2)

Unit III**8L**

Design of steel buildings exposed to fire – Multi-storey steel framed buildings.

Learning Outcomes

- To design various components of steel buildings exposed to fire (L6)
- To design simple steel buildings exposed to fire (L6)
- To design multi-storey steel framed buildings exposed to fire (L6)

Unit IV**8L**

Fire resistance ratings, verification methods, Generic ratings Projection system Mechanical properties of concrete at elevated temperature Test methods, Components of strain, Thermal strain, Stress related strain.

Learning Outcomes

- To assess the fire resistance ratings of various components of a building (L5)
- To summarise various mechanical properties of concrete at elevated temperatures (L2)
- To illustrate various testing methods for assessment of fire resistance (L2)

Unit V**10L**

Design of Concrete members exposed to fire member design, Simply supported slabs and beams, Tension and compression members. Design of individual members exposed to fire – Tension members – Compression members – Beams.

Learning Outcomes

- To design simply supported slabs exposed to fire (L6)
- To design beams exposed to fire (L6)
- To design tension and compression members exposed to fire (L6)

Text book(s):

1. Jain, V. K., “Fire Safety in Buildings”, 2/e, New Age Publishers, 2013.
2. Andrew H. Buchanan, “Structural Design for Fire safety”, Wiley – Blackwell, 2001.

References:

1. G.M. Newman and R.M. Lawson, Fire Resistant Design of Steel Structures: A Handbook to BS 5950 (1990).

Course outcomes

- Summarize the basic properties of materials for fire resistant design(L2)
- Design structural assemblies exposed to fire(L6)
- Design steel buildings exposed to fire(L6)
- Find out fire resistance rating of materials(L1)
- Determine size of concrete members exposed to fire(L5)

19ECE754: HYDRAULIC STRUCTURES**L T P C****3 0 0 3**

The main aim of this course is to have a comprehensive knowledge on hydraulic structures such as gravity dams, earth dams, spillways. The learner will gain the knowledge on the principles of stability analysis of gravity dams and earth dams. The learner will familiarize with the concepts of safety criteria and seepage analysis of earth dams. The learner will understand the over view of spillways and design principles of stilling basins. The learner will gain the knowledge on flood forecasting techniques and water conductor system.

Course Objectives:

This course provides an over view of hydraulic structures

- To explain the forces acting on gravity dam, seepage analysis of earth dam
- To teach the principles of stability analysis of Gravity dams and Earth dams
- To solve the problems related to stability analysis of gravity dam and earth dam
- To provide an over view about Spillways and Energy Dissipation
- To impart the skill about flood frequency analysis and Flood routing in reservoirs and rivers
- To design the intake structure of sluice of gravity dam.

Unit I**10L**

Gravity Dams: Classification of dams, gravity dams: forces acting, elementary profile, safety criteria, stability analysis of gravity dam including earthquake effects, construction joints, openings in dams-galleries, foundation treatment of gravity dam.

Learning outcomes:

- Estimate the forces acting on gravity dams (L-2)
- Check the stability of gravity dams (L-3)
- Apply the stability criteria of dams (L-4)

Unit II**8L**

Earth Dams: Types, causes for failure of earth dams, phreatic line, seepage analysis for homogeneous dams, stability analysis of earth dam by slip circle method, seepage control in earth dams.

Learning outcomes:

- Illustrate the causes of failure of earth dams (L-1)
- Estimate the seepage flow through earth dams (L-2)
- Check the stability of earth dams (L-3)

Unit III**8L**

Spillways: Essential requirements, spillway capacity, components, types of spillways and their working, design of ogee spillway, spillway crest gates, energy dissipation below spill way, use of hydraulic jump as energy dissipator – design of stilling basins – IS standard basins.

Learning outcomes:

- Illustrate the types and components of spillways (L-1)
- Estimate the profile of ogee spillway (L-2)
- Design the stilling basin (L-3)

Unit IV**8L**

Floods: Estimation of design flood, flood frequency analysis – Gumble's distribution method, Flood routing in reservoirs and rivers.

Learning outcomes:

- Estimate the design flood (L-2)
- Apply the flood frequency analysis (L-3)
- Compute the flood hydrograph through flood routing (L-4)

Unit V**8L**

Water Conductor System: Intake Structure, Trash rack, Design of trash Rack, intakes through Concrete dam, Design of Intake Structure.

Learning outcomes:

- Illustrate the components of water conductor system (L-2)
- Design the trash Rack (L-3)
- Design the Intake Structure (L-3)

Text Book(s):

1. B.C.Punmia, PandeB.B.Lal, Ashok Kumar Jain, Arun Kumar Jain, Irrigation and Water Power Engineering, 16/eLaxmi Publications, 2009.
2. S.K.Garg, Irrigation Engineering, and Hydraulic Structures, Khanna Publishers, 1987.

References:

1. P.N. Modi, Irrigation Water Resources and Water Power Engineering, 7/e, Standard Book House, 2008.
2. Ch.SatyanarayanaMurty, Water Resources Engineering, 2/eNew Age international publishers, Delhi, 2002.
3. K.R. Arora, Irrigation, Water Power and Water Resources Engineering,4/e, Standard Book Publishing, Delhi ,2018.
4. R.S.Varshney, S.C. Gupta, and R.L. Gupta, Theory & Design of Irrigation Structures, Vol.II, Chand &Bros.1987.
5. VenTe Chow, D. R. Maidment and L.W. Mays, Applied Hydrology, McGraw-Hill Books company, New Delhi.2017.

Course Outcomes:

At the end of course the students will be able to

- Estimate the forces acting on gravity dams (L-2)
- Check the stability of gravity dams and earth dams (L-3)
- Apply the stability criteria of dams (L-4)
- Compute the flood hydrograph through flood routing (L-4)
- Design the intake structure of sluice of gravity dam (L-6)

19ECE756: EARTHQUAKE ENGINEERING**L T P C****3 0 0 3**

Earthquake engineering is a branch of engineering that designs and analyzes structures, such as buildings and bridges, with earthquakes in mind. Its overall goal is to make such structures more resistant to earthquakes. An earthquake (or seismic) engineer aims to construct structures that will not be damaged in minor shaking and will avoid serious damage or collapse in a major earthquake. Earthquake engineering is the scientific field concerned with protecting society, the natural environment, and the man-made environment from earthquakes by limiting the seismic risk to socio-economically acceptable levels.

Course Objectives

- To explain the causes of earthquake and its consequences
- To interpret response spectra and design spectra
- To distinguish between Response History and response spectra analysis
- To determine the seismic force acting on Multi-storey structure
- To explain the structural behaviour of Water towers & Stack like structures due to Seismic excitation

Unit I**8L**

Earthquakes, Epicenter, Hypocenter and earthquake waves, Measurement of ground motion, Seismic Regions, Intensity and Isoseismals of an earthquake, Magnitude and energy of an earthquake, Consequences of earthquakes, Seismic zoning, Seismic effects on structure.

Learning outcomes:

After completion of this unit, the student will be able to

1. Explain the reasons for earthquakes (L2).
2. How to measure the intensity of earthquake (L1)
3. Understand where in the world earthquakes are most likely to occur (L2).
4. Differentiate between earthquake intensity and earthquake magnitude (L5).
5. Consequences of earthquake on structures (L4).

Unit II**10L**

Earthquake Response of Linear Systems: Earthquake excitation, Equation of motion, Response quantities, Response history, Response spectrum concept, Deformation, Pseudo-velocity, and Pseudo-acceleration, Response spectra, Peak structural response from the response spectrum, Response spectrum characteristics, Elastic design spectrum, comparison of design and response spectra, Distinction between design and response spectra, velocity and acceleration response spectra.

Learning outcomes:

After completion of this unit, the student will be able to

1. Develop equations to calculate earthquake force (L3).
2. Understand different concepts developed to estimate earthquake forces (L2).
3. Differentiate between velocity and acceleration (L5).

Unit III**8L**

Earthquake Analysis of Linear Systems:

Part-A: Response history analysis, Modal analysis, Multistorey buildings with symmetric plan. Multistorey buildings with unsymmetric plan, Torsional response of symmetric plan builds, structural idealization and earthquake response. Part-B: Response Spectrum Analysis: Peak response from earthquake response spectrum, Multistorey buildings with symmetric plan, Multistorey buildings with unsymmetric plan.

Learning outcomes:

After completion of this unit, the student will be able to

- Interpret the response history for a given earthquake excitation (L5)
- Construction of response spectrum (L6)
- Relate Deformation, Pseudo-velocity and Pseudo-acceleration spectra (L1)
- Estimate peak structural response quantities (L5)

Unit IV**8L**

Earthquake Response of Linear Elastic Buildings: Systems analysed, Design spectrum and response quantities, Influence of T_1 and p on response, Modal contribution factors, Influence of T_1 on higher mode response. Influence of p on higher-mode response, Height wise variation of higher-mode response, no of modes to include.

Aseismic Design of Structure: Design data and philosophy of design, Seismic coefficients. Permissible increase in stresses and load factors, Multistorey buildings, Base shear, fundamental period of buildings, distribution of forces along the height.

Learning outcomes:

After completion of this unit, the student will be able to

1. Understanding the behaviour of structure during the phase of earthquake (L2).
2. Different types of coefficients to be considered while estimating earthquake forces (L5).
3. Distributing earthquake forces to different levels of the multi-storey building (L4).

Unit V**8L**

Dynamic analysis of structures, Effective weight considerations. Earthquake resistant construction of buildings, Ductility provisions in reinforced concrete construction.

Earthquake analysis of Water towers: Introduction, Behaviour under earthquake loads, Design features, Water tower as a rigid jointed space frame, Hydrodynamic pressures in tanks. Earthquake analysis of Stack like structures: Introduction, Fundamental period of vibration, Dynamic bending moment, Shear diagram

Learning outcomes:

After completion of this unit, the student will be able to

1. Understand dynamic analysis of earthquake and its effect on structures (L2).
2. Effect of hydrodynamic water pressure on surface of water tank (L4).
3. Design of water tanks under the effect of earthquake loads (L6).

Text Book(s):

1. Jai Krishna and Chandrasekharan, Saritha Prakasham, "Elements of Earthquake Engineering", 2/e, South Asian Publishers, 2014.
2. Anil K. Chopra, "Dynamics of Structures, Theory and Applications to Earthquake Engineering", 4/e, Prentice Hall of India, 2015.

References:

1. Roberto Villaverde, Fundamental Concepts of Earthquake Engineering, CRC(2009).

Course Outcomes

By the end of the course the student will be able to:

- Summarize the causes of earthquake and its consequences (L2)
- Distinguish between response spectra and design spectra (L4)
- Classify between Response History and response spectra analysis (L4)
- Evaluate the seismic force acting on Multistory structure (L5)
- Design of Water towers & Stack like structures for Seismic excitation (L6)

19ECE758: NONLINEAR CONTINUUM MECHANICS**L T P C****3 0 0 3**

Continuum Mechanics is the analysis of a body assuming to be a continua and not discrete. This course will introduce the learner to preliminary tensor analysis and also expose to the preliminary ideas of non-linearity in solid mechanics.

Course Objectives:

1. To build ideas on tensor analysis.
2. To introduce kinematics of continuum.
3. To familiarize with various forms of stresses.
4. To compile balance laws and field equations.
5. To understand non linearity in solid mechanics.

Unit I**8L**

Vector and Tensor Algebra: Introduction to index notation, Kronecker delta, Einstein's summation, Tensor product, Symmetric tensors, Skew symmetric tensors, Orthogonal tensors.

Learning Outcomes:

Post completion of the unit the student will be able to:

- *Understand indicial notations. (L2)*
- *Classify types of tensors. (L2)*
- *Illustrate basics of tensor. (L2)*

Unit II**8L**

Basic Kinematics: Various configurations, Lagrangian and Eulerian descriptions, Material and Spatial Derivatives, Deformation gradient, Various Strain Tenors, Polar Decomposition, Differentiate between small strain and large strain assumptions.

Learning Outcomes:

Post completion of the unit the student will be able to:

- *Compare various configurations (L2.)*
- *Explain the importance of deformation gradient. (L2)*
- *Judge between small strain and large strain assumptions (L4)*

Unit III**8L**

Stress: Cauchy Stress tensor, Kirchhoff Stress tensor, Piola Kirchhoff Stress tensors, Work conjugacy.

Learning Outcomes:

Post completion of the unit the student will be able to:

- *Evaluate the various stresses in a body. (L5)*
- *Build the ideas behind applicability of various stresses .(L3)*

Unit IV**8L**

Balance laws and Field Equations: Balance of Mass, Momentum, Force and Torque. Equations of Motion.

Learning Outcomes:

Post completion of the unit the student will be able to:

- *Develop the various balance laws in a continuum framework.(L3)*
- *Assess the field equations in a continuum framework (L4)*

Unit V**10L**

Material Behaviour: Continuity Equation, Hooke's Law, Hyperelasticity (Neo Hookean and Mooney Rivlin Models).

Learning Outcomes:

Post completion of the unit the student will be able to:

- *Formulate the various materials laws. (L6)*
- *Develop hyperelastic material models (L3)*
- *Assess material and geometric non linearity (L5)*

Text Book(s):

1. J.N. Reddy, Principles of Continuum Mechanics, Cambridge English, ISBN 978-1108404242, 2017.
2. S. Hernandez and A. N. Fontan, Linear and Non-Linear Continuum Solid Mechanics, WIT Press, ISBN 978-1784662714, 2021.
3. George E. Mase, Schaum's Outline Of Continuum Mechanics, McGraw Hill, ISBN 978-9389691283, 2020.

References:

1. P.Chadwick, Continuum Mechanics, Dover Publications, ISBN 978-0486401805, 1998.
2. J. Bonet and R.D. Wood, Nonlinear Continuum Mechanics for Finite Element Analysis, Cambridge University Press, ISBN 978-0521838702, 2008.

Web Reference:

1. <https://www.continuummechanics.org/>

Course Outcomes:

Post completion of the course the learner will be able to

1. **Outline** the various laws of tensor algebra (L2).
2. **Build** the kinematic relationships of a deformable body (L3).
3. **Examine** the various stresses acting on a solid (L4).
4. **Deduct** various field equations (L5).
5. **Develop** models for material and geometric non linearity (L6).

19EMC741: RESEARCH METHODOLOGY AND IPR

L	T	P	C
2	0	0	2

This course introduces the student, to the fundamentals of research, research process, technical writing and intellectual property rights. Students will be able to use this knowledge to gain interest in their subject area and pursue their career in research.

Course Objectives

- To familiarize the meaning, objectives and sources of research
- To acquaint the student with the importance and methods of literature review/research ethics
- To impart the knowledge of technical writing for preparing reports, presentations, research proposals, conference/journal publications
- To introduce the terminology and process of obtaining intellectual property rights
- To expose the intricacies in the process of obtaining patent rights

Unit I**5L**

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

Learning Outcomes

After the completion of this unit, the student will be able to

- define the meaning of a research problem (L1)
- list the different sources of research problem (L2)
- enumerate the different criteria of good research and list the different errors in selecting research problem (L2)
- contrast the different approaches of research (L3)
- compare the different methods for data collection and analysis (L5)

Unit II**5L**

Effective literature studies approaches, analysis Plagiarism, Research ethics

Learning Outcomes

After the completion of this unit, the student will be able to

- list and elaborate the different steps of the research process (L1)
- explain the importance of carrying out an effective literature review (L2)
- identify the research gaps from literature review (L5)
- describe the ethical principles to be following during research process and authorship (L2)
- define the terminology and list the methods to avoid being accused of plagiarism (L1)
- list the different types of research misconduct (L2)

Unit III**5L**

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Learning Outcomes

After the completion of this unit, the student will be able to

- list the attributes, reasons and guidelines for effective technical writing (L1)
- contrast between conference paper, technical presentation and journal paper (L3)
- choose a particular research contribution for patenting or journal publication (L4)
- describe the terminology related to citation, citation index, h-index etc (L2)

Unit IV**5L**

Nature of Intellectual Property: Patents, Designs, Trademarks and Copyright. 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.

Learning Outcomes

After the completion of this unit, the student will be able to

- describe the codes and standards in building intellectual property rights(L2)
- list the subject, importance and requirements for of patentability(L1)
- explain the process of patenting and commercialization in academia(L2)
- enumerate the procedure for application preparation, filing and grant of Patents(L2)

Unit V**8L**

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 etc. Traditional knowledge Case Studies, IPR and IITs.

Learning Outcomes

After the completion of this unit, the student will be able to

- explain the scope of patent rights(L2)
- describe the process for licensing and transfer of technology(L2)
- identify the sources of patent information and databases(L1)
- elaborate the administration of patent system(L2)
- describe the new developments in IPR in computer software, biological systems etc(L3)

Text Book(s):

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for Science and engineering students", Tata McGraw Hill India, 2013.
2. Ranjit Kumar, "Research Methodology: A Step by Step Guide for beginners", 2/e, Prentice Hall of India, 2013.

References:

1. Halbert, "Resisting Intellectual Property", Taylor and Francis Limited, 2007.
2. Mayall, "Industrial Design", McGraw Hill, 1992.
3. Niebel, "Product Design", McGraw Hill, 1974.
4. Asimov, "Introduction to Design", Prentice Hall, 1962.
5. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016
6. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand Publishers, 2008

Course Outcomes

After successful completion of the course, the student will be able to

- define the meaning, sources, approaches for research problems (L1)
- explain the guidelines for carrying out effective literature review and identify research gaps(L2)
- describe effective guidelines for preparing technical reports, research publications, presentations and research proposals(L2)
- describe the codes, standards and process of obtaining intellectual property rights(L3)
- enumerate the new developments of IPR in engineering systems(L3)

19EOE742: BUSINESS ANALYTICS

L	T	P	C
3	0	0	3

This course introduces students to the science of business analytics. The goal is to provide students with the foundation needed to apply data analytics to real-world challenges they confront daily in their professional lives. Students will learn to identify the ideal analytic tool for their specific needs; understand valid and reliable ways to collect, analyze, and visualize data; and utilize data in decision making for managing agencies, organizations or clients in their workspace

Course Objectives

- To familiarize the scope, process and advantages of business analytics
- To acquaint the student with the modeling and problem solving skills in business analytics
- To impart the organization and management of business analytics
- To introduce the forecasting models and techniques used in analytics
- To expose the formulation and decision strategies used in business analytics

Unit I**8L**

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

Learning Outcomes

After the completion of this unit, the student will be able to

- define the scope and process of business analytics (L1)
- choose an organizational structure to implement a business analytics process (L3)
- describe the statistical tools and methods used for data modeling and analysis (L2)
- identify the sampling and estimation requirements for data analysis (L1)

Unit II**8L**

Trendiness and Regression Analysis: Modeling 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.

Learning Outcomes

After the completion of this unit, the student will be able to

- identify the relationships and trends in data (L1)
- utilize linear regression methods for identifying data relationships (L4)
- list the types of data and their models used for business analytics (L1)
- describe the methods for visualization and exploration of data (L2)

Unit III**8L**

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.

Learning Outcomes

After the completion of this unit, the student will be able to

- describe the management issues in the organization structures (L2)
- define the designing information policy and its usage (L1)
- list the methods for ensuring data quality measuring contribution (L1)

- explain the use of data mining methodologies for predictive analytics analysis (L3)
- describe the use of prescriptive analytics methods in business analytics process (L2)

Unit IV**10L**

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 Carlo Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

Learning Outcomes

After the completion of this unit, the student will be able to

- classify and describe the use of forecasting models (L3)
- model the use of regression forecasting with casual variables (L5)
- identify the appropriate forecasting model for a given data (L5)
- explain the use of monte carlo simulation for forecasting and identify the involved risk (L2)

Unit V**8L**

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

Learning Outcomes

After the completion of this unit, the student will be able to

- formulate decision problems (L2)
- list the decision strategies with and without probabilities (L1)
- use the decision trees for analysis (L4)
- describe the value of information, utility and its use in decision making (L4)

Textbook(s):

1. Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Business analytics Principles, Concepts, and Applications Pearson FT Press, 2014.
2. James Evans, Business Analytics, Pearson Education, 2013.

Course Outcomes

Upon successful completion of the course, the student will be able to

- define the scope, process and advantages of business analytics (L1)
- explain the modeling and problem solving skills in business analytics (L2)
- describe the organization and management of business analytics (L3)
- utilize the forecasting models and techniques used in analytics (L4)
- enumerate and utilize the formulation and decision strategies (L2)

19EOE744: INDUSTRIAL SAFETY

L	T	P	C
3	0	0	3

Safety by design or prevention through design is in the core for maintaining engineering systems safe. The students will be equipped with concepts of engineering systems safety, dimensions of engineering systems safety, safety design and analysis mathematics, design for engineering systems safety and control for safety, and integrating safety with other operational goals such as quality and reliability

Course Objectives

- to impart knowledge on different facets and aspects of industrial systems safety
- to familiarize the student with tools, techniques and methodologies needed for prevention of occurrences of unsafe operations and accidents under different industrial settings
- to impart the knowledge of definition, function and types of maintenance activities
- to familiarize the different wear and corrosion mechanisms and their prevention methods
- to expose the students to different faults and their tracing mechanisms
- to impart the art of planning periodic and preventive maintenance mechanisms

Unit I**8L**

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 firefighting, equipment and methods.

Learning Outcomes

After the completion of this unit, the student will be able to

- list the different types of mechanical and electrical hazards in industrial systems(L1)
- enumerate the salient points of factories act 1948(L2)
- describe the health and safety measures to be enforced for industrial safety(L3)
- elaborate the different fire prevention and firefighting arrangements to be made(L2)

Unit II**8L**

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.

Learning Outcomes

After the completion of this unit, the student will be able to

- define the meaning and aim of maintenance engineering(L1)
- elaborate the primary and secondary functions of maintenance department(L2)
- classify the different types and applications of maintenance(L3)
- relate the replacement economy with maintenance cost(L5)
- estimate the service life of equipment from the specifications of individual components(L4)

Unit III**8L**

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.

Learning Outcomes

After the completion of this unit, the student will be able to

- explain the different types, causes and effects of Wear(L2)
- elaborate the different methods for reducing wear(L2)
- list the different types of lubricants and mention their applications(L1)
- define the principle and factors affecting corrosion(L1)
- classify the different types of corrosion and identify their prevention methods(L3)

Unit IV**8L**

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.

Learning Outcomes

After the completion of this unit, the student will be able to

- explain the different types, causes and effects of Wear(L2)
- use the concept of decision tree for fault tracing in machine tools(L4)
- build decision trees for different machine tools including pump, air compressor etc(L4)
- classify the different types of faults in machine tools and their causes(L3)

Unit V**10L**

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

Learning Outcomes

After the completion of this unit, the student will be able to

- explain the concept of periodic inspection and its need(L2)
- list the common troubles and remedies of electric motor(L1)
- define the need for preventive maintenance and list its steps(L3)
- elaborate the steps/procedure of periodic and preventive maintenance of diesel generating sets, pumps etc(L2)

Text Book(s):

1. Lindley R. Higgins, Lester Coridon Morrow, Maintenance Engineering Handbook, Da Information Services, 1977.
2. H. P. Garg, Maintenance Engineering, S. Chand and Company, 1987.
3. Audels, Pump-hydraulic Compressors, Mc Graw Hill Publication, 1992.
4. Winterkorn, Hans, Foundation Engineering Handbook, Chapman & Hall London, 1975

Course Outcomes

Upon successful completion of the course, the student will be able to

- describe the different facets and aspects of industrial systems safety(L2)
- demonstrate the use of tools, techniques and methodologies needed for prevention of occurrences of unsafe operations and accidents under different industrial settings(L4)
- define the function and list the types of maintenance activities(L1)
- describe the concept of wear and corrosion mechanisms and their prevention methods(L2)

- enumerate the different faults and their tracing mechanisms (L3)
- elaborate the planning periodic and preventive maintenance mechanisms needed for industrial safety(L4)

19EOE746: OPERATIONS RESEARCH

L	T	P	C
3	0	0	3

Optimization problems arise in all walks of human activity- particularly in engineering, business, finance and economics. The simplest optimization problems are linear in nature which may be subject to a set of linear constraints. This course will equip the student with the expertise to mathematically model real life optimization problems as Linear Programming (Optimization) Problems and subsequently educate the student to solve these models with the help of the available methods.

Course Objectives

- to impart knowledge on developing mathematical formulation for linear programming and transportation problem
- to familiarize the student in the construction of the required activities in an efficient manner to complete it on or before a specified time limit and at the minimum cost.
- to expose the development of mathematical model for interactive decision-making situations, where two or more competitors are involved under conditions of conflict and competition.
- to illustrate PERT and CPM techniques for planning and implementing projects.
- To impart the knowledge of formulating and analysis of real life problems using advanced tools and techniques for resource optimization
- to provide frameworks for analyzing waiting lines using advanced queuing theory concepts

Unit I**8L**

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Learning Outcomes

After completing this unit, the student will be able to

- identify and develop operational research models from the verbal description of the real system. **(L4)**
- understand the classification systems of effective Inventory control models **(L2)**

Unit II**8L**

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Learning Outcomes

After completing this unit, the student will be able to

- translate a real-world problem, given in words, into a mathematical formulation. **(L2)**
- utilize the mathematical tools that are needed to solve optimization problems. **(L2)**

Unit III**8L**

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Learning Outcomes

After completing this unit, the student will be able to

- describe the need and origin of the optimization methods **(L2)**
- classify optimization problems to suitably choose the method needed to solve the particular type of problem **(L3)**

Unit IV**8L**

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Learning Outcomes

After completing this unit, the student will be able to

- choose linear programming problems to suitably choose the method needed to solve the particular type of problem **(L1)**
- identify industrial problems involved in inventory, MRP and scheduling **(L2)**

Unit V**8L**

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

Learning Outcomes

After completing this unit, the student will be able to

- identify the values, objectives, attributes, decisions, uncertainties, consequences, and trade-offs in a real decision problem **(L2)**
- Apply the models to incorporate rational decision-making process in real life situations. **(L3)**
- Analyze various modeling alternatives & select appropriate modeling techniques for a given situation.. **(L3)**

Text Book(s):

1. H.A. Taha, Operations Research, An Introduction, Prentice Hall of India, 2008
2. H.M. Wagner, Principles of Operations Research, Prentice Hall of India, Delhi, 1982.
3. J.C. Pant, Introduction to Optimization: Operations Research, Jain Brothers, 2008
4. Hitler Libermann Operations Research: McGraw Hill Publishers, 2009
5. Pannerselvam, Operations Research: Prentice Hall of India, 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India, 2010

Course Outcomes

After the successful completion of the course, the students will be able to:

- Understand the basic concepts of different advanced models of operations research and their applications. (L2)
- Solve linear programming problems using appropriate techniques and optimization solvers, interpret the results obtained and translate solutions into directives for action. (L4)
- Apply the models to incorporate rational decision-making process in real life situations. (L4)
- Analyze various modeling alternatives & select appropriate modeling techniques for a given situation. (L3)
- Validate output from model to check feasibility of implementations. (L5)
- Create innovative modeling frameworks for a given situation. (L6)
- Conduct and interpret post-optimal and sensitivity analysis and explain the primal-dual relationship. (L3)

19EOE748: COST MANAGEMENT OF ENGINEERING PROJECTS

L	T	P	C
3	0	0	3

This course will equip the student with the expertise to mathematically model engineering projects and use effective methods and techniques to plan and execute engineering activities.

Course Objectives

- to introduce the basic principles of strategic cost management and the related terminology
- to familiarize the project planning and execution process involving technical/nontechnical activities
- to acquaint the student with detailed engineering activities and their cost management analysis
- to impart the knowledge of cost analysis and profit planning of engineering projects
- to familiarize the quantitative techniques for optimization of budget allocation

Unit I**8L**

Introduction and Overview of the Strategic Cost Management Process, Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Learning Outcomes

After the completion of this unit, the student will be able to

- describe the cost concepts in decision making(L2)
- define the various costs involved in the cost management process(L2)
- list the objectives of cost control(L2)
- identify the different fields of a database for operational control(L2)

Unit II**8L**

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities.

Learning Outcomes

After the completion of this unit, the student will be able to

- define the meaning of a project and list the different types(L2)
- identify the measures to manage cost overruns(L2)
- describe the various stages of project execution from conception to commissioning(L2)
- plan the proper order of technical/nontechnical activities as part of project execution(L2)

Unit III**8L**

Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.

Learning Outcomes

After the completion of this unit, the student will be able to

- identify the different clearance norms required in the pre-project execution phase(L2)
- describe the hierarchy of project team and identify the role of each member(L2)
- list the different contents of project contracts(L2)
- present the project cost control and planning through bar charts, network diagrams etc(L2)

Unit IV**8L**

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis.

Learning Outcomes

After the completion of this unit, the student will be able to

- describe the cost behavior and profit planning(L2)
- distinguish between marginal costing and absorption costing(L2)
- analyze the variance of standard costing(L2)
- analyze the pricing strategies in project costing(L2)
- identify the quality measures satisfying the appropriate constraints(L2)

Unit V**10L**

Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing. Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory

Learning Outcomes

After the completion of this unit, the student will be able to

- define and compare the different budgeting strategies(L2)
- model the cost management as a linear programming problem(L2)
- measure the divisional profitability and decide the appropriate pricing(L2)

Textbook(s):

1. Charles T. Horngren, Srikant M. Datar, George Foster, Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi, 2006.

References:

1. Charles T. Horngren, George Foster, Advanced Management Accounting, Greenwood Publishing, 2001.
2. Robert S Kaplan, Anthony A. Alkinson, Management & Cost Accounting, 1998.
3. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting, Wheeler Publisher, 2004.
4. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book, 2006.

Course Outcomes

After the successful completion of the course, the students will be able to

- list the basic principles of strategic cost management and define the related terminology(L1)
- plan the project execution process involving technical/nontechnical activities(L4)
- describe the detailed engineering activities and their cost management analysis(L2)
- carry out the cost analysis and profit planning of engineering projects(L5)
- utilize quantitative techniques for optimization of budget allocation(L6)

19EOE752: WASTE TO ENERGY

L	T	P	C
3	0	0	3

This course introduces the basic principles and different technologies of converting waste to energy. Student will be able to appropriately identify the methods and build biomass gasification systems of different capacities depending on application requirements.

Course Objectives

- to introduce the classification of waste for its usefulness in preparing different fuels
- to familiarize the biomass pyrolysis process and its yield issues
- to acquaint the student with biomass gasification processes and construction arrangements
- to impart the types and principles of biomass combustors
- to familiarize the calorific values and composition of biogas resources

Unit I**8L**

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Learning Outcomes

After the completion of this unit, the student will be able to

- distinguish between different types of waste (L1)
- classify the different types of waste for manufacturing different types of fuel (L3)
- identify the different conversion devices and their applications(L4)

Unit II**8L**

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Learning Outcomes

After the completion of this unit, the student will be able to

- classify the different types of pyrolysis methods based on speed(L1)
- describe the different methods of manufacturing charcoal (L2)
- explain the chemical processes involved in the manufacture of pyrolytic oils and gases(L2)

Unit III**8L**

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Learning Outcomes

After the completion of this unit, the student will be able to

- explain the design, construction and operation of different gasifiers(L2)
- describe the burner arrangement for thermal heating(L2)
- elaborate the gasifier engine arrangement for equilibrium and kinetic considerations(L3)

Unit IV**8L**

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Learning Outcomes

After the completion of this unit, the student will be able to

- explain the basic principle of biomass combustors(L2)

- classify different combustors based on their capacity and efficiency(L3)
- describe the construction and operation of fixed bed inclined grate, fluidized bed combustors (L2)

Unit V**10L**

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

Learning Outcomes

After the completion of this unit, the student will be able to

- list the properties of biogas(L1)
- elaborate the design, construction and operation of biogas plant(L2)
- classify the different biomass resources and their conversion process(L3)
- distinguish between different biogas plants and identify their applications(L5)

Text Book(s)

1. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

Course Outcomes

After the successful completion of the course, the student will be able to

- classify different types of waste for their usefulness in preparing different fuels(L3)
- describe the biomass pyrolysis process and its yield issues(L2)
- outline the different biomass gasification processes and their construction arrangements(L3)
- explain the types and principles of biomass combustors(L2)
- analyze the calorific values and composition of biogas resources(L5)

19EOE754: GREEN BUILDINGS

L	T	P	C
3	0	0	3

Green Buildings are the need of the 21st century as the construction industry must contribute towards reducing the effects of climate change. This course is designed to provide basic guidelines for the construction of Green Buildings and it gives an overview of all the processes involved from the start of site construction management to material selection, services management, energy & resources management and managing the indoor environment quality during building operation.

Course Objectives:

- To emphasize the need for energy efficient buildings
- To understand the considerations for an Energy Efficient building design.
- To have an insight into the existing Green Rating Systems in India.
- To illustrate various techniques that can be applied in buildings to make them green.

Unit I**8L**

Introduction to green buildings: Concept of green building design. Need for energy and resource efficient design. Factors affecting the Energy use in Buildings – Pre-Building Stage, Construction Stage & Post Occupancy stages. Building life cycle analysis. Need for Green Building rating Systems. Brief introduction to green rating systems in India.

Learning Outcomes:

Post completion of the unit the student will be able to:

- *Define the concept of Green Buildings. (L1)*
- *Explain the need of resource conservation. (L2)*
- *Illustrate the energy use in buildings as different stages. (L2)*
- *Select appropriate building rating systems. (L3)*

Unit II**8L**

Sustainable site construction and management – Selection of site, preserving and protecting landscape during construction, Top soil conservation, reducing hard paving on site, provide sanitation and safety facilities for construction workers Efficient design of services – water management: water supply and treatment methods, rain water harvesting, water recycling, reuse of water and installation of water efficient fixtures. Waste management: reduction of waste during construction, efficient segregation of waste, resource recovery from waste.

Learning Outcomes:

Post completion of the unit the student will be able to:

- *Choose appropriate methods of construction management. (L1)*
- *Summarise the process of site management. (L2)*
- *Identify the techniques of energy, water and waste management in buildings. (L3)*

Unit III**8L**

Building physics: heat transfer in buildings (conduction, convection and radiation) and importance material selection for building envelope. Specification of materials for walls and roofs in different climates. Building materials and resources: Sustainable Building Materials– Biodegradable & Non- Biodegradable Materials, resource reuse, recyclable materials, recycled content, Regional materials. Energy Efficient Construction Technology – Filler Slab, Rat trap Bond. Technologies developed by CBRI. Contemporary and future trends- Nanotechnology, smart materials.

Learning Outcomes:

Post completion of the unit the student will be able to:

- *Show the process of heat transfer through buildings. (L2)*
- *Examine the performance of building envelopes for heat transfer. (L4)*

- *Identify appropriate building materials. (L3)*
- *Demonstrate various energy efficient construction technologies being developed. (L2)*

Unit IV**8L**

Energy conservation: Optimizing building design to reduce conventional energy demand, reducing material usage and time of construction by adopting efficient technologies, conserving energy through selection energy efficient equipment. Alternative sources of energy: Renewable energy sources, Photo Voltaic Cells, small scale hydro and wind systems, photovoltaic cells.

Learning Outcomes:

Post completion of the unit the student will be able to:

- *Relate the process of building design with energy conservation. (L1)*
- *Outline the process of time & cost reduction in construction projects. (L2)*
- *Identify alternate sources of renewable energy on-site. (L3)*

Unit V**10L**

Indoor environmental quality: Need to improve indoor air quality-sick building syndrome, building related illness, multiple chemical sensitivity. Reducing indoor air pollutants- low-VOC paints / adhesives / sealants, Minimize ozone depleting substances, required levels of indoor ventilation. Indoor and outdoor noise levels. Case Study/Desktop Study: Case study of a live project on Green Buildings or a desktop study of a Green building.

Learning Outcomes:

Post completion of the unit the student will be able to:

- *Explain the need for high indoor air quality. (L2)*
- *List the indoor air pollutants and their sources like VOC, dust, noise, etc. (L1)*
- *Analyse the green aspects of a live project/case study. (L4)*

Text Book(s):

1. Abridged Version reference guide for New Buildings (IGBC rating system)
2. ECBC reference guide.

References:

1. New buildings reference guide
2. Heather L. Venhaus, Designing the Sustainable Site: Integrated Design Strategies for Small Scale Sites and Residential Landscapes
3. Faisal Zia, Vasudevan Rajaram, Solid and liquid waste management,
4. Siddiqui, Sanjeev Agrawal, Mohammed Emran Khan, Introduction to Architectural Science
5. S. V. Szokolay, The Basis of Sustainable Design
6. Sustainable Construction Techniques. From structural design to interior fit-out:
7. Sebastian / John, Viola / Zeumer, Martin Assessing and improving the environmental impact of buildings by El khoul.

Course Outcomes:

- The students will understand the importance of green building design. (L2)
- The students will simultaneously outline efficient techniques of optimizing resource usage in the process of building construction, building operation and post demolition. (L2)
- The students will evaluate effective selection of materials and other equipment.. (L5)
- The students will be able to analyze the sustainability any building and check for green features. (L4)

19EAC741: ENGLISH FOR RESEARCH PAPER WRITING

L	T	P	C
2	0	0	0

This course introduces the student, to the different aspects of research paper writing including planning, preparation, layout, literature review write-up etc. Specifically the perspective and style of writing in different sections of a research paper is highlighted. Students will be exposed to English language skills relevant to research paper writing.

Course Objectives:

- To write clearly, concisely and carefully by keeping the structure of the paper in mind.
- To use standard phrases in English and further improve his command over it.
- To write with no redundancy, no ambiguity and increase the readability of the paper.
- To plan and organize his paper by following a logical buildup towards a proper conclusion.
- To decide what to include in various parts of the paper.
- To write a suitable title and an abstract in order to attract the attention of the reader.
- To identify the correct style and correct tense.
- To retain the scientific value of the paper by using minimum number of words.

Unit I**5L**

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

Learning Outcomes:

After the completion of this unit, the student will be able to

- To know the expectations of various journals and referees (L2)
- To know the typical structure of a paper (L3)
- Learn to put words in a sentence in the correct order (L4)
- To write short and clear sentences from the very beginning of the paper (L4)
- To increase the readability of the paper by making it easy to read and 100% clear (L4)
- Learn to be concise without losing any important content (L4)
- To avoid some typical grammar mistakes made in research papers (L4)

Unit II**5L**

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

Learning Outcomes:

After the completion of this unit, the student will be able to

- Learn to make useful contribution worth recommending for publication (L4)
- Learn good use of language to make readers notice the key findings (L4)
- Learn to anticipate or predict possible objections to the claims made in the paper (L5)
- To understand what is plagiarism, and how to paraphrase other people's work (L4)
- Learn to attract the right kind of readers with a suitable title (L3)
- Learn to sell the abstract to potential readers by attracting their curiosity (L2)

Unit III**6L**

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check. key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

Learning Outcomes:

After the completion of this unit, the student will be able to

- have a deep knowledge about everything that has been previously written on the topic and decide what is important to know in Introduction. (L3)
- Learn to provide the right amount of literature regarding the sequence of events leading up to the current situation in the Literature review(L4)

Unit IV**6L**

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

Learning Outcomes:

After the completion of this unit, the student will be able to

- Learn to describe the materials used in experiments and/or the methods used to carry out the research (L2)
- The key skill is in reporting the results simply and clearly (L3)
- Learn to structure the Discussion and satisfy the typical requirements of the referees (L4)
- Learn to provide a clear and high-impact take-home message in the conclusion (L5)

Unit V**6L**

Good Paper Writing: Useful phrases, how to ensure paper is as good as it could possibly be the first-time submission.

Learning Outcomes:

After the completion of this unit, the student will be able to

- Learn various lists of frequently used phrases that have a general acceptance in all disciplines and use in specific sections of the paper (L3)
- Learn various kinds of things one should look for when doing the final check (L3)

Text Book (s):

1. Goldbort R, Writing for Science, Yale University Press, 2006
2. Day R, How to Write and Publish a Scientific Paper, Cambridge University Press, 2006
3. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM, Highman, 1998.

References:

1. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

Course Outcomes:

By the end of the course the students will be able to:

- Frame the structure of the paper precisely. (L2).
- Improve his command over English by using standard phrases. (L3).
- Avoid repetition and mistakes in the paper and increase its readability. (L3).
- Organize the paper logically towards a proper conclusion. (L4).
- Decide on the content to be included in various parts of the paper. (L5).
- Identify whether to use personal or impersonal style in the paper. (L5).
- Express the content in a clear and concise way. (L6).
- Attract the attention of the reader by providing a suitable title and an appropriate abstract. (L6).

19EAC742: DISASTER MANAGEMENT

L	T	P	C
2	0	0	0

This course is intended to provide fundamental understanding of different aspects of Disaster Management. It will expose the students to the concept and functions of Disaster Management and to build competencies of Disaster Management professionals and development practitioners for effective supporting environment as put by the government in legislative manner. It would also provide basic knowledge, skills pertaining to Planning, Organizing and Decision-making process for Disaster Risk Reduction.

Course Objectives

- to provide students an exposure to disasters, their significance, types & Comprehensive understanding on the concurrence of Disasters and its management.
- to ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention, risk reduction and the basic understanding of the research methodology for risk reduction measures.
- equipped with knowledge, concepts, and principles, skills pertaining to Planning, Organizing, Decision-making and Problem solving methods for Disaster Management.
- to develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity.

Unit I**5L**

Introduction Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Learning Outcomes

After the completion of this unit, the student will be able to

- define the meaning, list the factors and mention the significance of disaster (L1)
- distinguish between hazard and disaster (L3)
- compare manmade and natural disaster (L3)
- list the types of disaster and describe their magnitude (L2)

Unit II**5L**

Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

Learning Outcomes

After the completion of this unit, the student will be able to

- list the different repercussions of disasters and hazards(L1)
- describe the characteristics of natural disasters and the magnitude of their losses(L2)
- describe the characteristics of man-made disasters and the magnitude of their losses(L2)
- elaborate the outbreaks of diseases and epidemics after disasters (L3)

Unit III**6L**

Disaster Prone Areas in India Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics.

Learning Outcomes

After the completion of this unit, the student will be able to

- describe the seismic zones and their characteristics(L2)
- identify the areas prone to floods and droughts(L1)
- distinguish between landslides and avalanches(L3)
- identify areas prone to cyclonic and coastal hazards(L4)
- enumerate the post disaster diseases and epidemics(L2)

Unit IV**6L**

Disaster Preparedness and Management Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, media reports: governmental and Community Preparedness.

Learning Outcomes

After the completion of this unit, the student will be able to

- describe the monitoring of phenomena triggering a disaster/hazard(L2)
- evaluate the risk with the use of remote sensing and meteorological data(L5)
- list the governmental and community measures for disaster preparedness(L2)

Unit V**6L**

Risk Assessment Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

Learning Outcomes

After the completion of this unit, the student will be able to

- define and list the elements of disaster risk(L1)
- enumerate the measures for risk reduction(L2)
- apply the techniques of risk assessment (L4)
- identify the means of people's participation in risk assessment(L2)

Text Book(s):

1. R. Nishith, Singh A.K., Disaster Management in India: Perspectives, issues and strategies, New Royal Book Company., 2008.
2. Sahni, Pardeep, Disaster Mitigation Experiences and Reflections, Prentice Hall of India, New Delhi., 2012
3. Goel S. L., Disaster Administration and Management Text and Case Studies", Deep and Deep Publication, 2007.

Course Outcomes

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

- Identify management activities in pre, during and post phases of Disasters. (L1)
- Plan disaster management activities and specify measure for risk reduction(L4)
- apply risk assessment techniques in real life disaster scenarios(L4)

19EAC743: SANSKRIT FOR TECHNICAL KNOWLEDGE

L	T	P	C
2	0	0	0

This course is intended to expose the student to the fundamentals of Sanskrit language and its technical utility in forming the core principles of many engineering branches. Students taking this course shall be able to relate the core principles of engineering branches to semantics of Sanskrit language

Course Objectives

- to provide the knowledge of Sanskrit alphabets
- to expose the students to the basic grammar and sentence formation in past/present/future tenses
- to provide a classification of Sanskrit literature and its associated roots
- to demonstrate the relation of core engineering principles to the roots of Sanskrit literature

Unit I**9L**

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences.

Learning Outcomes

After the completion of this unit, the student will be able to

- List the different alphabets in Sanskrit (L1)
- Form sentences in past, present and future tenses (L4)
- Form concise/simple sentences with the right usage of words (L4)

Unit II**9L**

Order, Introduction of roots, Technical information about Sanskrit Literature.

Learning Outcomes

After the completion of this unit, the student will be able to

- classify the different branches of Sanskrit literature (L3)
- describe the order and roots of Sanskrit literature (L2)
- relate the applicability of Sanskrit literature to technical principles (L5)

Unit III**9L**

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Learning Outcomes

After the completion of this unit, the student will be able to

- relate the technical concepts of engineering to principles of electrical technology (L2)
- relate the technical concepts of engineering to principles of mechanical engineering (L2)
- apply the use of Sanskrit knowledge to describe the mathematical principles (L4)

Text Book(s):

1. Dr. Vishwas, Abhyastakam, Samskrita Bharti Publication, New Delhi, 2005.
2. Vempati Kutumb Shastri, Teach Yourself Sanskrit, Prathama Deeksha, Rashtriya Sanskrit Sansthanam, New Delhi Publication, 2003.
3. Suresh Soni, India's Glorious Scientific Tradition, Ocean books, New Delhi, 2011.

Course Outcomes

After successful completion of the course, the student will be able to

- get a working knowledge in illustrious Sanskrit, the scientific language in the world (L3)
- get a Learning of Sanskrit to improve brain functioning (L4)
- develop the logic in mathematics, science & other subjects with principles of sanskrit(L4)
- explore the huge knowledge from ancient literature with the help of sanskrit(L5)

19EAC744: VALUE EDUCATION

L	T	P	C
2	0	0	0

This course is intended to expose the student to the need for human values and methods to cultivate them for leading an ethical life with good moral conduct. Students taking this course will be able to experience a change in personal and professional behavior with these ethical principles guiding him throughout life

Course Objectives

- to expose the student to need for values, ethics, self-development and standards
- to make the student understand the meaning of different values including duty, devotion, self-reliance etc.
- to imbibe the different behavioral competencies in students for leading an ethical and happy life
- to expose the student to different characteristic attributes and competencies for leading a successful, ethical and happy profession life.

Unit I**7L**

Values and self-development –social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements

Learning Outcomes

After the completion of this unit, the student will be able to

- define the social values and individual attitudes for self development(L1)
- describe the Indian vision of humanism(L2)
- distinguish between moral and non-moral acts (L3)
- list the standards and value principles for moral conduct (L2)

Unit II**7L**

Importance of cultivation of values. Sense of duty. Devotion, self-reliance. Confidence, concentration. Truthfulness, cleanliness. Honesty, humanity. Power of faith, national unity. Patriotism, love for nature, discipline.

Learning Outcomes

After the completion of this unit, the student will be able to

- describe the importance of cultivating values(L2)
- list the different traits of self-developed individual(L1)
- explain the need for loving nature/country/humanity(L2)

Unit III**7L**

Personality and Behaviour Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature.

Learning Outcomes

After the completion of this unit, the student will be able to

- describe the benefits of positive thinking, integrity and discipline(L2)
- list the different methods for avoiding fault finding, anger(L1)
- explain the methods to overcome suffering, religious intolerance, self-destructive habits(L2)

Unit IV**7L**

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.

Learning Outcomes

After the completion of this unit, the student will be able to

- describe the science of reincarnation(L2)
- explain the relation between self-management and good health(L1)
- elaborate the role of different religions in reaching the common goal(L3)
- list the different techniques for mind-control to improve personality and studies(L1)

Text Book(s):

1. Chakroborty S.K., “Values and ethics for organizations: Theory and Practice”, Oxford University Press, 1998.

Course Outcomes

After successful completion of the course, the student will be able to

- describe the need for human values and methods for self development (L2)
- elaborate the different traits and benefits of a self-developed individual (L1)
- list the different attributes of self-developed individual (L1)
- elaborate the role and scope of books/faith/health/religions in character building and competence development(L3)

19EAC745: CONSTITUTION OF INDIA

L	T	P	C
2	0	0	0

This course is intended to expose the student to the philosophy of Indian constitution. Students will be able to understand their fundamental rights/duties and governance structure. Students also appreciate the role of election commission in establishing a democratic society.

Course Objectives

- to familiarize the student about the need for a constitution
- to make the student understand the role of constitution in a democratic society
- to acquaint the student with key constitutional features and fundamental rights of a citizen
- to impart the organs of governance and local administration hierarchy and their responsibilities
- to familiarize the student with the role, responsibilities and administration hierarchy of election commission

Unit I**5L**

History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working).

Philosophy of the Indian Constitution: Preamble, Salient Features

Learning Outcomes

After the completion of this unit, the student will be able to

- list the outline of drafting committee and their roles in the making of Indian constitution (L1)
- describe the need and role of a constitution in a democratic society(L2)
- elaborate the salient features of Indian constitution(L3)

Unit II**5L**

Contours of Constitutional Rights & Duties: Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

Learning Outcomes

After the completion of this unit, the student will be able to

- list the fundamental rights of a citizen(L1)
- explain the intricacies in the different rights(L2)
- elaborate the fundamental duties of a citizen(L3)
- describe the principles of state policy(L2)

Unit III**6L**

Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions

Learning Outcomes

After the completion of this unit, the student will be able to

- present the hierarchy of governance (L2)
- list the role/responsibilities/powers of different organs of governance(L1)
- elaborate the guidelines for appointment/transfer of judges(L2)

Unit IV**6L**

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Panchayat raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and

role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

Learning Outcomes

After the completion of this unit, the student will be able to

- describe the administrative organizational hierarchy of municipalities and panchayats(L2)
- appreciate the role/responsibilities/powers of mayor, CEO, elected officials(L3)
- appreciate the importance of grass root democracy(L3)

Unit V

6L

Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

Learning Outcomes

After the completion of this unit, the student will be able to

- describe the administrative hierarchy of election commission(L2)
- elaborate the roles/responsibilities/powers of election commissioners at different levels of hierarchy(L3)
- outline the welfare activities of SC/ST/OBC/Women by different bodies(L3)

Text Book(s):

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. S. N. Busi, Dr. B. R. Ambedkar, Framing of Indian Constitution, 1/e, 2015.
3. M. P. Jain, Indian Constitution Law, 7/e, Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes

After successful completion of the course, the student will be able to

- describe the philosophy and salient features of Indian constitution(L2)
- list the constitutional rights and duties of a citizen(L1)
- elaborate the central and local administrative hierarchy and their roles(L2)
- describe the roles/responsibilities/powers of different governing and administrative bodies(L2)
- explain the structure/functioning and power of election commission(L2)

19EAC746: PEDAGOGY STUDIES

L	T	P	C
2	0	0	0

This course is aimed to familiarizing the student with pedagogical principles, practices and methodologies. This course is intended for students interested in pursuing a career in teaching and research.

Course Objectives

- to familiarize the student about the need for pedagogy studies, background and conceptual framework
- to expose the student to pedagogical practices in formal/informal classrooms
- to acquaint the student with type of curriculum and guidance materials for effective pedagogy
- to familiarize the student with classroom practices and curriculum assessment procedures
- to make the student understand the effect of undertaking research on teaching quality

Unit I**5L**

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions. Overview of methodology and Searching.

Learning Outcomes

After the completion of this unit, the student will be able to

- define the aim and rationale behind teacher education(L1)
- classify the different theories of learning (L1)
- elaborate the need and role of curriculum, teacher education (L1)

Unit II**5L**

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

Learning Outcomes

After the completion of this unit, the student will be able to

- describe the different pedagogical practices used by teachers in formal and informal classrooms(L1)
- explain the pedagogical practices employed in developing countries (L1)
- enumerate the duties of faculty in terms of teaching, research, consultancy, administration (L1)

Unit III**6L**

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

Learning Outcomes

After the completion of this unit, the student will be able to

- list the measures for effective pedagogy(L1)
- identify the different documentation required to formalize curriculum implementation and quality assessment(L1)
- describe the teachers attitudes and beliefs in pedagogic strategies(L2)

Unit IV**6L**

Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes.

Learning Outcomes

After the completion of this unit, the student will be able to

- define the organizational hierarchy in a school administration system(L1)
- list the different barriers to learning(L3)
- enumerate the methods to overcome limited resources and handle large class sizes(L3)
- describe the follow-up support and peer-support in classroom practices(L2)

Unit V

6L

Research gaps and future directions: Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.

Learning Outcomes

After the completion of this unit, the student will be able to

- explain the need for and role of research in teaching profession(L2)
- list the different research activities to be taken up by teachers(L1)
- describe the impact of research on teaching quality and learning process(L2)

Text Book(s):

1. Ackers J, Hardman F, Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261, 2001
2. Agrawal M, Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379, 2004.
3. Akyeamong K, Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID., 2003.
4. Akyeamong K, Lussier K, Pryor J, Westbrook J, Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272-282., 2013.
5. Alexander RJ, Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell., 2001.
6. Chavan M, Read India: A mass scale, rapid, 'Learning to Read' campaign., 2003.

Course Outcomes

After successful completion of the course, the student will be able to

- describe the theories of learning and conceptual framework of pedagogy(L2)
- explain the pedagogical practices used by teachers in formal and informal classrooms(L2)
- visualize the administrative hierarchy of schools and colleges and define the role(L3)
- appreciate the need for research and define the future direction of teaching career(L3)
- describe the impact of curriculum and assessment on the teaching learning process of a student(L3)

19EAC747: STRESS MANAGEMENT BY YOGA

L	T	P	C
2	0	0	0

This course is aimed to familiarize the student with basic principles of yoga and different physical/mental practices for managing mind and body. This course helps the student in managing stress during education, home and workplace. Further, principles learnt in this course help in building overall personality for a stress-free, happy and independent life.

Course Objectives

- to familiarize the student about eight parts of yoga and their significance
- to expose the student to the importance and meaning of Yam and Niyam
- to make the student understand the meaning and importance of yogic principles including Ahimsa, Satya, Astheya etc
- to introduce the different yogic poses with a knowledge of their benefits for mind and body
- to familiarize the effect of different types of breathing techniques in concept and in activity

Unit I**9L**

Definitions of Eight parts of yoga (Ashtanga).

Learning Outcomes

After the completion of this unit, the student will be able to

- list the eight parts of yoga (L1)
- describe the effects of different parts of yoga on mind and body(L2)
- elaborate the importance of yoga in stress management and personality development(L3)

Unit II**9L**

Yam and Niyam.

Do's and Don't's in life.

- Ahimsa, satya, astheya, bramhacharya and aparigraha
- Shaucha, santosh, tapa, swadhyay, ishwarpranidhan.

Learning Outcomes

After the completion of this unit, the student will be able to

- elaborate the importance of Yam and Niyam(L2)
- describe the meaning and significance of Ahimsa, satya, astheya etc(L2)
- explain the need for shaucha, santosh, tapa, swadhyay in leading a healthy and fruitful life(L3)

Unit III**9L**

Asan and Pranayam

- Various yog poses and their benefits for mind & body
- Regularization of breathing techniques and its Effects-Types of pranayam.

Learning Outcomes

After the completion of this unit, the student will be able to

- demonstrate the different physical asanas and explain their physical and psychological effects(L4)
- demonstrate the different breathing techniques and describe their physical and mental effects (L4)
- distinguish between different types of pranayam(L5)

Text Books

1. Janardan, Yogic Asanas for Group Training-Part-I, Swami Yogabhyasi Mandal, Nagpur

2. Swami Vivekananda, “Rajayoga or conquering the Internal Nature”, Advaita Ashrama, Kolkata

Course Outcomes

After successful completion of the course, the student will be able to

- describe the eight parts of yoga and their significance(L1)
- explain the importance and meaning of Yam and Niyam(L2)
- define the meaning and importance of yogic principles including Ahimsa, Satya, Astheya etc(L1)
- demonstrate the different yogic poses and explain their benefits for mind and body(L4)
- demonstrate the different types of breathing techniques and explain their physical and mental benefits(L5)

19EAC748: PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

L	T	P	C
2	0	0	0

This course is aimed to familiarize the student with life enlightenment skills for personality development. This course helps the student in building his holistic personality through human values, ethics and spiritual attributes.

Course Objectives

- to familiarize the student to good personality traits through moral stories
- to make the student understand the goal of human life and importance of good personality in reaching the goal
- to expose the student to the study of Shrimad-Bhagwad-Geeta for developing his/her personality and achieve the highest goal in life
- to familiarize the student to leadership skills for driving nation and mankind to peace and prosperity
- to expose the role of Neetishatakam for developing versatile personality of students.

Unit I

9L

Neetisatakam-Holistic development of personality

Verses- 19,20,21,22 (wisdom)

Verses- 29,31,32 (pride & heroism)

Verses- 26,28,63,65 (virtue)

Verses- 52,53,59 (don't's)

Verses- 71,73,75,78 (do's).

Learning Outcomes

After the completion of this unit, the student will be able to

- describe the moral stories illustrating the traits of good personality(L2)
- define the meaning and importance of wisdom, pride, heroism, virtue etc(L1)
- identify do and don'ts in life from the foundations of human morals/ethics(L5)

Unit II

9L

Approach to day to day work and duties.

Shrimad BhagwadGeeta: Chapter 2-Verses 41, 47,48,

Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,

Chapter 18-Verses 45, 46, 48.

Learning Outcomes

After the completion of this unit, the student will be able to

- describe the characteristics and principles of bhakti yogam, jnana yogam and karma yogam (L1)
- identify the use of different yogic characteristics in different activities of daily life/duties(L4)
- apply the use of yogic principles for leading a stress-free, happy and fruitful life with good developed personality(L4)

Unit III**9L**

Statements of basic knowledge.

Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68

Chapter 12 -Verses 13, 14, 15, 16,17, 18

Personality of Role model. Shrimad BhagwadGeeta:

Chapter2-Verses 17, Chapter 3-Verses 36,37,42,

Chapter 4-Verses 18, 38,39

Chapter18 – Verses 37,38,63

Learning Outcomes

After the completion of this unit, the student will be able to

- list the characteristics of role model proposed by verses of bhagavad gita(L1)
- explain the methods for obtaining life enlightenment through the practice of four yoga appropriately (L2)
- describe the characteristics of karma yogi/jnana yogi for developing leadership personality (L2)

Text Book(s):

1. Swami Swarupananda, “Srimad Bhagavad Gita”, Advaita Ashram (Publication Department), Kolkata
2. P. Gopinath, Bhartrihari’s Three Satakam (Niti-Sringar-vairagya), Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes

After successful completion of the course, the student will be able to

- List the different parables of neethisathakam and identify their morals(L1)
- enumerate the different traits of human personality for life enlightenment(L2)
- describe the leadership attributes for driving nation and mankind to peace and prosperity(L2)
- explain the applicability of different types of yoga to day-to-day work and duties resulting in responsible personality (L2)

19EAC750: DEVELOPING SOFT SKILLS AND PERSONALITY

L	T	P	C
3	0	0	0

Soft skills comprise pleasant and appealing personality traits as self-confidence, positive attitude, emotional intelligence, social grace, flexibility, friendliness and effective communication skills. The course aims to cause a basic awareness within the students about the significance of soft skills in professional and inter-personal communications and facilitate an all-round development of personality.

Course Objectives

- to familiarize the student to the criteria for self assessment and significance of self-discipline
- to expose the student to attitudes, mindsets, values and beliefs
- to acquaint the student to plan career and goals through constructive thinking
- to enable the student to overcome barriers for active listening and persuasive speaking
- to familiarize the skill of conducting meetings, writing minutes and involving in active group discussions

Unit I**(8L)**

Self-Assessment; Identifying Strength & Limitations; Habits, Will-Power and Drives; Developing Self-Esteem and Building Self-Confidence, Significance of Self-Discipline

Learning Outcomes

After the completion of this unit, the student will be able to

- identify strengths & limitations through self-assessment(L3)
- list the attributes of personalities will good will-power and self-drives(L1)
- describe the reasons for building self-esteem and self-confidence(L2)
- explain the significance of self discipline(L2)

Unit II**(8L)**

Understanding Perceptions, Attitudes, and Personality Types: Mind-Set: Growth and Fixed; Values and Beliefs

Learning Outcomes

After the completion of this unit, the student will be able to

- define the characteristics of different perceptions, attitudes and personality types(L1)
- distinguish between fixed and growing mindsets(L3)
- define the importance and meaning of values and beliefs(L2)

Unit III**(8L)**

Motivation and Achieving Excellence; Self-Actualisation Need; Goal Setting, Life and Career Planning; Constructive Thinking

Learning Outcomes

After the completion of this unit, the student will be able to

- describe the need for having high motivation and achieving excellence(L2)
- define the need for self-actualization(L1)
- plan the life and career goals based on self assessment(L4)
- explain the attributes of constructive thinking(L2)

Unit IV**(8L)**

Communicating Clearly: Understanding and Overcoming barriers; Active Listening; Persuasive Speaking and Presentation Skills.

Learning Outcomes

After the completion of this unit, the student will be able to

- self-assess the barriers for communicating clearly (L4)
- list the attributes of active listening(L1)
- describe the minimal aspects of effective presentation(L2)
- organize ideas resulting a persuasive talk(L3)

Unit V**(8L)**

Conducting Meetings, Writing Minutes, Sending Memos and Notices; Netiquette: Effective E-mail Communication; Telephone Etiquette; Body Language in Group Discussion and Interview.

Learning Outcomes

After the completion of this unit, the student will be able to

- describe the format and structure of writing meeting minutes(L2)
- identify the essential components of memos and notices(L3)
- explain the principles of effective email communication(L2)
- list the basic etiquette of telephone conversation(L1)
- describe the effective body traits during group discussion and interviews(L2)

Text Books

1. Dorch, Patricia. What Are Soft Skills? New York: Execu Dress Publisher, 2013.
2. Kamin, Maxine. Soft Skills Revolution: A Guide for Connecting with Compassion for Trainers, Teams, and Leaders. Washington, DC: Pfeiffer & Company, 2013.
3. Klaus, Peggy, Jane Rohman& Molly Hamaker. The Hard Truth about Soft Skills. London: HarperCollins E-books, 2007.
4. Petes S. J., Francis. Soft Skills and Professional Communication. New Delhi: Tata McGraw-Hill Education, 2011.
5. Stein, Steven J. & Howard E. Book. The EQ Edge: Emotional Intelligence and Your Success. Canada: Wiley & Sons, 2006.

Course Outcomes

After successful completion of the course, the student will be able to

- carry out self assessment and describe the significance of self-discipline(L4)
- define, classify and compare attitudes, mindsets, values and beliefs(L3)
- plan career and goals through constructive thinking and personal assessment(L4)
- overcome barriers for active listening and persuasive speaking (L5)
- conduct meetings, write minutes and involve in active group discussions(L3)

HSMCH102 - UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY**L T P C**
2 1 0 3

Human Values Courses: During the Induction Program, students would get an initial exposure to human values through Universal Human Values – I. This exposure is to be augmented by this compulsory full semester foundation course.

Course Objectives:

1. Development of a holistic perspective based on self- exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

COURSE TOPICS: The course has 28 lectures and 14 practice sessions in 5 modules:

Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I.
2. Self-Exploration–what is it? - Its content and process; ‘Natural Acceptance’ and Experiential Validation- as the process for self-exploration.
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority.
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

Module 2: Understanding Harmony in the Human Being - Harmony in Myself!

1. Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’.
2. Understanding the needs of Self (‘I’) and ‘Body’ - happiness and physical facility.
3. Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer).
4. Understanding the characteristics and activities of ‘I’ and harmony in ‘I’.
5. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.
6. Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one’s own life.

Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

Module 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

1. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship.
 2. Understanding the meaning of Trust; Difference between intention and competence.
 3. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
 4. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
 5. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.
- Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

Module 4: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

1. Understanding the harmony in the Nature
2. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature.
3. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space.
4. Holistic perception of harmony at all levels of existence.
5. Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

Module 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics

1. Natural acceptance of human values
2. Definitiveness of Ethical Human Conduct
3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
4. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
5. Case studies of typical holistic technologies, management models and production systems
6. Strategy for transition from the present state to Universal Human Order:
7. At the level of individual: as socially and ecologically responsible engineers, technologists and managers
8. At the level of society: as mutually enriching institutions and organizations
9. Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions e.g. To discuss the conduct as an engineer or scientist etc.

READINGS:

Text Book

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

Reference Books

1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi.

19ECE891: PROJECT WORK I

L	T	P	C
0	0	26	13

Each student is required to submit a report of first part of project work i.e. about the problem definition, literature review and methodology to be adopted including experiments and tests to be performed on topic of project as per the guidelines decided by the department. The project work is to be evaluated through Presentations and Viva-Voce during the semester end.

19ECE892: PROJECT WORK II

L	T	P	C
0	0	26	13

Each student is required to submit a detailed project report about the work on topic of project as per the guidelines decided by the department. The project work is to be evaluated through Presentations and Viva-Voce during the semester and Final evaluation will be done at the end of semester as per the guidelines decided by the department from time to time. The candidate shall present/publish one paper in national/international conference/seminar/journal of repute. However candidate may visit research labs/institutions with the due permission of chairperson on recommendation of supervisor concerned.



GITAM School of Technology
GITAM (Deemed to be University)
Visakhapatnam | Hyderabad | Bengaluru