# DEPARTMENT
# OF
# CIVIL ENGINEERING
# SYLLABUS

## 21UCVC100/200 Elements of Civil Engineering and Mechanics (3-0-0) 3

**Course Learning Objectives (CLOs):**

The objectives of this course are to make students to learn basics of civil engineering concepts and infrastructure development, solve problems involving Forces, loads & moments and know their applications in allied subjects. It is a pre-requisite for several courses involving Forces, Moments, Frictional forces, Centroids and Moment of inertia.

**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | | Mapping to POs(1,12) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |
| CO-1 | Know basics of Civil Engineering, its scope of study, knowledge about Roads, Bridges and Dams | | | 1 |
| CO-2 | Summarize, sketch different force systems Analyze problems related to coplanar concurrent and non-concurrent force system | 1,2 | | 12 |
| CO-3 | Comprehend the action of Forces, Moments and other loads on systems of rigid bodies and compute the reactive forces that develop as a result of the external loads | 1,2 | | 12 |
| CO-4 | Understand laws of friction and solve problems related to blocks, interconnected blocks, wedges, ladder and belt | 1,2 | | 12 |
| CO-5 | Calculate geometric properties – CG and MI of planar elements | 1,2 | | 12 |

| POs | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mapping Level | 2.6 | 3 | | | | | | | | | | 1 |

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**Prerequisites:**

1. Basics of trigonometry.
2. Basics of calculus.
3. Newton’s laws of motion.

**Contents:**

**Unit I**

**Introduction to Civil Engineering, Scope of different fields of Civil Engineering** - Surveying, Building Materials, Construction Technology, Geotechnical Engineering, Structural Engineering, Hydraulics, Water Resources and Irrigation Engineering, Transportation Engineering, Environmental Engineering. Infrastructure: Types of infrastructure, Role of Civil Engineer in the Infrastructural Development, Effect of the infrastructural facilities on socioeconomic development of a country.

Roads: Classification of Roads and their functions

Bridges: Types of Bridges and Culverts.

Dams: Different types of Dams. **07 Hrs.**

**Unit II**

**Analysis of Force Systems- Concurrent & Non-Concurrent System:**

**Concurrent Force System:** Composition of forces - Definition of Resultant; Composition of coplanar - concurrent force system, Parallelogram Law of forces, Principle of resolved parts; Numerical problems on composition of coplanar concurrent force systems.

Non-Concurrent Force System: Composition of coplanar - non-concurrent force system, Varignon's principle of moments Numerical problems on composition of co planar non-concurrent Force system. **08 Hrs.**

**Unit III**

**Equilibrium of Concurrent and Non-concurrent Forces:**

**Equilibrium of forces** - Definition of Equilibrant; Conditions of static equilibrium for different force systems, Lami's theorem; Numerical problems on equilibrium of coplanar – concurrent and non-concurrent force systems.

**Support Reaction:**

Types of Loads and Supports, statically determinate beams, Numerical problems on support reactions for statically determinate beams subjected to point load, uniformly distributed loads, uniformly Varying loads and moments. **08 Hrs.**

**Self-study:** Types of supports- smooth, hinge, roller and fixed.

## Unit IV

**Friction:**

Definitions: Types of friction, Laws of static friction, Limiting friction, Angle of friction, angle of repose; Impending motion on horizontal and inclined planes; Numerical Problems on single and two blocks on inclined planes. Numerical problems on Ladder and Wedge friction. **07 Hrs.**

**Self-study:** Lifting machines like screw jack and pulley**.**

## Unit V

**Centroid and Moment of Inertia of Engineering Sections**

**Centroids:**

Introduction to the concept, centroid of area, centroid of basic geometrical figures, computing centroid for planar areas, composite planar sections with Numerical problems.

**Moment of Inertia:**

Introduction to the concept, Radius of gyration, Parallel axis theorem, Perpendicular axis theorem, Moment of Inertia of basic planar figures, computing moment of Inertia for planar and composite sections. **09 Hrs.**

**Self-study**: Centroid and moment of inertia for built up sections

**Question Paper Pattern**:

1. Each question will carry 20 marks with maximum of four sub divisions
2. Each unit will consists of two full questions
3. Students have to answer one full question from each unit and total five questions to be answered.
4. The question paper will have built in choice in the unit.

**Reference Books:**

1) Bhavikatti S. S. & Rajashekarappa K. G., "Engineering Mechanics", New Age International (P) Ltd.

2) Singer F.L., "Engineering Mechanics", Harper & Row Publication, London.

3) Ferdinand P. Beer and E. Russell Johnston "Mechanics for Engineers: Statics", McGraw-Hill Book Company, New York.

4) M.N.Shesha Prakash and Ganesh. B. Mogaveer, “Elements of Civil Engineering and Engineering Mechanics”, PHI Learning, 3rd Revised edition

# Academic Program: UG

## Academic Year 2021-22 Syllabus

# III & IV Semester B.E.

# (Civil Engineering)

SHRI DHARMASTHALA MANJUNATHESHWARA COLLEGE OF ENGINEERING & TECHNOLOGY,

DHARWAD – 580 002

**(An Autonomous Institution approved by AICTE & Affiliated to VTU, Belagavi)**

**Ph**: **0836-2447465 Fax: 0836-2464638** **Web:** www.sdmcet.ac.in

## SDM College of Engineering & Technology, Dharwad

It is certified that the scheme and syllabus for III & IV semester of UG program in Civil Engineering is recommended by Board of Studies of Civil Engineering Department and approved by the Academic Council, SDM College of Engineering & Technology, Dharwad. This scheme and syllabus will be in force from the academic year 2021-22 till further revision.

Principal

Chairman BoS & HoD

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# SDM College of Engineering & Technology, Dharwad

## Vision and Mission of the Institute

**Vision:**

To develop competent professionals with human values.

**Mission:**

- To have contextually relevant Curricula.
- To promote effective Teaching Learning Practices supported by Modern Educational Tools and Techniques.
- To enhance Research Culture.
- To involve the Industrial Expertise for connecting Classroom contents to real-life situations.
- To inculcate Ethics and soft skills leading to overall personality development.

# DEPARTMENT OF CIVIL ENGINEERING

## VISION AND MISSION

**Vision:**

To be the center of excellence providing the state of art civil engineering education developing competent engineers responsible for serving modern society.

**Mission:**

The stated vision can be achieved through:

- The development of robust curricula to meet the industrial expectations.
- Interactive teaching-learning process with modern educational tools and soft skills.
- Establishing synergy between teaching and research
- Industry-Institute interaction.

# Program Educational Objectives (PEOs)

**I. Technical adeptness**: The Civil Engineering Graduates will be technically adept to specific fields and other disciplines. Management towards Planning, Design, and Costing. Their technical skills and knowledge will enable them to perform their work with a commitment and quality, timeliness with continuous improvement.

**II. Interpersonal Skills**: Civil Engineering Graduates will exhibit effective interpersonal skills in teams and at workplace.

**III. Awareness of Social impact:** Graduates will be made aware of causes of impacts due to the development and to identify remedial measures if necessary.

**IV. Professionalism:** Understanding of professionalism, ethics, quality performance, sustainability and allow them to be professional leaders and contributors to society through their problem-solving capabilities and executing the work.

**V. Continuous Learning:** Civil Engineering Graduates will exhibit interest in lifelong learning including studies leading to professional licensure or higher studies in engineering that provides for continued development of their technical ability and management skills

# PROGRAM OUTCOMES (POs)

**Engineering Graduates will be able to:**

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PO2. **Problem analysis**: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

PO3. **Design/ development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. **Individual and teamwork**: Function effectively as an individual and as a

member or leader in diverse teams and in multi-disciplinary settings.

PO10.**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11.**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply the set one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.

PO12.**Lifelong learning**: Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context to technological change.

## PROGRAM SPECIFIC OUTCOMES(PSOs)

PSO13.**Project inception and design**: Conceptualize projects related to different fields of Civil Engineering, collect relevant data by direct and indirect methods, analyze the project requirement and design the project.

PSO14.**Draft specification**: Select material, prepare estimates/costing, schedule work plans.

PSO15.**Experimentation**: Apply knowledge of different fields of Civil Engineering, conduct experiments, analyze, interpret data, and design the system components.

## III Semester

| Course Code | Course Category | Course Title | Teaching | | Examination | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | L-T-P (Hrs/Week) | Credits | CIE | Theory (SEE) | | Practical (SEE) | |
| | | | | | Max. Marks | *Max. Marks | Duration in Hrs. | Max. Marks | Duration in Hrs. |
| 18UMAC300 | BS | Engg. Mathematics-III | 3 - 0 - 0 | 3 | 50 | 100 | 3 | - | - |
| 18UCVC300 | PC | Building Construction | 4 - 0 - 0 | 4 | 50 | 100 | 3 | - | - |
| 18UCVC301 | PC | Mechanics of Materials | 4 - 0 - 0 | 4 | 50 | 100 | 3 | - | - |
| 18UCVC302 | PC | Fluid Mechanics | 3 - 0 - 0 | 3 | 50 | 100 | 3 | - | - |
| 18UCVC303 | PC | Surveying | 4 - 0 - 0 | 4 | 50 | 100 | 3 | -- | -- |
| 18UCVC304 | PC | Concrete Technology | 3 - 0 - 0 | 3 | 50 | 100 | 3 | -- | -- |
| 18UCVL305 | PC | Basic Material Testing Laboratory | 0 - 0 - 3 | 1.5 | 50 | -- | -- | 50 | 3 |
| 18UCVL306 | PC | Surveying Practice Laboratory | 0 -0 - 3 | 1.5 | 50 | -- | -- | 50 | 3 |
| **Total** | | | **21 – 0 – 6** | **24** | **400** | **600** | | **100** | |

BS- Basic Science, PC- Program Core

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**IV Semester**

| Course Code | Course Category | Course Title | Teaching | | Examination | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | L-T-P (Hrs/Week) | Credits | CIE | Theory (SEE) | | Practical (SEE) | |
| | | | | | Max. Marks | *Max. Marks | Duration in Hrs. | Max. Marks | Duration in Hrs. |
| 18UMAC400 | BS | Engg. Mathematics-IV | 3 - 0 - 0 | 3 | 50 | 100 | 3 | - | - |
| 18UCVC400 | PC | Structural Analysis – I | 4 - 0 - 0 | 4 | 50 | 100 | 3 | - | - |
| 18UCVC401 | PC | Highway Engineering | 4 - 0 - 0 | 4 | 50 | 100 | 3 | - | - |
| 18UCVC402 | PC | Water supply Engineering | 4 - 0 - 0 | 4 | 50 | 100 | 3 | - | - |
| 18UCVC403 | PC | Building Planning & Drawing | 2 - 0 - 2 | 3 | 50 | 100 | 3 | -- | -- |
| 18UCVC404 | PC | Hydraulics and Hydraulic Machines | 3 - 0 - 0 | 3 | 50 | 100 | 3 | -- | -- |
| 18UCVL405 | PC | Fluid Mechanics Laboratory | 0 - 0 - 3 | 1.5 | 50 | -- | -- | 50 | 3 |
| 18UCVL406 | PC | Applied Engineering Geology Laboratory | 0 -1- 2 | 1.5 | 50 | -- | -- | 50 | 3 |
| 18UCVL407 | PC | Introductory Project | 0 -0- 2 | 1 | 50 | -- | -- | -- | -- |
| **Total** | | | **20 -1 - 9** | **25** | **450** | **600** | | **100** | |

BS- Basic Science, PC- Program Core

**18UMAC300 Engineering Mathematics-III (3 - 0 - 0) 3**

**Contact Hours: 39**

**Course Learning Objectives (CLOs):**

To have an insight into Laplace transforms, Fourier series, Fourier transforms, Difference equations and Z-transforms. To develop the proficiency in variational calculus and solving ODE's arising in engineering applications, using numerical methods.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs (1-12)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| **CO-1** | Transform the given function using Laplace/Fourier transforms depending on the nature of engineering applications. | | | 1 |
| **CO-2** | Express periodic function as a Fourier series and obtain the various harmonics of the Fourier series expansion for the given numerical data. | | | 1,2 |
| **CO-3** | Solve difference equations using Z-transform. | | | 1 |
| **CO-4** | Solve first and second order ordinary differential equations arising in engineering problems using single step and multistep numerical methods. | | 1,2 | |
| **CO-5** | Determine the extremals of functional using calculus of variations and solve problems arising in engineering. | | | 1,2 |

| **POs/PSOs** | **1** | **2** |
|---|---|---|
| **Mapping Level** | 1.2 | 1.3 |

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**Pre-requisites:** A basic course on differentiation and integration of function.

**Contents:**

**Unit-I**

**Laplace Transforms:** Definition and Properties. Laplace transform of elementary functions. Laplace transforms of Periodic functions and unit-step function problems. **Laplace Transforms**: Inverse Laplace transform - problems, Convolution theorem (without proof) to find the inverse Laplace transform and problems, solution of linear differential equations using Laplace transform. **8 Hrs.**

**Unit-II**

**Fourier Series:** Periodic functions, Dirichlet's condition. Fourier series of periodic functions of period $2\pi$ and arbitrary period. Half- range Fourier series. Practical harmonic analysis, examples from engineering field. **8 Hrs.**

**Unit-III**

**Fourier Transforms**: Infinite Fourier transforms, Fourier sine and cosine transforms. Inverse Fourier transforms. Simple problems.

**Z-Transforms and Difference Equations**: Z-transform- definition, Standard Z-transforms, Damping and shifting rules, Initial value and Final value theorems (without proof) with problems. Inverse Z-transform. Simple problems. Difference equations-basic definition. Application of Z-transform to solve Difference equation. **8 Hrs.**

**Unit-IV**

**Numerical Solutions of Ordinary Differential Equations (ODE's):** Numerical solution of ODE's of first order and first degree-Taylor's series method, Modified Euler's method. Runge–Kutta method of fourth order, Milne's predictor and corrector method (No derivations of formulae). Problems. **7 Hrs.**

**Unit-V**

**Numerical Solution of Second Order ODE's:** Runge-Kutta method and Milne's predictor and Corrector method. (No derivations of formulae).

**Calculus of Variations**: Variation of function and functional, variational problems, Euler's equation (without proof), Geodesics (plane), hanging chain problems.**8 Hrs**

**Reference Books:**

1. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 44th edition, 2017.
2. E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, 10th edition (Reprint), 2016.
3. Srimanta Pal et al: Engineering Mathematics, Oxford University Press, 3rd edition, 2016.

**18UCVC300 Building Construction (4-0-0)4**

**Contact Hours: 52**

**Course Learning Objective (CLOs):** Building Construction is taught as a core course in Civil Engineering program. In this course, topics on introduction and exposure to traditional and modern building materials, types of soils and foundations, brick/stone masonry, floorings, stairs, damp proofing and termite proofing, roofs, building services and cost-effective construction techniques are covered. Two topics viz. doors & windows and, lintels and arches are included for the self-study by students. The delivery of the topics is achieved through lecture classes and preparation of working drawings for building components and for building services. The evaluation is made by means of the internal assessment tests and semester end examination.

**Course Outcomes (COs):**

| **Description of the Course Outcome: At the end of the course the student will be able to:** | | **Mapping to POs (1-12)/ PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Explain the traditional / modern/ cost effective building materials. Identify different types of foundations and their suitability based on soil and other conditions. | | 1, 7 | 6, 12 |
| CO-2 | Define the technical terms related to masonry works and differentiate between different types of brick and stone masonry | | 1 | 6, 12 |
| CO-3 | Discuss damp proofing and termite proofing using different methods & different materials and identify different types of flooring materials and different types of floors and their suitability | | 1 | 6, 12 |
| CO-4 | Explain different components and develop geometric design of stairs. explain different types of roofs for different spans including roofing materials. | | 1 | 6, 12 |
| CO-5 | Classify and select different mortars, paints, plumbing and electrical materials for different applications, explain the basics of cost-effective construction. | | 1 | 6, 12 |

| POs/PSOs | PO-1 | PO-6 | PO-7 | PO-12 |
|---|---|---|---|---|
| Mapping Level | 2 | 1 | 2 | 1 |

**Contents:**

**Unit-I**

**Building materials:** Bricks, stones, timber and modern building materials.

**Types of foundation:** Masonry footings, isolated footings, Combined and strap RCC footings, Raft footing, Pile foundations. (Friction and Load bearing piles), Foundation in black cotton soils. **12 Hrs.**

**Unit-II**

**Brick Masonry:** Definition of terms used in masonry, English and Flemish Bond, Reinforced brickwork, construction using hollow blocks.

**Stone Masonry:** Types: Rubble Masonry, Coursed Rubble Masonry, Un-coursed rubble masonry, Random rubble masonry, Ashlar Masonry; Comparison of stone & brick masonry. **10 Hrs.**

**Unit-III**

**Damp proofing and Termite proofing:** Causes, effects, methods, materials and treatment.

**Floorings:** Types of floorings, materials and method of laying of granolithic, mosaic, ceramic, marble, polished granite and industrial flooring. **10 Hrs.**

**Unit-IV**

**Staircase:** Classification and types, technical terms, requirements of a good stair, geometric design of stairs.

**Roofs and roofing systems:** RCC and tiled roofing systems, Lean-to-roof, trusses (King post and queen post truss), steel trusses for various spans, roof coverings. **10 Hrs.**

**Unit-V**

**Plastering, pointing & painting:** Introduction to plastering and pointing, terminologies used, materials and methods of plastering, defects in plasters, characteristics of an ideal paint, constituents, classification and types of paints.

**Building services:** Water supply & sanitation and electrification.

**Introduction to cost effective construction:** Materials and methods of construction; Green buildings. **10 Hrs.**

**Self-study:**

**Doors and windows:** Introduction, definition of terms, location, types and sizes, fixtures and fastenings.

**Lintels and Arches:** Classification, materials and method of construction, stability of arches.

**Reference Books:**

1) Punmia B.C., “Building Construction”, Laxmi Publication (P) Ltd., New Delhi.

2) Duggal S. K. “Building Materials”, New Age Publishers, New Delhi.
3) Sushil Kumar, “Building Construction”, Standard Publishers, New Delhi.
4) Jha and Sinha,” Building Materials”, Khanna Publishers.

## 18UCVC301 Mechanics of Materials (4-0-0) 4

**Contact Hours: 52**

**Course Learning Objectives (CLOs):** Mechanics of Materials is taught as a core course in Civil Engineering program. In this course, topics on Simple stresses and strains, Compound stresses, BMD and SFD for determinate beams, bending and shear stresses in beams, deflection of beams, Torsion of circular shafts, stability of columns and thin and thick cylinders are dealt. The evaluation is made by means of the internal assessment tests and semester end examination.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs (1-12)/ PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Analyze and calculate simple stresses and strains, Elastic constants, thermal stresses. | 1,2 | | |
| CO-2 | Analyze and calculate Compound stresses by analytical and graphical method. | 1,2 | | |
| CO-3 | Analyze, calculate and draw BMD, SFD and calculate bending Stresses, Shear Stresses in beam cross section. | 1,2 | 3 | |
| CO-4 | Analyze and calculate Slopes and deflections of beams & columns and buckling loads for long columns. | 1,2 | | |
| CO-5 | Analyze and calculate stresses and strains in circular shafts subjected to torsion and thin and thick cylinders subjected to internal pressures. | 1,2 | 3 | |

| **POs/PSOs** | PO-1 | PO-2 | PO-3 |
|---|---|---|---|
| **Mapping Level** | 3 | 3 | 2 |

**Prerequisites:**
Students taking this course shall have the knowledge of following:
Engineering Mechanics

**Contents:**

**Unit-I**

**Simple stresses and strains:** Simple Stresses & Strains, Elastic constants, compound bars, thermal effects. **10 Hrs.**

**Unit-II**

**Compound stresses**: Inter-relations of direct and shear stresses, Mohr's circle of stresses **9 Hrs.**

**Unit-III**

**Bending Moment and Shear Force Diagram**: Simply supported, Cantilever, overhanging beams for standard and general loadings.
**Bending & Shear stresses**: Calculation of bending and shear stresses in rectangular and flanged sections. **12 Hrs.**

**Unit-IV**

**Slopes and deflections**: Calculation of slopes and deflections in determinate beams by Double Integration Method and Macaulay's method.
**Long Columns:** Elastic stability of Columns, Euler's theory, Rankine's formula.
**12 Hrs.**

**Unit-V**

**Torsion**: Torsion of circular shafts, power transmitted, design and comparison of hollow & solid shafts.
**Thin and Thick Cylinders**: Analysis and design of thin and thick Cylinders.
**9 Hrs.**

**Reference Books:**

1) Punmia B.C., Ashok Jain, Arun Jain, "Strength of Materials", Lakshmi Publications, New Delhi.
2) Basavarajaiah and Mahadevappa, "Strength of Materials", Khanna Publishers, New Delhi
3) Bhavikatti S.S., "Strength of Materials", Vikas Publishers, New Delhi.
4) Ramamrutham, "Strength of Materials", DhanapathRai Publishers, New Delhi.
5) Beer & Johnston, "Mechanics of Materials", McGraw Hill Education.

| 18UCVC302 | Fluid Mechanics | (3-0-0)3 |
|---|---|---|

**Contact Hours: 39**

**Course Learning Objectives (CLOs):** Fluid Mechanics is taught as a core course in Civil Engineering program. In this course, topics on Fluid Mechanics development, Properties of fluid, Fluid Pressure and its measurement, Hydrostatics, Kinematics of fluids, Dynamics of fluid flow and flow measurement. The delivery of topics will be made through lecture classes and demonstration. The

evaluation is made by means of the internal assessment tests and semester end examination.

**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | | Mapping to POs (1-12)/ PSOs (13-15) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level(1) |
| CO-1 | Explain fundamental properties of fluids and fluid continuum. | | 1 | |
| CO-2 | Calculate pressures using different types of pressure measuring devices and solve problems on hydrostatics, including practical applications. | | 1 | |
| CO-3 | Apply fundamental laws of fluid mechanics and Bernoulli's principle for practical applications. | 2 | | 1 |
| CO-4 | Compute the discharge through pipes, notches and weirs. | 2 | | 1 |
| CO-5 | Explain behavior of pipes under different types of flow closure conditions and surge analysis in pipes. | 2 | | 1 |

| POs/PSOs | PO-1 | PO-2 |
|---|---|---|
| Mapping Level | 1.4 | 3 |

**Prerequisites:**

Students taking this course shall have the knowledge of following:

1) Physics
2) Mathematics
3) Engineering Mechanics

**Contents:**

**Unit-I**

**Fluids & Their Properties:** Concept of fluid, Systems of units and dimensions. Properties of fluid; Mass density, Specific weight, Specific gravity, Specific volume, Viscosity, Cohesion, Adhesion, Surface tension & Capillarity. Fluid as a continuum, Newton's law of viscosity (theory & problems).Capillary rise in a vertical tube and between two plane surfaces (theory & problems).Vapor pressure of liquid, saturation vapor pressure, compressibility and bulk modulus, pressure inside a water droplet, pressure inside a soap bubble and liquid jet, Numerical problems. **7 Hrs.**

**Unit-II**

**Fluid Pressure and Its Measurements:** Definition of pressure, Pressure at a point, Pascal's law, Hydrostatic law; Variation of pressure with depth. Types of pressure, atmospheric, gauge and vacuum pressure. Measurement of pressure using simple, differential & inclined manometers (theory & problems). Introduction to Mechanical and electronic pressure measuring devices.

**Hydrostatics:** Definition, Total pressure, center of pressure, total pressure on horizontal, vertical and inclined plane surface, total pressure on curved surfaces.

**10 Hrs.**

**Unit-III**

**Fluid Dynamics:** Introduction, Forces acting on fluid in motion. Euler's equation of motion along a streamline and Bernoulli's equation. Assumptions and limitations of Bernoulli's equation. Modified Bernoulli's equation. Problems on applications of Bernoulli's equation (with and without losses). Vortex motion; forced vortex, free vortex, problems. Momentum equation and problems on pipe bends. Applications: Introduction to Venturimeter, Orifice meter, Pitot tube, (Numerical Problems).

**7Hrs.**

**Unit-IV**

**Flow measurements:** Orifice and Mouthpiece: Introduction, classification, flow through orifice, hydraulic coefficients and Numerical problems. Mouthpiece, classification, Borda's Mouthpiece (No problems). Notches and Weirs: Introduction. Classification, discharge over rectangular, triangular, trapezoidal notches, Cipolletti notch, broad crested weirs, Numerical problems. **07 Hrs.**

**Unit-V**

**Flow through Pipes:** Introduction. Major and minor losses in pipe flow. Darcy's Weisbach equation for head loss due to friction in a pipe. Pipes in series, pipes in parallel, equivalent pipe-problems. Minor losses in pipe flow, equation for head loss due to sudden expansion (Numerical problems). Hydraulic gradient line, energy gradient line.

**Surge Analysis in Pipes:** Water hammer in pipes, equations for pressure rise due to gradual valve closure and sudden closure for rigid and elastic pipes. Problems.

**08 Hrs.**

**Reference Books:**

1) Modi P.N. and Seth S.M., "Hydraulics and Fluid Mechanics", Standard Book House, Delhi.
2) Bansal R.K., "Fluid Mechanics and Hydraulic Machines", Lakshmi publications.
3) Jain A.K., "Fluid Mechanics", Khanna Publishers, Delhi.
4) Subramanya K., "1000 Solved Problems in Fluid Mechanics", Tata McGraw Hill Publishers, New Delhi.

| 18UCVC303 | Surveying | (4-0-0)4 |
|---|---|---|

**Contact Hours: 52**

**Course Learning Objective (CLOs):** Surveying is taught as a core course in Civil Engineering program. The course deals with topics on measurement of distances, angles and elevations. The usage of instruments like chains, tapes, dumpy level and theodolite are dealt with. The delivery of topics will be made through lecture classes and demonstrations. The evaluation is made by means of the internal assessment tests and semester end examination.

**Course Outcomes (COs):**

| **Description of the Course Outcome: At the end of the course the student will be able to:** | | **Mapping to POs (1-12)/ PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Explain basic principles of surveying, carry out leveling operations. | 1 | | |
| CO-2 | Carry out theodolite survey and determine heights and distances by trigonometrical methods. | 1 | 9 | |
| CO-3 | Determine heights and distances by tacheometric principle and understand the concept of contours. | 1 | 9 | |
| CO-4 | Design different types of curves based on suitability. | 3 | 9, 6, 15 | |
| CO-5 | Calculate areas and volumes of civil engineering works, set out works and use modern equipment like GPS and Total Station. | 5 | 9, 8 | 10 |

| **POs/PSOs** | PO-1 | PO-3 | PO-5 | PO-6 | PO-8 | PO-9 | PO-10 | PO-15 |
|---|---|---|---|---|---|---|---|---|
| **Mapping Level** | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 2 |

**Prerequisites:**

Students taking this course shall have the knowledge of following:

1) Trigonometry and geometry

**Contents:**

**Unit-I**

**Introduction:** Definition and classification of surveying, units of measurements, maps and plans, Survey of India Topographical maps and their numbering, Basic

principles of surveying. Measurement of horizontal distances - Chains and Tapes, Ranging of lines-Direct and Indirect.

**Levelling:** Principles and basic definitions, Fundamental axes and part of a dumpy level, Temporary adjustments of a dumpy level, Types of levelling. **10 Hrs.**

**Unit-II**

**Theodolite Survey:** Types of theodolites, Measurement of horizontal and vertical angles by repetition and reiteration methods.

**Trigonometric Levelling:** Determination of heights and distances. **10 Hrs.**

**Unit-III**

**Tacheometry:** Principles of tacheometry, measurement of heights and distances

**Contouring:** Contours, characteristics and uses. **10 Hrs.**

**Unit-IV**

**Curve Setting:** Curves-Necessity-Types of curves, Simple curves, Compound curves, Reverse curves, transition curves and vertical curves. Setting of simple circular curves by successive bisection of chords, offsets from long chord, Rankin's method. Compound curve, Reverse curves of equal and unequal radius. Examples. Transition curves–Necessity, elements and type of curves, Vertical curves -Types of vertical curves- Numerical examples. **10 Hrs.**

**Unit-V**

**Areas and Volumes:** Computations of areas and volumes by trapezoidal and prismoidal methods

**Construction Survey:** Setting out of works for buildings and tunnels

**Modern surveying instruments:** Introduction to GPS, Total station and drone survey. **12 Hrs.**

**Reference Books:**

1) Punmia B.C., "Surveying, Vol- 1& 2", Laxmi Publishers (Pvt.) Ltd., New Delhi.
2) Chandra A.M., "Plane Surveying", New Age International (P) Ltd.
3) Chandra A.M., "Higher Survey", New Age International (P) Ltd.
4) S.K Kanetkar, "Surveying", Vol- 1& 2".

| 18UCVC304 | Concrete Technology | (3-0-0)3 |
|---|---|---|

**Contact Hours: 39**

**Course Learning Objective (CLOs): Concrete Technology** is taught as one of core subjects for Civil Engineering Program. In this course, topics on ingredients of concrete, manufacture of concrete, properties of fresh and hardened concrete, special concrete, non-destructive testing of concrete and concrete mix design are dealt. The delivery of topics will be made through lecture classes and demonstration. The evaluation is made by means of the internal assessment tests and semester end examination.

**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | | Mapping to POs (1-12)/ PSOs (13-15) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |
| CO-1 | Explain various properties of ingredients of concrete. | | 1,2,6 | |
| CO-2 | Select materials and follow procedures to manufacture concrete and evaluate the properties of concrete in fresh state. | 3,4 | 9 | 7,12 |
| CO-3 | Evaluate properties of concrete in hardened state and explain non-destructive tests. | 3,4,5 | 6,7,9 | 12 |
| CO-4 | Identify suitable type of concretes based on site conditions for specific purpose of works. | 13 | 7 | 12 |
| CO-5 | Design concrete mix as per IS IS 456: 2000 and IS10262: 2019. | 3,13 | 4 | 6,12 |

| POs/PSOs | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-9 | PO-12 | PSO-13 |
|---|---|---|---|---|---|---|---|---|---|---|
| Mapping Level | 2 | 2 | 3 | 2.7 | 3 | 1.7 | 1.7 | 2 | 1 | 3 |

Mapping level: 1 = Low, 2=Moderate, 3=Substantial

**Prerequisites:**

Students taking this course shall have the knowledge of following:

1) Engineering Chemistry

**Contents:**

**Unit-I**

**Ingredients of concrete:**

Cement: Manufacture of Portland cement, chemical composition, hydration of cement, classification and types of cement, tests on cement.

Aggregate: Classification, mechanical and physical properties, deleterious materials, soundness, alkali-aggregate reaction, grading of aggregate, tests on aggregate, artificial and recycled aggregate.

Water: Quality of Water, mixing water, curing water. **10 Hrs.**

**Unit-II**

**Manufacture of concrete:** Batching, mixing, transporting, placing, compaction, finishing, curing.

**Properties of concrete in fresh state:** Factors affecting workability, segregation and bleeding, harshness, measurement of workability, admixture, plasticizers, accelerators, retarders and air entraining agents. **07 Hrs.**

**Unit-III**

**Properties of concrete in hardened state:** Unit weight, strength characteristics, impermeability, durability, dimensional changes.

**Non-destructive testing of concrete:** Importance, methods-Rebound hammer test, penetration and pullout test, Ultrasonic pulse velocity test-Principles, applications and limitations. **06 Hrs.**

**Unit-IV**

**Special concretes:**

Light weight concrete, polymer concrete, fiber reinforced concrete, ready mix concrete, Ferro cement concrete, mass concrete, high strength/performance concrete, pumped concrete, no fines concrete. Under water concreting / hot and cold weather concreting / shotcreting. Introduction to self-compacting concrete. **07 Hrs.**

**Unit-V**

**Concrete Mix design:** Concept of Mix design, variables in proportioning, Exposure conditions, Procedure of mix design as per IS 10262-2019, numerical examples of mix design with and without mineral admixtures. **09 Hrs.**

**Reference Books:**

1) Shetty M.S., “Concrete Technology” -Theory and Practice, S. Chand and company, New Delhi.
2) Neville A.M. & Brooks J.J., “Concrete Technology”, Trans-Atlantic Publications, Philadelphia, USA.
3) Gambhir M.L., “Concrete Technology”, Tata McGraw Hill, Education, New Delhi.
4) IS 10262: 2019, “Recommended guidelines for concrete mix design”, BIS publication, New Delhi.
5) IS 456: 2000., “Plain and Reinforced Concrete – Code of practice”.

| 18UCVL305 | Basic Material Testing Lab | (0-0-3) 1.5 |
|---|---|---|

**Contact Hours: 36**

**Course Learning Objectives (CLOs)** Basic Material Testing Laboratory is taught as one of the regular labs for III Semester Civil Engineering students. In this coarse various test on steel, aggregates cement, bricks, concrete blocks are dealt. The delivery of topics will be made through instruction classes, demonstration and laboratory works as per IS codes. The evaluation will be carried out through continuous evaluation & end semester practical examination.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | **Mapping to POs (1-12)/ PSOs (13-15)** | | |
|---|---|---|---|
| | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |

| | | | | |
|---|---|---|---|---|
| CO-1 | Perform tests on metals and Interpret results. | 4 | 9 | 8 |
| CO-2 | Perform tests on fine and coarse aggregate and arrive at suitability of aggregates based on test results. | 4 | 9 | 8 |
| CO-3 | Perform test on Cement, interpret results. and Identify grade of cement. | 4 | 9 | 8 |
| CO-4 | Perform tests on Bricks and classify based on results. | 4 | 9 | 8 |

| **POs/PSOs** | PO-4 | PO-8 | PO-9 |
|---|---|---|---|
| **Mapping Level** | 3 | 1 | 2 |

**Prerequisite:**

1) Building Construction
2) Strength of Materials

**Contents:**

1) **Test on steel & metals:** Tension, compression, shear, Hardness and impact test.
2) **Test on fine aggregate:** Specific gravity, Bulk density, Silt and deleterious materials.
3) **Test on Coarse aggregate:** Specific gravity, Bulk density, water absorption.
4) **Test on Cement:** Specific gravity, Fineness, Normal Consistency, Initial and Final setting time.
5) **Tests on Bricks:** Size, water absorption, Compression strength.

**Reference Books:**

1) Duggal S.K, “Materials Testing Laboratory Manual”, Tata McGraw Hill Publishers, New Delhi.

## 18UCVL306 Surveying Practice Laboratory (0-0-3) 1.5

**Contact Hours: 36**

**Course Learning Objectives (CLOs):** Surveying practice laboratory is taught as a laboratory course for Civil Engineering Program. In this course, measurement of distances, angles, heights, elevations and contouring are dealt. The delivery of topics will be made through instruction classes, demonstration and Laboratory work. The evaluation will be carried out through continuous evaluation & end semester practical examination.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs (1-12)/ PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Measure horizontal distance, vertical distance, elevation by using chain, tape and theodolites. | 5, 15 | 9 | |
| CO-2 | Construct simple curve by different methods. | 5, 15 | 9 | |
| CO-3 | Make use of Total station for cadastral survey, prepare maps, verify plumb of tall vertical structures and set out Civil Engineering works. | 5, 15 | 9 | |

| **POs/PSOs** | PO-5 | PO-9 | PSO-15 |
|---|---|---|---|
| **Mapping Level** | 3 | 2 | 3 |

**Prerequisites:**

Students taking this course shall have the knowledge of following subject:

1) Surveying

**Contents:**

1) **Chain surveying:** To measure distance between two points using direct ranging, indirect ranging and to set out perpendiculars.
2) **Levelling:** To determine difference in elevation between two points and to conduct fly back levelling; profile levelling.
3) **Theodolite surveying:** Measurement of horizontal angles by the method of repetition and reiteration using theodolite/total station. Measurement of vertical angles using theodolite/total station.
4) **Trigonometric levelling:** To determine heights and distances by single plane and double plane method.
5) **Curve setting:** To set out simple curves using linear methods, -perpendicular offsets from long chord and offsets from chords produced and Rankine's method.
6) **Total station survey:** Open land survey for the determination of areas and plotting the features.
   a) Cadastral survey and plotting.
   b) Heights and distances.
   c) Checking of plumb of towers/chimneys.

d) Setting out of civil works.

**Reference Books:**

1) Punmia B.C., “Surveying Vol- 1& 2”, Laxmi Publications.
2) Chandra A.M., “Plane Surveying Vol-I”, New Age International Ltd.
3) Surveying Practice Lab Manual.

## 4th Semester

**18UMAC400 Engineering Mathematics-IV (3 - 0 - 0) 3**

**Contact Hours: 39**

**Course Learning Objectives (CLOs):**

To provide an insight into applications of conformal mapping, integration of complex functions and application of probability distributions in Engineering.

**Course Outcomes (COs):**

| **Description of the Course Outcomes:** At the end of the course the student will be able to: | | **Mapping to POs (1-12)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| **CO-1** | Construct and use the concepts of analytic function to solve the problems arising in Engineering field. | | | 1 |
| **CO-2** | Utilize conformal transformation and complex integral to transform irregular domain onto a relatively simple domain. | | 1 | |
| **CO-3** | Apply discrete and continuous probability distributions in analyzing the probability models arising in engineering field. | | 1 | |
| **CO-4** | Make use of the correlation and regression analysis to fit a suitable mathematical model for the statistical data. | | 1,2 | |
| **CO-5** | Estimate the correlation, covariance using joint probability distributions. Also use student's t-distribution, Chi-square distribution as a test of goodness of it. | | 1,2 | |

| **POs/PSOs** | **1** | **2** |
|---|---|---|
| **Mapping Level** | 1.8 | 2 |

**Pre-requisites:** 1.A basic course on Differentiation and integration of function.
2. A basic course on probability and statistical averages.

**Contents:**

**Unit-I**

**Calculus of complex functions:** Review of function of a complex variable, limits, continuity, and differentiability. Analytic functions: Cauchy-Riemann equations in Cartesian and polar forms. Construction of analytic functions: Milne-Thomson method-Problems. **7 Hrs.**

**Unit-II**

**Conformal transformations:** Introduction. Discussion of transformations

$w = e^z; w = z^2, w = z + \frac{1}{z}, z \neq o)$. Bilinear transformations- Problems.

**Complex integration:** Line integral of a complex function, Cauchy's theorem and Cauchy's Integral theorem. **8 Hrs.**

**Unit-III**

**Statistical Methods:** Correlation and regression-Karl Pearson's coefficient of correlation and rank correlation-problems. Regression analysis- lines of regression–problems.

**Curve Fitting:** Curve fitting by the method of least squares- fitting the curves of the form $= ax + b; y = ax^2 + bx + c; y = ax^b$ **.** **8 Hrs.**

**Unit-IV**

**Probability Distributions:** Review of basic probability theory. Random variables (discrete and continuous), probability mass/density functions. Binomial, Poisson, exponential and normal distributions-problems (No derivation for mean and standard deviation)-Illustrative examples. **8 Hrs.**

**Unit-V**

**Joint probability distribution:** Joint Probability distribution for two discrete random variables, expectation and covariance.

**Sampling Theory:** Introduction to sampling distributions, standard error, Type-I and Type-II errors. Test of hypothesis for means, student's t-distribution, Chi-square distribution as a test of goodness of fit. **8 Hrs.**

**Reference Books:**

**1.** E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons**,** 10th edition. (Reprint) 2016.

2. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 44th edition, 2017.

3. Srimanta Pal et al: Engineering Mathematics, Oxford University Press, 3rd edition, 2016.

| 18UCVC400 | Structural Analysis–I | (4-0-0) 4 |
|---|---|---|

**Contact Hours: 52**

**Course Learning Objectives (CLOs):** Structural Analysis-I is taught as one of the core courses in Civil Engineering program. In this course, topics on Structural systems, Deflection of beams, Strain Energy, Arches and Cables, Influence Line Diagram for Beams and Analysis of Indeterminate beams are dealt. The delivery of topics will be made through lecture classes. The evaluation is made by means of the internal assessment tests and semester end examination

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs (1-12)/ PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Classify the different Structural Systems and Calculate the deflection in beams by Moment Area Method, Conjugate Beam Method, | 1,2 | | |
| CO-2 | Analyze beams, frames and trusses using energy principles and energy theorems. | 1,2 | | |
| CO-3 | Calculate the forces in arches and cables. | 1,2 | | |
| CO-4 | Calculate and sketch the bending moment and shear force in the beam under moving load using ILD. | 1,2 | | |
| CO-5 | Analyze the indeterminate beams by consistent deformation method and Clapeyron's theorem of three moments. | 1,2 | | |

| **POs/PSOs** | PO-1 | PO-2 |
|---|---|---|
| **Mapping Level** | 3 | 3 |

**Prerequisites:**

Students taking this course shall have the knowledge of following:

1) Engineering Mechanics
2) Strength of Materials

**Contents:**

**Unit-I**

**Introduction to Structural Systems**: Forms of structures, conditions of equilibrium, degree of freedom, linear and non-linear structures, one, two and three-dimensional structural systems, determinate and indeterminate structures [Static and Kinematics].

**Deflection of beams:** Moment area method, conjugate beam method. **12 Hrs.**

**Unit-II**

**Energy Principles and Energy Theorems:** Strain energy and complimentary strain energy, strain energy due to axial load, bending and shear, theorem of minimum potential energy, Law of conservation of energy, principle of virtual work, the first theorem of Castigliano, Betti's law, Clarke -Maxwell's theorem of reciprocal deflection, deflection of beams and trusses using strain energy and unit load methods. **12 Hrs.**

**Unit-III**

**Arches and cables:** Three hinged circular and parabolic arches with support at same levels and different levels, determination of thrust, shear and bending moment, analysis of cables under point loads and UDL, length of cables supports at same level and at different levels. **10 Hrs.**

**Unit-IV**

**Influence line diagrams for beams:** Influence line for maximum shear force, maximum bending moment for simply supported, cantilever and overhanging beams. **08 Hrs.**

**Unit-V**

**Analysis of beams:** Consistent deformation method -propped cantilever and fixed beams, strain energy method -propped cantilever and fixed beams Clapeyron's theorem of three moments -continuous beams. **10 Hrs.**

**Reference Books:**

1) Devdas Menon, “Structural Analysis”, Alpha Science International Ltd.
2) Reddy C. S., “Basic Structural Analysis”, Tata McGraw Hill.
3) Punmia B.C., Jain A.K., “Strength of Materials and Theory of Structures Vol I & II”, Laxmi Publication
4) Ramamrutham S., “Theory of Structures”; Dhanpat Rai & Sons, Delhi.
5) Bhavikatti S.S., “Structural Analysis Volume - I”, Vikas Publications, New Delhi.

| 18UCVC401 | Highway Engineering | (4-0-0) 4 |
|---|---|---|

**Contact Hours: 52**

**Course Learning Objectives (CLOs):** Highway Engineering is taught as one of the core subjects of Civil Engineering in which the basic knowledge of Highway alignment, design of pavement imparted to the students. Topics covered include the Highway Planning and alignment, geometric design, pavement design, highway

economics, pavement maintenance and highway drainage along with numerical problems. The delivery of the topics is achieved through lecture classes, problem solving and demonstrations. The evaluation is made by means of the internal assessment tests and semester end examination.

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**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | | Mapping to POs (1-12)/ PSOs (13-15) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |
| CO-1 | Explain historical development of roads in India and recognize ideal highway alignment through a systematic highway planning. | | | 1 |
| CO-2 | Design the Geometrical features of highway. | 1,2,3 | | |
| CO-3 | Design the pavement layers of Flexible pavement and Rigid pavement. | 1,2,3 | | |
| CO-4 | Comprehend the construction of various types of roads including highway drainage. | | | 1,12 |
| CO-5 | Analyze the economical aspect of highway construction and to evaluate its structural and functional behavior. | | 1,12 | |

| POs/PSOs | PO-1 | PO-2 | PO-3 | PO-12 |
|---|---|---|---|---|
| Mapping Level | 2 | 3 | 3 | 1 |

**Prerequisites:**

Students taking this course shall have the knowledge of following:

1) Surveying

**Contents:**

**Unit-I**

**Introduction:** Importance of transportation, modes, characteristics, comparison of different modes, Jayakar Committee recommendation and implementation, present scenario of road development in India.

**Highway Planning and Alignment:** Road patterns, planning surveys, master plan, saturation system of road planning with problems, factors affecting alignment, ideal

alignment, surveys and drawings for new and realignment projects (As per IRC). **09 Hrs.**

**Unit-II**

**Highway geometric design:** Importance cross sectional elements, width of carriage way, camber, shoulder width, design speed, sight distances, design of horizontal and vertical alignment, problems on above. **12 Hrs.**

**Unit-III**

**Pavement Design:** Types of pavements, design factors, determination of ESWL and EWL factors and problems, IRC method of flexible pavement design based on CSA method, stresses in rigid pavement and design as per IRC (IRC 37: 2018 and IRC 58: 2018) only. Design of joints, Tie bars, dowel bars. **10 Hrs.**

**Unit-IV**

**Pavement Construction**: Construction procedure of WBM, WMM, Bituminous and concrete roads, quality control measures.

**Highway Drainage**: Subsurface drainage system for road pavements, types, functions, and basic design principles **10 Hrs.**

**Unit-V**

**Highway Economics and Financing:** Highway user benefits - VOC using charts only — Highway costs — Economic analysis by annual cost method and benefit cost ratio method. Highway financing - ROT and BOOT concepts.

**Pavement Maintenance:** Functional & Structural deterioration of pavements, principles of pavement evaluation, types pavement failures, cases, maintenance measures for road drainage & system & pavements. **11 Hrs.**

**Reference Books:**

1) Khanna S.K. and Justo C E G., “Highway Engineering”, Nemchand and Bros, Roorkee.
2) Kadiyali L.R., “Traffic Engineering and Transport Planning”, Khanna Publishers, New Delhi.
3) Subramanian K.P., “Transportation Engineering–I”, Scitech Publications, Chennai.

**18UCVC402 Water Supply Engineering (4-0-0) 4**

**Contact Hours: 52**

**Course Learning Objective (CLOs):** Water Supply Engineering is taught as one of the core courses in Civil Engineering program. In this course, basic knowledge of drinking water, its requirement, effects on health & utility, source finding, its quality and quantity, transportation of raw water to the treatment plant, water treatment as per IS codes & design of distribution system are dealt. The delivery of topics will be made through lecture classes, demonstrations and field visits. The delivery of

topics will be made through lecture classes. The evaluation is made by means of the internal assessment tests and semester end examination.

**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | | Mapping to POs (1-12)/ PSOs (13-15) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level(1) |
| CO-1 | Characterize the sources of drinking water with respect to quantity and quality. Compute water demand by population forecasting methods. | 3,4 | 12 | |
| CO-2 | Explain the quality parameters of water and their effects on human health. | | 3,4 | |
| CO-3 | Identify suitable source for water supply scheme and Design a system for transporting water to the treatment plant. | | 3,4 | |
| CO-4 | Design water treatment plant. | 11 | | |
| CO-5 | Explain miscellaneous water treatment techniques and design distribution system. | | 5 | |

| POs/PSOs | PO-3 | PO-4 | PO-5 | PO-11 | PO-12 |
|---|---|---|---|---|---|
| Mapping Level | 2.33 | 2.33 | 2 | 3 | 2 |

**Prerequisites:**

Students taking this course shall have the knowledge of following:

1) Engineering Chemistry

**Contents:**

**Unit-I**

**Introduction**: Human activities and environmental pollution. Water for various beneficial uses and quality requirement. Need for protected water supply.

**Demand of water**: Types of water demands- domestic demand in detail, institutional and commercial, public uses, fire demand. Per capita consumption – factors affecting per capita demand, population forecasting, different methods with merits &demerits- variations in demand of water. Fire demand – estimation by

Kuichling's formula, Freeman formula & national board of fire underwriter's formula, peak factors, design periods & factors governing the design periods. **10 Hrs.**

**Unit-II**

**Quality of water**: Objectives of water quality management. wholesomeness & palatability, water borne diseases. Water quality parameters – Physical, chemical and Microbiological. Sampling of water for examination. Water quality analysis (IS: 3025 and IS: 1622) using analytical and instrumental techniques. Drinking water standards BIS & WHO guidelines. Health significance of Fluoride, Nitrates and heavy metals like Mercury, Chromium, Cadmium, Arsenic etc. **09 Hrs.**

**Unit-III**

**Sources**: Surface and subsurface sources – suitability about quality and quantity.

**Collection and conveyance of water**: Intake structures – different types of intakes; factor of selection and location of intakes. Pumps- Necessity, types – power of pumps; factors for the selection of a pump. Pipes – Design of the economical diameter for the rising main; Nomograms – use; Pipe appurtenances. **09 Hrs.**

**Unit-IV**

**Water treatment**: Objectives – Treatment flow-chart. Aeration Principles, types of Aerators. sedimentation: Theory, settling tanks, types, design. Coagulant aided sedimentation, jar test, chemical feeding, flash mixing, and clariflocculator.

**Filtration**: Mechanism – theory of filtration, types of filters, slow sand, rapid sand and pressure filters including construction, operation, cleaning and their design – excluding under drainage system – back washing of filters. Operational problems in filters.

**Disinfection**: Theory of disinfection, types of disinfection, Chlorination, chlorine demand, residual chlorine, use of bleaching powder. **12 Hrs.**

**Unit-V**

**Miscellaneous treatment**: UV irradiation treatment – treatment of swimming pool water, softening – definition, methods of removal of hardness by lime soda process and zeolite process, RO & Membrane technique. Removal of color, odor, taste, use of copper sulfate, adsorption technique, fluoridation and de-fluoridation.

**Distribution systems**: System of supply, service reservoirs and their capacity determination, methods of layout of distribution systems network analysis using Hardy Cross method. Pipe appurtenances, various valves, type of fire hydrants, pipefitting, Layout of water supply pipes in buildings. **12 Hrs.**

**Reference Books:**

1) S. K. Garg., "Water Supply Engineering", Khanna Publishers.
2) B C Punmia and Ashok Jain, "Environmental Engineering I", Laxmi Publication.

3) K. N. Duggal, “Elements of Environmental Engineering”, S Chand Publishing.
4) Metcalf and Eddy, Wastewater Engineering, Treatment and Reuse,Tata McGraw Hill Publishing Co. Ltd.
5) Peavy H.S., Rowe D.R., and Tchobanoglous G., “Environmental Engineering”, Mc Graw Hill Book Co.

## 18UCVC403 Building Planning & Drawing (2-0-2)3

**Contact Hours: 39**

**Course Learning Objective (CLOs):** Building Planning and Drawing is taught as one of the core courses in Civil Engineering program**.** In this course, topics on architectural planning and designing of residential and public buildings following the principles of planning and rules of regular setback are dealt. The delivering of topics will be made through lecture classes and drawing sessions. The evaluation is made by means of the internal assessment tests and semester end examination.

**Course Outcomes (COs):**

| **Description of the Course Outcome: At the end of the course the student will be able to:** | | **Mapping to POs (1-12)/ PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level(1)** |
| CO-1 | Explain principles of planning, rules of setback and Architecturally plan and design small independent / row houses. | 3 | 2 | 1 |
| CO-2 | Illustrate planning and architectural design of public buildings. | 3 | 2 | 1 |

| **POs/PSOs** | PO-1 | PO-2 | PO-3 |
|---|---|---|---|
| **Mapping Level** | 1 | 2 | 3 |

**Prerequisites:**

1) Building Construction

**Contents:**

**Unit-I**

**Introduction to planning and architectural design:** Principles of planning, zoning regulations, building bye laws.

**Planning and designing of Residential Buildings:** Planning and architectural design of residential buildings following principles of planning for load bearing and framed structure for ground floor and ground plus one floor only. **27 Hrs.**

**Unit-II**

**Planning and designing of public buildings:** Primary health centre, Primary school building, other building, office building (plan and elevation only). **12 Hrs.**

**Note: Scheme of evaluation for CIE:** 3 IAs of 1 ½ hour duration each (best two) 40 marks.
**Drawings to be prepared:** Residential buildings - Three sheets; public buildings - four sheets. The drawing sheets prepared during the drawing sessions will be evaluated for 10 marks as CTA.

**Pattern of question paper for SEE:** Duration is three hours. There shall be two questions, one from Unit I on design residential building carrying 70 marks and another from Unit II on design of public building carrying 30 marks. In Unit II, two questions will be given, and the candidate shall answer anyone.

**Reference Books:**

1) Shah M.G and Kale C.M., Patki S.Y., "Building Drawing", Tata McGraw Hill Publishing Co. Ltd., New Delhi.
2) Malik R S and Meo G S, "Civil Engineering Drawing", Asian Publishers / Computech Publications Pvt. Ltd.
3) Time Saver Standards by Dodge F. W., F. W. Dodge Corporation.
4) IS: 962-1989 (Code of practice for architectural and building drawings).
5) National Building Code, BIS, New Delhi.
6) Building byelaws of local authority.

## 18UCVC404 Hydraulics and Hydraulic Machines (3-0-0)3

**Contact Hours: 39**

**Course learning objectives (CLOs):** Hydraulic and Hydraulic Machines is taught as one of the core courses in Civil Engineering program. In this course, topics on dimensional analysis & model testing, open channel flow design of economical sections, energy concepts of fluid in open channel, the working principles of the hydraulic machines like turbines and pumps are dealt with. The delivering of topics will be made through lecture classes. The evaluation is made by means of the internal assessment tests and semester end examination.

**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | | Mapping to POs (1-12)/ PSOs (13-15) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |
| CO-1 | Apply dimensional analysis technique to develop mathematical model and compute the parametric values in prototype by analyzing the | 1,2 | | |

| | | | | |
|---|---|---|---|---|
| | corresponding model parameters. | | | |
| CO-2 | Explain uniform flow in open channel and design most economical cross sections, including economical channel sections, apply energy concepts to flow in open channels and Calculate specific energy. | 1,2 | | |
| CO-3 | Explain phenomenon of hydraulic jump, calculate sequential depths, differentiate between different types of flows. | 1,2 | | |
| CO-4 | Classify turbines, explain working principles of turbines, draw velocity triangles and explain various characteristics. | 1,2 | | |
| CO-5 | Classify pumps, define different heads, explain working principles of pumps and calculate efficiencies. | 1,2 | | |

| **POs/PSOs** | PO-1 | PO-2 |
|---|---|---|
| **Mapping Level** | 3 | 3 |

**Prerequisites:**

Students taking this course shall have the knowledge of following:

1) Fluid mechanics
2) Physics
3) Mathematics
4) Engineering Mechanics

**Contents:**

**Unit-I**

**Dimensional analysis:** Dimensional analysis and similitude: Dimensional homogeneity, Non-Dimensional parameter, Rayleigh methods and Buckingham ð theorem, dimensional analysis, choice of variables, examples on various applications. Model analysis: Model analysis, similitude, types of similarities, force ratios, similarity laws, model classification, Reynolds model, Froude's model, Euler's Model, Webber's model, Mach model, scale effects, Distorted models. Numerical problems on Reynolds's, and Froude's Model. **07 Hrs.**

## Unit-II

**Open Channel Flow:** Uniform Flow; Introduction, Classification of flow through channels, Chezy's and Manning's equation for flow through open channel, most economical channel sections and uniform flow through open channels. Specific energy and specific energy curve, critical flow and corresponding critical parameters and metering flumes. **08 Hrs.**

## Unit-III

**Non-Uniform Flow:** Suddenly varied flow; Hydraulic Jump, Expressions for conjugate depths and Energy loss. Gradually varied flow equation, Back water curve and afflux, Description of water curves or profiles, mild, steep, critical, horizontal and adverse slope profiles, Control sections.

**Impact of jet on vanes:** Introduction, Impulse-Momentum equation. Impact of jet on stationary and moving curved vanes. Introduction to concept of velocity triangles, impact of jet on series of curved vanes- Problems. **10 Hrs.**

## Unit-IV

**Turbines:** Impulse Turbines-Introduction to turbines, general lay out of a hydroelectric plant, Heads and Efficiencies, classification of turbines. Pelton wheel components, working principle, velocity triangle, maximum power, efficiency and working proportions. Reaction Turbines: Radial flow reaction turbines: (i) Francis turbine Descriptions, working proportions and design. (ii) Kaplan turbine-Descriptions, working proportions and design. Draft tube theory and unit quantities. **08 Hrs.**

## Unit-V

**Pumps:** Components and Working of centrifugal pumps, Types of centrifugal pumps, Work done by the impeller, Heads and Efficiencies, Minimum starting speed of centrifugal pump, Numerical problems, Multi-stage pumps. Working of different types of reciprocating pumps. **06 Hrs.**

**Reference Books:**

1) Modi P.N. and Seth S.M., "Hydraulics and Fluid Mechanics", Standard Book House, Delhi.
2) Bansal R.K., "Fluid Mechanics and Hydraulic Machines", Lakshmi publications.
3) Jain A.K., "Fluid Mechanics", Khanna Publishers, Delhi.
4) Subramanya K., "Fluid Mechanics and Hydraulic Machines", Tata McGraw Hill Publishing Co. Ltd.
5) Mohd. Kaleem Khan, "Fluid Mechanics and Machinery", Oxford University Press.

**18UCVL405 Fluid Mechanics Laboratory (0-0-3)1.5**

**Contact Hours: 36**

**Course learning objectives (CLOs):** Fluid Mechanics laboratory is taught as a laboratory course in Civil Engineering program. In this course, use flow measuring devices as per the requirements, calculate major and minor losses in pipe and pipe fittings, calibration of triangular and trapezoidal notches, calibration of venture meter, determination of hydraulic coefficients for orifices and mouthpieces, calibration of broad crested weir and ogee weir, calibration of venture flume experiments are dealt. The delivery of topics will be made through demonstration and Laboratory work. The evaluation will be carried out through continuous evaluation & Semester End practical examination.

**Course Outcomes (COs):**

| **Description of the Course Outcome: At the end of the course the student will be able to:** | | **Mapping to POs (1-12)/ PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Calculate coefficient of discharge for flow measuring equipment in open channels and closed conduits. | | 15 | 9 |
| CO-2 | Calculate friction factor and major & minor losses in pipes. | | 15 | 9 |
| CO-3 | Test and verify Bernoulli's theorem. | | 15 | 9 |

| **POs/PSOs** | PO-9 | PO-15 |
|---|---|---|
| **Mapping Level** | 1 | 2 |

**Contents:**

1) Calibration of flow measuring devices in open channel such as triangular and rectangular notches.
2) Calibration of flow measuring devices in pipe such as Venturimeter and Orificemeter.
3) Determination of hydraulic coefficients for orifices and mouthpieces (external cylindrical only).
4) Calibration of broad crested weir.
5) Calibration of Venturiflume.
6) Estimate major and minor losses in pipe and pipe fittings.
7) Verification of Bernoulli's theorem.



**Reference Books:**

1) Sarbjit Singh, "Experiments in Fluid Mechanics" -PHI Pvt. Ltd., New Delhi.

2) Mohd. Kaleem Khan, “Fluid mechanics and Machinery”, Oxford University Press.
3) P.N. Modi and S.M. Seth,“Hydraulics and Fluid Mechanics”, Standard Book House, New Delhi.

## 18UCVL406 Applied Engineering Geology Laboratory (0-1-2)1.5

**Contact Hours: 36**

**Course Learning Objective (CLOs):** Applied Engineering Geology laboratory is taught as laboratory course in Civil Engineering Program. In this course, topics like finding width and thickness of the rock beds using their geometry and attitude for quarry and estimation of quantity (volume) of the rocks, their quality including mineral composition for various construction activities, understand the subsurface geological conditions from bore hole data, preparation of geological maps, evaluation of the site for various civil engineering projects by studying geological cross sections.

The delivery of topics will be made through instruction classes, demonstration and laboratory work. The evaluation will be carried out through continuous evaluation & Semester End practical examination.

**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | | Mapping to POs (1-12)/ PSOs (13-15) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |
| CO-1 | Solve simple problems like estimation of quantity of rocks, shortest approach for quarry, location of water harvesting structure, spread of the water etc., by using dip and strike information of beds and bore hole information. | | 1,15 | |
| CO-2 | Prepare geological map based on contour map and bore hole information. | | | 1 |
| CO-3 | Analyze geological conditions through geological cross section studies for safety and suitability of civil engineering structures. | | 3,15 | |
| CO-4 | Characterize minerals for its | | | 2 |

| | | | | |
|---|---|---|---|---|
| | industrial and ornamental application, hazardous effects on construction site. | | | |
| CO-5 | Evaluate rock properties based on their physical characteristics for application and use in construction, decorative purpose. | | 1 | |

| POs/PSOs | PO-1 | PO-2 | PO-3 | PSO-15 |
|---|---|---|---|---|
| Mapping Level | 1.67 | 1 | 2 | 2 |

**Contents:**

1) Dip and strike problems –for minimum depth cutting, excavation, road construction - 3 types. **2T+4L**
2) Thickness of strata and surface exposure for artificial recharge structure -3 types of bore hole problems and interpretation of underground structure (on level ground). **2T+4L**
3) Study and interpretation of standard structural geological maps with respect to engineering structures (road, dam, tunnel, rainwater harvesting, artificial recharge, mining); preparation of geological maps from borehole data and contour maps. **3T+6L**
4) Identification of minerals and their uses based on physical properties: Quartz and its varieties; Silicates; carbonates, oxides, sulphates, sulphides. **2T+4L**
5) Identification of rocks based on their Geological properties. Igneous rocks Sedimentary rocks, Metamorphic Rocks. **3T+6L**

**Reference Books:**

1) Mukerjee P.K., “A Textbook of Geology”, World Press Pvt. Ltd., Culcutta.
2) Parbin Singh., “Engineering and General Geology”, S. K. Kataria & Sons Pvt. Ltd.
3) Sathyanarayana Swamy B.S., “Engineering Geology Laboratory Manual”, Delhi.
4) Venkat Reddy D., “Engineering Geology for Civil Engineers”, Oxford and IBH Publishing Co. Pvt. Ltd.

## 18UCVL407 Introductory Project (0-0-2)1

**Contact Hours: 24**

**Course Learning Objectives (CLOs):** Introductory Project is introduced as a course to provide exposure to students to identify simple societal problems, conduct relevant literature review, identify the required data and formulate the

methodology. It also helps them to find and use appropriate tool to obtain the solution and prepare a report based on the work carried out.

**Course Outcomes (COs):**

| **Description of the Outcome: Upon completion of the course, the student will be able to:** | | **Mapping to POs (1-12) / PSOs (13,14)** | | |
|---|---|---|---|---|
| | | **Level 3 Substantial** | **Level 2 Moderate** | **Level 1 Slight** |
| CO-1 | Identify a socially/ technically relevant problem and formulate a problem statement. | | 2 | 6, 7 |
| CO-2 | Carry out literature review in the relevant field. | 2 | 6, 7 | 11 |
| CO-3 | Identify the suitable data required to carry out the project. | 1, 3, 12 | 9, 10, 13 | |
| CO-4 | Formulate the methodology. | 9 | 12 | |
| CO-5 | Prepare a report based on the work carried out. | 5, 9 | 12, 13 | |

| **POs/PSOs** | PO-1 | PO-2 | PO-3 | PO-5 | PO-6 | PO-7 | PO-9 | PO-10 | PO-11 | PO-12 | PO-13 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mapping levels** | 3 | 2.5 | 3 | 3 | 1.5 | 1.5 | 2.67 | 2 | 1 | 2.3 | 2 |

**Contents:**

Introductory project is introduced with an objective of understanding and identifying the community expectation in terms of possible Engineering solutions by applying the fundamental knowledge of basic sciences and basic engineering courses. The project shall be engineering oriented in terms of problem definition, related literature survey and existing solutions.

**Evaluation:**

The team consisting of 10-12 students shall be asked to identify the problems related to community and try to propose a solution. The faculty members handling the courses for that semester shall guide the students. A committee consisting of minimum 3 faculty members shall evaluate at the end for CIE. There is no SEE for introductory project.

# Academic Program: UG

## Academic Year 2021-22 Syllabus

# V & VI Semester B.E.

# (Civil Engineering Branch)

SHRI DHARMASTHALA MANJUNATHESHWARA COLLEGE OF ENGINEERING & TECHNOLOGY,

DHARWAD – 580 002

**(An Autonomous Institution approved by AICTE & Affiliated to VTU, Belagavi)**

**Ph**: **0836-2447465 Fax: 0836-2464638** **Web:** www.sdmcet.ac.in

## SDM College of Engineering & Technology, Dharwad

It is certified that the scheme and syllabus for V & VI semester of UG program in Civil Engineering is recommended by Board of Studies of Civil Engineering Department and approved by the Academic Council, SDM College of Engineering & Technology, Dharwad. This scheme and syllabus will be in force from the academic year 2021-22 till further revision.

Principal Chairman BoS & HoD

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# SDM COLLEGE OF ENGINEERING & TECHNOLOGY, DHARWAD

## Vision and Mission of the Institute

### Vision

To develop competent professionals with human values.

### Mission

- To have contextually relevant Curricula.
- To promote effective Teaching Learning Practices supported by Modern Educational Tools and Techniques.
- To enhance Research Culture.
- To involve the Industrial Expertise for connecting Classroom contents to real-life situations.
- To inculcate Ethics and soft-skills leading to overall personality development.

# DEPARTMENT OF CIVIL ENGINEERING

## Vision and Mission

**Vision:**

To be the center of excellence providing the state of art civil engineering education developing competent engineers responsible for serving modern society.

**Mission:**

The stated vision can be achieved through:

- The development of robust curricula to meet the industrial expectations.
- Interactive teaching-learning process with modern educational tools and soft skills.
- Establishing synergy between teaching and research
- Industry-Institute interaction.

# Program Educational Objectives (PEOs)

**I. Technical adeptness**: The Civil Engineering Graduates will be technically adept to specific fields and other disciplines. Management towards Planning, Design, and Costing. Their technical skills and knowledge will enable them to perform their work with a commitment and quality, timeliness with continuous improvement.

**II. Interpersonal Skills**: Civil Engineering Graduates will exhibit effective interpersonal skills in teams and at workplace.

**III. Awareness of Social impact:** Graduates will be made aware of causes of impacts due to the development and to identify remedial measures if necessary.

**IV. Professionalism:** Understanding of professionalism, ethics, quality performance, sustainability and allow them to be professional leaders and contributors to society through their problem-solving capabilities and executing the work.

**V. Continuous Learning:** Civil Engineering Graduates will exhibit interest in lifelong learning including studies leading to professional licensure or higher studies in engineering that provides for continued development of their technical ability and management skills

# Program Outcomes (POs)

**Engineering Graduates will be able to:**

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PO2. **Problem analysis**: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9.**Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary settings.

PO10.**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11.**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply the set one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.

PO12.**Lifelong learning**: Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context to technological change.

## Program Specific Outcomes (PSOs)

PSO13.**Project inception and design**: Conceptualize projects related to different fields of Civil Engineering, collect relevant data by direct and indirect methods, analyze the project requirement and design the project.

PSO14.**Draft specification**: Select material, prepare estimates/costing, schedule work plans.

PSO15.**Experimentation**: Apply knowledge of different fields of Civil Engineering, conduct experiments, analyze, interpret data, and design the system components.

## V Semester

| Course Code | Course Category | Course Title | Teaching | | Examination | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | L-T-P (Hrs/Week) | Credits | CIE | Theory (SEE) | | Practical (SEE) | |
| | | | | | Max. Marks | *Max. Marks | Duration in Hrs. | Max. Marks | Duration in Hrs. |
| 18UHUC500 | HU | Management, Entrepreneurship and IPR | 4 - 0 - 0 | 4 | 50 | 100 | 3 | - | - |
| 18UCVC500 | PC | Structural Analysis-II | 4 - 0 - 0 | 4 | 50 | 100 | 3 | - | - |
| 18UCVC501 | PC | Design of RC Structural Elements | 4 - 0 - 0 | 4 | 50 | 100 | 3 | - | - |
| 18UCVC502 | PC | Geotechnical Engineering – I | 3 - 0 - 0 | 3 | 50 | 100 | 3 | - | - |
| 18UCVC503 | PC | Hydrology | 3 - 0 - 0 | 3 | 50 | 100 | 3 | -- | -- |
| 18UCVE5XX | PE | Program Elective-1 | 3 - 0 - 0 | 3 | 50 | 100 | 3 | -- | -- |
| 18UCVL504 | PC | Computer Aided Design Laboratory | 0 - 0 - 3 | 1.5 | 50 | -- | -- | 50 | 3 |
| 18UCVL505 | PC | Concrete and highway Laboratory | 0 - 0 -3 | 1.5 | 50 | -- | -- | 50 | 3 |
| 18UCVL506 | PC | Minor Project-1 | 0 - 0 -2 | 1 | 50 | -- | -- | -- | -- |
| 18UHUL507 | HU | Soft skills/Aptitude | 0 - 0 -2 | 1 | 50 | -- | -- | -- | -- |
| **Total** | | | **21- 0 -10** | **26** | **500** | **600** | | **100** | |

HU- Humanities, PE-Program Elective, PC- Program Core

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## List of Program Elective 1

| Course Code | Course Title |
|---|---|
| 18UCVE515 | Design of Masonry Structures |
| 18UCVE516 | Harbour, Dock & Tunnel Engineering |
| 18UCVE517 | Railway and Airport Engineering |
| 18UCVE518 | Watershed Management |
| 18UCVE519 | Alternative Building Materials |
| 18UCVE520 | Advanced Concrete Technology |
| 18UCVE521 | Photogrammetry and Remote Sensing |

**VI Semester**

| Course Code | Course Category | Course Title | Teaching | | Examination | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | L-T-P (Hrs/Week) | Credits | CIE | Theory (SEE) | | Practical (SEE) | |
| | | | | | Max. Marks | *Max. Marks | Duration in Hrs. | Max. Marks | Duration In Hrs. |
| 18UCVC600 | PC | Quantity Surveying and Estimation | 4 - 0 - 0 | 4 | 50 | 100 | 3 | - | - |
| 18UCVC601 | PC | Geotechnical Engineering - II | 4 - 0 - 0 | 4 | 50 | 100 | 3 | - | - |
| 18UCVE6XX | PE | Program elective 1 | 3 - 0 - 0 | 3 | 50 | 100 | 3 | - | - |
| 18UCVE6XX | PE | Program elective 2 | 3 - 0 - 0 | 3 | 50 | 100 | 3 | - | - |
| 18UCVO6XX | OE | Open Elective 1 | 3 - 0 - 0 | 3 | 50 | 100 | 3 | -- | -- |
| 18UCVL602 | PC | Geotechnical Engineering Laboratory | 0 - 0 - 3 | 1.5 | 50 | -- | -- | 50 | 3 |
| 18UCVL603 | PC | Software Laboratory | 0 - 0 - 3 | 1.5 | 50 | -- | -- | 50 | 3 |
| 18UCVL604 | PC | Minor Project 2 (Extensive Survey project) | 0 - 0 - 4 | 2 | 50 | -- | -- | 50 | 3 |
| 18UHUL605 | HU | Soft skills/Aptitude | 0 - 0 -2 | 1 | 50 | -- | -- | -- | -- |
| **Total** | | | **17 - 0 -12** | **23** | **450** | **500** | | **150** | |

PC- Program Core, PE-Program Elective, HU- Humanities

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## List of Program Electives

| Course Code | Course Title |
|---|---|
| 18UCVE615 | Matrix Method of Structural Analysis |
| 18UCVE616 | Design of Special RC Structures |
| 18UCVE617 | Advanced Structural Analysis |
| 18UCVE619 | Open channel Hydraulics |

## List of Open Elective

| Course Code | Course Title |
|---|---|
| 18UCVO601 | Traffic Engineering |

*** Open elective for VI Semester**

**18UMAO675 Applied Mathematics – All Engineering Branches**

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| 18UHUC500 | Management, Entrepreneurship & Intellectual Property Rights | (4-0-0) 4 |
|---|---|---|

**Contact Hours:52**

**Course Learning Objective (CLOs):** Management, Entrepreneurship & Protection of Intellectual Property is taught as one of the core subjects in Civil Engineering program. In this course, topics on Management, Planning, Organizing, Staffing, Directing and Controlling, SSI, Government/ Institutional support and Project Formulation, Copyright, Patent, Trademark and Industrial Design and their protection through the intellectual property laws are dealt. The delivery of the topics is made through lecture classes. The evaluation will be carried out through Internal evaluation and Semester End Examination.

**Course Outcomes (COs):**

| **Description of the Course Outcome: At the end of the course the student will be able to:** | | **Mapping to POs (1-12)/ PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Define and explain the management and concepts of planning, forecasting and decision making. | | 11 | |
| CO-2 | Define and explain the concepts of organizing, staffing, motivating and controlling. | | 9,11 | |
| CO-3 | Define and explain the concepts of entrepreneurship and the small-scale industries (SSI). | | 6,8,11 | |
| CO-4 | Explain the Government and institutional support to SSI, formulate a project report by identifying the business opportunities. | | 11 | |
| CO-5 | Define and explain the different forms of intellectual properties viz. copy right, patent, trademark and industrial design. | | 6,8 | |

| **POs/PSOs** | PO-6 | PO-8 | PO-9 | PO-11 |
|---|---|---|---|---|
| **Mapping Level** | 2 | 2 | 2 | 2 |

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**Contents:**

**Unit–I**

**Engineering and Management:** Historical Development of Engineering, Management, Engineering & Management a synthesis.

**Planning, Forecasting and Decision Making:** Nature of Planning, Planning concepts, Forecasting, Decision making, Tools for decision making. **10 Hrs.**

**Unit–II**

**Organizing and staffing:** Nature of organizing, Concepts of Organization, Technical and Modern organization structures, Staffing process in technical organizations, Authority and Power; Delegation, Meeting & Committees.

**Motivating and Controlling:** Motivation, Process of Motivation, Motivational theories, Leadership and styles, Process of control, Requirements of Effective control system, Financial and non-financial controls. **10Hrs.**

**Unit–III**

**Foundations of Entrepreneurship:** Meaning of entrepreneur, Functions of entrepreneur, Types of entrepreneur, Concept of entrepreneurship, Role of entrepreneurs in economic development, Barriers of entrepreneurship.

**Small Scale Industry (SSI):** Definition, Characteristics, Objectives, Role of SSI in economic development, Advantages of SSI, Steps to start SSI, Impact of liberalization, privatization and globalization on SSI, Definition of Ancillary and Tiny industry. **10 Hrs.**

**Unit–IV**

**Government and Institutional Support:** Government and Institutional support to SSI, Objectives and functions of MSME Development Institute, SIDBI, DIC, Single window agency, KIADB, KSSIDC, KSFC.

**Preparation of Project:** Meaning of project, Importance of project report, Contents of a standard project, Identification of business opportunities, Feasibility studies, Types and purpose. **10 Hrs.**

**Unit–V**

**Introduction:** Meaning and forms of intellectual property right, Competing rationale for protection, International conventions, World court.

**Copyright and Patent:** Meaning and content of copyright, Ownership and rights, Period of copyright, Assignment and relinquishment of copyright, License, Infringement of copy right, Offenses and penalties, Fair use. Concept of patent, Patentable and non-patentable inventions, Procedure for obtaining patent, Rights and obligations of patent holder, Infringements, Remedies, Offenses and penalties.

**Industrial Design and Trademark:** Concept and significance of Industrial Design and Trademark. **12 Hrs.**

**Reference Books:**

1) Naidu N.V.R. and T. Krishna Rao, "Management and Entrepreneurship", I.K. International Publishing House, Bangalore.
2) Babcock Daniel L., "Managing Engineering and Technology", PHI.
3) Drucker Peter, "The Practice of Management", Harper Business.
4) Acharya N.K., "Textbook on Intellectual Property Rights", Asia Law House.

## 18UCVC500 Structural Analysis-II (4-0-0) 4

**Contact Hours: 52**

**Course Learning Objectives (CLOs):** Structural Analysis-II is taught as a core course in Civil Engineering program. In this course, topics on redundant trusses, Moment Distribution Method, Slope Deflection Method, Analysis of multi-storey frames, Matrix Methods are dealt. The evaluation will be carried out through Internal evaluation and Semester End Examination.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs (1-12)/ PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Analyze statically indeterminate structures by strain energy method. | 1,2 | | |
| CO-2 | Analyze redundant trusses with lack of fit and temperature stresses. | 1,2 | | |
| CO-3 | Analyze statically indeterminate beams, rigid plane frames by slope deflection method and moment distribution method. | 1,2 | | |
| CO-4 | Analyze multi storey frames by substitute method, portal frame method, cantilever method and factor method. | 1,2 | | |
| CO-5 | Analyze statically indeterminate beams, rigid plane frames and pin-jointed plane frames by matrix method. | 1,2 | | |

| **POs/PSOs** | PO-1 | PO-2 |
|---|---|---|
| **Mapping Level** | 3 | 3 |

**Prerequisites:**

1) Engineering Mechanics
2) Strength of Materials and
3) Structural Analysis- I

**Contents:**

**Unit-I**

**Redundant Trusses:** Introduction, analysis of statically indeterminate structures using strain energy method, analysis of trusses (Redundant up to second degree), lack of fit in member of indeterminate trusses, temperature stress in redundant trusses. **10Hrs.**

**Unit-II**

**Moment Distribution Method:** Non-sway and sway analysis for continuous beams and frames. **10 Hrs.**

**Unit-III**

**Slope Deflection Method:** Introduction, sign convention, deflection equations, analysis of continuous beams and frames. **11 Hrs.**

**Unit-IV**

**Analysis of Multi-Storey Frames:** By substitute method, portal frame method, cantilever method, factor method, non- sway analysis only. **9 Hrs.**

**Unit-V**

**Matrix Methods:** Introduction, **a**nalysis of determinate beams by Stiffness & flexibility method. **12Hrs.**

**Reference Books:**

1) Reddy C. S., “Basic Structural Analysis”, Tata McGraw Hill Publication Company Ltd.
2) Gupta S. P., Pandit G. S. and Gupta R. “Theory of Structures Vol. 2”, Tata McGraw Hill Publication Company Ltd.
3) Prakash Rao D. S., “Structural Analysis- A unified approach”, University Press India Ltd., Hyderabad.
4) Wang Chu-Kia, “Statically Indeterminate Structures”, Tata McGrawHill Publishers, Delhi.
5) Bhavikatti S.S., “Structural Analysis II”, Vikas Publication, New Delhi.

**18UCVC501 Design of RC Structural Elements (4-0-0) 4**

**Contact Hours: 52**

**Course Learning Objectives (CLOs):** Design of reinforced concrete structures is taught as a core course in Civil Engineering program. In this course, introduction to Working Stress Method and Limit State Method of design for design of beams,

slabs, columns, footings, staircases are dealt. The delivery of topics will be made through lecture classes and site visits. The evaluation will be carried out through Internal evaluation and Semester End Examination.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs (1-12)/ PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Explain working stress method and limit state method. | | 1 | |
| CO-2 | Design and detail different types of beams for different support conditions. | 1,3 | 2 | 6,8 |
| CO-3 | Design and detail different types of slabs. | 1,3 | 2 | 6,8 |
| CO-4 | Design and detail columns and footings. | 1,3 | 2 | 6,8 |
| CO-5 | Design different types of staircases. | 1,3 | 2 | 6,8 |

| **POs/PSOs** | PO-1 | PO-2 | PO-3 | PO-6 | PO-8 |
|---|---|---|---|---|---|
| **Mapping Level** | 2.8 | 2 | 3 | 1 | 1 |

**Prerequisites:**

1) Mechanics of Materials
2) Structural Analysis I

**Contents:**

**Unit-I**

**General features of Reinforced Concrete:** Introduction, design loads, materials for reinforced concrete, code requirements of reinforcements, elastic theory of RC sections, moment of resistance of section, balanced, under reinforced and over reinforced sections.

**Principles of Limit State Design and Ultimate Strength of RC Section:** Philosophy of limit state design, principles of limit states, factor of safety, characteristic and design loads, characteristic and design strength, Analysis of sections for flexure and shear. **12 Hrs.**

**Unit-II**

**Design of Beams:** Practical requirements of an RCC beam, designing and detailing of singly reinforced, doubly reinforced and flanged beams for different support conditions. **9Hrs.**

**Unit-III**

**Design of Slabs:** Introduction, general consideration of designing and detailing of slabs, spanning in one direction, spanning in two directions for various boundary conditions and for different support conditions. **9 Hrs.**

**Unit-IV**

**Design of Columns:** General aspects, effective length, loads on columns slenderness limits for columns, minimum eccentricity, design of short axially loaded columns, design of column subjected to combined axial load and uniaxial moment using SP16. **7 Hrs.**

**Design of Footings:** Introduction, loads for foundation, design basis, design of isolated footings subjected to axial load. **8 Hrs.**

**Unit-V**

**Design of Staircase:** General features, types of staircase, loads on staircases, effective span as per IS code provisions, distribution of loading on stairs, design of staircases. Straight, dog legged and open well stairs. **7 Hrs.**

**Reference Books:**

1) IS Codes: IS 456-2000 & SP16.
2) Varghese P.C., “Limit State Design of Reinforced Concrete”, Prentice Hall of India, New Delhi.
3) Karve S R. and Shah V.L., “Limit state theory and design of reinforced concrete”, Vidyarthi Prakashan, Pune.
4) Jain A.K., “Limit state method of design,” Nemichand and Bros, Roorkee.
5) Krishnaraju N., “Reinforced concrete design”, New Age Publication.

**18UCVC502 Geotechnical Engineering – I (3-0-0) 3**

**Contact Hours: 39**

**Course Learning Objective (CLOs):** Geotechnical Engineering – I is taught as one of core subject for Civil engineering program. It consists of various engineering properties of soil and the principles of soil mechanics are imparted to the students. Topics covered include the index properties of soil, soil classification, flow of water through soils, compaction/ consolidation of soils and shear strength of soil along with numerical problems. The delivery of the topics is achieved through lecture classes, problem solving and demonstrations. The evaluation will be carried out through Internal evaluation and Semester End Examination.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | **Mapping to POs (1-12)/ PSOs (13-15)** | | |
|---|---|---|---|
| | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |

| | | | | |
|---|---|---|---|---|
| CO-1 | Explain the soil formation, phase diagram, derive inter relations, identify soils in the field, explain various index properties of soil. | | 4 | 1, 2 |
| CO-2 | Explain soil classification, compute the permeability of soils, explain the laboratory methods for determination of permeability, explain seepage / superficial velocity and the quicksand phenomenon. | 4 | | 1,2 |
| CO-3 | Describe the compaction of soils, Explain the laboratory methods for determining the compaction parameters, explain the field compaction control. | 4 | 2 | 1 |
| CO-4 | Explain the consolidation and its characteristics of soils. | | 2, 4 | 1 |
| CO-5 | Explain the shear strength of soil, Mohr Coulomb strength theory, explain various laboratory shear tests. | | 2, 4 | 1 |

| **POs/PSOs** | PO-1 | PO-2 | PO-4 |
|---|---|---|---|
| **Mapping Level** | 1 | 1.6 | 2.4 |

**Prerequisites:**

Students taking this course shall have the knowledge of following:

1) Strength of Material
2) Building Engineering Science

**Contents:**

**Unit-I**

**Introduction:** Origin and formation of soil, phase diagram, inter relations of soil properties, field identification of soils.

**Index Properties of Soils:** Definition and importance of Index properties of soils, viz., specific gravity, water content, particle size distribution, consistency limits and indices, in situ density, and density index etc. Determination of specific gravity, particle size distribution and consistency limits. **8Hrs.**

## Unit-II

**Classification of Soils:** Particle size classification, MIT classification, textural classification, unified soil classification and IS classification, plasticity chart and its importance.

**Permeability:** Darcy's law, assumptions and validity; coefficient of permeability and its determination in laboratory, Factors affecting permeability, Permeability of stratified soils, Seepage velocity, Superficial velocity and coefficient of percolation, quicksand phenomenon, Capillary phenomenon. **8Hrs.**

## Unit-III

**Compaction of Soils:** Definition, standard and modified Proctor's compaction tests, factors affecting compaction, effect of compaction on soil properties, field compaction methods, rollers and vibrators, field compaction control, Procter's needle **8Hrs.**

## Unit-IV

**Consolidation of soils:** Definition, mass-spring analogy, Terzaghi's one dimensional consolidation theory, assumptions and limitations, normally consolidated, under consolidated and over consolidated soils, pre-consolidation pressure and its determination by Casagrande's method, consolidation characteristics of soil viz., co-efficient of consolidation, co-efficient of volume change, co-efficient of compressibility, compression index. Foundation Settlement, ill effects of settlement of soil on buildings, immediate, primary and secondary settlements. **8Hrs.**

## Unit-V

**Shear Strength of Soil:** Concept of shear strength, Mohr's strength theory, Mohr Coulomb theory, measurement of shear parameters, direct shear test, unconfined compression test, triaxial compression test and vane shear test, Factors affecting shear strength of soils. **7Hrs.**

**Reference Books:**

1) Punmia B.C., "Soil Mechanics and Foundations", Laxmi Publications (P) Ltd., New Delhi.
2) Gopal Ranjan and A.S.R Rao., "Basic and applied soil mechanics", New Age International Publishers, Bangalore.
3) Narasimha Rao A.V. and Venkatramaiah C., "Geotechnical Engineering", University Press (India) Ltd., Hyderabad.
4) Singh Alam and Chowdhary G.R., "Soil Engineering in Theory and Practice", CBS Publishers and Distributors Ltd., New Delhi.
5) IS 1498 – 1970 - Classification and identification of soils for general engineering purposes.
6) IS 2720 Part-I,2,3,4,5,6,7,8,9,10,11,13,14,15,16,17,28,29,36.

| 18UCVC503 | Hydrology | (3-0-0)3 |
|---|---|---|

**Contact Hours: 39**

**Course Learning Objective (CLOs):** Hydrology is taught as a core course for Civil Engineering Program. In this course, topics on precipitation, losses, runoff, stream flow measurement, reservoir sedimentation and ground water hydrology are dealt. The delivery of topics will be made through lecture classes. The evaluation will be carried out through internal evaluation and Semester End Examination.

**Course Outcomes (COs):**

| **Description of the Course Outcome: At the end of the course the student will be able to:** | | **Mapping to POs (1-12)/ PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level(1)** |
| CO-1 | Summarize the importance of hydrology, water availability, Explain Horton's hydrological cycle, types of precipitation and estimation. | 1 | | |
| CO-2 | Calculate different losses such as evaporation, infiltration and runoff. | 1 | 2 | |
| CO-3 | Analyze and draw different hydrographs. | 1,2 | | |
| CO-4 | Explain different methods of stream flow measurement, sediment yield and its control in catchment. | 1 | | |
| CO-5 | Understand ground water hydrology and well hydraulics | 1 | 2 | |

| **POs/PSOs** | PO-1 | PO-2 |
|---|---|---|
| **Mapping Level** | 3 | 2.33 |

**Prerequisites:**

1) Engineering Mathematics IV
2) Fluid Mechanics
3) Hydraulics and Hydraulic Machines
4) Engineering Geology

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**Contents:**

**Unit-I**

**Introduction:** Definition of hydrology, importance of hydrology, global water availability, India's water availability, practical applications of hydrology, hydrology cycle (Horton's) qualitative and engineering representations.

**Precipitation:** Definition, types of precipitation, measurement of rain fall using Symon's and Syphon type of rain gauges, optimum number of rain gauge stations, consistency of rainfall data (double mass curve method), computation of mean rainfall, estimation of missing data, presentation of precipitation data, mass curve, rainfall hyetographs, intensity duration frequency curves. **9 Hrs.**

**Unit-II**

**Losses:** Introduction, evaporation process, factors affecting evaporation, measurement using IS class-A Pan, estimation using empirical formulae, Blaney Cridle equation, Infiltration, factors affecting infiltration capacity, double ring infiltrometer, Horton's infiltration equation, infiltration indices.

**Runoff:** Definition, concept of catchment, geomorphology of catchment, water budget equation, components, factors affecting runoff, rainfall - runoff relationship using regression analysis. **9 Hrs.**

**Unit-III**

**Theory of Hydrographs:** Definition, components of hydrograph, base flow separation, unit hydrograph and its derivation from simple storm hydrographs, S-curve and its computations. **8 Hrs.**

**Unit-IV**

**Stream Flow Measurement:** Introduction, measurement of stage, measurement of discharge by Area – Velocity method, stage discharge, introduction to moving boat only, simple stage discharge relation.

**Reservoir Sedimentation:** Introduction, process of erosion, factors affecting erosion, sediment yield, reservoir sediment control, determination of sediment yield at a reservoir site. **7 Hrs.**

**Unit-V**

**Ground Water Hydrology and Well Hydraulics:** Scope and importance of ground water hydrology, occurrence of ground water. Definitions: Aquifers, aquitard, aquifuge, aquiclude, perched aquifer. Aquifer parameters. Darcy's law and its validity. Steady radial flow into a well in confined and unconfined aquifers. Safe yield, yield of an open well Pumping test and recuperation test. **6 Hrs.**

**Reference Books:**

1) Jayarami Reddy, "A Textbook of Hydrology", Lakshmi Publications, New Delhi.
2) H.M. Raghunath, "Hydrology", Wiley Eastern Publication, New Delhi.

3) VenTe Chow, “Applied Hydrology”, Tata McGraw Hill Publishers, New Delhi.
4) K. Subramanya, “Engineering Hydrology”, Tata McGraw Hill Publishers, New Delhi.
5) David K. Todd and Larry W. Mays, “Ground Water Hydrology”, Wiley Publications.

## 18UCVL504 Computer Aided Design Laboratory (0-0-3) 1.5

**Contact Hours: 36**

**Course Learning Objectives (CLOs):** Computer Aided Design Laboratory deals with application of computers in solving Civil Engineering related problems. In this course, topics on spread sheets for Civil Engineering problems, C- Programming for analysis and design of beams are dealt. The evaluation will be carried out through continuous evaluation & Semester End practical examination.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs (1-12)/ PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Develop spread sheets for: design of horizontal and vertical alignment, computation of earthwork volume and calibration of notches & weirs. | **3** | **5** | **1** |
| CO-2 | Develop C programs for calculation and drawing of BM and SF diagrams for beams. | **3** | **5** | **1** |
| CO-3 | Use Civil Engineering software. | **3** | **5** | **1** |

| **POs/PSOs** | PO-1 | PO-3 | PO-5 |
|---|---|---|---|
| **Mapping Level** | 1 | 3 | 2 |

**Contents:**

1) Spread sheet for design of horizontal and vertical alignment, computation of earthwork, calibration of notches and weirs, problems on mechanics of materials.
2) Calculation and drawing of BM and SF diagrams using C programming.
3) Introduction to software related to Civil Engineering.

## 18UCVL505 Concrete & Highway Laboratory (0-0-3) 1.5

**Contact Hours: 36**

**Course learning objectives (CLOs):** In this course, characteristics of cement, strength of aggregate, shape tests on aggregate, strength parameters of concrete,

properties of bitumen are dealt. The delivery of topics will be made through demonstration and Laboratory work. The delivery of topics will be made through instruction classes, demonstration and Laboratory work. The evaluation will be carried out through continuous evaluation & Semester End practical examination.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs (1-12)/ PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Perform tests on cement and coarse aggregate. | | 15 | 9 |
| CO-2 | Perform tests on fresh and hardened concrete. | 3 | 15 | 9 |
| CO-3 | Perform tests on bitumen. | | 15 | 9 |

| **POs/PSOs** | PO-3 | PO-9 | PO-15 |
|---|---|---|---|
| **Mapping Level** | 3 | 1 | 2 |

**Contents:**

1. **Cement:** Determination of grade of Cement.
2. **Aggregates:** Abrasion**,** Impact, crushing strength, shape tests - Flakiness & Elongation.
3. **Fresh concrete:** Concrete Mix design, workability - slump, compaction factor and Vee-Bee test.
4. **Hardened concrete:** Compressive strength and NDT.
5. **Bituminous materials and mixes:** Specific Gravity, Penetration, Ductility, Softening point, Flash and fire point, Viscosity. Marshall Stability tests, bitumen extraction. Sub grade Soil CBR Test.

**Reference Books:**

**1)** Gambhir. M.L., “Concrete Manual”, Dhanpat Rai & sons New Delhi.
**2)** “Highway Material Testing Laboratory Manual”, Nem Chand & Bros.
**3)** Relevant IS Codes and IRC Codes.

**18UCVL506 Minor Project–1 (0-0-2) 1**

**Contact Hours:24**

**Course Learning Objective (CLOs): Minor Project–1** is carried out under the guidance of a faculty. In this course, the students will finalize the project title, collect the data required by indirect and direct methods and carry out literature review and formulate the methodology.

**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | | Mapping to POs (1-12)/ PSOs (13-15) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |
| CO-1 | Identify the project area. | 13 | 1 | 9,12 |
| CO-2 | Collect data by direct and indirect methods. | 2 | 13 | 9,12 |
| CO-3 | Collect required literature survey and organize them. | 1 | | 9,12 |
| CO-4 | Define the problem definition from research gap and formulate the methodology. | 2 | | 9,12 |
| CO-5 | Interpret the test data/ results, draw conclusions and suggest strategies. | 15 | 5 | 9,12 |

| POs/PSOs | PO-1 | PO-2 | PO-5 | PO-9 | PO-12 | PO-13 | PO-15 |
|---|---|---|---|---|---|---|---|
| Mapping Level | 2.5 | 3 | 2 | 1 | 1 | 2.5 | 3 |

Mapping level: 1 = Low, 2=Moderate, 3=Substantial

**Contents:**

Domain related problems, Technical solutions and recommendations.

**Evaluation:**

The team consisting of 10-12 students shall be asked to identify the problems related to community and try to propose the solution. The faculty members handling the courses for that semester shall guide the students. A committee consisting of minimum 3 faculty members shall evaluate at the end for CIE. There is no SEE for Minor project 1.

**18UHUL507 Soft skills/Aptitude (0-0-2) 1**

**Contact Hours: 24**

**Course Learning Objectives (CLOs):** This is included with the objectives of improving the communication skills, proficiency in English language and aptitude ability of the student to enhance the employability.

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**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | | Mapping to POs (1-12)/ PSOs (13-15) | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Explain the significance of communication in the profession. | | 10 | |
| CO-2 | Use the English language with proficiency | | 10 | 12 |
| CO-3 | Solve Aptitude related problems | | 9 | 12 |
| CO-4 | Demonstrate the competency in the placement activities. | | 9 | |

| **POs/PSOs** | PO-9 | PO-10 | PO-12 |
|---|---|---|---|
| **Mapping Level** | 2 | 2 | 1 |

**Contents:**

Training on communication skills, proficiency in English language and aptitude ability involving the internal and external resource.

**Evaluation:**

Both the internal and external resource persons shall be engaged in imparting the related knowledge and shall have only CIE as the evaluation component. There shall be one test conducted at the end for 25 marks in Aptitude testing and there shall be one presentation by the student for 25 marks or any other suitable testing components. The arrangement for CIE evaluation is to be done by the department and maintain the relevant documents.

**18UCVE515 Design of Masonry Structures (3-0-0)3**

**Contact Hours: 39**

**Course Learning Objective (CLOs):** Design of Masonry Structures is taught as one of elective subject for civil engineering program. In this course, types of materials, masonry units, masonry construction, strength and stability of masonry construction, permissible stresses, design of masonry construction and gravity retaining walls are dealt. The delivery of topics will be made through lecture classes. The evaluation will be carried out through Internal evaluation and Semester End Examination.

**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | | Mapping to POs(1-12)/ PSOs (13-15) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |
| CO-1 | Summarize engineering properties and uses of masonry units. Explain masonry construction strength and stability. Identify defects and crack in masonry and its remedial measures. | 1 | | |
| CO-2 | Explain permissible stresses in masonry construction, calculate slenderness ratio of columns and walls and load distribution on lintels and arches. | 1 | | |
| CO-3 | Design free standing walls and walls subjected to axial/eccentric load with and without openings | 1,3 | 4 | |
| CO-4 | Design solid and cavity walls subjected to concentrated axial load as per IS: 1905. | 1,3 | 4 | |
| CO-5 | Design walls subjected to eccentric loads with and without openings. | 1,3 | 4 | |

| POs/PSOs | PO-1 | PO-3 | PO-4 |
|---|---|---|---|
| Mapping Level | 3 | 3 | 2 |

**Prerequisites:**

Students taking this course shall have the knowledge of following:

1) Strength of Materials
2) Structural Analysis

**Contents:**

**Unit-I**

**Masonry Units, Materials and Masonry Construction:** Brick, stone and block masonry unit, strength, modulus of elasticity, water absorption, masonry materials, classification and properties of mortars, selection of mortars. Defects and errors in masonry construction, cracks in masonry, types, reasons for cracking, methods of avoiding cracks.

**Strength and Stability:** Concentrically loaded masonry walls, effect of unit

strength, mortar strength, joint thickness, rate of absorption, effect of curing, effect of ageing, workmanship, strength formulae and mechanism of failure for masonry subjected to direct compression. **10Hrs.**

**Unit-II**

**Permissible Stresses:** Permissible compressive stress, reduction and shape reduction factors, increase in permissible stresses for eccentric vertical and lateral loads, permissible tensile, shear stresses.

**Design Considerations:** Effective height of walls and columns, opening in walls, effective length, effective thickness, slenderness ratio, eccentricity, load dispersion, arching action in lintels. **7Hrs.**

**Unit-III**

**Design of Structural Masonry:** Wall carrying axial load, eccentric load with different eccentricity ratios, walls with openings, free standing wall, design of load bearing masonry for building up to 2 storeys using IS: 1905 and SP: 20 procedure. **7Hrs.**

**Unit-IV**

**Design of walls subjected to concentrated axial loads:** Solid walls, cavity walls, solid wall supported at the ends by cross wall, walls with piers, design of wall with openings. **8Hrs.**

**Unit-V**

**Design of walls subjected to eccentric loads:** Design criteria – stress distribution under eccentric loads – problems on eccentrically loaded solid walls, cavity walls, walls with piers. **7Hrs.**

**Reference Books:**

1) Hendy A W., - “Structural Masonry”, Macmillan Education Ltd.
2) Dayaratnam P., “Brick and Reinforced Brick Structures”, Oxford & IBH.
3) Sinha B. P.,Davies S R., “Design of masonry structures” E&FN spon.
4) IS Codes: IS 1905-1987, “Code of practice for structural use of un-reinforced masonry, SP 20 (S&T).

**18UCVE516 Harbour, Dock and Tunnel Engineering (3-0-0)3**

**Contact Hours: 39**

**Course Learning Objectives (CLOs):** Harbour, Dock and Tunnel Engineering is taught as one of the elective courses in Civil Engineering program. In this course, harbour layout, natural phenomena viz. winds, waves and tides, Harbour components viz. Breakwaters, Approach Channel, Wharves, Jetties, Quays, Warehouses, Wet and Dry Docks, Navigational Aids viz. Light House, Buoys, Beacons, Sound Signals And Tunnel Surveys, Soft Soil Tunneling methods, Tunneling in Rock, Explosives for Rock Tunneling, Tunnel Lining, Tunnel Ventilation are dealt. The delivery of topics will be made through lecture classes

and demonstrations. The evaluation will be carried out through Internal evaluation and Semester End Examination.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs (1-12)/ PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Define components of harbours and natural phenomena. | | 2 | 1 |
| CO-2 | Classify and describe types of harbours and docks. | | 2 | 1 |
| CO-3 | Classify and characterize signals and navigational aids. | | 2 | 1 |
| CO-4 | Define, classify and describe components of tunnels and methods of tunneling in rock. | | 2 | 1,6 |
| CO-5 | Describe and discuss modern tunneling, mucking, ventilation and drainage methods. | | 2 | 1,6 |

| **POs/PSOs** | PO-1 | PO-2 | PO-6 |
|---|---|---|---|
| **Mapping Level** | 1 | 2 | 1 |

**Prerequisites:**

Students taking this course shall have the knowledge of following:

1) Building Materials and Construction
2) Geotechnical Engineering.

**Contents:**

**Unit-I**

**Harbours:** Definition of Harbour, classification of Harbours (with sketches), general design features, definition of various terminology. Natural forces on Harbours, winds, waves, tides, currents, effects of each on the Harbour structures. **7Hrs.**

**Unit-II**

**Harbour structures and docks**: Breakwaters, quays and jetties (with sketches). Types (sketches), differences of Harbours and Docks, construction details of dry docks, wet docks-operation, self-docking docks. **8 Hrs.**

**Unit-III**

**Signals:** Bouys and Bouyage systems, Light house purpose, construction details, sound signals. **7 Hrs.**

**Unit-IV**

**Tunnels:** Definition, components, advantages and disadvantages, Cross sections of tunnels for various purposes (with sketches). Tunnel surveying, transfer of level and grade on surface survey, equipment used, methods of Rock tunneling, drilling patterns, explosives, blasting. **9 Hrs.**

**Unit-V**

**Modern Tunneling methods**: Shield tunneling, lining of tunnels, tunnel ventilation and drainage. **8 Hrs.**

**Reference Books:**

1) Srinivasan R., "Harbours Docks and Tunnel Engineering", Charotar Publishing House Pvt. Ltd.
2) Oza and Oza, "Harbours and Docks", Charotar Publishing House Pvt. Ltd.

| 18UCVE517 | Railway and Airport Engineering | (3-0-0)3 |
|---|---|---|

**Contact Hours: 39**

**Course Learning Objectives (CLOs): Railway and Airport Engineering** is taught as one of the elective courses for Civil Engineering program. In this course, salient features of permanent way, geometric design of railway, design of turnout are dealt. Further, aspects related to airport planning, design of runway and taxiway are taught. The delivering of topics will be made through lecture classes. The evaluation will be carried out through Internal evaluation and Semester End Examination.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs (1-12)/ PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Explain the importance of rail transport, qualities of ideal permanent way and calculate the quantity of materials to lay railway track. | | | 1,2 |
| CO-2 | Design the geometrical elements of railway track. | | 1,2 | |
| CO-3 | Design turnouts, points and crossings and state types of stations, yards and signal systems. | | | 1,2 |

| | | | | |
|---|---|---|---|---|
| CO-4 | Identify the ideal site for airport construction and design the geometrical elements of runway. | | 1,2 | |
| CO-5 | Design the geometrical element of taxiway and illustrate the various Airport Markings. | | 1,2 | |

| **POs/PSOs** | PO-1 | PO-2 |
|---|---|---|
| **Mapping Level** | 1.6 | 1.6 |

**Prerequisites:**

Students taking this course shall have the knowledge of following:

1) Highway Engineering.

**Contents:**

**Unit-I**

**Introduction**: Role of railways in transportation, selection of routes.

**Permanent way**: Gauges in railways, railway track, cross sections, coning of wheels, rails, rail sections, ballast, sleepers, wear on rails, rail joints, welding of rails, creep of rails, rail fixtures, calculation of quantity of materials required for laying of tracks, traction and tractive resistances, tractive power, hauling capacity. Problems on above. **9 Hrs.**

**Unit-II**

**Geometric design of track**: grade, ruling gradient, minimum gradient, pusher grade, speed of train, super elevation, cant deficiency, negative cant, speed calculation based on IR formulae for high speed tracks only. Problems on above. **7 Hrs.**

**Unit-III**

**Points and Crossing:** turnout, design of turnout, stations and yards, signaling and interlocking, track defects, track maintenance, level crossing, Indian Railway standards and relevant problems. **7 Hrs.**

**Unit-IV**

**Airport planning:** Characteristics of aircraft, Airport- classifications and site selection, regional planning .

**Runway design**: Analysis of wind data, determination of the best orientation of the runway configurations, basic length of the runway, corrections to runway length by ICAO and FAA specification, runway cross sections. Windrose type I & II diagrams. Problems on above. **9 Hrs.**

**Unit-V**

**Taxiway design:** Taxiway-Factors affecting the layout of the taxiway, geometrics of taxiway, design of exit taxiways.

**Visual aids:** Airport Marking**,** Lightings, ILS. **7 Hrs.**

**Reference Books:**

1. Saxena S.C and Arora S. P., "Railway Engineering", DhanpatRai Publications, New Delhi.
2. Agarwal M.M., "Indian Railway Track", Prabha& Co., New Delhi.
3. Khanna S.K., AroraM.G and Jain S.S, "Airport Planning and Design", Nemchand, Roorkee.
4. Mundrey J. S., "Railway Track Engineering", Tata McGraw Hill Publications, New Delhi.
5. Horenjeff, "Planning and Design of Airports", McGraw Hill Publications, New Delhi.

| 18UCVE518 | Watershed Management | (3-0-0)3 |
|---|---|---|

**Contact Hours: 39**

**Course Learning Objective (CLOs):** Watershed Management is taught as one of the elective courses in Civil Engineering program. In this course, topics like the concept of watershed management, water demand, water conservation methods, water harvesting, sustainable watershed approach, coastal watersheds, application of Remote Sensing and GIS in watershed management etc. are dealt. The evaluation will be carried out through Internal evaluation and Semester End Examination.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs (1-12)/ PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Discuss surface and ground water resources system and, human influences. | | 1,13 | |
| CO-2 | Integrate water resources system in arid and semi-arid regions and explain watershed aquifer for management. | | 2 | 13 |
| CO-3 | Analyze water resources related issues for conservation and synthesize augmentation of water resources. | | 3,13 | 6 |
| CO-4 | Design integrated watershed management system. | | 7,15 | |
| CO-5 | Apply modern tools in watershed management. | | 5 | |

| POs/PSOs | PO-1 | PO-2 | PO-3 | PO-5 | PO-6 | PO-7 | PO-13 | PO-15 |
|---|---|---|---|---|---|---|---|---|
| Mapping Level | 2 | 1 | 2 | 2 | 1 | 2 | 1.67 | 2 |

**Prerequisites:**

Students taking this course shall have the knowledge of following:

1. Hydrology

**Contents:**

**Unit-I**

**Principles of Watershed Management:** Basics concepts, hydrology and water availability, surface water, ground water, conjunctive use, human influences in the water resources system. **6 Hrs.**

**Unit-II**

**Water resources systems:** Integrated water resources system, river basins, watershed management practices in arid and semi-arid regions, watershed management through wells, management of water supply, case studies, short term and long-term strategic planning. **7 Hrs.**

**Unit-III**

**Conservation of Water:** Perspective on recycle and reuse, wastewater reclamation, social aspects of watershed management, community participation, private sector participation, institutional issues, socio-economy, integrated development, water legislation and implementations, case studies.

**Water Harvesting:** Rainwater management, conservation, storage and effective utilization of rainwater, structures for rainwater harvesting, roof catchments system, check dams, aquifer storage. **11 Hrs.**

**Unit-IV**

**Sustainable Watershed Approach:** Sustainable integrated watershed management, natural resources management, agricultural practices, integrated farming, soil erosion and conservation. **6 Hrs.**

**Unit-V**

**Applications of RS and GIS in Watershed management:** Role of decision support system in watershed management, watershed characteristics of coastal regions, coastal aquifer tor management, uniqueness of coastal water resources. **9 Hrs.**

**References Books:**

1) Singh Rajvir., “Watershed Planning and Management”, Yash Publishing House, Bikaner.
2) Murthy J.V.S., “Watershed Management in India”, Wiley Eastern, New Delhi.

3) "Decision Support System for Integrated Watershed Management", Colorado State University.
4) Murthy J.V.S. & Allam G.I.Y., "Watershed Management", New Age International, New Delhi.

## 18UCVE519 Alternative Building Materials (3-0-0)3

**Contact Hours: 39**

**Course Learning Objectives (CLOs):** Alternative Building Materials is taught as one of the elective courses in Civil Engineering program. In this course, the students understand environmental issues due to building materials and the energy consumption in manufacturing building materials. The course also exposes the students to the study the various masonry blocks, masonry mortar and the study the alternative building materials in the present context. Students shall also understand the alternative building technologies which are followed in present construction field. The evaluation will be carried out through Internal evaluation and Semester End Examination.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs (1-12)/ PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Explain the facts of energy, environment, cost effectiveness of different building materials. | | | 1 |
| CO-2 | Explain the elements of structural masonry. | | | 1 |
| CO-3 | Explain the types, characteristics and strength of mortars. | | | 1 |
| CO-4 | Explain and apply the concepts of alternative building materials, types, properties. | | 1,2,7 | |
| CO-5 | Discuss the equipment for production of alternative materials and cost concepts. | | | 1 |

| **POs/PSOs** | PO-1 | PO-2 | PO-7 |
|---|---|---|---|
| **Mapping Level** | 1.2 | 2 | 2 |

**Contents:**

**Unit-I**

**Introduction:** Energy in building materials, environmental issues concerned to

building materials, Global warming and construction industry, environment friendly and cost-effective building technologies, requirements for building of different climatic regions. **6 Hrs.**

**Unit-II**

**Elements of Structural Masonry:** Elements of Structural Masonry, Masonry materials, requirements of masonry units, characteristics of bricks, stones, clay blocks, concrete blocks, stone boulders, laterite blocks, Stabilized mud block. Manufacture of stabilized blocks, cementations materials, sand, natural & manufactured. **8 Hrs.**

**Unit-III**

**Mortars:** Types of mortars, classification of mortars as per BIS, characteristics and requirements of mortar, selection of mortar, uses of masonry, masonry bonding, Compressive strength of masonry elements, Factors affecting compressive strength, Bond strength of masonry, Flexure and shear, Elastic properties of masonry materials. **8 Hrs.**

**Unit-IV**

**Conventional and Non-conventional Materials:** Lime, Pozzolana cement, Raw materials & Manufacturing process, Properties and uses. Fibers- metal and synthetic, Properties and applications. Fiber reinforced plastics, Matrix materials, Fibers organic and synthetic, Properties and applications. Building materials from agro and industrial wastes, Types of agro wastes, Types of industrial and mine wastes, Properties and applications. Masonry blocks using industrial wastes. Construction and demolition wastes. **9 Hrs.**

**Unit-V**

**Equipment for Production of Alternative Materials and cost concepts:** Machines for manufacture of concrete, Equipment for production of stabilized blocks, Moulds and methods of production of precast elements, Cost concepts in buildings, Cost saving techniques in planning, design and construction, Cost analysis, Case studies using alternatives. **8 Hrs.**

**Reference Books:**

1) K. S. Jagadish, B.V Venkatarama Reddy and K.S Nanjunda Rao, “Alternative Building Materials and Technologies”, New Age International Pvt. Ltd.
2) Arnold W Hendry, “Structural Masonry”, Macmillan Publishers.
3) S. K. Duggal, “Building Materials”, New Age International Pvt. Limited.

| 18UCVE520 | Advanced Concrete Technology | (3-0-0)3 |
|---|---|---|

**Contact Hours: 39**

**Course Learning Objective (CLOs):** Advanced Concrete Technology is taught as one of elective courses for Civil Engineering Program. In this course, topics on ingredients of concrete, rheology of concrete, properties of fresh and hardened concrete, special concrete, microstructure of concrete and high strength and high-performance concrete are dealt. The delivery of topics will be made through lecture classes and demonstration. The evaluation will be carried out through Internal evaluation and Semester End Examination.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs (1-12)/ PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Explain the constituents and properties of cement and polymers, fibres, adhesives and sealants | | 1,2,6 | |
| CO-2 | Explain the concept of Rheology of fresh concrete and its applications. | 3,4 | 9 | 7,12 |
| CO-3 | Explain the microstructure of aggregate phase and its importance in concrete. | 3,4,5 | 9 | 12 |
| CO-4 | Explain the special concrete and high performance/high strength concrete. | 13 | 6,7 | 12 |
| CO-5 | Explain methods for special curing, Shotcreting, under water concreting and formwork. | 3,13 | 4 | 6,12 |

| **POs/PSOs** | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-9 | PO-12 | PSO-13 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Mapping Level** | 2 | 2 | 3 | 2.66 | 3 | 1.67 | 1.5 | 2 | 2 | 3 |

Mapping level: 1 = Low, 2=Moderate, 3=Substantial

**Prerequisites:**

Students taking this course shall have the knowledge of following:

1. Concrete Technology

**Contents:**

**Unit-I**

**Introduction:** Concrete and reinforcement, constituent materials, composite cement and properties. Types of reinforcements, corrosion of reinforcing steel - electro-chemical process, measures of protection. Polymers, fibers, adhesives and sealants - types and uses. **10 Hrs.**

**Unit-II**

**Properties of fresh concrete:** Rheology of Concrete - Introduction, factors affecting rheology of concrete, equation for measuring the rheological parameters, rheometer. **07 Hrs.**

**Unit-III**

**Properties of hardened concrete:** Microstructure of the aggregate phase, microstructure of the hydrated cement paste, Interfacial Transition Zone (ITZ) in concrete -microstructure, strength influence of the interfacial transition zone on properties of concrete. Quantitative estimation of product of hydration by Mercury

Intrusion Porosimetry, X-Ray Diffraction Analysis (XRD Analysis) and Scanning Electron Microscopy (SEM). **06 Hrs.**

**Unit-IV**

**Special Concretes:** High performance and High strength concrete, Bacterial Concrete, Ferro-cement - Definition, fresh &hardened Properties, applications. **07 Hrs.**

**Unit-V**

**Special Topics:** Curing methods - Steam, water curing. vacuum dewatering of concrete. Shotcrete - definition, wet mix and dry mix process, general use and advantages. Underwater concreting- Introduction, basic requirements, strength, workability. **09 Hrs.**

**Reference Books:**


1. Shetty M.S., “Concrete Technology” -Theory and Practice, S. Chand and company, New Delhi.
2. Neville A.M. & Brooks J.J., “Concrete Technology”, Tans-Atlantic Publications, Philadelphia, USA.
3. Gambhir M.L., “Concrete Technology”, Tata McGraw Hill, Education, New Delhi.
4. John Newman and Ban Seng Choo, "Advanced Concrete Technology – Process", ISBN 0 7506 51059, Elsevier Ltd
5. IS 456: 2000 – “Plain and reinforced concrete – Code for practice”.
6. IS 10262: 2009 – “Concrete mix proportioning – Guidelines”.
7. IS 383: 2016 – “Coarse and fine aggregate for concrete – Specification”.


| 18UCVE521 | Photogrammetry and Remote Sensing | (3-0-0)3 |
|---|---|---|

**Contact Hours: 39**

**Course Learning Objective (CLO): Photogrammetry and Remote Sensing** is taught as one of the elective courses for Civil Engineering program. In this course, topics on measurements like of heights, distances, angular separation from the terrestrial and aerial photos, scale, flight planning, and instruments used in photogrammetry for quantitative measurements; fundamentals of remote sensing and application of remote sensing in Civil Engineering are dealt. The subject will be taught through classroom lectures, demonstration and by solving numerical. The evaluation will be carried out through Internal evaluation and Semester End Examination.

**Course Outcomes (CO):** At the end of this course, students should meet the learning objectives through following observable and measurable outcomes by undergoing various tests planned by the course teacher as a part of course assessment.

| **Description of the Course Outcome:** At the end of the course the student will be able to: | **Mapping to POs (1-12)/ PSOs (13-15)** |
|---|---|

| | | 3 | 2 | 1 |
|---|---|---|---|---|
| CO-1 | Analyze the advantage and limitations of terrestrial, aerial photogrammetry and Remote sensing. | | 1 | |
| CO-2 | Explain quantitative measurements and qualitative analysis from terrestrial, aerial photogrammetry and satellite data. | | 2 | |
| CO-3 | Infer the scale, influencing factors and plan for aerial photogrammetric survey. | 3 | 13 | |
| CO-4 | Use instruments for quantitative measurements from photographs and generate maps. | | 1 | |
| CO-5 | Apply principles of remote sensing technology to different projects of Civil Engineering, use of advanced survey tools in the concerned project. | | 1,5,13 | |

| **POs/PSOs** | PO-1 | PO-2 | PO-3 | PO-5 | PO-13 |
|---|---|---|---|---|---|
| **Mapping Level** | 2 | 2 | 3 | 2 | 2 |

Mapping level: 1 = Low, 2=Moderate, 3=Substantial

**Prerequisites:**

Students taking this course shall have the knowledge of following:

1) Surveying – I
2) Surveying – II
3) Engineering Physics

**Contents:**

**Unit-I**

**Photogrammetry:** Introduction, metric and non-metric photogrammetry, metric cameras, advantages of photogrammetry, terrestrial photogrammetry, terrestrial and aerial photogrammetry, introduction of digital photogrammetry. **08 Hrs.**

**Unit-II**

**Aerial Photogrammetry:** Advantages over ground survey methods, vertical, titled and oblique photographs, geometry of vertical photographs-scale of vertical photographs, ground coordinates, relief displacement, titled photograph, scale, ground coordinates relief displacement, flight planning. Stereoscope, parallax, measurement of parallax, parallax equations, elevation by parallax differences.

**08 Hrs.**

**Unit-III**

**Terrestrial Photogrammetry:** Photo-theodolites, locating points from two photos,

determinations of focal length. **07 Hrs.**

**Unit-IV**

**Remote Sensing:** Advantages electromagnetic radiations idealized remote sensing system, types of sensors, satellites, Indian and other remote sensing satellites, black body radiation, gray body, atmospheric windows, spectral signature, multi concept in R.S. Remote sensing products, Basics of image processing. **08 Hrs.**

**Unit-V**

**Applications of remote sensing:** water resources, land use and land cover analysis-environmental applications, Geological applications Geo Hazards, Disaster management, Terrain mapping. **08 Hrs.**

**Reference Books:**

1) Punmia B.C, “Surveying Vol II and III” Lakshmi Publications, New Delhi.
2) Duggal, “S.K. Surveying Vol I & II” Tata McGraw Hill publishing Co.,
3) Lillisand and Kiefer, “Principles of Remote Sensing and image interpretation”, John Wiley and Sons.
4) Sabins F.F, Freeman W.H and company (NY) “Remote Sensing-Principles & Interpretation”.

## 6th Semester

**18UCVC600 Quantity Surveying and Estimation (4-0-0) 4**

**Contact Hours: 52**

**Course Learning Objective (CLOs):** Quantity Surveying and estimation is taught as core course in Civil Engineering program. In this course, estimate and types, method of taking out quantities of various items of works for buildings, RCC slab culverts, manhole and septic tank, brief and detailed specifications and rate analysis for items of works, measurement of earthwork for roads, contracts, terms related to contracts, invitation of bids, award of contract, recording and checking of measurements, completion of contract, payment of bills, breach of contract, termination of contract, disputes and dispute resolution mechanisms are dealt. The delivery of topics will be made through lecture classes, demonstrations and field visits. The evaluation will be carried out through Internal evaluation and Semester End Examination.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs (1-12)/ PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Explain contracts, procedure for calling bids, award of contract, execution of works, payment of bills, control, including methods of dispute resolutions. | 6 | | 9,12 |
| CO-2 | Explain brief and detailed specifications for various items of works for building. Evaluate rates for the standard items of works for buildings. | 14 | | 6, 7 |
| CO-3 | Compute quantities of earthwork for roadwork by different methods. | 1 | | |
| CO-4 | Explain different types of estimates, study of various drawings attached to buildings, units of measurement. Calculate the quantities of various items of works. | 1 | | |
| CO-5 | Calculate the quantities of small civil works - RCC slab culverts, manhole and septic tanks. | 1 | | |

| POs/PSOs | PO-1 | PO-6 | PO-7 | PO-9 | PO-12 | PO-14 |
|---|---|---|---|---|---|---|
| Mapping Level | 3 | 2 | 1 | 1 | 1 | 3 |

**Prerequisites:**

Students taking this course shall have the knowledge of following:

1) Building Engineering Science
2) Building Planning and Drawing

**Contents:**

**Unit-I**

**Contracts:** Works, approval of works, administrative approval - technical sanction, contracts- types, essentials of contract agreement. Duties and liabilities of department and contractor. Definition of the terms - Tender, earnest money deposit, security deposit**;** acceptance of contract documents, comparative statements and issue of work orders.

**Execution of work**: Quality control, procedure for recording and checking measurements, measurement book, preparation of bills**,** completion certificate, refund of deposits; NMR. Breach of contract, consequences of breach - claims and compensation, termination of contract and reasons. Disputes and dispute resolution mechanisms. **12 Hrs.**

**Unit-II**

**Specifications:** Definition of specification, objective of writing specifications, essentials in specifications, general and detailed specifications of standard items of works in buildings.

**Rate Analysis:** Definition and purpose, working out rates for standard items of works for a building. **12 Hrs.**

**Unit-III**

**Earthwork for roads:** Computation of earthwork by mid-section, mean sectional area, trapezoidal, prismoidal methods for different terrains. **8 Hrs.**

**Unit-IV**

**Estimation:** Objective and importance of preparing estimates, types of estimates, various drawing attached to estimates, units of measurement. Methods of taking out quantities by center line method and / or long wall and short wall method. For simple load bearing buildings or framed structures with flat or sloped RCC roofs. **12 Hrs.**

**Unit-V**

**Estimation of minor civil works:** RCC slab culvert, manhole and septic tank. **8 Hrs.**

**Reference Books:**

1) Dutta B.N., “Estimating and Costing in Civil Engineering”, UBS Publishers and Distributors, New Delhi.

2) Chakraborti N., “Estimating and Costing in Civil Engineering”, Published by author, Calcutta.
3) Schedule of Rates of PWD and Irrigation Department, GOK.
4) Karnataka Public Works Departmental Code.

**Pattern of question paper for SEE:** There shall be one question from each unit. The first question from Unit I to find out quantities of selected items of work for given residential building for 40 marks. The remaining questions shall be one from each Unit for 15 marks each. There shall not be any choice of question in Unit I, II and III.

| 18UCVC601 | Geotechnical Engineering–II | (4-0-0) 4 |
|---|---|---|

**Contact Hours:52**

**Course Learning Objective (CLOs): Geotechnical Engineering – II** is taught as one of core courses for Civil engineering program. In this course, topics on principles of soil mechanics in different soil engineering problems, subsurface exploration, dewatering, stresses in soil, lateral earth pressure, stability analysis of earth slopes, bearing capacity of soils, Pile foundations and foundation settlements along with the typical field problems and their solutions are dealt. The delivery of the topics is achieved through lecture classes and demonstrations. The evaluation will be carried out through Internal evaluation and Semester End Examination.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs (1-12)/ PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Explain various methods of sub-surface exploration and determine the type of method to be employed. | | | 1 |
| CO-2 | Explain the different methods of dewatering, calculate the stress components at a point below the loaded soil mass, explain the pressure distribution diagrams. | 3 | 1,2 | |
| CO-3 | Calculate the lateral earth pressure on retaining walls for different backfills and loading conditions, explain the causes / types of slope failures and examine safety of slope. | 3 | 1,2 | |
| CO-4 | Derive the general bearing capacity | | 1,2 | |

| | | | | |
|---|---|---|---|---|
| | equation and calculate the safe bearing capacity of soil under different conditions of loading and water table. | | | |
| CO-5 | Classify piles, calculate bearing capacity of single pile and pile group, explain settlements and their ill effects on the buildings. | | 1,2 | |

| **POs/PSOs** | PO-1 | PO-2 | PO-3 |
|---|---|---|---|
| **Mapping Level** | 1.8 | 2 | 3 |

**Prerequisites:**

Students taking this course shall have the knowledge of following:

1. Geotechnical Engineering – I

**Contents:**

**Unit-I**

**Subsurface Exploration**: Importance, exploration program, methods of exploration, boring, sounding tests, geophysical methods, electrical resistivity and seismic refraction methods, types of samples, undisturbed, disturbed and representative samples, samplers, sample disturbance, area ratio, recovery ratio, clearance, stabilization of bore holes, typical boring log. **10 Hrs**.

**Unit-II**

**Drainage and Dewatering**: Necessity and importance, sumps and ditches, well point systems, shallow well and deep well. Vacuum and electro osmosis methods.

**Stresses in soils**: Boussinesq's and Westergard's theories for concentrated and circular loads. Comparison of Boussinesq's and Westergard's analysis. Pressure distribution diagrams, contact pressure, Newmark's chart. **10 Hrs.**

**Unit-III**

**Lateral Earth Pressure**: Active and Passive Earth pressures, earth pressure at rest, earth pressure coefficients, earth pressure theories –Rankine's and Coulomb's –assumptions and limitations, graphical solutions for active earth pressure (cohesion less soils only), Cullman's and Rebhan's methods.

**Stability of Earth Slopes**: Types of slopes, causes and types of failure of slopes, definition of factor of safety, stability of finite slopes, method of slices, Fellineous method, Taylor's stability number. **12 Hrs**.

**Unit-IV**

**Bearing Capacity**: Definitions of ultimate, net and safe bearing capacity, allowable bearing pressure, Terzaghi's bearing capacity equation & derivation, assumptions

and limitations, bearing capacity of footings subjected to eccentric loading, effect of ground water table on bearing capacity, plate load test and its limitations. **09 Hrs.**

**Unit-V**

**Pile Foundations**: Introduction, types of piles, load carrying capacity of piles, group action in piles, laterally loaded piles, under reamed piles. **11 Hrs.**

**Reference Books:**


1) Punmia B.C., "Soil Mechanics and Foundations", Laxmi Publications Pvt. Ltd., New Delhi.
2) Narasimha Rao A. V. and Venkatramaiah C., "Geotechnical Engineering", University Press (India) Ltd., Hyderabad.
3) Gopalranjan and A.S.R Rao., "Basic and Applied Soil Mechanics", New Age Publishers, Bangalore.
4) Singh Alam and Chowdhary G.R., "Soil Engineering in Theory and Practice", CBS Publishers and Distributors Ltd., New Delhi.
5) IS 2131- 1981 - Method for standard penetration test for soils.
6) IS 2132 -1986 - Code of practice for thin-walled tube sampling of soils.
7) IS 2911 – 2010 - Design and Construction of Pile Foundations - code of practice, part 1: concrete piles, section 1: driven cast in-situ concrete piles.
8) IS 1892 -1979 - Code of practice for subsurface investigation for foundations.
9) IS 4968 – 1976 - Method for subsurface sounding for soils, Part 3: Static cone penetration test.


**18UCVL602 Geo-technical Engineering Lab. (0-0-3)1.5**

**Contact Hours: 36**

**Course Learning Objective (CLOs): Geotechnical Engineering Laboratory** is taught as one of laboratory for Civil engineering program. In this course, topics on specific gravity of soil, moisture content of soil, grain size analysis and consistency of soil, compaction parameters, shear strength, relative density and various index of soil are dealt. The delivery of topics will be made through instruction classes, demonstration and Laboratory work. The evaluation will be carried out through continuous evaluation & Semester End practical examination.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs (1-12)/ PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Determine index properties of soils and interpret the results. | 3 | 1,4 | 9,4,15 |
| CO-2 | Determine engineering properties of soils and interpret the results. | 3 | 1,4 | 9,4,15 |

| POs/PSOs | PO-1 | PO-3 | PO-4 | PO-9 | PSO-3 |
|---|---|---|---|---|---|
| Mapping Level | 2 | 3 | 1.5 | 1 | 1 |

**Contents:**

Tests for the determination of:

1) Specific gravity by density bottle, by pycnometer.
2) Moisture content by oven drying method and pycnometer.
3) Grain size analysis of soil (Sieve analysis).
4) In situ density by core cutter and sand replacement methods.
5) Consistency limits, liquid limit (Casagrande and cone penetration methods), plastic limit and shrinkage limit.
6) Compaction parameters by Standard Proctor compaction test and modified Proctor compaction test.
7) Coefficient of permeability by constant head and variable head methods.
8) Shear strength by unconfined compression test, Direct shear test, Triaxial test (undrained), Vane shear test.
9) Relative density

**Reference Books:**

1) Lambe T.W., “Soil testing for engineers”, Wiley Eastern Ltd., New Delhi.
2) Head K.H., “Manual of soil laboratory testing”, Pentech Press, London.
3) Bowles J.E., “Engineering properties of soils and their measurements”, McGraw Hill Book Co., New York.
4) IS 2720 - 1983 - Methods of test for soils, Part 1: Preparation of dry soil samples for various tests.
5) IS 2720 – 1973 - Methods of test for soils, Part 2: Determination of water content.
6) IS 2720 - Part,3,4,5,6,7,8,9,10,11,13,14,15,16,17,28,29,36.

## 18UCVL603 Software Laboratory (0-0-2)1

**Contact Hours: 24**

**Course Learning Objective (CLOs):** Software Laboratory is taught as a laboratory course for Civil Engineering Program. In this course, analysis and design of RC building using FEM based software, plotting of survey data using Survey software, preparation of shape and thematic maps using GIS software package are dealt. The evaluation will be carried out through continuous evaluation & Semester End practical examination.

**Course Outcomes (COs):**

| Description of the Course Outcome: | Mapping to POs (1-12)/ PSOs (13-15) |
|---|---|

| At the end of the course the student will be able to: | | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |
|---|---|---|---|---|
| CO-1 | Design a RC building using FEM based software. | 5 | 6 | 9 |
| CO-2 | Preparation of maps using Total Station/GPS data. | 5 | 6 | 9 |
| CO-3 | Prepare shape and thematic files of features using GIS software. | 5 | 6 | 9 |

| POs/PSOs | PO-5 | PO-6 | PO-9 |
|---|---|---|---|
| Mapping Level | 3 | 2 | 1 |

Mapping level: 1 = Low, 2=Moderate, 3=Substantial

**Contents:**

1) **Reinforced Concrete buildings:** Analysis and design of RC buildings using FEM based software package.
2) **Preparation of maps:** Use of Total Station and GPS data.
3) **GIS applications:** Create shape files for point, line and polygon features with a map as reference. Create decision maps for specific purpose.

**18UCVL604 Minor Project–2 (0-0-4)2**

**Contact Hours: 36**

**Course Learning Objective (CLOs): Extensive survey** is carried out as a project work for Civil Engineering program. In this project work students will formulate, organize and carry out the project work related to water supply, highway, restoration of old tank and new tank projects. The project will be carried out through field surveys and office work. The evaluation will be carried out through presentations and viva voce.

**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | | Mapping to POs(1-12)/ PSOs (13-15) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level(1) |
| CO-1 | Use Surveying equipment, schedule and conduct necessary field surveys. | 5,9,11 | | |
| CO-2 | Collect data by direct and indirect methods. | 9,13,15 | | |
| CO-3 | Plan, organize and prepare project reports. | 9,13 | | |

| POs/PSOs | PO-5 | PO-9 | PO-11 | PSO-13 | PSO-15 |
|---|---|---|---|---|---|
| Mapping Level | 3 | 3 | 3 | 3 | 3 |

Mapping level: 1 = Low, 2=Moderate, 3=Substantial

(Any two of the following projects in detail is to be carried out between fifth & sixth semester for a period of 2 weeks; Viva voce conducted along with sixth semester exams). An extensive survey training involving investigation and design of the following projects is to be conducted for 2 weeks. The students shall submit a project report consisting of designs & drawings. (Total station and GPS to be used). General instructions, Reconnaissance of the sites and fly leveling to be used to establish benchmarks.

1. **New Tank Project**: Alignment of center line of the proposed bund, longitudinal and cross sections of center line, capacity surveys, details at waste weir and sluice points, canal alignment.
2. **Restoration of an Existing Tank**: Alignment of center line of the existing bund, longitudinal and cross sections along the center line, capacity surveys, details at sluice and waste weir.
3. **Water Supply Project:** Examination of sources of water supply, calculation of quantity of water required based on existing and projected population, preparation of village map by any suitable method of surveying (like plane tabling), location of sites for ground level and overhead tank.
4. **Highway Project:** Preliminary and detailed investigations to align a new road between two obligatory points. The investigations shall consist of topographic surveying of strip of land for considering alternate routes and for final alignment. Report should justify the selected alignment with details of all geometric designs for traffic and design speed assumed. Drawing shall include key plan initial alignment, final alignment, longitudinal section along final alignment, typical cross sections of road.

**References:**

1. Training manuals and User manuals.
2. Relevant course reference books

**18UHUL605 Soft Skills/ Aptitude (0-0-2) 1**

**Contact Hours:24**

**Course Learning Objectives (CLOs):** This is included with the objective of improving the communication skills, proficiency in English language and aptitude ability of the student to enhance the employability.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs(1-12)/ PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Explain the significance of communication in the profession. | | 10 | |
| CO-2 | Use the English language with proficiency | | 10 | 12 |
| CO-3 | Solve Aptitude related problems | | 9 | 12 |
| CO-4 | Demonstrate the competency in the placement activities. | | 9 | |

| **POs/PSOs** | PO-9 | PO-10 | PO-12 |
|---|---|---|---|
| **Mapping Level** | 2 | 2 | 1 |

**Contents:**

Training on communication skills, proficiency in English language and aptitude ability involving the internal and external resource.

**Evaluation:**

Both the internal and external resource persons shall be engaged in imparting the related knowledge and shall have only CIE as the evaluation component. There shall be one test conducted at the end for 25 marks in Aptitude testing and there shall be one presentation by the student for 25 marks or any other suitable testing components. The arrangement for CIE evaluation is to be done by the department and maintain the relevant documents.

**18UCVE615 Matrix Method of Structural Analysis (3-0-0) 3**

**Contact Hours: 39**

**Course Learning Objective (CLOs): Matrix Method of Structural Analysis** is taught as one of elective subject for civil engineering program. In this program, advanced concepts of structural analysis using matrix method are provided. The delivery of topics will be made through lecture classes. The evaluation will be carried out through Internal evaluation and Semester End Examination.

**Course Outcomes (COs):**

| **Description of the Course Outcome: At the end of the course the student will be able to:** | **Mapping to POs(1-12)/ PSOs (13-15)** | | |
|---|---|---|---|
| | **Substantial** | **Moderate** | **Slight** |

| | | Level (3) | Level (2) | Level (1) |
|---|---|---|---|---|
| CO-1 | Formulate flexibility matrix. | 2 | | 1 |
| CO-2 | Analyze indeterminate structures such as beams, trusses and frames (element approach) using matrix flexibility method. | | 2 | |
| CO-3 | Formulate stiffness matrix. | 2 | | 1 |
| CO-4 | Analyze indeterminate structures such as beams, trusses and frames (element approach) using matrix stiffness method | | 2 | |
| CO-5 | Formulate and solve trusses and beams using direct stiffness method | | 2 | 1,5 |

| **POs/PSOs** | PO-1 | PO-2 | PO-5 |
|---|---|---|---|
| **Mapping Level** | 1 | 2.4 | 1 |

**Prerequisites:**

Students taking this course shall have the knowledge of following:

1. Engineering Mathematics – All courses
2. Structural Analysis – I
3. Structural Analysis – II

**Contents:**

**Introduction to flexibility method**: Element flexibility matrix, Principle of contra gradience, and Force Transformation Matrix, Member Flexibility matrix, Construction of structure flexibility matrix, Matrix determination of the displacement vector, Determination of member forces and analysis of indeterminate beam problems. **7 Hrs.**

**Element flexibility matrix**: Principle of contra gradience, and Force Transformation Matrix, Member Flexibility matrix, Construction of structure flexibility matrix, Matrix determination of the displacement vector, Determination of member forces and analysis of trusses and frames. **8 Hrs.**

**Fundamentals of the stiffness method**: Displacement Transformation matrix. Member stiffness matrix, Total or System stiffness matrix, Truss analysis by stiffness method using Displacement Transformation matrix. **8 Hrs.**

**Element stiffness matrix:** Equivalent joint loads, Displacement Transformation matrix. Member stiffness matrix, Total or System stiffness matrix, Continuous beams and rigid frame analysis by stiffness method using Displacement Transformation matrix. **8 Hrs.**

**Direct Stiffness Method**: local and global coordinate systems, direct assembly of element stiffness matrices, analysis of indeterminate structures, trusses, continuous beams & Simple frames. **8 Hrs.**

**Reference Books:**


1. Weaver W and Gere J H., "Matrix Analysis of Framed Structures", CBS Publications, New Delhi
2. Rajasekaran S, "Computational Structural Mechanics ", PHI, New Delhi
3. Pandit and Gupta, "Theory of Structures", Vol II, TMH Publications, New Delhi
4. Amin Ghali and Adam Neville, "A unified classical and Matrix Approach", CRC Press.
5. C S Reddy, "Basic Structural Analysis", TMH Publications, New Delhi.


**18UCVE616 Design of Special RC Structures (3-0-0)3**

**Contact Hours: 39**

**Course Learning Objective (CLO):** Design of Special R.C. Structures is taught as one of the elective courses for Civil Engineering program. In this course design of flat slabs, grid floors, continuous beams, bunkers and silo's, shells and folded plates, yield line analysis of slabs and curved beams are dealt. The delivery of topics will be made through lecture classes and site visits. The evaluation will be carried out through Internal evaluation and Semester End Examination.

**Course Outcomes (COs):**

| **Description of the Course Outcome: At the end of the course the student will be able to:** | | **Mapping to POs (1-12) / PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Analyze, design and detail the reinforcement for different types of flat slabs. | 2,3 | | 8 |
| CO-2 | Analyze, design grid floors as per IS code and Rankin's methods and detail the reinforcement. | 2,3 | | 8 |
| CO-3 | Determine moment capacities and ultimate load carrying capacities by yield line method, design slabs using Yield Line Method. | 2,3 | | 8 |
| CO-4 | Differentiate between bunkers and | 2,3 | | 8 |

| | | | | |
|---|---|---|---|---|
| | silos and design bunkers and silos. | | | |
| CO-5 | Analyze and design continuous beams and beams curved in plan. | 2,3 | | 8 |

| POs/PSOs | PO-2 | PO-3 | PO-8 |
|---|---|---|---|
| Mapping Level | 3 | 3 | 1 |

Mapping level: 1 = Low, 2=Moderate, 3=Substantial

**Prerequisites:**

Students taking this course shall have the knowledge of following:

1) Engineering Mechanics.
2) Strength of Materials.
3) Structural Analysis Volume I and II.

**Unit-I**

**Design of Flat Slabs:** Flat slab by direct design method (with and without drops). **09 Hrs.**

**Unit- II**

**Design of Grid Floors:** Rankine's Method and Approximate method. **09 Hrs.**

**Unit-III**

**Yield Line Analysis of Slabs:** Virtual and equilibrium methods, design of slabs using yield line theory. **07 Hrs.**

**Unit-IV**

**Design of Bunkers and silos:** Johnson's and Airy's Theorem. **06 Hrs.**

**Unit-V**

**Design of Continuous Beams:** Bending moment envelops, moment redistribution, IS Code provisions. **06 Hrs.**

**Beams curved in plan:** Introduction, Design. **02Hrs.**

**Reference Books:**

1) Krishna Raju N., "Advanced Reinforced Concrete design", New Age Publication.
2) Punmia B.C., "Reinforced Concrete Structures", Laxmi Publication, New Delhi.
3) Shaw H.J., "Reinforced Concrete Structures", Charotar-Publishers, Anand.
4) Varghese P.C., "Advanced Reinforced Concrete", PHI, New Delhi.
5) IS: 456 - 2000, SP16.

## 18UCVE617 Advanced Structural Analysis (3-0-0)3

**Contact Hours:39**

**Course Learning Objectives (CLOs):** Advanced Structural Analysis is taught as elective subject in Civil Engineering program**.** In this course, topics on formulae differentiate equation, simultaneous equation, differentiate boundary condition, probability analysis and size value problem for beams and columns in Civil Engineering are dealt. The subject will be taught through classroom lectures,

demonstration and by solving numerical. The evaluation will be carried out through Internal evaluation and Semester End Examination.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs (1-12)/ PSOS (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Analyze the structural elements using mathematical differential equations. | 2 | 3 | 13 |
| CO-2 | Analyze the structural elements using Numerical methods. | 2 | 3 | 13 |
| CO-3 | Analyze of structural elements by finite difference method | 2 | 3 | 13 |
| CO-4 | Explain probability and different variables by distribution methods. | 2 | 3 | 13 |
| CO-5 | Analyze critical load on column and beams using Eigen value method. | 2 | 3 | 13 |

| **POs/PSOs** | PO-2 | PO-3 | PO-13 |
|---|---|---|---|
| **Mapping Level** | 3 | 2 | 1 |

**Prerequisites:**

1) Engineering mathematics
2) Structural Analysis
3) Design of RC structural Elements.

**Contents:**

**Unit-I**

**Differential equations:** $2^{nd}$, $4^{th}$ order, partial differential equations, Application to problem of beams, columns, plots, beams on elastic foundation and vibration problems **08 Hrs.**

**Unit-II**

**Numerical methods:** The solution of simultaneous linear equations Application - Moment - distribution as relaxation method, Kani's iteration method. **07Hrs.**

**Unit-III**

**Finite difference method:** Derivatives by finite difference, errors in finite difference, boundary conditions, application to beams critical loads of columns with variable moment of inertial and plates. **08Hrs.**

**Unit-IV**

**Probability:** Probability Random variable, elementary definition of probability, density function, different types of distribution, application to reinforced concrete structures. **08 Hrs.**

**Unit-V**

**Eigen value problem:** Application to critical loads of columns and beams, vibration problems. **08Hrs.**

**Reference Books:**

1) Devdas Menon, “Advanced Structural analysis”, Alpha Science International, Delhi.
2) A.K.Jain, “Advanced Structural Analysis”, Nemchand Publications, Roorkee.

| 18UCVE619 | Open Channel Hydraulics | (3-0-0)3 |
|---|---|---|

**Contact Hours:39**

**Course Learning Objectives (CLOs)**: Open channel hydraulics is taught as one of the elective courses in Civil Engineering program. In this course difference between pipe and open channel flow, momentum equation, uniform flow, design of channel sections, gradually varying flow and rapidly varied flow along with sediment transport are dealt with. The delivery of topics will be made through lecture classes and field visits. The evaluation will be carried out through Internal evaluation and Semester End Examination.

**Course Outcomes (COs):**

| **Description of the Course Outcome: At the end of the course the student will be able to:** | | **Mapping to POs (1-12)/ PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Differentiate between pipe flow and open channel flow, energy and momentum equations. | | 1,2 | |
| CO-2 | Design channel for uniform, critical flow. | 3 | | |
| CO-3 | Explain different forms of gradually varied flow and their profiles. | 2 | 5 | |
| CO-4 | Compute gradually varied flow by using direct integration, Bresse’s and Chow’s solution. | 3 | 5 | |
| CO-5 | Explain length, height, location of hydraulic jump and application. | 3 | 5 | |

| POs/PSOs | PO-1 | PO-2 | PO-3 | PO-5 |
|---|---|---|---|---|
| Mapping Level | 2 | 2.5 | 3 | 2 |

**Prerequisites:**

1) Fluid mechanics
2) Hydraulics and Hydraulic Machines

**Contents:**

**Unit-I**

**Introduction:** Introduction, difference between pipe flow and open channel flow, classification of flow, energy equation, momentum equation, kinetic energy and momentum factors.

**Uniform Flow:** Concepts, uniform flow equations, conveyance, hydraulic exponent for uniform flow, design of channels for uniform flow. **9 Hrs.**

**Unit-II**

**Critical Flow:** Concepts, specific energy, classification of flow, design of channels, section factor, hydraulic exponent for critical flow, and critical depth as a flow measuring consent. **7 Hrs.**

**Unit-III**

**Gradually Varied Flow:** Concepts, GVF equation, its different forms, classification and analysis of flow profiles, control sections. **8 Hrs.**

**Unit-IV**

**Gradually Varied Flow Computations:** Different methods, direct integration method, Bresse's & Chow's solution, direct step method, standard step method. **8 Hrs.**

**Unit-V**

**Rapidly Varied Flow:** Concepts, hydraulic jump in rectangular channels, classification of jumps, characteristics of hydraulic jumps, length, location, height, applications of hydraulic jump. **7 Hrs.**

**Reference Books:**

1) Modi and Seth, "Hydraulics & Fluid Mechanics including Hydraulics Machines", Rajsons Publications, Delhi.
2) Subramanya K., "Flow in open channels", McGraw Hill Education.
3) Ven Tee Chow, "Open Channel Hydraulics", Blackburn.
4) Henderson, "Open Channel Hydraulics", Pearson.

## 18UCVO601 Traffic Engineering (3-0-0)3

**Contact Hours: 39**

**Course Learning Objectives (CLOs): Traffic Engineering** is taught as one of open elective course for Civil Engineering Program. In this course, students are given exposure to measure various traffic flow parameters, design traffic control

devices, apply statistical methods for transport planning. The delivery of topics will be made through lecture classes and field visits. The evaluation will be carried out through Internal evaluation and Semester End Examination.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs(1-12)/ PSOS (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Apply Engineering science to determine the power performance of the vehicle under various resisting forces. | | | 1,2 |
| CO-2 | Illustrate and apply traffic flow parameters to develop an efficient transport system. | 1,2,3 | | |
| CO-3 | Summarize Traffic Flow theories to understand the traffic pattern. | | | 1,2 |
| CO-4 | Examine the transport system problems and apply statistical methods to overcome. | | 1,2 | |
| CO-5 | Illustrate various traffic regulation and control devices and develop suitable traffic signal system. | 1,3,12 | | |

| **POs/PSOs** | PO-1 | PO-2 | PO-3 | PO-12 |
|---|---|---|---|---|
| **Mapping Level** | 2 | 1.75 | 3 | 3 |

**Prerequisites:**

Students taking this course shall have the knowledge of following:

1) Highway Engineering.

**Contents:**

**Unit-I**

**Introduction:** Definition, Objectives, Scope of Traffic Engineering.

**Road User and Vehicle Characteristics**: Static and Dynamic characteristics, Power performance of vehicles, Resistances to the motion of vehicles, Reaction time of driver, Problems on above **7 Hrs.**

**Unit-II**

**Traffic Parameter Studies and Analysis:** Objectives and Method of study, Definition of study area, Sample size, Data Collection and Analysis Interpretation of following Traffic Studies, Volume, Spot Speed, Origin and Destination, Speed and

Delay, Parking on Street and off Street Parking, Accidents, Causes, Analysis (right angle collision only with parked vehicle), Measures to reduce Accident, Problems. **10 Hrs.**

**Unit-III**

**Traffic Regulation and Control:** Vehicle and Road controls, Traffic Regulations, One Way, Traffic Signs, Traffic signals, Vehicle actuated and synchronized signals, Webster's method of signal Design, IRC Method, Problems. **7 Hrs.**

**Unit-IV**

**Traffic Island:** Traffic Rotary elements and traffic operation, Relevant Problems on above. Traffic markings. **7 Hrs.**

**Unit-V**

**Probability Distribution:** Poisson's Distribution and application to Traffic Engineering, Normal Distribution, Significance tests for observed Traffic Data, Chi square test, Problems on above, Sample size. **8 Hrs.**

**Reference Books:**

1) Khanna S.K. and Justo C E G.,"Highway Engineering", Nemchand and Bros, Roorkee.
2) Kadiyali L.R.,"Traffic Engineering and Transport Planning", Khanna Publishers, New Delhi.
3) Matson,Smith and Hurd., "Traffic Engineering", McGraw Hill and Co.
4) Pignataro, "Traffic Engineering", Prentice Hall.

| 18UMAO675 | Applied Mathematics | (3 - 0 - 0) 3 |
|---|---|---|

**Contact Hours: 39**

**Course Learning Objectives (CLOs):**

The students are expected to learn about mathematical modelling, use of numerical techniques to deal with engineering systems. Further, they need to learn LPP and statistical tools for interpretation. They are also expected to carry out sampling distribution analysis and use of graph theory for engineering problems.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs(1-12)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| **CO-1** | Obtain Mathematical model of Engineering Systems using different domains. | | 1,2 | |
| **CO-2** | Formulate LPP and obtain optimal solutions using different tools. | | 1,2 | |
| **CO-3** | Apply statistical tools to Interpret the data using different tools. | | 1,2 | |
| **CO-4** | Determine Type errors and test for goodness of fit using different methods. | | 1,2 | |
| **CO-5** | Use graph theory to obtain solution for engineering problems. | | 1,2 | |

| **POs** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mapping Level** | 2 | 2 | - | - | - | - | - | - | | - | - | - |

**Pre-requisites:**

A basic course on the concepts of algebra, geometry, calculus, trigonometry and laws of physics, Statistical averages and probability theory.

**Contents:**

**Unit I**

**Introduction to Mathematical Modelling and Numerical Techniques:** Introduction, Modelling technique, classification and characteristics. Mathematical modelling through algebra, geometry, calculus, trigonometry. Mathematical model of engineering system. **8 Hrs.**

**Unit II**

**Linear and Non-Linear programming:** Introduction, Mathematical formulation of a L.P.P, basic solution. Geometric (or graphical) method, Simplex method.Assignment problem. Non Linear Programming – Constrained extremal problems-Lagrange's multiplier method- Kuhn- Tucker conditions and solutions.

**8 Hrs.**

**Unit III**

**Statistical Techniques:** Co-efficient of Variation, Skewness, Karl Pearson's co-efficient of Skewness, Moments, Pearson's Beta and Gamma co-efficient, Kurtosis. Time series and Forecasting. **7 Hrs.**

**Unit IV**

**Sampling distribution:** Introduction, population and samples. Type-I and Type- II errors. Test of hypothesis for means, student's t-distribution, Chi-square Distribution as a test of goodness of fit. **8 Hrs.**

**Unit V**

**Graph Theory**: Definition of a graph theory, incidence and degree, walks, paths, circuits, Connectedness, Eulerian and Hamiltonian graphs, Trees, basic properties of trees, Binary trees, Preorder and post order traversals, Spanning and Minimal spanning trees, Connectivity and Separability, fundamental circuits and cut sets Isomorphism of graphs, Matrix representation of graphs, adjacency and incidence matrix Graph theoretical algorithms: Dijkstra, Prims and Kruskal.

**8 Hrs.**

**Reference Books:**


**1)** B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th edition, 2017.

**2)** E. Kreyszig Advanced Engineering Mathematics John Wiley & Sons, 10th edition, 2016.

**3)** Srimanta Pal et al, Engineering Mathematics, Oxford University Press, 3rd edition, 2016.

**4)** Dougas B. West, Introduction to Graph theory, second edition, PH Learnig Private Limited, 2009.

# Academic Program: UG

## Academic Year 2021-22 Syllabus

# VII & VIII Semester B.E.

# (Civil Engineering)

SHRI DHARMASTHALA MANJUNATHESHWARA COLLEGE OF ENGINEERING & TECHNOLOGY,

DHARWAD – 580 002

**(An Autonomous Institution approved by AICTE & Affiliated to VTU, Belagavi)**

**Ph**: **0836-2447465 Fax: 0836-2464638 Web:** www.sdmcet.ac.in

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## SDM College of Engineering & Technology, Dharwad

It is certified that the scheme and syllabus for VII & VIII semester of UG program in Civil Engineering is recommended by Board of Studies of Civil Engineering Department and approved by the Academic Council, SDM College of Engineering & Technology, Dharwad. This scheme and syllabus will be in force from the academic year 2021-22 till further revision.

Principal

Chairman BoS & HoD

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## SDM College of Engineering & Technology, Dharwad

## Department of Civil Engineering

## Vision and Mission of the Institute

### SDMCET –Vision

To develop competent professionals with human values.

### SDMCET – Mission

- To have contextually relevant Curricula.
- To promote effective Teaching Learning Practices supported by Modern Educational Tools and Techniques.
- To enhance Research Culture.
- To involve the Industrial Expertise for connecting Classroom contents to real-life situations.
- To inculcate Ethics and soft skills leading to overall personality development.

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## DEPARTMENT OF CIVIL ENGINEERING

## VISION AND MISSION

### Vision:

To be the center of excellence providing the state of art civil engineering education developing competent engineers responsible for serving modern society.

### Mission:

The stated vision can be achieved through:

- The development of robust curricula to meet the industrial expectations.
- Interactive teaching-learning process with modern educational tools and soft skills.
- Establishing synergy between teaching and research
- Industry-Institute interaction.

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## Program Educational Objectives (PEOs)

I. **Technical adeptness**: The Civil Engineering Graduates will be technically adept to specific fields and other disciplines. and Management towards Planning, Design, and Costing. Their technical skills and knowledge will enable them to perform their work with a commitment and quality, timeliness with continuous improvement.

II. **Interpersonal Skills**: Civil Engineering Graduates will exhibit effective interpersonal skills in teams and at workplace.

III. **Awareness of Social impact:** Graduates will be made aware of causes of impacts due to the development and to identify remedial measures if necessary.

IV. **Professionalism:** Understanding of professionalism, ethics, quality performance, sustainability and allow them to be professional leaders and contributors to society through their problem-solving capabilities and executing the work.

V. **Continuous Learning:** Civil Engineering Graduates will exhibit interest in lifelong learning including studies leading to professional licensure or higher studies in engineering that provides for continued development of their technical ability and management skills

## PROGRAM OUTCOMES (POs)

**Engineering Graduates will be able to:**

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PO2. **Problem analysis**: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The Engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principle sand commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. **Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with

the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11.**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply the set one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.

PO12.**Lifelong learning:** Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context to technological change.

## PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO13.**Project inception and design:** Conceptualize projects related to different fields of Civil Engineering, collect relevant data by direct and indirect methods, analyze the project requirement and design the project.

PSO14.**Draft specification**: Select material, prepare estimates/costing, schedule work plans.

PSO15.**Experimentation**: Apply knowledge of different fields of Civil Engineering, conduct experiments, analyze, interpret data, and design the system components.

## VII Semester B. E.

| Course Code | Course Category | Course Title | Teaching | | Examination | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | L-T-P (Hrs/Week) | Credits | CIE | Theory (SEE) | | Practical (SEE) | |
| | | | | | Max. Marks | *Max. Marks | Duration in Hrs. | Max. Marks | Duration In Hrs. |
| 18UCVC700 | PC | Wastewater Engineering | 4 - 0 - 0 | 4 | 50 | 100 | 3 | - | - |
| 18UCVC701 | PC | Design of Steel Structures | 4 - 0 - 0 | 4 | 50 | 100 | 3 | - | - |
| 18UCVE7XX | PE | Program Elective-4 | 3 - 0 - 0 | 3 | 50 | 100 | 3 | - | - |
| 18UCVO7XX | OE | Open Elective 2 | 3 - 0 - 0 | 3 | 50 | 100 | 3 | -- | -- |
| 18UCVL702 | PC | Major Project Phase-1 | 0- 0 -4 | 2 | 50 | -- | -- | 50 | 3 |
| 18UCVL703 | PC | Internship | 4 w e e k s | 2 | 50 | -- | -- | 50 | 3 |
| 18UCVL704 | PC | Environmental Engineering Laboratory | 0 - 0 - 2 | 1 | 50 | -- | -- | 50 | 3 |
| | | **Total** | **14 - 0 - 6** | **19** | **350** | **400** | | **150** | |

PC- Program Core, PE-Program Elective, OE- Open Elective and HU- Humanities,

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## List of Elective Courses

| Course Code | Course Title |
|---|---|
| 18UCVE714 | Advanced design of RC Structures |
| 18UCVE715 | Introduction to Bridge Engineering |
| 18UCVE716 | Structural Dynamics |
| 18UCVE718 | Advanced Foundation Design |
| 18UCVE724 | Construction Contract Management |
| 18UCVE725 | Earthquake resistant structures |
| 18UCVE726 | Construction Equipment and Management |
| 18UCVE727 | Design of Prestressed Concrete Structures |
| 18UCVE728 | Urban Transport Planning |

## List of Open Elective Course

| Course Code | Course Title |
|---|---|
| 18UCVO701 | Introduction to law for Engineers |

**CIE**: Continuous Internal Evaluation **Semester End Examination**: Semester End Examination
**L**: Lecture **T**: Tutorials **P**: Practical
*Semester End Examination for theory courses is conducted for 100 marks and reduced to 50 marks.

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## VIII Semester B. E.

| Course Code | Course Category | Course Title | Teaching | | Examination | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | L-T-P (Hrs/Week) | Credits | CIE | Theory (SEE) | | Practical (SEE) | |
| | | | | | Max. Marks | *Max. Marks | Duration in Hrs. | Max. Marks | Duration In Hrs. |
| 18UCVC800 | PC | Water resources Engineering | 4 - 0 - 0 | 4 | 50 | 100 | 3 | - | - |
| 18UCVE8XX | PE | Program Elective-5 | 3 - 0 - 0 | 3 | 50 | 100 | 3 | - | - |
| 18UCVO8XX | OE | Open Elective 3 | 3 - 0 - 0 | 3 | 50 | 100 | 3 | -- | -- |
| 18UCVL801 | PC | Technical Seminar | 0 - 0 - 2 | 1 | 50 | -- | -- | -- | -- |
| 18UCVL802 | PC | Major Project Phase-2 | 0 - 0 -12 | 7 | 50 | -- | -- | 50 | 3 |
| | **Total** | | **10 – 0 - 14** | **18** | **250** | **300** | **--** | **50** | **--** |

PC- Program Core, PE-Program Elective and OE- Open Elective

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**List of Elective Courses**

| Course Code | Course Title |
|---|---|
| 18UCVE818 | Principles and Practice of Construction Project Management |
| 18UCVE819 | Ground Improvement Techniques |
| 18UCVE825 | Design of Reinforced Concrete Bridges |
| 18UCVE826 | Solid Waste Management |
| 18UCVE827 | Air Pollution Control |
| 18UCVE828 | Advanced Design of Steel Structure |

**List of Open Elective Course**

| Course Code | Course Title |
|---|---|
| 18UCVO801 | Remote Sensing and GIS |

**CIE**: Continuous Internal Evaluation **Semester End Examination**: Semester End Examination
**L**: Lecture **T**: Tutorials **P**: Practical
*Semester End Examination for theory courses is conducted for 100 marks and reduced to 50 marks.

*** Open Elective for VIII Semester**
**18UPHE876 Nanotechnology – All Engineering Branches**

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| 18UCVC700 | Wastewater Engineering | (4-0-0) 4 |
|---|---|---|

**Contact Hours: 52**

**Course Learning Objectives (CLOs):** Wastewater Engineering is taught as a core course in Civil Engineering program. In this course, topics on wastewater, its generation, disposal, quantification and characterization of sewage to design sewers and treat sewage to the required standards, are dealt. The evaluation will be carried out through IAs and Semester End Examination.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs (1-12)/ PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Describe the necessity for sanitation, types of sewerage systems, compute the quantity of sewage. | | 1,6 | |
| CO-2 | Describe sewer appurtenances, design the sewers. | 3 | 2 | 6 |
| CO-3 | Analyze sewage for various parameters, design the pumping system. | | 4 | |
| CO-4 | Describe self-purification, design sewage disposal systems. | 7 | 9 | 12 |
| CO-5 | Analyze various treatment methods for sewage, design various treatment units. | 13 | 4 | 12 |

| **POs/PSOs** | PO-1 | PO-2 | PO-3 | PO-4 | PO-6 | PO-7 | PO-9 | PO-12 | PSO-13 |
|---|---|---|---|---|---|---|---|---|---|
| **Mapping Level** | 2 | 2 | 3 | 2 | 1.5 | 3 | 2 | 1 | 3 |

**Prerequisites:**

Students taking this course shall have the knowledge of following:

1) Water supply Engineering.

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**Contents:**

**Unit-I**

**Introduction** - Necessity for sanitation, methods of sewage disposal, types of sewerage systems and their suitability.

**Quantity of Sewage:** Dry weather flow, factors effecting dry weather flow, flow variations and their effects on design of sewerage system, computation of design flow, estimation of storm flow, time of concentration, rational method and empirical formulae of design of storm water drain. **10 Hrs**

**Unit-II**

**Design of Sewers:** Hydraulic formulae for velocity, self-cleansing and non-scouring velocities, design of hydraulic elements for circular sewers flowing full and for partially full**.**

**Materials of Sewers and Sewer Appurtenances:** Sewer materials, shapes of sewers, laying of sewers, jointing and testing of sewers, ventilation and cleaning of sewers. Catch basins, manholes, flushing tanks, oil and grease traps, drainage traps, basic principles of house drainage, typical layout plan showing house drainage connections, maintenance of house drainage. **10 Hrs**

**Unit-III**

**Analysis of Sewage:** Physical, chemical and biological characteristics, concepts of aerobic and anaerobic activity, CNS cycles, with emphasis on BOD and COD. Sampling, significance, techniques and frequency.

**Sewage Pumping:** Need, types of pumps, design of pumps and pumping stations. **10 Hrs**

**Unit-IV**

**Disposal of Effluents:** By dilution, self-purification, phenomenon, design sewage disposal systems - oxygen sag curve, zones of purification, sewage farming, sewage sickness, disposal standards on land and water, chlorination of sewage. **10 Hrs**

**Unit-V**

**Treatment of Sewage:** Flow diagram of municipal sewage treatment plant**,** primary treatment, screening, grit chambers, skimming tanks, primary sedimentation tanks, designs, secondary treatment: trickling filter, theory and operation, types and designs, activated sludge process, principle and flow diagram, methods of aeration, modifications, F/M ratio, designs of ASP, methods of sludge disposal, sludge drying beds, sludge digestion and filter beds.

**Miscellaneous Treatment Methods:** Septic tanks, oxidation ponds – design. Introduction to RBC, UASB, anaerobic filters. **12 Hrs**



**Reference Books:**

1) Garg S.K., “Wastewater Treatment”, Khanna Publishers, New Delhi,

2) CPHEEO-Manual on Wastewater Treatment, Ministry of Urban Development, New Delhi.
3) E.W. Steel and Terence J. McGee, “Water Supply and Sewage”, Tata McGraw Hill Publications, New Delhi.
4) Ethlers Victor M, Schroeder Edward D and Steel E.W, “Water and Wastewater treatment”, McGraw Hill, New Delhi.
5) Garg S.K, “Sewage Disposal and Air Pollution Engineering”, Khanna Publishers, New Delhi.

## 18UCVC701 Design of Steel Structures (4-0-0)4

**Contact Hours: 52**

**Course Learning Objectives (CLOs):** Design of steel structures is taught as a core course in Civil Engineering program. In this course, topics on steel connections-bolted and welded, tension members, truss ties, lug angles, compression members, struts, columns, built-up column sections, laced columns, battened columns, column splices, slab bases, gusseted bases and beams are dealt, based on limit state method of design. The delivery of topics will be through lecture classes using black board & PPT and site visits. The evaluation will be carried out through IAs and Semester End Examination.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs (1-12)/ PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Define design stresses in structural steel and fasteners as per IS:800-2007 and analyze / design of Bolted connections. | 3,4 | | |
| CO-2 | Analyze / design welded connections and design tension members with bolted or welded end connections. | 3,4 | | |
| CO-3 | Analyze / design simple and built-up compression members and column splices. | 3,4 | | |
| CO-4 | Design lacing and battening systems for built-up columns and column bases. | 3,4 | | |
| CO-5 | Analyze / design laterally supported | 3,4 | | |

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| | | | | |
|---|---|---|---|---|
| | beams subjected to low and high shear by Plastic Analysis method as per IS:800-2007. | | | |

| **POs/PSOs** | PO-3 | PO-4 |
|---|---|---|
| Mapping Level | 3 | 3 |

**Prerequisites:**

Students taking this course shall have the knowledge of following:

1) Strength of Materials
2) Structural Analysis - I
3) Structural Analysis - II

**Contents:**

**Unit-I**

**Introduction:** Advantages and disadvantages of Steel structures, Loads and load combinations, Structural forms, Discussions of design concepts. IS code provisions, Fire resistance and ductility of steel.

**Structural Fasteners:** Bolted connections, HSFG Bolts, Standard notations specifications strength of bolts, Design of bolted connections, Analysis and Design of Bolted bracket connections **10 Hrs**

**Unit-II**

**Welds:** Fillet and Butt welds — Defects, Strength and design of connections, analysis and design of welded brackets- type1 and type2.

**Design of Tension Members:** Axially loaded tension members and their connections, design of lug angles-Comparison, Design of truss ties-Single and Double Angle- and joints **12 Hrs**

**Unit-III**

**Design of Compression Members:** Effective length, Radius of gyration, Design Compressive Stress, Single and Double Angle struts, I-Section Columns, Built-up Columns, I-Sections with Cover Plates on Flanges.

**Column splicing:** Type-1 and Type-2 **10 Hrs**

**Unit-IV**

**Double Channel Built-up Column**: Back to Back and Toe to Toe- Laced and Battened systems,

**Steel Foundations:** Column bases-simple slab-base, gusseted base **10 Hrs**

**Unit-V**

**Design of beams:** Plastic Analysis, Plastic Section Modulus, Low Shear and High Shear Beams

**Design of Laterally supported beams**: Low and High shear Beams, Built-up Beams **10 Hrs**

**Reference Books:**

1) N Subramanian, “Steel Structures: Design and practice”, Oxford Publishers.
2) Bhavikatti S.S., “Design of Steel Structures”, I.K. Publishers.
3) IS 800: 2007, “Code of construction – Steel Structures”, BIS.
4) Pramod K.V., “Steel Data Handbook”, I.K. International, New Delhi.

| 18UCVL702 | Major Project Phase – I | (0-0-4) 2 |
|---|---|---|

**Contact Hours: 52**

**Course Learning Objective (CLOs): Major Project phase-I** is carried out under the guidance of a faculty. In this course, the students will finalize the project title, collect the data required by indirect and direct methods and carry out literature review and formulate the methodology.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs (1-12)/ PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Identify and define the project. | 13 | 1 | 9,12 |
| CO-2 | Collect data by direct and indirect methods. | 2 | 13 | 9,12 |
| CO-3 | Carry out literature survey. | 1 | | 9,12 |
| CO-4 | Formulate the methodology. | 2 | 2 | 9,12 |
| CO-5 | Conduct required experiment. Interpret the test data/ results, draw conclusions. | | 15 | 9,12 |

| **POs/PSOs** | PO-1 | PO-2 | PO-9 | PO-12 | PO-13 | PO-15 |
|---|---|---|---|---|---|---|
| **Mapping Level** | 2.5 | 2.66 | 1 | 1 | 2.5 | 2 |

| 18UCVL703 | Internship | (0-0-4) 2 |
|---|---|---|

**Duration: 4 Weeks**

**Course Learning Objective (CLOs):** Internship is carried out in a construction company/ organization/ Civil Engineering Department of State or Central Governments with well-defined scope and objectives. Students during their vacation at the end of their VI semester, will approach a construction company/

organization/ industry/ Relevant Government Departments/ PSUs and will undergo internship. During this process, they finalize the objectives, scope, formulate methodology, collect the required data, interpret the data/ results, draw conclusions and suggest strategies under the guidance of a supervisor/ representative of the industry. They present the study in the form of an Internship report under guidance of the faculty member during their VII semester.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs (1-12)/ PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Identify and define the problem. | 13 | 1 | 9,12 |
| CO-2 | Will collect data by direct and indirect methods. | 2 | 13 | 9,12 |
| CO-3 | Collect required literature survey and organize them. | 1 | | 9,12 |
| CO-4 | Formulate the methodology | 2 | 2 | 9,12 |
| CO-5 | Conduct required experiment. | | 15 | 9,12 |
| CO-6 | Interpret the data/ results, draw conclusions and suggest strategies. | 15 | 5 | 9,12 |

| **POs/PSOs** | PO-1 | PO-2 | PO-9 | PO-12 | PO-13 | PO-15 |
|---|---|---|---|---|---|---|
| **Mapping Level** | 2.5 | 2.66 | 1 | 1 | 2.5 | 2.5 |

## 18UCVL704 Environmental Engineering Laboratory (0-0-3)1.5

**Contact Hours: 36**

**Course Learning Objective (CLOs):** The course deals with testing and characterization of water and wastewater parameters learnt in the core environmental subjects. The usage of trimetric and instrumental methods is dealt with. The delivery of topics will be made through instruction classes, demonstration and Laboratory work.

**Course Outcomes (COs):**

| **ID** | **Description of the Course Outcome:** At the end of the course the student will be able to: | **Mapping to POs (1-12)/ PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |

| | | | | |
|---|---|---|---|---|
| CO-1 | Determine the potability of water and interpret the results as per IS standards. | 15 | 7 | 9 |
| CO-2 | Determine the level of pollution in water & wastewater and interpret the results for different uses. | 15 | 7 | 9 |

| POs/PSOs | PO-7 | PO-9 | PO-15 |
|---|---|---|---|
| Mapping Level | 2 | 1 | 3 |

Mapping level: 1 = Low, 2=Moderate, 3=Substantial

**Prerequisites:**

Students taking this course shall have the knowledge of following:

1) Engineering Chemistry.
2) Water supply engineering.

**Course contents:**

1. Determination of solids in sewage: Total, suspended, dissolved, volatile, fixed, settleable.
2. Determination of turbidity: By Jackson, Nephelo, Aplab turbidity meters.
3. Determination of electrical conductivity, Chlorides and Sulphates.
4. Determination of Alkalinity, Acidity and pH.
5. Determination of calcium, magnesium and total hardness.
6. Determination of Dissolved Oxygen and BOD.
7. Determination of COD.
8. Determination of percentage of available chlorine in bleaching powder, Residual Chlorine and Chlorine Demand.
9. Jar Test for Optimum Dosage of Alum.
10. Determination of Iron.
11. Determination of Fluorides and Nitrates.
12. Total Count Test & Determination of MPN.

**Reference Books/Manuals/ IS Codes:**

1) IS: 10500- 2012.
2) “Standard Methods for Examination of Water and Wastewater”, APHA, AWWA, WPCF.
3) “Manual of Water & Wastewater Analysis”, NEERI Publication.
4) Sawyer and Mc Carty, “Chemistry for Environment Engineering and Science”, McGraw Hill.

| 18UCVE714 | Advanced Design of RC Structures | (3-0-0) 3 |
|---|---|---|

**Contact Hours: 39**

**Course Learning Objectives (CLOs):** Advanced design of RC structure is taught as one of the elective courses in Civil Engineering program. In this course, design and drawing of simple portal frame, circular and rectangular water tank, cantilever and counter fort retaining wall and raft and strap beam footings are dealt along with detailed drawings of structural components. The delivery of topics will be made through lecture classes. The evaluation will be carried out through IAs and Semester End Examination.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs (1-12)/ PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Design Portal frame, water tank, retaining wall and foundations. | | 2,13 | 1 |
| CO-2 | Prepare the structural drawings of Portal frame, water tank, retaining wall and foundations. | | 2,13 | 1 |
| CO-3 | Prepare the structural drawings for staircase, continuous beam, column footing, slab systems, prepare layout drawings for the components of the structure. | | 2,13 | 1 |

| POs/PSOs | PO-1 | PO-2 | PSO-13 |
|---|---|---|---|
| Mapping Level | 1 | 2 | 2 |

**Prerequisites:**

1) Design of RC structural elements
2) Structural Analysis

**Contents:**

**Unit-I**

**Portal frames:** Design and Drawing of the portal frames (single bay, single storey). **7 Hrs**

**Unit-II**

**Water tank:** Design and Drawing of the water tanks (circular and rectangular resting on the ground) as per IS code method. **8 Hrs**

**Unit-III**

**Retaining wall:** Design and Drawing of the cantilever and counterfort retaining walls. **8 Hrs**

**Unit-IV**

**Foundation:** Design and Drawing of the combined, raft and strap beam footing. **8Hrs**

**Unit-V**

**Detailing:** Prepare detailed drawings of staircases, beam and slab systems, column footing and layout drawing for a structure. **8 Hrs**

**Question paper pattern:**

Part A – 2 Questions of 60 marks each are to be set from Unit I to unit IV out of which anyone is to be answered.

Part B – 3 Questions of 20 marks each are to be set from Unit V out of which any two are to be answered.

**Reference Books:**


1) Krishnamurthy, “Structural Design and Drawing (Concrete Structures)”, CBS, Publications New Delhi.
2) Krishnaraju N., “Design of RCC Structures”, CBS publishers, New Delhi.
3) Punmia B.C., “Reinforced Concrete Structures”, Vol 1 & 2, Laxmi Publication Pvt Ltd
4) Krishnaraju N., “Structural Design and Drawing”, University press, Hyderabad.
5) IS Codes: SP-34, SP-16, IS 456: 2000, IS 3370: 2009 and IS: 875 :1987 Part I to V.


| 18UCVE715 | Introduction to Bridge Engineering | (3-0-0)3 |
|---|---|---|

**Contact Hours: 39**

**Course Learning Objectives (CLOs):** Introduction to Bridge Engineering is taught as one of the elective courses in Civil Engineering program. In this course, basics of reinforced concrete, PSC and steel bridges, linear waterway, scour, afflux, loadings on highway and railway bridges, stability of abutments and piers, types of bearings, types of foundations and concepts of load distributions in bridges are dealt. The delivery of topics will be made through lecture classes. The evaluation will be carried out through IAs and Semester End Examination.

**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | Mapping to POs (1-12)/ PSOs (13-15) | | |
|---|---|---|---|
| | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |

| | | | | |
|---|---|---|---|---|
| CO-1 | Summarize and appreciate basic concepts in selection of type of bridge for a given geography, functions of components of bridges. | 1, 2 | | |
| CO-2 | Plan and design linear waterway, economic span for a bridge, | 1, 2 | 3 | |
| CO-3 | Define standard loadings and identify loads on bridges. Define and distinguish different types of bridge bearings. | 1, 2 | | |
| CO-4 | Select suitable foundation, analyze abutments/piers, | 1, 2,3 | | |
| CO-5 | Select type of wing wall, design pipe culverts. | 3 | | |

| POs/PSOs | PO-1 | PO-2 | PO-3 |
|---|---|---|---|
| Mapping Level | 3 | 3 | 2.67 |

**Prerequisites:**

Students taking this course shall have the knowledge of following:

1) Design of RC Structures
2) Design of Steel Structures
3) Hydrology & Water Resource Engineering

**Contents:**

**Unit-I**

**Introduction:** Components of Bridges, classification of bridges, masonry, arches, RCC, PSC, Steel and composite, brief description of different types and proportionate sketching, preliminary design principles. **8 Hrs.**

**Unit-II**

**Investigation:** Site selection criteria, collection of design data, road, stream, surrounding area, etc.

**Preliminary Calculations (Equations only):** Linear waterway, afflux, economic span, scour depth, determination of flood discharge. **8 Hrs.**

**Unit-III**

**Standard Loadings:** IRC and Railway loadings, equivalent loadings for preliminary design.

**Bearings:** Metallic, Concrete and Elastomeric bearings - types & sketches. **8 Hrs.**

**Unit-IV**

**Foundations:** Depth of foundation - Scour effect, types of foundation, Pile, Raft, Well, Caisson - sketches and brief description, Cofferdams.

**Substructure:** Abutments, piers, forces acting on them, stability consideration. **8 Hrs.**

**Unit-V**

**Wing walls**: Types (sketches), Splay, Batter, Returns.

**Design of Pipe Culvert:** Design with final detailed sketch. **7 Hrs.**

**Reference Books:**

1) Victor D.J. and Johnson, "Essentials of Bridge Engineering", Oxford and IBH.
2) Bindra S.P., "Bridge Engineering", Dhanpat Rai Publications.

**18UCVE716 Structural Dynamics (3-0-0) 3**

**Contact Hours:39**

**Course Learning Objectives (CLOs):** Structural Dynamics is taught as one of the elective courses for civil engineering program. In this course, mathematical model for single degree, multi degree of freedom systems for un-damped, damped forced and free vibrations are dealt. The delivery of topics will be made through lecture classes. The evaluation will be carried out through IA tests and Semester End Examination.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs(1-12)/ PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Explain D-Alembert's principle, SDOFS for free vibration of damped un-damped systems. | 1,2 | 3 | |
| CO-2 | Explain Harmonic loading case and vibration isolation system for SDOFS. | 1,2 | 3 | |
| CO-3 | Analyze the Multi storey shear building under free and forced vibration for damped and un-damped conditions. | 1,2 | 3 | |
| CO-4 | Explain the effect of impulse load using Duhamel's Integral. | 1,2 | 3 | |
| CO-5 | Apply the knowledge of Fourier series in structural dynamics. | 1,2 | 3 | |

| POs/PSOs | PO-1 | PO-2 | PO-3 |
|---|---|---|---|
| Mapping Level | 3 | 3 | 2 |

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**Prerequisites:**

Students taking this course shall have the knowledge of following:

1) Engineering Mechanics
2) Structural Analysis – I
3) Structural Analysis – II

**Contents:**

**Unit-I**

**Single Degree of Freedom System:** Degrees of freedom, un-damped system, springs in parallel and series. Newton's laws of motion, free body diagrams. D'Alembert's principle, solution of the differential equation of motion, frequency and period, amplitude of motion. Damped Single degree of freedom system – viscous damping, equation of motion, damped system - critically, over, under and logarithmic decrement. **8 Hrs**

**Unit-II**

**Harmonic Loading:** Response of single degree of freedom system to harmonic loading – un-damped harmonic excitation, damped harmonic excitation, evaluation of damping at resonance, bandwidth method (Half power) to evaluate damping, response to support motion, force transmitted to the foundation, seismic instruments, generalized single degree of freedom system (rigid body and distributed elasticity). **8 Hrs**

**Unit-III**

**Multi Degree of Freedom System:** Introduction, Generalized Co-ordinates and Rayleigh's method, Multistory Shear Building, free vibration – natural frequencies and normal modes, zero modes of vibration, forced vibration – modal superposition method, response of a shear building to base motion. Damped motion of shear building – equations of motions, Introduction to dampers and its types. **8 Hrs**

**Unit-IV**

**Impulse load using Duhamel's integral:** Response to general dynamic loading, Impulsive loading and Duhamel's integral, numerical evaluation of Duhamel's integral, un-damped system, numerical evaluation of Duhamel's integral. **7 Hrs**

**Unit-V**

**Application of Fourier series:** Fourier analysis and response in frequency domain – Fourier analysis, Fourier co-efficient for piece-wise linear functions, exponential form of Fourier series, discrete Fourier analysis, fast Fourier transforms. **8 Hrs**

**Reference Books:**


**1)** Mario Paz, "Structural dynamics: Theory and Computation", CBS Publisher and Distributors, New Delhi.

**2)** Clough and Penzien, "Dynamics of Structures", McGraw-Hill, New Delhi.

**3)** Mukhopadhyay, "Vibration, Dynamics and Structural problems", Oxford IBH Publishers, New Delhi.


## 18UCVE718 Advanced Foundation Design (3-0-0)3

**Contact Hours: 39**

**Course Learning Objective (CLOs):** Advanced Foundation Design is taught as one of the elective courses for Civil Engineering program. In this course, design of shallow foundations, deep foundations such as piles, piers, caissons, well foundations and the effect of dynamic loads on foundations are dealt. The delivery of the topics is achieved through lecture classes. The evaluation will be carried out through IAs and Semester End Exam.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs (1-12)/ PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Explain bearing capacity and factors affecting it; calculate the dimensions of shallow foundations based on bearing capacity. | | 1,2 | 3 |
| CO-2 | Explain necessity and classification of piles, negative skin friction, calculate load bearing capacity, efficiency and settlement of single pile and pile group, explain pile load test, under reamed piles. | | 1,2 | 3 |
| CO-3 | Explain drilled piers, construction, design aspects of caissons, explain shapes, characteristics, components, sinking of wells, causes and remedies of tilts and shifts. | | 1,2 | 3 |
| CO-4 | Explain the expansive soils, identification methods, construction | | 1,2 | |

| | | | | |
|---|---|---|---|---|
| | and treatment of foundations. | | | |
| CO-5 | Explain design aspects of foundations for special structures such as antenna/ transmission line towers/ tall chimneys. | | 1,2 | 3 |

| POs/PSOs | PO-1 | PO-2 | PO-3 |
|---|---|---|---|
| Mapping Level | 2 | 2 | 1 |

**Prerequisites:**

Students taking this course shall have the knowledge of following:

1) Building Construction.
2) Geotechnical Engineering – I.
3) Geotechnical Engineering – II.

**Contents:**

**Unit-I**

**Shallow foundations**: Presumptive bearing capacity according to BIS, factors affecting bearing capacity and settlement, factors influencing selection of depth of foundation, types of shallow foundations – isolated footing. Combined footing, strap footing, strip footing and raft. **8Hrs**

**Unit-II**

**Pile foundations**: Necessity, classification, load bearing capacity by static and dynamic formula, pile load and penetration tests, pile groups – group capacity of piles in sand and clay, group efficiency of piles, settlement of piles, negative skin friction, under-reamed piles. **9Hrs**

**Unit-III**

**Drilled piers and caissons**: Introduction, construction, advantages and disadvantages of drilled piers. Design of open, pneumatic and floating caissons. Advantages and disadvantages of floating caissons.

**Well foundation**: Different shapes and characteristics of wells. Components of well foundation. Forces acting on well foundation. Sinking of wells. Causes and remedies of tilts and shifts. **7Hrs**

**Unit-IV**

**Foundations in expansive soils**: Definition, Identification, index properties, swell potential, swell pressure, free swell, CNS layer, foundation treatment for structures. **8Hrs**

**Unit-V**

**Design of special foundation:** Design aspects of foundation for antenna and transmission line towers, tall chimneys. **7Hrs**

**Reference Books:**

1) Murthy V.N.S., "Soil Mechanics & Foundation Engineering", CBS Publishers.
2) Bowles J.E., "Foundation Analysis and Design", McGraw Hill Pub. Co., New York.
3) Purushotham Raj P, ""Soil Mechanics & Foundation Engineering", Pearson Education Ltd Publishers.
4) Venkataramaiah C., "Geotechnical Engineering", New Age Publications, Delhi.

| 18UCVE724 | Construction Contract Management | (3-0-0)3 |
|---|---|---|

**Contact Hours: 39**

**Course Learning Objective (CLOs):** Construction Contract Management is taught as one of the elective courses in Civil Engineering program. In this course, silent features of Indian Contract Act, general conditions of contract for domestic and international works, aspects related to contract administration and laws applicable to construction industry, dispute resolution techniques are dealt. The delivering of topics will be made through lecture classes. The evaluation will be carried out through IAs and Semester End Exam.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs (1-12)/ PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Understand Indian legal system and how it affects construction industry, Indian Contracts Act and its application to construction industry. | 6 | | |
| CO-2 | Explain features of contract, essentials of a valid contract, general conditions of contract, domestic, international contracts and their comparative study. | 6 | | |
| CO-3 | Explain various aspects related to administration of contract. | 8 | | |
| CO-4 | Explain various laws applicable to Indian Construction industry. | 6 | | |
| CO-5 | Evaluate various dispute resolution techniques and evolve strategies for dispute minimization. | 8 | 4 | 9 |

| POs/PSOs | PO-4 | PO-6 | PO-8 | PO-9 |
|---|---|---|---|---|
| Mapping Level | 2 | 3 | 3 | 1 |

**Prerequisites:**

Students taking this course shall have the knowledge of following:

1) Building Construction.
2) Quantity Surveying and Estimation.

**Course Content:**

**UNIT I**

**Introduction to legal system:** Introduction and controls it exerts on the activities of engineers and managers in practice.

**Indian Contract Act 1872:** Salient features of Act and its applicability to construction industry. **8 Hrs**

**UNIT II**

**Contracts:** Definitions, salient features of a contract, essentials for a legally valid contract, documents for an engineering contract.

**General conditions of contract:** Domestic - CPWD and International Contract – FIDIC; Special conditions of contract; Comparative study of contract conditions. **8 Hrs.**

**UNIT III**

**Contract Administration:** Performance / Discharging of a contract, Obligations of Employer and contractor, Breach of contract - Definition and Classification, Common Breaches by – Employer, Contractor.

Delay and extension of time, extras, variation in quantity, price escalation. Construction claims and their management: Claims for Damages and liquidated damages; Quantum Meruit, Force Majeure. **8 Hrs.**

**UNIT IV**

**Laws applicable to construction activity:** Need and broad provisions of following Acts including important case laws.

The Building and Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996; Industrial Disputes Act, 1947; Workmen's Compensation Act, 1952; Employers' Liability Act, 2008; Payment of Wages Act, 1936; The Employees Provident Fund, 1952; Contract Labor (Regulation and Abolition) Act, 1970; Minimum Wages Act, 1948; Interstate Migrant Workmen (Regulation of Employment and Conditions of Service) Act, 1979. **8Hrs**.

**UNIT V**

**Disputes and Resolution Techniques:** Methods for dispute resolution − Negotiations, Mediation, Conciliation, Dispute Resolution Boards, Arbitration,

Arbitration and Conciliation Act 1996: Act of 1996 and Arbitration Case Studies. Litigation / Adjudication by courts, Approach to dispute minimization. **7 Hrs**.

**Reference Books:**


**1)** Markanda P. C., "Building and Engineering Contracts, Vol 2", LexisNexis, Butterworths, Wadhwa, Nagpur.
**2)** Kishor Gajria, "G.T. Gajria's Laws relating to Buildings and Engineering Contracts in India", LexisNexis.
**3)** Jimmie Hinze, "Construction Contracts", McGraw Hill.
**4)** Joseph T. Bockrath, "Contracts and the Legal Environment for Engineers and Architects", McGraw Hill.
**5)** Anupam Kurlwal, "An Introduction to Alternative Dispute Resolution System (ADR)", Central Law Publications, Allahabad.
**6)** Government of India, "CPWD Works Manual 2014".
**7)** General Conditions of Contract, Central Public Works Department 2014, New Delhi.
**8)** "Conditions of Contract for Construction for Building and Engineering Woks Designed by the Employer", FIDIC, 1999.
**9)** Bare Acts: Indian Contract Act, Arbitration Act and other relevant Acts.


| **18UCVE725** | **Earthquake Resistant structures** | **(3-0-0) 3** |
|---|---|---|

**Contact Hours: 39**

**Course Learning Objectives (CLOs):** Earthquake Resistant Structures is taught as one of elective courses for Civil Engineering Program. In this course, topics on Seismic hazard assessment; Earthquake effects on structures, Concepts of earthquake resistant design of masonry and earthen buildings are dealt. The delivery of topics will be made through lecture classes. The evaluation will be carried out through IAs & SEE.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs (1-12)/ PSOS (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Discuss Engineering seismology, seismic instruments, Structural behavior under seismic load, dampers and base isolation techniques. | | 6 | |
| CO-2 | Discuss characteristics of earthquake force by response | 2,3 | | |

| | | | | |
|---|---|---|---|---|
| | spectrum, tripartite plot, calculate seismic forces using standard procedures. | | | |
| CO-3 | Discuss structural configuration and concepts for earthquake resistant masonry buildings as per codal provisions. | 2,3 | | |
| CO-4 | Design reinforced concrete buildings. | 2,3 | | |
| CO-5 | Carry out seismic evaluation and select appropriate retrofitting method. | | 6 | |

| POs/PSOs | PO-2 | PO-3 | PO-6 |
|---|---|---|---|
| Mapping Level | 3 | 3 | 2 |

**Prerequisites:**
Design of RC structural Elements

**Contents:**

**Unit-I**

**Seismic Hazard assessment:** Introduction to engineering seismology, Geological and tectonic features of India, Origin and propagation of seismic waves, characteristics of earthquake and its quantification – Magnitude and Intensity scales, seismic instruments. Earthquake Hazards in India, Earthquake Risk Evaluation and Mitigation. Structural behavior under gravity and seismic loads, Lateral load resisting structural systems, Requirements of efficient earthquake resistant structural system, damping devises, base isolation systems. **10 Hrs**

**Unit-II**

**Earthquake effects on structure:** The Response history and strong motion characteristics. Response Spectrum – elastic and inelastic response spectra, tripartite (D-V-A) response spectrum, use of response spectrum in earthquake resistant design. Computation of seismic forces in multi-storied buildings – using procedures (Equivalent lateral force and dynamic analysis) as per IS1893. **8 Hrs**

**Unit-III**

**Concepts of earthquake resistant design:** Structural Configuration for earthquake resistant design, Concept of plan irregularities and vertical irregularities, Soft storey, Torsion in buildings. Design provisions for these in IS-1893. Effect of infill masonry walls on frames, modeling concepts of infill masonry

walls. Behavior of masonry buildings during earthquakes, failure patterns, strength of masonry in shear and flexure, Slenderness concept of masonry walls, concepts for earthquake resistant masonry buildings – codal provision. **7 Hrs**

**Unit-IV**

**Design of earthquake resistant RC structures:** Design of Reinforced concrete buildings for earthquake resistance-Load combinations, Ductility and energy absorption in buildings. Confinement of concrete for ductility, design of columns and beams for ductility, ductile detailing provisions as per IS-1893. Structural behavior, design and ductile detailing of shear walls. **8Hrs**

**Unit-V**

**Seismic response control**: Seismic demand, seismic capacity, Overview of linear and nonlinear procedures of seismic analysis. Performance Based Seismic Engineering methodology, Seismic evaluation and retrofitting of structures. **6 Hrs**

**Reference Books:**

1) Chopra A.K., “Dynamics of structures”, Prentice-Hall of India Pvt. Ltd., New Delhi.
2) Clough R.W. and Penzien J., “Dynamics of Structures”, McGraw Hill Book Co. New York.
3) Biggs M., “An Introduction to Structural Dynamics”, McGraw Hill Book Co., New York.
4) IS 1893 (Part 1): 2002, “Criteria for Earthquake resistant design of structures”.
5) IS13920:2016, “Ductile design and detailing of reinforced concrete structures subjected to seismic forces – code of practice”.

## 18UCVE726 Construction Equipment and Management (3-0-0)3

**Contact Hours: 39**

**Course Learning Objectives (CLOs):** Construction, Equipment and Management is taught as one of the elective courses in Civil Engineering program. In this course, topics on construction industry and management, construction planning, construction equipment and construction safety are dealt. The delivery of topics will be made through lecture classes and site visits. The evaluation will be carried out through IAs and Semester End Exam.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | **Mapping to POs (1-12)/ PSOS (13-15)** | | |
|---|---|---|---|
| | **Substantial** | **Moderate** | **Slight** |

| | | Level (3) | Level (2) | Level (1) |
|---|---|---|---|---|
| CO-1 | Explain importance of construction industry, various aspects of material, labor, financial management. | 1,8,11 | 10 | 12 |
| CO-2 | Prepare project schedule using PERT and CPM. | 2 | 4 | 5 |
| CO-3 | Explain project costs resource management. | 2 | 6 | |
| CO-4 | Explain construction equipment and their suitability for different works. | | 6 | 10,11 |
| CO-5 | Explain causes of accidents, safety measures and methods of improvements of safety at site. | 6 | 8 | 12 |

| POs/PSOs | PO-1 | PO-2 | PO-4 | PO-5 | PO-6 | PO-8 | PO-10 | PO-11 | PO-12 |
|---|---|---|---|---|---|---|---|---|---|
| Mapping Level | 3 | 3 | 2 | 1 | 2.33 | 2.5 | 1.5 | 2 | 1 |

**Contents:**

**Unit-I**

**Construction industry:** Introduction to construction industry, labor, material, time and financial management. **8 Hrs**

**Unit-II**

**Construction planning:** Introduction, Project planning methods, Bar and Milestone chart.

**Network Analysis:** Introduction to PERT and CPM. Numerical problems. **8 Hrs**

**Unit-III**

**Project Cost:** Cost model, direct, indirect and optimum costs, optimum duration and numerical problems.

**Resource Management:** Introduction, types of resources, resource allocation, updating and line of balance technique. **8 Hrs**

**Unit-IV**

**Introduction to Equipment:** Types of equipment, factors for selection of equipment, efficiency, output and maintenance of equipment.

**Construction Equipment:** Earth moving equipment, concrete mixer and plants, highway construction equipment, hoisting equipment, conveyors and rollers, trenching machines. **8 Hrs**

**Unit-V**

**Construction safety:** Introduction, causes of accidents, common hazards, occupational health & hygiene, risks to health at work, general safety precautions.

**Improvement in Safety:** Approaches to improve construction safety, organizational approval, physical approach, behavioral and economic incentive approach, safety measures for fire and noise. **7 Hrs**

**Reference Books:**


1) Seetharaman S., "Construction Engineering and Management", Umesh publication, Delhi.
2) Peurifoy R.L., Ledbetter W.B., Schexnayder C., "Construction Planning, Equipment and Methods", Tata McGraw Hill, New Delhi.
3) Sharma S.C., "Construction Equipment and Management", Khanna Publishers, New Delhi.
4) Deodhar S.V., "Construction Equipment and Job Planning", Khanna Publishers, New Delhi.
5) SP 7:2005, "National Building Code of India", Bureau of Indian Standards, New Delhi.
6) SP 70:2001, "Handbook on Construction safety Practices", Bureau of Indian Standards, New Delhi.
7) S.S. Chitkara, "Construction project management: Planning, scheduling and controlling", McGraw Higher Ed.


## 18UCVE727 Design of Prestressed Concrete Structures (3-0-0) 3

**Contact Hours: 39**

**Course Learning Objectives (CLOs):** Design of Prestressed Concrete Structures is taught as one of elective courses in Civil Engineering program. In this course, basic material properties, fundamental principles of prestressing, analysis and design of flexural members, loss of prestress, design of end-blocks and design of composite sections are dealt. The delivery of topics will be made through lecture classes. The evaluation will be carried out through IAs and SEE.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs (1-12)/ PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Explain basic properties of | 1 | 13 | |

| | | | | |
|---|---|---|---|---|
| | prestressed concrete constituents and analyze different methods. | | | |
| CO-2 | Evaluate short term and long-term losses and deflections in prestressing structures. | 2 | | |
| CO-3 | Analyze sections for shear and flexure. | 3,8 | | |
| CO-4 | Analyze stresses in anchorage zones, composite beams and design the end blocks as per relevant I.S. codes. | 2,8 | | |
| CO-5 | Design different types of prestressed concrete beams. | 3,8 | | |

| POs/PSOs | PO-1 | PO-2 | PO-3 | PO-8 | PO-13 |
|---|---|---|---|---|---|
| Mapping Level | 3 | 3 | 3 | 3 | 2 |

**Prerequisites:**

1) Strength of Materials
2) Engineering Mechanics
3) Design of RC structural elements

**Contents:**

**Unit-I**

**Materials:** High strength concrete and steel, Stress-Strain characteristics and properties

**Basic principles of pre-stressing:** Fundamentals, Pre-tensioning and post-tensioning systems, tensioning methods and end anchorages Load balancing concept, Stress concept, Strength concept, P Line.

**Analysis of sections for flexure:** Stresses in concrete due to pre-stress and loads, stresses in steel due to loads, Cable profiles. **9Hrs**

**Unit-II**

**Losses of pre-stress:** Various losses encountered in pre-tensioning and post tensioning methods, determination of jacking force.

**Deflections:** Prediction of short term and long-term deflections of un-cracked members **10 Hrs**

**Unit-III**

**Limit state of collapse and serviceability:** IS Code recommendations – Ultimate flexural and shear resistance of sections, shear reinforcement. Limit state of

serviceability, control of deflections and cracking. Type of members and flexural tensile stress.

**Flexural strength of PSC section:** Estimate flexural strength of section using IS code method. **7 Hrs**

**Unit-IV**

**Design of end blocks:** Transmission of prestress in pretensioned members, transmission length, anchorage stress in post-tensioned members. Bearing stress and bearing tensile force-stresses in end blocks-Methods, IS Code, provision for the design of end block reinforcement, design of bearing plates.

**Analysis of composite PSC beams:** Propped and un-propped beams. **7 Hrs**

**Unit-V**

**Design of beams:** Design of pre-tensioned and post-tensioned symmetrical and asymmetrical sections. Permissible stress, design of pre-stressing force and eccentricity, limiting zone of pre-stressing force cable profile. **6 Hrs**

**Reference Books:**

1) Krishna Raju N., “Prestressed Concrete”, Tata McGraw.
2) Ned H Burns and T.Y. Lin, “Prestressed Concrete Structures”, Wiley India.
3) Vanakudre S.B. & Ashish Yeligar, “Prestressed Concrete Materials, Analysis & Design”, Khanna Publishers, New Delhi.
4) IS 1343: 2012 “Code of Practice for Prestressed Concrete”.

## 18UCVE728 Urban Transport Planning (3-0-0) 3

**Contact Hours: 39**

**Course Learning Objectives (CLOs):** Urban Transport Planning is taught as one of the elective subjects for Civil Engineering program. In this course, system approach to urban transport planning, transport survey, trip generation, trip distribution, modal split, trip assignment is dealt. The delivering of topics will be made through lecture classes. The evaluation will be carried out through IAs and Session End Examination.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs (1-12)/ PSOS (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Discuss System Approach for transport planning process. | | | 1,2 |
| CO-2 | Summarize various surveys for an | 1,2,12 | | |

| | | | | |
|---|---|---|---|---|
| | efficient transit system and develop multiple regression equation to predict trip generation rate. | | | |
| CO-3 | Evaluate trip distribution between internal zonal movements. | | | 1,2 |
| CO-4 | Analyze the trip rate by modal split in the study area. | | 1,2,12 | |
| CO-5 | Examine the trip interchanges in different parts of road network. | | | 1,2,12 |

| POs/PSOs | PO-1 | PO-2 | PO-12 |
|---|---|---|---|
| Mapping Level | 1.6 | 1.6 | 2 |

**Prerequisites:**

Students taking this course shall have the knowledge of following:

1. Traffic Engineering.

**Contents:**

**Unit-I**

**Introduction:** Scope of Urban Transport Planning, Inter dependence of land use and traffic, System approach to Urban Transport Planning.

**Stages in Urban Transport Planning:** Trip Generation-Trip Production-Trip distribution-modal - split-trip assignment, Fratar and Furnace methods **10 Hrs**

**Unit-II**

**Urban Transport Survey:** Definition of study area-zoning-types of surveys-inventory of Transport facilities - expansion of data from sample.

**Trip Generation:** Trip purpose-factors governing trip generation and attraction-category analysis - problems **7 Hrs**

**Unit-III**

**Trip Distribution:** Methods-Growth factor methods-synthetic methods-Fratar Method and Furness method- problems. **7 Hrs**

**Unit-IV**

**Trip Assignment:** Assignment techniques-traffic forecasting, problems

**Modal Split:** factors affecting- characteristics of split- modal split in Urban Transport Planning and Problems. **8 Hrs**

**Unit-V**

**Urban Transport Planning for Small and Medium Cities:** Introduction-difficulties in Transport planning-recent studies.

**Urban transport systems** – Introduction to urban transport systems. **7 Hrs**

**Reference Books:**


1) Kadiyali L. R.," Traffic Engineering and Transport Planning", Khanna Publishers.
2) Black John, "Urban Transport Planning", Croom Helm Ltd., London
3) Flutchinson A G., "Urban and Regional Models in Geography & Planning", John Wiley and Sons, London.
4) Wilson A G., "Entropy in Urban and Regional Modeling", Pion Ltd., London.


| 18UCVO701 | Introduction to Law for Engineers | (3-0-0)3 |
|---|---|---|

**Contact Hours: 39**

**Course Learning Objective (CLOs):** Law for Engineers is taught as one of open elective courses for Engineering Program. In this course, Law of Tort, and important laws pertaining to Business Law, Corporate Law, Banking law and Workplace Law with reference to definition, provisions, applicability, enforcement and remedy are dealt. The delivering of topics will be made through lecture classes. The evaluation will be carried out through IAs & Semester End Examination.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to PO (1-12)/ PSO (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Understand definition, elements, nature, general principles, liability of state, and remedy of Law of Torts including specific torts and its application to consumer protection. | | 6 | 8 |
| CO-2 | Comprehend Indian Contract Act of 1872 with reference to general principles, essentials of a valid contract, performance of contract, breach of contract, contingent and quasi contract.<br>Understand The sale of Goods Act of 1930 with reference to formation of contract of sale, conditions and warrantees, transfer of ownership and delivery of goods, unpaid seller and his rights.<br>Understand the Competition Act of 2002 with reference to definition and meaning, anti-competitive agreements, abuse of dominant | 6 | | 8 |

| | | | | |
|---|---|---|---|---|
| | position, breach, enforcement of law and formation of Competition Commission of India and the Competition Appellate Tribunal. | | | |
| CO-3 | Comprehend The Companies Act of 2013 with reference to corporate personality, promoters, registration and incorporation, MOA, AOA, prospectus, directors, meetings, dividends, shares and debentures, types, procedure for allotment, rights and privileges of shareholders, preventions of oppression and mismanagement, different modes of winding up of companies.<br>Understand the Information Technology act of 2000 – need, objectives and important provisions. | 6 | | 8 |
| CO-4 | Understand definitions, various provisions, applicability and enforcement of The Negotiable Instruments Act of 1881, Banking Regulation Act of 1949, The Securitization and Reconstruction of Financial Assets and Enforcement of Security Interest Act of 2002, Prevention of Money Laundering Act of 2002. | | 6 | 8 |
| CO-5 | Understand definitions, various provisions, applicability and enforcement of Law of Industrial Disputes Act of 1947, The Minimum Wages Act of 1948, The Employees Provident Fund Act of 1952, The Shops and Establishment Act of 1953, The Maternity Benefit Act of 1961, Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act of 2013 and, Introduction to Labour Codes | | | 6,8,9 |

| POs/PSOs | PO-6 | PO-8 | PO-9 |
|---|---|---|---|
| Mapping Level | 2.2 | 1 | 1 |

**Prerequisites:**

Students taking this course shall have the knowledge of following:

1. Constitution of India and Professional Ethics
2. Management, Entrepreneurship and Protection of Intellectual Property

**Contents:**

**Unit I**

**Law of Tort:** Definition, Elements and nature of torts, General Principles of Law of Torts, Liability of State in Tort, Damages as remedy in Tort, Specific torts and its application to consumer protection. **8 Hrs**

**Unit II**

**Business Law: Indian Contract Act of 1872:** General principles the Act (section 1 to 75), essentials of a valid contract, performance of contract, breach of contract, contingent and quasi contract.

**The sale of Goods Act of 1930:** Formation of contract of sale, conditions and warrantees, transfer of ownership and delivery of goods, unpaid seller and his rights.

**The Competition Act of 2002:** Definition and meaning, anti-competitive agreements and abuse of dominant position, breach, enforcement of law, Competition Commission of India and the Competition Appellate Tribunal. **8 Hrs**

**Unit III**

**Corporate Law- The Companies Act of 2013:** Corporate personality and its kinds, promoters, Registration and Incorporation - MOA, AOA, Prospectus, Directors, Meetings, Role of Company Secretary, Dividends, Issue of Shares, types of shares, debentures, procedure for allotment of shares and debentures, share capital, rights and privileges of shareholders, preventions of oppression and mismanagement, different modes of winding up of companies.

**The Information Technology Act of 2000:** Need, Objectives, Application, Important provisions, Offences and penalty under the Act. **8 Hrs**

**Unit IV**

**Banking Law:** The Negotiable Instruments Act of 1881, Banking Regulation Act of 1949, The Securitization and Reconstruction of Financial Assets and Enforcement of Security Interest Act of 2002, Prevention of Money Laundering Act of 2002. **8Hrs**

**Unit V**

**Workplace Law -** Law of Industrial Disputes Act of 1947, The Maternity Benefit Act of 1961, The Minimum Wages Act of 1948, The Employees Provident Fund Act of 1952, The Shops and Establishment Act of 1953, Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act of 2013. Labour

Codes on: Wages, Social Security, Industrial Relations, Occupational Safety, Health and Working Conditions. **7 Hrs**

**Note: If new legislations are enacted in place of existing legislations, the syllabus would include corresponding provisions of such new legislations with effect from the date notified by the institute.**

**Reference Books:**

1. Anirudh Wadhwa, 'Mulla: Indian Contract Act', LexisNexis.
2. J.N. Pandey, 'Law of Torts (With Consumer Protection Act and Motor Vehicles Act)', Central Law Publications, Allahabad.
3. Avtar Singh, 'Company Law', Eastern Book Company, Lucknow.
4. Kondaiah Jonnalagadda, 'Securities Law', LexisNexis.
5. Kandasami K.P, Natarajan S & Parameswaran, 'Banking Law and Practice', S Chand, New Delhi.

Bare Acts on all laws mentioned in the syllabus.

## 8th Semester

| 18UCVC800 | Water Resources Engineering | (4-0-0) 4 |
|---|---|---|

**Contact Hours: 52**

**Course Learning Objective (CLOs): Water Resources Engineering** is taught as one of the core courses in Civil Engineering program. Topics on Irrigation and methods of irrigation system, water requirements of crops, canals, canal works, diversion work, gravity dam, earthen dams and spillways are dealt. The delivery of topics will be made through lecture classes. The evaluation will be carried out through IAs and Semester End Exam.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs (1-12)/ PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Explain Irrigation and Irrigation systems. Calculate the water requirement of crops and to evaluate Duty, Delta and Base Period for the Crop. | | 1,2 | |
| CO-2 | Explain the canal system and canal works such as regulators, canal drops and types of cross drainage works. | | 1 | |
| CO-3 | Understand the Diversion head work and design of impermeable floors. Reservoir planning and yield of catchment | | 1,2 | 3 |
| CO-4 | Analyze safety, modes of failure of gravity Dam. | 3 | 2 | |
| CO-5 | Analyze earthen Dam for safety, modes of failure, understand construction methods of earthen dam and Explain importance of spillway, location of spillway, components of spillway. | 3 | 2 | 1 |

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| POs/PSOs | PO-1 | PO-2 | PO-3 |
|---|---|---|---|
| Mapping Level | 2.33 | 2 | 2.33 |

**Prerequisites:**

Students taking this course shall have the knowledge of following:
1). Hydrology and Water Resource Engineering
2). Hydraulics and Hydraulic Machines

**Course content:**

**Unit I**

**Irrigation and water requirements of crops**: Definition of irrigation, Types of irrigation-surface and lift irrigation, advantages and disadvantages of irrigation, quality standards of irrigation water, Methods of applying water to crops for irrigation. Water requirements of crops, Duty, Delta and Base period of crop, and relation between them. Factors affecting duty of water, crop and crop seasons, Crop rotation, Irrigation efficiencies, Depth and Frequency of irrigation. Consumptive use of crops. **10 Hrs**

**Unit II**

**Canal and canal works:** Definition of gross command area, cultural command area, intensity of irrigation Types of canals, lined and unlined canals, Alignment of canals, time factor, crop factor, Standard sections of canals, Design of canals by Lacey's and Kennedy's theory. Classification and suitability of canal regulators, Canal drop, Canal escape, Types of cross drainage works, Hydraulic principles of cross drainage works. **10 Hrs**

**Unit III**

**Diversion work:** Definition and objectives of diversion head works, Layout of diversion, components and functions of head works, Weir and barrages, Design of impermeable floors - Bligh's and Khosla's theories, Silt control works - silt ejectors and silt excluder. **7 Hrs**

**Reservoir Planning**: Introduction, classification of Reservoirs, Storage zones of a reservoir, Mass curve, fixing capacity of a reservoir, safe yield, problems, density currents, Trap efficiency, life of a reservoir, economic height of a dam, problems. **5 Hrs**

**Unit IV**

**Gravity dams:** Introduction, forces on a gravity dam, stress analysis in gravity dam, Problems, combination of forces for design. Elementary & practical profiles of a gravity dam, stability analysis (without earthquake forces), problems, galleries in gravity dams. **8 Hrs**

**Unit-V**

**Earthen Dams:** Introduction, types of Earth dams, construction methods, Design criteria for Earth dams, causes of failure of earth dams, section of dam,

preliminary design criteria, problems, control of seepage through earth dams, Safety measures. **7 Hrs**

**Spillways:** Essentials of a spillway, spillway components, factors affecting type & design of spillways. Ogee spillway (simple design problems), Energy dissipation below spillways (hydraulic jump- No design). **5 Hrs**

**Reference books:**

1) Modi P.N., "Water Resources and Waterpower Engineering", Standard book house, Delhi.
2) Garg S.K., "Irrigation Engineering and Hydraulic Structures", Khanna publications, New Delhi.
3) Punmia and Lal Pandey, "Irrigation and Waterpower Engineering", Lakshmi publications, New Delhi.
4) Sharma R.K., "Irrigation Engineering and Hydraulics", Oxford & IBH Publishing Co., New Delhi.

| 18UCVL801 | Technical Seminar | (0-0-2) 1 |
|---|---|---|

**Contact Hours:26**

**Course Learning Objective (CLOs):** In this course, students will collect information on current issues being practiced in different fields of Civil Engineering like Structural Engineering, Water Resources, Geotechnical Engineering, Environmental Engineering, Transportation Engineering etc. by referring journals and other online sources leading to a comprehensive study of the topic selected. Students may also visit field for collection of data or any kind of validation the chosen study topic requires. The evaluation will be carried out through presentation and viva-voce.

**Course Outcomes (COs):**

| ID | Description of the Course Outcome:<br><br>At the end of the course the student will be able to: | Mapping to POs (1-12)/ PSOs (13-15) | | |
|---|---|---|---|---|
| | | Substantial<br><br>Level (3) | Moderate<br><br>Level (2) | Slight<br><br>Level (1) |
| CO-1 | Identify a topic relevant to Civil Engineering on recent development/ case studies. | 4 | 1,2,5 | 12 |
| CO-2 | Carry out the literature review. | 4 | 1,2,5 | 12 |
| CO-3 | Compile data by direct and indirect methods. | 9 | 1,2 | 12 |

| | | | | |
|---|---|---|---|---|
| CO-4 | Organize the data and prepare report. | 4,9 | 1,2,5 | 12 |
| CO-5 | Defend the presentation. | 4,9 | 1,2,5 | |

| POs/PSOs | PO-1 | PO-2 | PO-4 | PO-5 | PO-9 | PO-12 |
|---|---|---|---|---|---|---|
| Mapping Level | 2 | 2 | 3 | 2 | 3 | 1 |

**Technical Seminar:** The students are expected to learn how to carry out literature survey to locate the state-of-the-art technology in engineering domain of their interest. They are required to carry out selection of an emerging topic beyond the syllabus relevant to the branch of study, understand the concept, analyze and present effectively for 15-20 minutes followed by 5 minutes of questions and answers before their classmates and faculty. They can also present the technical innovative/novel work carried out in the laboratory. Students are also required to learn the effective communication and modalities of technical interactions.

**18UCVL802 Major Project Phase-II (0-0-12) 7**

**Total Hrs:100**

**Course Learning Objective (CLOs):** Project Phase-II is carried out under the guidance of a faculty. In this course, the students will analyze the data collected, interpret the results, draw conclusions, design project components, evaluate/ assess the project and redesign if necessary, following relevant codes/ standards of practice, if applicable. The evaluation will be carried out through presentation and viva-voce.

**Course Outcomes (COs):**

| ID | Description of the Course Outcome: At the end of the course the student will be able to: | Mapping to POs (1-12)/ PSOs (13-15) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |
| CO-1 | Analyze and interpret the data collected and draw conclusions. | 9,13,14,15 | 3,4 | 8,11,12 |
| CO-2 | Design different components of the project following relevant IS codes if applicable. | 9,13,14,15 | 3,4 | 8,11,12 |
| CO-3 | Evaluate and redesign if required. | 9,13,14,15 | 3,4 | 8,11,12 |
| CO-4 | Prepare project report. | 9,13,14,15 | 3,4 | 11 |
| CO-5 | Defend the presentation. | 4,9 | 1,2,5 | |

| POs/PSOs | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-8 | PO-9 | PO-11 | PO-12 | PO-13 | PO-14 | PO-15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mapping Level | 2 | 2 | 2 | 2.2 | 2 | 1 | 3 | 1 | 1 | 3 | 3 | 3 |

**Major project phase-2** is the continuation from phase –I. The same project team formed for phase –I will continue the work under the guidance of the same faculty member. A committee consisting of minimum 3 faculty members of which guide is a member shall evaluate at the end for CIE. There is a viva voce examination which shall be examined by two examiners one internal and one external to the college appointed by COE based on the suggestions by the respective HoD.

## 18UCVE818 Principles and Practice of Construction Project Management (2-0-2) 3

**Contact Hours:39**

**Course Learning Objectives (CLOs):** Principles and Practice of Construction Project Management is taught as one of the elective courses in Civil Engineering program. In this course, various concepts of construction project management viz. planning, scheduling, resource analysis, optimizing and executing are dealt. Practical training using project management software is imparted. The course is taught through lecture classes and computer laboratory practical. The evaluation will be carried out through IAs & Semester End Examination.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs (1-12)/ PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Explain construction projects, project management techniques, planning and scheduling principles, methods of scheduling. | | | 1,11 |
| CO-2 | Create a network schedule, CPM and PERT Network diagram for a construction project using the defined rules. | | 3,11 | |
| CO-3 | Understand costs and Resources of a construction project and to effect Resource smoothing, leveling and updating of the Project. | | | 11 |

| | | | | |
|---|---|---|---|---|
| CO-4 | Create a project, build a work break down structure, add activities and create relationships. | 3,11 | | |
| CO-5 | Assign resources, analyze schedule dates, resource allocation, execute the project plan and create reports. | 4,9 | | |

| POs/PSOs | PO-1 | PO-3 | PO-4 | PO-9 | PO-11 |
|---|---|---|---|---|---|
| Mapping Level | 1 | 0.83 | 3 | 3 | 1.75 |

**Contents:**

**Unit-I**

**Introduction:** Introduction to Construction Projects and Project Management, Project Phases & Life Cycle of a Project. Introduction to Project management techniques- CPM, PERT and Project Management Software.

**Planning and Scheduling for Construction Projects:** Introduction, Steps involved in Planning, Objectives, Principles and Advantages of Planning, Preparation of construction schedules, Uses and advantages of scheduling, Methods of scheduling – Bar charts, Mile stone charts, Job lay out, Work break down structure, Line of balance technique. **7L hrs**

**Unit-II**

**Project Management through Networks:** Introduction and definition of a network, Objectives, Interrelationship of events, Interrelationship of activities, Types of networks, Assumptions for creating a network schedule, Rules for drawing a network. Fulkerson's rule.

**Program Evaluation and Review Technique (PERT):** Introduction, Time estimates, Earliest expected time, Latest allowable occurrence time, Tabular format and computations, Slack, Critical path, Probability of completion time for a project. **9L hrs**

**Unit-III**

**Critical Path Method (CPM):** Introduction, Difference between CPM and PERT, Earliest and latest event times, Activity time, Float, Criticality and critical activity, Tabular format and computations

**Time:** Cost Relationship and Resource Allocation: Introduction, Direct costs, Indirect costs, Total Project costs, Optimization of cost through network contraction, Resource smoothing and leveling, Project updating. **9L hrs**

**Following chapters under Unit no's - IV & V shall have Laboratory Practical using Project Management software**

**Unit-IV**

**Structuring of the Project:** Create a Project, Describe the Enterprise Project Structure (EPS),Set up and understand the Organizational Breakdown Structure

(OBS), Set up User Preferences, Navigate in the Project window, Modify Project Information, Create a Work Breakdown Structure (WBS) and Multiple levels of WBS hierarchy, Understand Activity types, Describe Activity components, Add activities, Set up Project Parameters, Assign Project Codes, Resource Codes, Activity Codes, Modify activity Information.

**Scheduling and Resource Management of the Project:** View Network logic diagram, Apply activities relationships (Logical connection), Describe Relationship Types, Scheduling, Describe the Forward and Backward Pass, Understand Total Float, Calculate schedule, Assign constraints, Describe and Apply activity level Constraints, Format schedule data, Create layouts, Utilize grouping, sorting and filtering, Understand Resource types, Assign Resource to activities, Analyze and resolve resource over allocation. **7P hrs**

**Unit-V**

**Optimizing and Executing of the Project:** Optimize the Project Plan- Analyze schedule dates, Shorten the Project Plan, Analyze Resources and Cost, Create a Baseline Plan, Assign the baseline to the Project, Display baseline bars in the Gantt chart, Project Execution- Describe methods of applying Progress, Progress Update, Update activity information, Set up Project Thresholds, Level the Project Resources, Project Tracking.

**Reporting:** Reporting- Describe available Reporting Methods, Run a schedule Report, Procurement Report, Project Progress Report, Schedule Comparison Report, Weekly Report, Project Cost Report, Project Closing Report, Client Report. **7P hrs**

**Reference Books:**


1) Chitkara, K.K.," Construction Project Management: Planning, Scheduling and Control", McGraw Hill Publishing Company, New Delhi, 1998.
2) S. Seetharaman, "Construction Engineering and Management", Umesh Publications, Delhi,2005
3) Feigenbaum, L.," Construction Scheduling with Primavera Project Planner", Prentice Hall Inc.
4) Raina V.K., "Construction Management Practices: The inside story", Tata McGraw Hill Publishing Company Ltd. New Delhi 1998.
5) Project Management Software and relevant user manuals.


| 18UCVE819 | Ground Improvement Techniques | (3-0-0)3 |
|---|---|---|

**Contact Hours: 39**

**Course Learning Objective (CLOs):** Ground Improvement Techniques is taught as one of elective courses for Civil Engineering Program. The course refers to the improvements or modifications to the engineering properties of soil or rock that are carried out at the site. Mechanical modification, hydraulic modification,

chemical modification, grouting, geosynthetic material properties and applications and other miscellaneous methods are dealt along with typical field problems and their remedial measures. The delivery of the topics is achieved through lecture classes, problem solving and demonstrations. The evaluation will be carried out through IAs & Semester End Examination.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs (1-12)/ PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Explain the objectives of ground improvement and various methods, liquefaction, compaction mechanics and methods. | 1 | 1,2 | 12 |
| CO-2 | Explain dewatering and methods, pre-compression, vertical drains. | 1 | 2 | 12 |
| CO-3 | Explain methods of chemical stabilization using cement, lime, fly-ash and other chemicals. | | 1 | 7,12 |
| CO-4 | Explain vibration and grouting techniques, procedures and applications. | 1 | | 12 |
| CO-5 | Explain the miscellaneous methods of ground improvement techniques. | | 1 | 12 |

| POs/PSOs | PO-1 | PO-2 | PO-7 | PO-12 |
|---|---|---|---|---|
| Mapping Level | 2.5 | 2 | 1 | 1 |

**Prerequisites:**

Students taking this course shall have the knowledge of following:
1) Geotechnical Engineering – I
2) Geotechnical Engineering - II

**Contents:**

**Unit-I**

**Ground improvement:** Definition, Objectives of soil improvement, classification of ground improvement techniques, factors to be considered in the selection of suitable soil improvement technique.

**Liquefaction:** Potential – Hazardous, poor and favorable ground conditions. Compaction mechanics, field procedures, surface compaction, dynamic compaction, selection of field compaction methods, compaction control. **8Hrs**

**Unit-II**

**Drainage Methods:** Introduction, Seepage, filter requirements, ground water and seepage control, methods of dewatering, design of dewatering system including pipeline, effects of dewatering. Drains and types of drains.

**Pre-compression and Vertical Drains:** Importance, vertical drains, sand drains, drainage of slopes, electro kinetic dewatering, preloading. **8Hrs**

**Unit-III**

**Chemical Stabilization:** Objectives, special effects, and methods, techniques - sandwich technique, admixtures, cement stabilization. Hydration - effect of cement stabilization on permeability, swelling and shrinkage, criteria for cement stabilization, lime stabilization-suitability, process, special effects, criteria for lime stabilization, other chemicals - chlorides, hydroxides, lignin, hydrofluoric acid, fly ash in cement stabilization, properties of chemical components, reactions and effects, bitumen, tar or asphalt in stabilization. **8Hrs**

**Unit - IV**

**Vibration methods:** Introduction, Vibro compaction – blasting, vibratory probe, Vibro displacement – displacement piles, vibro flotation, sand compaction piles, stone columns, heavy tamping.

**Grouting methods**: Introduction, effect of grouting. chemicals and materials used. Types, procedures and applications of grouting. **8Hrs**

**Unit-V**

**Miscellaneous methods:** Soil reinforcement, thermal methods, ground improvement by confinement - crib walls, gabions & mattresses, anchors, rock bolts and soil nailing. **7Hrs**

**Reference Books:**

1) Manfred Hausmann, “Engineering principles of ground modification”, McGraw Hill Pub. Co., New York.
2) Bell, F.G., “Methods of treatment of unstable ground”, Butterworths, London.
3) Ingles, C.G and Metcalf.J.B., “Soil Stabilization; Principles and Practice”, Butterworths, London.
4) Purushottam Raj P., “Ground Improvement Technique”, Laxmi Publications.

## 18UCVE825 Design of Reinforced Concrete Bridges (3-0-0) 3

**Contact Hours:39**

**Course Learning Objectives (CLOs):** Design of Reinforced Concrete bridges is taught as one of the elective courses in Civil Engineering program. In this course, analysis and design of reinforced concrete bridges viz, slab culvert, T beam bridge, and box culvert are dealt. The delivery of topics will be made through lecture classes. The evaluation will be carried out through IAs & Semester End Examination.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs (1-12)/ PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Analyze and design slab culvert. | 1,3 | 13 | |
| CO-2 | Analyze and design T beam slab panel. | 1,3 | 13 | |
| CO-3 | Analyze and design cross girder | 1,3 | 13 | |
| CO-4 | Analyze and design longitudinal girder. | 1,3 | 13 | |
| CO-5 | Analyze and design box culvert. | 1,3 | 13 | |

| POs/PSOs | PO-1 | PO-3 | PO-13 |
|---|---|---|---|
| Mapping Level | 3 | 3 | 2 |

**Prerequisites:** Students taking this course shall have the knowledge of following:
1) Design of RC Structures.
2) Introduction to Bridge Engineering.

**Contents:**

**Unit-I**

**Design of RCC Slab Culvert:** Design of slab culvert for IRC Class AA tracked and Class A Wheel load condition. **10 Hrs**

**Unit-II**

**Design of T Beam Bridge Slab Panel**: Design of interior Slab panel Using IRC Class AA Tracked Loading and IRC Class A wheel loading. **6 Hrs**

**Unit III**

**Design of Cross Girder**: Design of cross girder for dead load & live load using IRC Class AA Tracked, Class A Wheel Loading. **6 Hrs**

**Unit-IV**

**Design of Longitudinal Girder**: Design of longitudinal girder using IRC Class AA Tracked, Class A wheel Loading. **8 Hrs**

**Unit-V**

**Design of Box Culvert**: Design of Box culvert for different load cases. **9 Hrs**

**Reference Books:**

1) Victor D.J and Johnson, “Essentials of Bridge Engineering”, Oxford and IBH.
2) Krishnaraju N., “Design of bridges”, Oxford & IBH Publishers.
3) Bindra S.P., “Bridge Engineering”, Dhanpat Rai Publications.
4) T R Jagadish and M A Jayaram, “Design of Bridge Structures”, PHI, Eastern Economy Edition.

| 18UCVE826 | Solid Waste management | (3-0-0)3 |
|---|---|---|

**Contact Hours: 39**

**Course Learning Objectives (CLOs):** Solid Waste Management is taught as one of elective courses for Civil Engineering Program. In this course, topics on sources, impacts, treatment, disposal of solid waste, design aspects of landfills and monitoring leachates and gases are dealt with. The delivery of topics will be made through lecture classes and field visits. The evaluation will be carried out through IAs and Semester End Examination.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs (1-12)/ PSOs (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Estimate the quantities of Solid wastes from different sources and recognize the possible health hazards of their disposal. | | 1, 2 | - |
| CO-2 | Analyze physical, chemical biological and energy characteristics of solid wastes and differentiate hazardous and non-hazardous wastes. | 2,3 | 4,6,7 | 13 |
| CO-3 | Plan for Optimizing the route for disposal. | 4,13 | | |
| CO-4 | Analyze different disposal methods for bio-degradable and non- | 2,3,4 | 13 | |

| | | | | |
|---|---|---|---|---|
| | biodegradable, hazardous and non-hazardous solid wastes. | | | |
| CO-5 | Design Engineered land fill for MSW and Industrial wastes. | 3,4,13 | 6 | |

| POs/PSOs | PO-1 | PO-2 | PO-3 | PO-4 | PO-6 | PO-7 | PO-13 |
|---|---|---|---|---|---|---|---|
| Mapping Level | 2 | 2.66 | 3 | 2.75 | 2 | 2 | 2.25 |

**Prerequisites:** Students taking this course shall have the knowledge of following:

1) Environmental Engineering – I
2) Environmental Engineering - II

**Contents:**

**Unit-I**

**Introduction:** Solid waste- Definition, Land Pollution - scope and importance of solid waste management, Integrated Solid waste Management, Hierarchy and future trends, functional elements of solid waste management.

**Sources of solid wastes:** Classification and characteristics- municipal, hospital/ biomedical waste, Quantity — Generation rate, methods. Hazardous and Non-hazardous wastes found in MSW; e-waste; C&D waste. **8Hrs.**

**Unit-II**

**Collection and transportation:** Systems of collection, collection equipment, garbage chutes, transfer stations — bailing and compacting, route Optimization, hauled contained and stationary system, Collection Routes-Guidelines for laying out routes.

**Recycle and reuse**: Material and energy recovery operations, reuse in other industries, plastic wastes, environmental significance and reuse. **8Hrs.**

**Unit-III**

**Treatment / processing techniques:** Components separation, volume reduction, size reduction, chemical reduction and biological processing.

**Thermal processes:** Incineration - 3 Ts, factors affecting incineration process, incinerators - types, prevention of air pollution, pyrolysis. Biomedical waste. **8Hrs.**

**Unit-IV**

**Composting:** Aerobic and anaerobic composting, factors affecting composting, Mulching, Indore and Bangalore processes, mechanical and semi mechanical composting processes.

**Vermi-culture Biotechnology**: Environmental factors governing Vermi-culture biotechnology; Types of earthworms and their classification; Substrates for earthworms; Applications and advantages of vermicast. **7Hrs.**

**Unit-V**

**Sanitary land filling**: Definition, methods, trench area, Ramp, and pit method, site selection, basic steps involved, cell design, prevention of site pollution, collection and processes used for treatment of leachate, control methods - land fill liners, Vadose monitoring probe- gas collection systems. Closure and post closure operations.

**Disposal methods:** Open dumping, selection of site, Hog feeding; Sludge drying beds; Ocean disposal of solid wastes; nuclear waste disposal; Organic waste management in food process industries, case studies. **8Hrs.**

**Reference Books:**

1) George Tehobanoglous, “Integrated Solid Waste Management”, McGraw Hill.
2) George Tehobanoglous, Frank Kreith, “Handbook on Solid Waste Disposal”, McGraw Hill, New Delhi.
3) M S Bhat, Asheref Illiyan, “Solid Waste Management”, Synergy Books India
4) Pandey G N Carney G C, “Environmental engineering”, Tata McGraw Hill, New Delhi.

## 18UCVE827 Air Pollution and Control (3-0-0)3

**Contact Hours: 39**

**Course Learning Objective (CLOs):** Air pollution and Control is taught as one of elective courses for Civil Engineering Program. In this course, topics on air pollutants, effects on man and surroundings, meteorological variables and their effects, sources of pollutions, sampling, measurement, analysis and design of control methods of air pollution. The delivery of topics will be made through lecture classes and demonstrations. The evaluation will be carried out through IAs and Semester End Examination.

**Course Outcomes (COs):**

| ID | Description of the Course Outcome: At the end of the course the student will be able to: | Mapping to POs (1-12)/ PSOs 13,15) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |
| CO-1 | Classify air pollutants, identify their sources and describe their effects on environment, man, material & vegetation. | | 2 | |

| | | | | |
|---|---|---|---|---|
| CO-2 | Discuss sampling methods for air pollutants and relevant standards & legislations for air pollution control. | 4 | 6 | 9 |
| CO-3 | Predict changes in atmosphere by meteorological variables and their effects. | | 5 | |
| CO-4 | Analyze and design air pollution control methods for gaseous and particulate matter. | 15 | 3 | |
| CO-5 | Analyze air pollution due to automobiles, global effects of air pollution and EIA. | | 10 | |

| POs/PSOs | PO-2 | PO-3 | PO-4 | PO-6 | PO-5 | PO-9 | PO-10 | PSO – 15 |
|---|---|---|---|---|---|---|---|---|
| Mapping Level | 2 | 2 | 3 | 2 | 2 | 1 | 2 | 3 |

**Prerequisites:** Students taking this course shall have the knowledge of following:
1) Environmental Engineering – I
2) Environmental Engineering - II

**Contents:**

**Unit-I**

**Introduction:** Definition - Classification and properties of air pollutants, primary and secondary air pollutants, concentrations of air pollutants and sources, behavior and fate of air pollution: Chemical reaction in the atmosphere, photochemical smog.

**Effects of air pollution:** On human health, animals, plant and properties, major Episodes. 8**Hrs.**

**Unit-II**

**Sampling and analysis of air pollutants:** Sampling and measurement of Gaseous and particulate pollutants stack sampling, smoke and its measurements.
**Standards and legislation**: Air quality and emission standards-legislation and regulation. Air pollution index. **7 Hrs.**

**Unit-III**

**Meteorology:** Introduction - Meteorological Variables. Lapse Rate, Adiabatic Dispersion/ inversion, Stability Conditions, windrose, General characteristics of stack plumes**.** **8 Hrs**

**Unit-IV**

**Control of air pollutants:** Control methods - Particulate emission control, gravitational settling chambers, cyclone separators, fabric filters, Electrostatic precipitators, wet scrubbers, control of gaseous emissions. **8 Hrs.**

**Unit-V**

**Air pollution due to automobiles:** Air pollution due to gasoline driven and Diesel driven engines, effects, control-direct and indirect methods.

**Global environmental issues:** Acid rain, Green House effect, Global warming, Ozone layer Depletion, Environmental Impact Assessment in industrial plant locations and planning **8 Hrs**

**Reference Books:**

**1)** Rao M.N., "Air Pollution", Tata McGraw Hill Education.
**2)** Rao C.S., "Environmental pollution control", Wiley Eastern Ltd.

## 18UCVE828 Advanced Design of Steel Structures (3-0-0)3

**Contact Hours: 39**

**Course Learning Objectives (CLOs):** Advanced Design of Steel Structures is taught as one of the elective courses in Civil Engineering program. In this course, topics on design of welded plate girder with and without stiffeners, gantry girder with overhead crane, roof truss (loads and forces given), member design – top chord, bottom chord, web members are dealt. The delivery of topics will be through lecture classes using black board power point presentation and site visits. The evaluation will be carried out through IAs & Semester End Examination.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs (1-12)/ PSOS (13-15)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Design bolted beam connections-framed and seated. | 3,4 | 1,2 | |
| CO-2 | Design welded beam connections-framed and seated. | 3,4 | 1,2 | |
| CO-3 | Design plate girder. | 3,4 | 1,2 | |
| CO-4 | Design gantry girder. | 3,4 | 1,2 | |
| CO-5 | Design roof truss members. | 3,4 | 1,2 | |

| POs/PSOs | PO-1 | PO-2 | PO-3 | PO-4 |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| Mapping Level | 2 | 2 | 3 | 3 |

**Prerequisites:**

Students taking this course shall have the knowledge of following:

1) Mechanics of Materials.
2) Design of Steel Structures

**Contents:**

**Unit-I**

**Design of bolted beam connections:** Framed connection, Unstiffened seated connection, Stiffened seated connection. **7 Hrs.**

**Unit-II**

**Design of welded beam connections:** Framed connection, Unstiffened seated connection, Stiffened seated connection. **7 Hrs.**

**Unit-III**

**Design of plate girder**: Introduction, Basic assumptions, depth to thickness ratio of web, approximate depth of web, area of flanges, check for moment, shear, deflection, design of welded connection between web and flanges. **9 Hrs.**

**Unit-IV**

**Design of gantry girder:** Introduction impact effect, calculations of vertical moment and shear, horizontal moment and shear, selection of section, calculations of impressions flange section modulus, check for vertical and horizontal moments and shear capacities, check for biaxial moment and shear, check for deflection, check for buckling and crippling strength of web, design of welded connections between I and channel section. **8 Hrs.**

**Unit-V**

**Design of Truss:** Introduction, types, design of top chord member, design of bottom chord member, design of typical intermediate member, reversal of stresses, check for slenderness ratio, design of connections. **8 Hrs.**

**Reference Books:**

1) Bhavikatti S. S. “Design of Steel Structures”, I.K. Publishers.
2) IS:800 – 2007, “General Construction in steel: Code of practice”.
3) Pramod K.V., “Steel Data Handbook”, IK International, New Delhi.

## 18UCVO801 Remote Sensing and GIS (3-0-0)3

**Total Hrs: 39**

**Course Learning Objective (CLOs): Remote Sensing and Geographical information systems** is taught as one of the Open Elective courses for Civil

Engineering Program. In this course, topics on fundamentals of remote sensing platforms, sensors, introduction to GIS, GIS data models querying, analysis and cartographic output are dealt. The subject will be taught through classroom lectures, demonstration. The evaluation will be carried out through IAs & SEE.

**Course Outcomes (COs):**

| ID | Description of the Course Outcome: At the end of the course the student will be able to: | Mapping to POs (1-12)/ PSOS (13-15) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |
| CO-1 | Explain principles of remote sensing technology. | | 1 | |
| CO-2 | Explain use of remote sensing technology for different applications. | | 4 | 1 |
| CO-3 | Explain GIS is and its applications | 5 | 2 | |
| CO-4 | Identify type of data required and use the same for applications. | 4 | 2 | |
| CO-5 | Collect, analyze the data and prepare output in the form of maps and tables. | 4 | 2 | |

| POs/PSOs | PO-1 | PO-2 | PO-4 | PO-5 |
|---|---|---|---|---|
| Mapping Level | 1.5 | 2 | 2.67 | 3 |

**UNIT I**

**Remote Sensing**: Basic concept of Remote sensing, Data and Information, Remote sensing data collection, Remote sensing advantages & Limitations, Remote Sensing process. Electromagnetic Spectrum, Energy interactions with atmosphere and with earth surface features (soil, water, and vegetation), Resolution, image registration and Image and False color composite, elements of visual interpretation techniques **7 hrs**

**UNIT II**

**Remote Sensing Platforms and Sensors:** Indian Satellites and Sensors characteristics, Remote Sensing Platforms, Sensors and Properties of Digital Data, Data Formats: Introduction, platforms- IRS, Landsat, SPOT, Cartosat, Ikonos, Envisat etc. sensors, sensor resolutions (spatial, spectral, radiometric and temporal). Basics of digital image processing- introduction to digital data, systematic errors(Scan Skew, Mirror-Scan Velocity, Panoramic Distortion, Platform Velocity , Earth Rotation) and non-systematic [random] errors(Altitude,

Attitude), Image enhancements(Gray Level Thresholding, level slicing, contrast stretching),image filtering. **8 hrs**

**UNIT III**

**Introduction:** What is GIS, components of GIS, GIS Subsystems, Historical roots of GIS, Early & Current Systems, GIS Applications, Modeling Real World Features, Definition of a map, how maps convey descriptive info, how maps convey spatial relationships. **8 hrs**

**UNIT IV**

**GIS Data Models:** Spatial Data Models, Vector Data Model, Raster Data Model, Image Data Model, Vector Vs Raster Data Models, Attribute Data Models, File Structures, Database Structures, Sources of Data, Data Input Techniques, Manual Digitizing, Scanning & Vectorisation, Co-ordinate Geometry, Existing digital data, Entering attribute data, Data Verification, Errors in Spatial Data, Errors in Attribute Data , Data Editing, Interactive Graphic Editing, , Edge Match/Rubber Sheeting, Data Organization & Storage, Vertical Data Organization, Horizontal Data Organization, Data Quality & Accuracy, Accuracy & Precision. **8 hrs**

**UNIT V**

**GIS Analysis:** Measurements, From Vector Data, From Raster Data, Accuracy, Querying Data, Spatial Selection, Logical Selection, Classification, User Controlled, Automatic Overlay Operations, Proximity Analysis, Network Analysis, Cartographic Output, Layout design, Symbology, Vector Display Devices, Raster Display Devices. **8 hrs**

**Reference Books:**

1. Lillisand and Kiefer- “Principles of Remote Sensing and image interpretation”, John Wiley and Sons.
2. Bauseb Bhatta, “Remote sensing & GIS”, Oxford University Press.
3. Ian Heywood, Sarahand Steve, “An introduction to Geographic Information Systems” , Pearson Education Asia.
4. Michael N.Demers, “Fundamentals of Geographic Information Systems”, John Wiley & sons

| 18UPHE876 | Nanotechnology | (3-0-0)3 Credits |
|---|---|---|

**Contact Hours: 39, CIE: 50 Marks, SEE: 100 Marks, Exam Duration: 3 Hrs.**

**Course Learning Objectives (CLOs):**

The students are expected to learn about the fundamentals and multidisciplinary nature of nanotechnology and to understand the advantages of nanomaterials to bring novelty in the devices. The student learns the size and shape dependent properties, classification of nanomaterials, different methods to prepare nanostructures including hybrid fabrication approaches and characterization techniques. Finally, they are expected to be acquainted with the significance of nanomaterials.

**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | | Mapping to POs (1,12) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |
| **CO-1** | Understand the basics of nanoscience and nanostructures | 2 | 1 | |
| **CO-2** | Elaborate the various synthesis methods of nanostructures | 1 | 2 | |
| **CO-3** | Understand to the construction and working principle of a broader range of characterization techniques. | 1 | 2 | |
| **CO-4** | Realize the carbon clusters and nanocomposites for device applications | 1 | 2 | |
| **CO-5** | Outline the application of nanomaterials | 2 | 1 | |

| POs | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mapping Level | 2.6 | 2.4 | | | | | | | | | | |

**Prerequisites:**Nil

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**Contents:**

**Unit I**

**Basics of Nanoscale Materials:** Wave particle duality, Quantum size effect-Schrödinger wave equation, Particle in box problem, Formation of bands in solids, Density of states. Introduction to nanoscale materials and their classification, Size dependent properties of Nano materials- Physical, electrical optical and magnetic properties. **8 Hrs.**

**Unit II**

**Synthesis of Nanostructured materials:** Top-down and Bottom-up approaches of synthesis of nanomaterial, Top down approach – Mechanical attrition, Nanolithography-photo, electron beam and dip pen lithography.

Bottom up approach –Sol gel methods, Chemical vapour deposition (CVD), solvothermal synthesis, Spin coating and spray pyrolysis. Sputtering, laser ablation, molecular beam epitaxy. **8 Hrs.**

**Unit III**

**Characterization techniques:** Principle and working of XRD technique, Construction and working principle of Optical spectroscopy (UV-VIS, photoluminescence spectroscopy), Electron microscopy - scanning electron microscopy, Scanning Tunneling Microscopy, transmission electron microscopy (TEM), EDAX, atomic Force Microscopy. **7 Hrs.**

**Unit IV**

**Carbon nano structures and Nanocomposites:** Carbon clusters: Fullerenes (Buckminister fullerene), graphene – introduction, properties. Carbon nanotubes – classification, Synthesis, Properties and their applications.

Nanocomposites: Introduction, Ceramic and polymer-based nano-composites, grapheme, carbon nanotube and metal-matrix fillers, Properties and applications of nano-composites. **8 Hrs.**

**Unit V**

**Applications of Nanomaterials:** Optoelectronic applications-Hybrid solar cells, LED, nano-sensors. Photo-catalysis, Fuel cells, nanofluids, electrochemical energy storage systems, spintronics, MEMS and NEMS. Applications in medical field (drug delivery), food processing and agriculture. **8 Hrs.**

**Reference Books:**

1) Sulabha K Kulkarni, Nanotechnology-Principles and Practices, Capital Publishing Company, 2007.
2) T. Pradeep, Nano: The Essentials, Tata McGraw Hill Education Pvt Ltd., 2013.
3) James Murday, Textbook of Nano-science and Nanotechnology, University Press-IIM, 2012.

4) Charles. P. Poole and F. J. Owens, Introduction to Nanotechnology, John Wiley & Sons Inc., 2003.
5) P. Mukhopadhyay and R. K. Gupta, Graphite, Graphene and their polymer Nanocomposites. CRC Press, Taylor & Francis Group. 2012.

# Academic Program: PG

# Academic Year 2020-21

# Syllabus

# I & II Semester M.Tech.

# COMPUTER AIDED DESIGN OF STRUCTURES

## Department of Civil Engineering

## ACADEMIC AUTONOMY

SHRI DHARMASTHALA MANJUNATHESHWARA COLLEGE OF
ENGINEERING & TECHNOLOGY,
DHARWAD – 580 002

**(An Autonomous Institution Approved by AICTE & Affiliated to VTU, Belagavi)**

**Ph**: **0836-2447465Fax: 0838-2464638 Web: www.sdmcet.ac.in**

**SDM College of Engineering & Technology, Dharwad**

It is certified that the scheme and syllabus for I&II semester M.Tech. Computer Aided Design of Structures is recommended by the Board of Studies of Civil Engineering and approved by the Academic Council, SDM College of Engineering &Technology, Dharwad. This scheme and syllabus will be in force from the academic year 2020-21 till further revision.

Principal

Chairman BoS & HoD

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## SDM College of Engineering & Technology, Dharwad

## VISION AND MISSION

**VISION:**

To develop competent professionals with human values

**MISSION:**

- To have contextually relevant curricula.
- To promote effective teaching learning practices supported by modern educational tools and techniques.
- To enhance research culture.
- To involve industrial expertise for connecting classroom content to real life situations.
- To inculcate ethics and impart soft-skills leading to overall personality development.

**SDM College of Engineering & Technology, Dharwad**

**Civil Engineering Department**

## DEPARTMENT VISION AND MISSION

### VISION:

To be a Centre of excellence, practice state-of-art civil engineering education and developing high quality engineers to serve society.

### MISSION:

The stated vision can be achieved through

- Development of robust curriculum to meet the expectations of industry.
- Interactive teaching-learning process with modern educational tools.
- Establishing synergy between teaching and research.
- Networking with industry.

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## PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

1. To provide proficiency in the basic principles and advanced courses of technology in Computer Aided Design of Structures so that students are able to formulate, analyze and solve the societal problems for sustainable development related to Structural Engineering.

2. To expose students to the latest innovations and trends with a view to inculcate strong research orientation in Computer Aided Design of Structures as well as in multidisciplinary streams.

3. To create a congenial environment that promotes learning, growth and imparts ability to work with inter-disciplinary groups in professional, industry and research organizations.

4. To produce Structural Engineers who integrate and build on the program's core curricular concepts in the pursuit of professional leadership, teamwork, life-long learning, and successful career advancement.

## PROGRAMME OUTCOMES (PO):

PO1: An ability to independently carry out design /research/investigation and development work to solve practical problems.

PO2: An ability to write and present a substantial technical report/document.

PO3: Students should be able to demonstrate a degree of mastery over design of structures using software tools as per the specialization of the program.

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## Scheme of Teaching and Examination

### I Semester M. Tech.

| Course Code | Course Title | Teaching | | Examination | | | | |
|---|---|---|---|---|---|---|---|---|
| | | L-T-P (Hrs./Wk.) | Credits | CIE | Theory (SEE) | | Practical (SEE) | |
| | | | | Max. Marks | *Max. Marks | Duration in hours | Max. Marks | Duration in hours |
| 20PRMIC100 | Research Methodology and IPR | 2-0-0 | 2 | 50 | 50 | 2 | | |
| 20PCDSC101 | Computational Structural Mechanics – Classical and FE Approach | 4-0-0 | 4 | 50 | 100 | 3 | | |
| 20PCDSC102 | Continuum Mechanics – Classical and FE Approach | 4-0-0 | 4 | 50 | 100 | 3 | | |
| 20PCDSC103 | Structural Dynamics -Theory & Computations | 4-0-0 | 4 | 50 | 100 | 3 | | |
| 20PCDSExxx | Elective-1 | 4-0-0 | 4 | 50 | 100 | 3 | | |
| 20PCDSL104 | Cad Lab –Structural Analysis | 0-0-3 | 2 | 50 | - | - | 50 | 3 |
| 20PCDSL105 | **Seminar | 0-0-2 | 1 | 50 | - | - | - | - |
| **Total** | | **18-0-5** | **21** | **350** | **450** | | **50** | |

**CIE**: Continuous Internal Evaluation **SEE**: Semester End Examination

**L**: Lecture **T**: Tutorials **P**: Practical

***SEE** for theory courses is conducted for 100 marks and reduced to 50 marks.

****** Seminars are to be conducted every week and 2-3 students/week will present a topic from emerging areas in Computer Aided Structural Engineering preferably the contents not studied in their regular courses. The seminar shall be evaluated by 3 faculty members having specialization in Structural Engineering and allied areas.

## List of Electives

| Course Code | Elective Courses |
|---|---|
| 20PCDSE125 | Structural Optimization - Theory & Computations |
| 20PCDSE126 | AI and Expert Systems in Structural Engineering |
| 20PCDSE127 | Action and Response of Structural Systems |
| 20PCDSE128 | Geotechnical Aspects of Foundations and Earth Retaining Structures |
| 20PCDSE129 | Numerical Methods and Programming |
| 20PCDSE130 | Composite and Smart Materials |

## Scheme of Teaching and Examination

## II Semester M.Tech.

| Course Code | Course Title | Teaching | | Examination | | | | |
|---|---|---|---|---|---|---|---|---|
| | | L-T-P (Hours/Week) | Credits | CIE | Theory (SEE) | | Practical (SEE) | |
| | | | | Max. Marks | *Max. Marks | Duration in hours | Max. Marks | Duration in hours |
| 20PCDSC201 | Structural Stability Analysis - Classical and FE Approach | 4-0-0 | 4 | 50 | 100 | 3 | | |
| 20PCDSC202 | Advanced Design of Reinforced Concrete Structural Elements | 4-0-0 | 4 | 50 | 100 | 3 | | |
| 20PCDSExxx | Elective-2 | 4-0-0 | 4 | 50 | 100 | 3 | | |
| 20PCDSExxx | Elective-3 | 4-0-0 | 4 | 50 | 100 | 3 | | |
| 20PCDSExxx | Elective-4 | 4-0-0 | 4 | 50 | 100 | 3 | | |
| 20PCDSL204 | Cad Lab - FE Analysis | 0-0-3 | 2 | 50 | - | - | 50 | 3 |
| 20PCDSL205 | **Seminar | 0-0-2 | 1 | 50 | - | - | - | - |
| **Total** | | **20-0-5** | **23** | **350** | **500** | | **50** | |

**CIE**: Continuous Internal Evaluation **SEE**: Semester End Examination

**L**: Lecture **T**: Tutorials **P**: Practical

***SEE** for theory courses is conducted for 100 marks and reduced to 50 marks.

****** Seminars are to be conducted every week and 2-3 students/week will present a topic from emerging areas in Computer Aided Structural Engineering preferably the contents not studied in their regular courses. The seminar shall be evaluated by 3 faculty members having specialization in Structural Engineering and allied areas.

## List of Electives

| Course Code | Elective Courses |
|---|---|
| 20PCDSE225 | Analysis of Plates - Classical and FE Approach |
| 20PCDSE226 | Reliability Analysis and Design of Structural Elements |
| 20PCDSE227 | Advanced Design of Steel Structures |
| 20PCDSE228 | Design of Stack Tower and Water Storage Structural Systems |
| 20PCDSE229 | Seismic Resistant Design of Structural Systems |
| 20PCDSE230 | Advanced Structural Dynamics |
| 20PCDSE231 | Design of Tall Structures |

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## I Semester

**20PRMIC100 Research Methodology and IPR (2-0-0) 2**

**Contact Hours: 26**

**Course Learning Objectives (CLOs):** The students are expected to learn about the need and types of research, problem formulation, literature review, measurement, scaling, data collection, testing of hypothesis, result interpretation and report writing. Further, the students shall know about the intellectual property rights, copyrights, trademarks, patents, patents filing procedure, infringement & remedies and information technology act etc.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs(1 to 3)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| **CO-1** | **Formulate** the research problem, carry out literature survey and decide the methodology. | | 1 | |
| **CO-2** | **Use** measurement and scaling and **carryout** data collection. | | 1 | |
| **CO-3** | **Test** the hypothesis, **interpret, analyze** the results and **write** the report. | 2 | 3 | |
| **CO-4** | **Explain** the need of IPR, copyright, patents, trademarks,& the filing procedure and know about infringement, remedies and regulatory framework. | | 2 | |

| **POs** | PO-1 | PO-2 | PO-3 |
|---|---|---|---|
| **Mapping Level** | 2 | 2.5 | 2 |

**Prerequisites:**

1) Branch specific course on problem analysis (Preferred)



**Contents:**

1) **Research Methodology:** Introduction, meaning of research, objectives of research, motivation in research, types of research, research approaches, significance of research, research methods versus methodology, research

and scientific method, importance of knowing how research is done, research process, criteria of good research and problems encountered by researchers in India. **2 Hours**

**Defining the Research Problem:** Research problem, selecting the problem, necessity of defining the problem, technique involved in defining a problem, an llustration. **1 Hour**

2) **Reviewing the literature:** Importance of the literature review in research, How to review the literature, searching the existing literature, reviewing the selected literature and writing about the literature reviewed. **2 Hours.**
**Research Design:** Meaning of research design, need for research design, features of a good design, important concepts relating to research design, different research designs, basic principles of experimental designs, important experimental designs. **3 Hours**

3) **Measurement and Scaling:** Measurement in research, measurement scales, sources of error in measurement, scaling, meaning of scaling and important scaling techniques **2 Hours**
**Data Collection:** Collection of primary data, observation method, interview method, collection of data through questionnaires, collection of data through schedules, difference between questionnaires and schedules, collection of secondary data. **2 Hours**

4) **Testing of Hypotheses:** What is a Hypothesis? Basic concepts concerning testing of hypotheses, procedure for hypothesis testing, flow diagram for hypothesis testing, measuring the power of a hypothesis test, tests of hypotheses. **2 Hours**

5) **Interpretation and Report Writing:** Meaning of interpretation, technique of interpretation, precaution in interpretation, significance of report writing, different steps in writing report, layout of the research report, types of reports, oral presentation and mechanics of writing a research report, precautions for writing research reports, plagiarism and its significance. **3 Hours**

6) **Introduction to Intellectual Property Rights:** Meaning and conception of IPR, competing, rationale for protection, international conventions, world court. **1 Hour**
**Copyright:** Historical evolution of the law on copyright, meaning, content, substance, ownership, primary, special rights, obligations, period, assignment and relinquishment of copyrights. License and application for

registration of copyright.

**Industrial design:** Significance & registration **2 Hours**

**Trademarks:** Definitions and conceptions of Trademark, advantages of registration, marks which are not registrable, known and well-known trademarks, application for registration and procedure for registration, procedure and certification of Trademarks. **1 Hour**

**Patents:** Meaning of Patent, purpose and policy object of patent law, gains to inventor, application of patents, joint application, discovery and invention, patentable and non-patentable inventions, publications and public use, priority date and its purpose, procedure for obtaining patent. Stages of procedure, refusal to grant patent - consequence, protection period, drafting if claims, grant of patent and significance of date of patent and date of ceiling. Services available with patent office, jurisdiction, appellate authorities, powers and obligations of central government, patent agent and controller – not a civil court. **3 Hours**

**Infringement and Remedies:** Meaning of infringement, acts of infringements, suit against infringement and defence against infringement, reliefs and certificate of validity. **1 Hour**

**The information Technology Act**: Definitions, certifying authority, meaning of compromise of digital signature, offences and penalties, applicability of IPRs, cybercrimes, adjudicating officer, violation, damages and penalties, Cyber regulation appellate tribunal, World Wide Web and domain names and cyber flying. **1 Hour**

**Reference Books:**

1) C.R. Kothari, Gaurav Garg, Research Methodology: Methods and Techniques, New Age International, 4th Edition, 2018.
2) Ranjit Kumar, Research Methodology a step-by-step guide for beginners, SAGE Publications, 3rd Edition, 2011.
3) Fink A, Conducting Research Literature Reviews: From the Internet to Paper, Sage Publications, 2009.
4) N. K. Acharya, Text book on Intellectual Property Rights, 4th Edition, Asia Law House, Hyderabad.

## 20PCDSC101 Computational Structural Mechanics–Classical and FE Approach (4-0-0) 4

**Contact Hours: 52**

**Course Learning Objectives (CLOs):** Calculation of distribution of forces within the structure and the displaced state of the system forms the crux of design process. The objective of this course is to make students learn computer aided methods of analysis adopted in industry for such purposes.

**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | | Mapping to POs (1 to 3) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |
| CO-1 | Apply Direct stiffness method and Analyze 2D-truss structures | **3** | **1** | |
| CO-2 | Apply Direct stiffness method and Analyze continuous beams and 2D-frames | **3** | **1** | |
| CO-3 | Formulate finite element method with respect to structures | **3** | **1** | |
| CO-4 | Formulate and Apply finite element method for bar element | **3** | **1** | |
| CO-5 | Formulate and Apply finite element method for beam element | **3** | **1** | |
| CO-6 | Apply Knowledge of problem solving skills using computer aided methods | **3** | **1** | |

| **POs** | PO-1 | PO-2 | PO-3 |
|---|---|---|---|
| **Mapping Level** | 2 | | 3 |

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**Prerequisites:**

1. Strength of Materials
2. Structural Analysis I & II
3. Matrix Method of Analysis

**Contents:**

**Module 1: Direct Stiffness Method — Trusses:** Degrees of Static and Kinematic indeterminacies, Concepts of Stiffness and Flexibility, Local and Global Coordinate System, Analysis of indeterminate Trusses, with and without initial strains for different types of boundary conditions such as Fixed, Hinged, Roller, supports, support settlement.

**11 Hours**

**Module 2: Direct Stiffness Method - Continuous Beam, 2D Frames:** Analysis of Continuous beams, for different types of boundary conditions such as Fixed, Hinged, Roller, supports, support settlement. Analysis of Simple 2D Frames with and without sway, Element stiffness matrix for 3D frames and Grids

**11 Hours**

**Module 3: Basic Concept of Finite Element Method:** Concept of FEM, principle of virtual work, Principles minimum potential energy, Method of Weighted Residuals (Galerkin's)

**10 Hours**

**Module 4: FE Analysis using Bar Elements:** Derivation of Shape Function for Linear and Higher order elements using Inverse and Lagrange Interpolation formula, Element Stiffness matrix Two and Three noded elements. Examples with constant and varying cross sectional area subjected to concentrated loads, distributed body force and surface traction and Initial strains due to temperature, Isoparametric formulation.

**10 Hours**

**Module 5: FE Analysis using Beam Element**: Derivation of Shape Function for two noded beam element, Hermitian Interpolation, Element Stiffness matrix, Consistent Nodal loads, Concept of Reduced or Lumped Loads, Examples: Cantilever and Simply Supported beams,

**10 Hours**

**Reference Books:**

[1]Rajasekaran.S, "Computational Structural Mechanics", PHI, New Delhi.

[2] Reddy.C.S, "Basic Structural Analysis," TMH, New Delhi.

[3] Robert D Cook et al, "Concepts and Applications of Finite Element Analysis", 3rd Edition, John Wiley and Sons, New York

[4] Beaufait.F.W.et al., "Computer Methods of Structural Analysis", Prentice Hall.

[5] Weaver. W and Gere. J. H., Matrix, "Analysis of Framed Structures", Van Nastran.

[6] Rubinstein M.F, Matrix Computer Methods of Structural Analysis Prentice-Hall.

[7] Bathe.K.J, "Finite element procedures in Engineering Analysis" .PHI NewDelhi.

| 20PCDSC102 | Continuum Mechanics –Classical and FE Approach | (4-0-0) 4 |
|---|---|---|

**Contact Hours: 52**

**Course Learning Objectives (CLOs):** To introduce students to the fundamental concepts of the mechanics of deformable bodies along with state-of-the-art computational methods in civil engineering. The range of material behavior considered includes: Finite Deformation Elasticity The delivery of topics will be made through lecture classes.

**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | | Mapping to POs (1 to 3) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |
| CO-1 | Apply knowledge of mathematics, science, and engineering by developing the Equilibrium equations | | **1,2,3** | |
| CO-2 | Formulate, analyze and solve two dimensional elasticity rectangular and polar coordinate problems using classical approach. | | **1,2,3** | |
| CO-3 | Formulate, analyze and solve three dimensional stress-strain problems using classical approach. | | **1,2,3** | |
| CO-4 | Formulation and implementation of Isoparametric finite element models for two and three-dimensional deforming bodies | **1,2,3** | | |
| CO-5 | Use FEM for solving continuum mechanics problems. | **1,2,3** | | |

| POs | PO-1 | PO-2 | PO-3 |
|---|---|---|---|
| Mapping Level | 2.4 | 2.4 | 2.4 |

**Prerequisites:**

1. Strength of Materials
2. Structural Analysis I & II
3. Matrix Method of Analysis

**Contents:**

**Module 1: Basic Concepts:** Definition of stress and strain at a point, components of stress and strain at a point, strain displacement relations in cartesian coordinates, constitutive relations, equilibrium equations, compatibility equations and boundary conditions in 2-D and 3-D cases, plane stress, plane strain — Definition.

**10 Hours**

**Module 2:Two-dimensional problems in Rectangular Coordinates:** Airy's stress function approach to 2-D problems of elasticity. Solution by Polynomials— End Effects, Saint — Venant's Principle — solution of some simple beam problems, including working out of displacement components.

**11 Hours**

**Module 3: Two - dimensional problems in Polar coordinates:** General equation in Polar coordinates —Strain and displacement relations, equilibrium equations - Stress distribution symmetrical about an axis — Pure bending of curved bars — Displacements for symmetrical stress distributions —Bending of a curved bar by a force at the end — The effect of a small circular hole on stress distribution in a large plate subjected to uniaxial tension and pure shear.

**11 Hours**

**Module 4: Analysis of Stress and Strain in Three Dimensions:** Introduction — Principal stresses —Determination of the principal stresses and principal planes.— Stress invariants — Determination of the maximum shearing stress- Octahedral stress components, Principal strains — strain invariants.

**10 Hours**

**Module 5: FE approach:** 2D and 3D Elements - CST, LST, Rectangular family, Tetrahedra and Hexahedra : Shape functions, Element Stiffness matrix, Equivalent Loads, Isoparametric formulation of Triangular and General quadrilateral elements, Axisymmetric elements, Gauss Quadrature.

**10 Hours**

**Reference Books:**

[1]TimoshenkoandGoodier," Theory Of Elasticity" McGrawHill BookCompany,IIIEdition,1983.

[2] Valliappan.S, "ContinuumMechanicsfundamentals ",Oxford And IBH.
[3] Robert D Cook etl,"Concepts and Applications of Finite Element Analysis",3rdEdition, John Wiley and Sons, NewYork
[4] Srinath.L.S.,"Advanced Mechanics of Solids",Tata McGraw-Hill Publishing Co. Ltd.,NewDelhi
[5]Bathe.K.J, "Finite element procedures in Engineering Analysis". PHI. NewDelhi.
[6]Zienkiewicz.O.C,"The Finite Element Method",Tata-McGraw-Hill Publishing Company
[7]Krishnamoorthy C.S,"Finite Element Analysis",Tata-McGraw-Hill Publishing Company

## 20PCDSC103 Structural Dynamics -Theory & Computations (4-0-0) 4

**Contact Hours: 52**

**Course Learning Objectives (CLOs):** This course focuses on how to model single degree, multi degree of freedom systems and continuous vibratory systems for un-damped, damped forced and free vibrations. Quantification of responses of these systems is also discussed.

**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | | Mapping to POs (1 to 3) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |
| CO-1 | Evaluation of effect of structural vibrations on safety and reliability of structural systems | | **1,3** | |
| CO-2 | Develop the equations of motion for vibratory systems and solve for the free and forced response required for modeling structures for dynamic analyses. | **1,3** | | |
| CO-3 | Analyze and modify a vibratory structure order to achieve specified requirements by developing a model. | | **3** | |
| CO-4 | Emphasize the role of | **3** | | |

| | | | | |
|---|---|---|---|---|
| | damping and its influence upon structural response to limit the possibility of their structures being influenced by resonance that may affect the structural safety and reliability of engineering systems. | | | |
| CO-5 | Apply modal methods to calculate the forced response of SDOF and MDOF systems. | **3** | | |
| CO-6 | Analyze vibrations of the structures using finite element methods. | | **3** | |

| **POs** | PO-1 | PO-2 | PO-3 |
|---|---|---|---|
| **Mapping Level** | 2.5 | | 2.5 |

**Prerequisites:**

1. Strength of Materials
2. Structural Analysis I & II
3. Matrix Method of Analysis

**Contents:**

**Module1: Single Degree of Freedom System:** Degrees of freedom, undamped system, springs in parallel, in series. Newton's laws of motion, free body diagrams. D'Alembert's principle, 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, over damped system, under damped system, and logarithmic decrement. Response of single degree of freedom system to harmonic loading — undamped harmonic excitation, damped harmonic excitation, evaluation of damping at resonance, bandwidth method (Half power) to evaluate damping, response to support motion, force transmitted to the foundation, seismic instruments.

**11 Hours**

**Module 2; Response to General Dynamic Loading**: Impulsive loading and Duhamel's integral, numerical evaluation of Duhamel's integral, undamped system, numerical evaluation of Duhamel's integral, damped system. Fourier analysis and response in frequency domain — Fourier analysis, Fourier coefficient for piecewise linear functions, exponential form of Fourier series, discrete Fourier analysis, fast Fourier transform.

**11 Hours**

**Module 3: Generalized Coordinates and Rayleigh's method:** Principle of virtual work, generalized single degree of freedom system (rigid body and distributed elasticity), Rayleigh's method. Hamilton's principle. Multistory Shear Building. Free vibration — natural frequencies and normal modes. Forced motion — modal superposition method — response of a shear building to base motion. Damped motion of shear building — equations of motions — uncoupled damped equation — conditions for uncoupling. Damping.

**10 Hours**

**Module 4 : Discretization of Continuous Systems:** Longitudinal Vibration of a uniform rod. Transverse vibration of a pretensioned cable. Free transverse vibration of uniform beams — Rotary inertia and shear effects — The effect of axial loading. Orthogonality of normal modes. Undamped forced vibration of beams by mode superposition.

**10 Hours**

**Module 5: Dynamic Analysis of Beams:** Stiffness matrix, mass matrix (lumped and consistent); equations of motion for the discretized beam in matrix form and its solutions.

**10 Hours**

**Reference Books:**

[1]MarioPaz,"Structural Dynamics,Theory And Computation",2nd Edition,CBSPublisher
[2] Mukhopadhyaya, "Vibration,Dynamics And Structural Problems,"Oxford IBH Publishers
[3] Clough,Ray W and Penzien J,"Dynamics of Structures",2nd Edition,McGraw-Hill,
[4] Roy R.Craig, Andrew J. Kurdila,"Fundamentals of Structural Dynamics",John Wiley & Sons

## 20PCDSE125 Structural Optimization - Theory & Computations (4-0-0) 4

**Contact Hours: 52**

**Course Learning Objectives (CLOs):** In this course, topics on Classical Optimization Techniques, Linear Programming, Nonlinear Programming, Stochastic Programming and Genetic Algorithms are dealt.

**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | | Mapping to POs (1 to 3) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |
| CO-1 | Classify the Optimization problems and techniques. | 3 | 1 | |
| CO-2 | Solve the Optimization problems by Linear programming method and sketch them graphically. | 3 | 1 | |
| CO-3 | Solve the Optimization problems by Non - Linear programming method. | 3 | 1 | |
| CO-4 | Solve the Optimization problems by Stochastic programming method. | 3 | 1 | |

| POs | PO-1 | PO-2 | PO-3 |
|---|---|---|---|
| Mapping Level | 2 | | 3 |

**Contents:**

**Module1: Classical Optimization Techniques:** Engineering applications, Statement of optimization problem, Classification of optimization problems, Optimization techniques. Single variable optimization, Multivariable optimization with no constrains, with equality constraints-Lagrange multiplier-method, constrained variation method- and with inequality constraints Kuhn-Tucker conditions.

**11 Hours**

**Module2: Linear Programming**: Standard form of Linear programming problem, simplex method, revised simplex Method.

**11 Hours**

**Module 3: Nonlinear Programming**: One dimensional minimization methods, Elimination and Interpolation methods, unconstrained Optimization Techniques, Direct Search methods, Descent Methods, Constrained Optimization Techniques, Direct methods, indirect methods. **10 Hours**

**Module4: Stochastic Programming**: For optimization of design of structural elements with random variables. Application Problems: Optimum Design RC, PSC, Steel structural elements. Algorithms for optimum designs.

**10 Hours**

**Module5: Genetic Algorithms:** Introduction fitness functions including the effect of constraints crossover, mutation. **10 Hours**

**Reference Books:**

[1] Rao.S.S- Optimization Theory and Applications, Wiley Eastern Limited, 1978.

[2] Fox.R.L. - Optimization Methods for Engineering Design", Addison Wesley,

[3] Stark.R.M.Nicholls. R.L., Mathematical Foundations for Design", McGraw Hill Book Company.

[4] Narsing k Deo— System simulation with digital computer", Prentice- Hall of India Pvt ,Ltd. New Delhi—

## 20PCDSE126 AI and Expert Systems in Structural Engineering (4-0-0) 4

**Contact Hours: 52**

**Course Learning Objectives (CLOs):**Expert systems are the most mature and widely used commercial application coming out of artificial intelligence. In an expert system, the computer applies heuristics and rules in a knowledge-specific domain to render advice or make recommendations, much like a human expert would.

**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | | Mapping to POs (1 to 3) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |
| CO-1 | Use expert systems to achieve fairly high levels of performance in task areas which require a good deal of specialized knowledge and training. | **3** | **1** | |
| CO-2 | Develop expert systems to perform tasks which are physically difficult, tedious, or expensive to have a human perform | **3** | **1** | |

| **POs** | PO-1 | PO-2 | PO-3 |
|---|---|---|---|
| **Mapping Level** | 2 | | 3 |

**Contents:**

**Module 1: Artificial Intelligence:**
Introduction: AI - Applications fields, defining the problems - state space representation - problem characteristics - production system - production system characteristics. Knowledge Representation: Formal logic - predicate logic - logic programming - forward v/s backward reasoning - matching control knowledge. **11 Hours**

**Module 2: Search and Control:**
Concepts - uninformed / blind search: depth first search - breadth first search - bi-directional search - informed search - heuristic graph search - generate and test - hill climbing – best-first search - AND OR graph search. Non-formal Knowledge Representation - semantic networks - frames— scripts— production systems, Programming in LISP. **11 Hours**

**Module 3: Expert Systems:**
Their superiority over conventional software — components of an expert system — expert system life cycle-expert system development process- nature of expert knowledge — techniques of soliciting and encoding expert knowledge. Inference: Forward chaining - backward chaining - rule value approach.

**10 Hours**

**Module 4: Uncertainty**
Symbolic reasoning under uncertainty: logic for non-monotonic reasoning. Statistical reasoning: Probability and Bayes' theorem - certainty factor and rule based systems - Bayesian network –Dempster - Shafer theory.

**10 Hours**

**Module 5; Fuzzy reasoning and Neural Networks:**
Features of rule-based, network- based and frame -based expert systems — examples of expert systems in Construction Management and Structural Engineering. Expert system shells. Neural Networks: An introduction — their possible applications in Civil Engineering.

**10 Hours**

**Reference Books:**

[1] Adeli,H., "Expert Systems in Construction and Structural Engg",Chapman & Hall,NewYork
[2] PattersonD W,"Artificial Intelligence and Expert Systems",Prentice-Hall,NewJersey.
[3] Rich,E.and Knight K."Artificial Intelligence",TMH, NewDelhi.
[4] Rolston, D.W.,"Artificial Intelligence and Expert Systems"McGrawHill,NewYork.
[5] Nilsson,N.J.,"Principles of Artificial Intelligence",Narosa.,New Delhi.

## 20PCDSE127 Action and Response of Structural Systems (4-0-0) 4

**Contact Hours: 52**

**Course Learning Objectives (CLOs):** A structural system may be subjected to several combinations of actions when deployed into service. Certain important decisions such as, proper identification of structural systems, design actions on them and the recourse to the type of analysis have to be made during the design process. The focus of this course is on how to calculate the various design loads, known as actions, which are required to determine the design forces, known as 'Response" or effects of actions.

**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | | Mapping to POs (1 to 3) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |
| CO-1 | Understand the importance of appropriate code provisions | **1** | **3** | |
| CO-2 | Familiarize with procedures for calculating action effects for different types of structures frequently encountered in practice | **1** | **3** | |
| CO-3 | Assess the basic need, concepts and procedures of different types of analysis | | **3** | |
| CO-4 | Characterize the response of different types of structural systems for Tall buildings | | **3** | |

| **POs** | PO-1 | PO-2 | PO-3 |
|---|---|---|---|
| **Mapping Level** | 3 | | 2 |

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**Contents:**

**Module 1: IS 875 PART 1, 2, 4, 5:** Sources, Nature and Magnitude, Probabilistic assessment, Characteristic and Design values. IS875 PART1 and 2 code provisions. Load combination rules for design. Estimation of DL and LL on structural elements such as Slab, Beams, Columns, indifferent types of structural systems, Joint Loads on Trusses, Distributed load on Purlins- Numerical examples. Accidental loads Impact and collisions, Explosions and Fire – Numerical examples. **11 Hours**

**Module2: Wind Load- IS875 PART 3: Buildings:** Nature and Magnitude, Factors influencing wind loads, Internal and External pressure distribution, Design Wind Speeds and Pressure, Numerical Examples to calculate external and internal pressure for different types of buildings and regions— Flat roof, Pitched Roof, mono slope roof, Hipped roof, Sign board, Water tank on braced and shaft staging, Multistory Frames. **11 Hours**

**Module3: Seismic Loads IS1893 Buildings-**Nature and Magnitude, Centre of mass and rigidity, Calculation of Design Seismic Force by Static Analysis Method, Dynamic Analysis Method Location of Centre of Mass, Location of Centre of Stiffness, and Lateral Force Distributions as per code provisions.
**10 Hours**

**Module4: Vehicles Loads as per IRC 6-2010 on Road Bridge**s— Class70R, Class AA, Class A, Class B ,Tracked Vehicle, Wheeled Vehicle, Load Combinations, Impact, Wind, Water Currents, Longitudinal Forces: acceleration, breaking and frictional resistance, Centrifugal forces, temperature, Seismic forces, Snow Load, Collision Loads. Load Combinations- Simple Numerical examples

**10 Hours**

**Module5:Types of Analysis and Behavior of Tall Buildings:** Linear, Nonlinear behavior, Material nonlinearity, Geometric nonlinearity, Rigid and Elastic Supports, First Order Elastic Analysis, Second Order Elastic Analysis, First order Inelastic Analysis, Second order Inelastic Analysis— Concepts and Brief descriptions Behavior of Structural forms in Tall buildings— Rigid frame, Braced Frames, Shear Walls, Core walls, Tubular, Belt Truss, Outrigger. **10 Hours**

**Reference Books:**

[1]IS Codes IS875 Parts (1to5), IS1893, IRC6,
[2] An explanatory Handbook on IS875 (PART3); Wind Load on Building and Structures,
[3] Document No: IITK-GSDMAWind07V1.0-IITK-GSDMAProject on Building Codes
[4] Explanatory Examples on Indian Seismic Code IS1893 (Part I): Document No: IITK- GSDMA-EQ21-V2.O-IITK-GSDMAProject on Building Codes

## 20PCDSE128 Geotechnical Aspects of Foundations and Earth Retaining Structures (4-0-0) 4

**Contact Hours: 52**

**Course Learning Objectives (CLOs):** This course focuses on how to Plan a site investigation, classify and characterize soils for foundation design to estimate the capacity of foundations, and the settlement of the soil under the foundation load as well as computation of earth pressure and stability of different types of retaining structures.

**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | | Mapping to POs(1 to 3) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |
| CO-1 | Plan a subsurface exploration | **3** | **1** | |
| CO-2 | Evaluate appropriate bearing capacity correction factors to use in design | **3** | **1** | |
| CO-3 | Identify strategies to mitigate the effects of expansive soils on foundations | **3** | **1** | |
| CO-4 | Select the appropriate deep foundation type for different soil profiles | **3** | **1** | |
| CO-5 | Compute earth pressure and implement the design procedure for block foundation | **3** | **1** | |

| **POs** | PO-1 | PO-2 | PO-3 |
|---|---|---|---|
| **Mapping Level** | 2 | | 3 |

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**Contents:**

**Module 1: Bearing Capacity of Soils:** Generalized Bearing Capacity Equation; Field tests for Bearing Capacity and settlement estimation; Settlement of shallow foundations - Elastic and consolidation settlements; Settlement estimates from penetration tests; Settlement tolerance; Allowable bearing pressure. **11 Hours**

**Module 2: Design Parameters for Substructures:** Factors influencing selection of depth of Foundation, Subgrade Reaction, Winkler hypothesis and Beams on Elastic Foundation Approach; Soil Line Method; Foundations on expansive soils. Geotechnical failure of foundations during earthquake — Earthquake Resistant design of Shallow foundation —Liquefaction and Remedial measures.

**11 Hours**

**Module 3: Pile Foundations;** Classification of pile foundations and general considerations of design; Ultimate load capacity of piles; Pile settlement; Analysis of single pile and pile group; laterally loaded piles and ultimate lateral resistance. Uplift resistance of piles and anchored foundations; under reamed Pile; Pile load tests; Design examples.

**10 Hours**

**Module 4:Retaining structures:** Earth pressure theories, Fill Walls, Concrete/Gravity walls, Mechanically Stabilized Earth (MSE) walls- Analysis and Design,; Sheet pile walls, internally braced excavations (struts), externally braced excavations (tieback excavations), Soil Nailing.

**10 Hours**

**Module 5: Elements of Soil Dynamics and Design of Machine Foundations**: IS 2974 Parts I to IV Machine- Foundation System , Block Foundations, Frame Foundations, Design Criteria, Tuning of Foundation, DOF of a Rigid Block Foundation, Linear Elastic Spring, Elastic Half Space Analog, Parameters influencing Dynamic Soil Parameters, Soil Mass Participation, Effect of Embedment, Soil Damping, Machine Parameters, Vibration Isolation System. **10 Hours**

**Reference Books:**

[1] Bowles J.E “Foundation Analysis and Design”, McGraw Hill.
[2] Swami, S. (1999). “Soil Dynamics and Machine Foundation”, Galgotia Publications Pvt Ltd, New Delhi
[3] Dr. B C Punmia, Soil Mechanics and Foundation Engineering
[4] Leonards. G.A, “Foundation Engineering”, McGraw Hill.
[5] Varghese P C, “Foundation Engineering”, PHI Learning Pvt. Ltd
[6] Srinivasulu. P. and Vaidyanathan, V. (1980). “Handbook of Machine Foundations”, Tata McGraw- Hill Publishing Company, New Delhi

**20PCDSE129 Numerical Methods and Programming (4-0-0) 4**

**Contact Hours: 52**

**Course Learning Objectives (CLOs):** An overlying goal of the course is the realization of the necessity of numerical methods and programming techniques in order to simulate technological and scientific processes.

**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | | Mapping to POs (1 to 3) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |
| CO-1 | Identify various mathematical problems and reformulate these in a way suitable for numerical treatment | **1,3** | | |
| CO-2 | Select a suitable numerical method for the treatment of the given problem | **1,3** | | |
| CO-3 | Motivate the choice of a method by describing its advantages and limitations | **1,3** | | |
| CO-4 | Select an algorithm leading to efficient computation, and implement this in a suitable programming language, e.g. Matlab | **1,3** | | |
| CO-5 | Write well-structured programs in the programming language. | **1,3** | | |

| **POs** | PO-1 | PO-2 | PO-3 |
|---|---|---|---|
| **Mapping Level** | 3 | | 3 |

**Prerequisites**

Students taking this course shall have the knowledge of following:

1. Engineering Mathematics
2. Computer Programming

**Contents:**

**Module 1: Solutions of linear equations:** Direct method – Cramer's rule, Gauss – Elimination method- Gauss –Jordan elimination – Triangulation (LU Decomposition) method – Iterative methods Jacobi – Iteration method – Gauss –

Seidel iteration, Successive over –relaxation method. Eigenvalues and Eigenvectors: Jacobi Method for symmetric matrices- Given's method for symmetric matrices-Householder's method for symmetric matrices-Rutishauser method of arbitrary matrices – Power method.

**11 Hours**

**Module 2: Interpolation: Linear Interpolation** - Higher order Interpolation - Lagrange Interpolation – Interpolating polynomials using finites differences-Hermite Interpolation -piece-wise and spline Interpolation

**11 Hours**

**Module 3: Finite Difference and their Applications**: Introduction-Differentiation formulas by Interpolating parabolas – Backward and forward and central differences- Derivation of Differentiation formulae using Taylor series-Boundary conditions- Beam deflection – Solution of characteristic value problems- Richardson's extrapolation- Use of unevenly spaced pivotal points-Integration formulae by interpolating parabolas-Numerical solution to spatial differential equations

**10 Hours**

**Module 4: Numerical Differentiation**: Difference methods based on undetermined coefficients- optimum choice of step length– Partial differentiation. Numerical Integration: Method based on interpolation-method based on undetermined coefficient – Gauss – Lagrange interpolation method- Radau integration method- composite integration method – Double integration using Trapezoidal and Simpson's method.

**10 Hours**

**Module 5: Ordinary Differential Equation**: Euler's method – Backward Euler method – Midpoint method – single step method, Taylor's series method-Boundary value problems.

**10 Hours**

**Note**

1. Emphasis is on developing algorithms / flow charts and converting them into working programs.
2. Programs can be written in C / C++ / Matlab or any other programming language that the student finds it suitable. In the class, C++ and/or Matlab will be used.
3. Pre-requisites: Working knowledge of C / C++ / Matlab. This shall be done during I & II Semesters through value addition courses.

**Reference Books:**

[1] Gerald, C.F. and Wheatley, P.O., Applied Numerical Analysis, 6ed. Pearson Education, 1999.

[2]Chapra, S.C. and Canale, R.P., Numerical Methods for Engineers with Programming
and Software Applications, 3ed., Tata McGraw Hill, New Delhi, 1998.
[3] Schilling, R.J. and Harries, S.L., Applied Numerical Methods for Engineers using
Matlab and C, Thomson Brooks/Cole, 2000.

## 20PCDSE130 Composite and Smart materials (4-0-0) 4

**Contact Hours: 52**

**Course Learning Objectives (CLOs):** A great deal of fundamental and developmental research has been made to bring composite materials in various applications such as automobile, space, medical, automotive, building construction, etc. The advent of composite materials has introduced a new dimension in application of energetic, smart and reactive materials. The objective of this course is to know the processing and application of composite and smart materials.

**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | | Mapping to POs (1 to 3) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |
| CO-1 | Identify and understand the basic properties and manufacturing process along with their application for different types of composites. | 3 | 1 | |
| CO-2 | Compose and Analyze Laminated Composites | 3 | 1 | |
| CO-3 | Failure theories of composites and Analyze Cross-ply and Angle-ply Laminates | 3 | 1 | |
| CO-4 | Familiarize with different classes of ceramic and polymeric smart materials; development of actuators and sensors and their integration into a smart structure | 3 | 1 | |
| CO-5 | Generate controllable force and response of a system. | 3 | 1 | |

| | | | | |
|---|---|---|---|---|
| | Monitor the response of the system. | | | |

| POs | PO-1 | PO-2 | PO-3 |
|---|---|---|---|
| Mapping Level | 2 | | 3 |

**Prerequisites:**

1. Strength of Materials
2. Structural Analysis I & II
3. Matrix Method of Analysis

**Contents:**

**Module1: Introduction to Composite materials** Classifications and applications. Of fibers, volume fraction and load distribution among constituents, minimum & critical volume fraction, compliance & stiffness matrices, coupling

**10 Hours**

**Module2: Anisotropic elasticity** Unidirectional and anisotropic lamina, thermo-mechanical properties, micro- mechanical analysis, classical composite lamination theory, Cross and angle—ply laminates, symmetric, antisymmetric and general symmetric laminates, mechanical coupling, and laminate stacking

**11 Hours**

**Module3: Analysis of simple laminated structural elements** Ply-stress and strain, lamina failure theories-first Ply failure, environmental effects, manufacturing of composites.

**11 Hours**

**Module4: Smart materials** Introduction, Types of smart structures, actuators & sensors, embedded & surface mounted, piezoelectric coefficients, phase transition, piezoelectric constitutive relation

**10 Hours**

**Module5:** Beam modeling with strain actuator, bending extension relation

**10 Hours**

**Reference Books:**

[1]Robart M Jones,“Mechanics of Composite Materials”,McGraw Hill Publishing Co.

[2]Bhagwan D Aggarwal, and Lawrence J Brutman,“Analysis and Performance of Fiber Composites”,John Willy and Sons.

[3]MadhujitMukhopadhyay, “Mechanics of Composite Materials and Structures”,Universities Press(2004)

[4]Lecture notes on "SmartStructures", by Inderjith Chopra, Department of Aerospace Engg., University of Maryland.
[5]Crawley, E and DeLuis, J.,"Use of piezoelectric actuators as elements of intelligent structures",AIAA Journal,Vol.25No10, Oct 1987, PP1373-1385.
[6]Crawley, E and Anderson,E.,"Detailed models of Piezoceramic actuation of beams",Proc. Of the 30th AIAA/ASME/ASCE/AHS/ASC- Structural dynamics and material conference, AIAA WashingtonDC,April1989.

## 20PCDSL104 Cad lab —Structural Analysis (0-0-3) 2

**Contact Hours: 35**

**Course Learning Objectives (CLOs):**In a professional design scenario, it is very important to use industry standard software in a Proficient manner besides knowing the theoretical concepts of structural analysis. The programming exercises help in understanding the implementation of algorithms into a program.

**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | | Mapping to POs (1 to 3) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |
| CO-1 | Use industry standard software in a professional set up. | **2** | **3** | |
| CO-2 | Apply finite element modeling, specification of loads and boundary condition, performing analysis and interpretation of results for final design | **2** | **3** | |
| CO-3 | Develop customized design automation tools | **2** | **3** | |

| **POs** | PO-1 | PO-2 | PO-3 |
|---|---|---|---|
| **Mapping Level** | | 3 | 2 |

**Contents:**

1. Structural Analysis of 2D and 3D Trusses

2. Structural Analysis of Continuous Beams using for different types of loadings and support conditions

3. Structural Analysis of 2D and 3D Rigid and Braced Frames for different types of loadings , support conditions, section orientations and stiffness variation between columns and beams, Member offsets, End release, Tension only members, Active and Inactive member specifications, Soil - Structure Interaction Problems using Winkler Springs

4. Program Development for Matrix operations- Multiplication, Transpose, Inverse, Gauss elimination and Gauss-Seidel, Cholesky methods for solution of linear system of equations using VBA / MATLAB / C++

5. Program Development for Analysis of Trusses, Beams and Frames using VBA / MATLAB / C++

   * *Exercises 1 to 3 on Structural Analysis using Industry Standard Software's*

**20PCDSL105 Seminar (0-0-2) 1**

**Course Learning Objectives (CLOs):** Develop skills in searching technical literature, analyzing and evaluating it to compare the various approaches and prepare a written report and also presenting it orally.

**Course Outcomes (COs):**

| **Description of the Course Outcome: At the end of the course the student will be able to:** | | **Mapping to POs (1 to 3)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Prepare reports and compile data. | | **2** | |
| CO-2 | Prepare presentations and communicate findings to the audience. | | **2** | |

| POs | PO-1 | PO-2 | PO-3 |
|---|---|---|---|
| Mapping Level | | 2 | |

The student has to prepare, submit a seminar report and make a presentation on the Seminar topic allotted. The seminar shall be evaluated as internal assessment by a committee constituted by the HOD.

## II Semester

| 20PCDSC201 | Structural Stability Analysis - Classical and FE Approach | (4-0-0) 4 |
|---|---|---|

**Contact Hours: 52**

**Course Learning Objectives (CLOs):** The objective of this course is to learn buckling characteristics of various structural elements and plates by energy and FE approach. Solution to practical problems will be emphasized including integration with finite element analysis. The delivery of topics will be made through lecture classes.

**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | | Mapping to POs (1 to 3) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |
| CO-1 | Illustrate detailed treatment of buckling characteristics of various structural elements | **1** | **3** | |
| CO-2 | Calculate critical load by elastic energy method | **1** | **3** | |
| CO-3 | To assess different methods to solve stability problems including integration with finite element procedures | **1** | **3** | |
| CO-4 | Calculate and analyze buckling of simply supported rectangular plate | **1** | **3** | |
| CO-5 | Calculate and analyze buckling of simply supported rectangular plate under combined bending and compression | **1** | **3** | |

| POs | PO-1 | PO-2 | PO-3 |
|---|---|---|---|
| Mapping Level | 3 | | 2 |

**Prerequisites:**

1. Strength of Materials
2. Structural Analysis I & II

**Contents:**

**Module 1: Beam column**: Differential equation. Beam column subjected to (i) lateral concentrated load, (ii) several concentrated loads, (iii) continuous lateral load. Application of trigonometric series. Euler's formulation using fourth order differential equation for pinned-pinned, fixed-fixed, fixed-free and fixed- pinned columns.

**11 Hours**

**Module 2: Buckling of frames and continuous beams:** Elastic Energy method: Approximate calculation of critical loads for a cantilever. Exact critical load for hinged-hinged column using energy approach. Buckling of bar on elastic foundation. Buckling of cantilever columns under distributed loads. Determination of critical loads by successive approximation. Bars with varying cross section. Effect of shear force on critical load. Columns subjected to non-conservative follower and pulsating forces.

**11 Hours**

**Module 3: Stability analysis by finite element approach**: Derivation of shape functions for a two noded Bernoulli-Euler beam element (lateral and translational DOF) —element stiffness and Element geometric stiffness matrices — Assembled stiffness and geometric stiffness matrices for a discretized column with different boundary conditions — Evaluation of critical loads for a discretized (two elements) column (both ends built-in). Algorithm to generate geometric stiffness matrix for four noded and eight noded isoparametric plate elements. Buckling of pin jointed frames (maximum of two active DOF)-symmetrical single bay Portal frame.

**10 Hours**

**Module 4: Buckling of simply supported rectangular plate:** Buckling of uniformly compressed rectangular plate simply supported along two opposite sides perpendicular to the direction of compression and having various edge condition along the other two sides- Buckling of a Rectangular Plate Simply Supported along Two opposite sides and uniformly compressed in the Direction Parallel to Those sides.

**10 Hours**

**Module 5: Buckling of simply supported rectangular plate —combined effects**: Buckling of a Simply Supported Rectangular Plate under Combined Bending and Compression — Buckling of Rectangular Plates under the Action of Shearing Stresses — Other Cases of Buckling of Rectangular Plates.

**10 Hours**

**Reference Books:**

[1]Stephen P. Timoshenko, James M. Gere, "Theory of Elastic Stability", 2nd Edition, McGraw-Hill, New Delhi.
[2]Zeiglar.H," Principles of Structural Stability", Blasdell Publication
[3] Robert D Cook et al, "Concepts and Applications of Finite Element Analysis", 3rd Edition, John Wiley and Sons, New York
[4]Rajashekaran. S, "Computational Structural Mechanics", Prentice-Hall, India.
[5]Ray W Clough and J Penzien,"Dynamics of Structures", 2nd Edition, McGraw-Hill,New Delhi.

| 20PCDSC202 | Advanced Design of Reinforced Concrete Structural Elements | (4-0-0) 4 |
|---|---|---|

**Contact Hours: 52**

**Course Learning Objectives (CLOs):**To provide a detailed treatment of fundamental concepts for the design of RC structural elements, and to present different methods for the design of RC beams subjected to shear and torsion, Deep beams, flat slab systems including integration with finite element procedures. The course also aims at explaining the underlying theory for the provisions in IS standards.

**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | | Mapping to POs (1 to 3) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |
| CO-1 | Discuss the behavior of Reinforced Concrete Beams in Shear and Torsion. | | 1,3 | |
| CO-2 | Apply redistribution of moments in design of Reinforced Concrete beam. | 1,3 | | |
| CO-3 | Design of Reinforced Concrete Deep Beams | 1,3 | | |
| CO-4 | Analysis and design of | 1,3 | | |

| | | | | |
|---|---|---|---|---|
| | compression members | | | |
| CO-5 | Design of flat slabs | | 1,3 | |

| POs | PO-1 | PO-2 | PO-3 |
|---|---|---|---|
| Mapping Level | 2.6 | | 2.6 |

**Prerequisites:**

1. Strength of Materials
2. Structural Analysis I & II
3. Design of RC elements

**Contents:**

**Module 1: Behavior of RC Beams in Shear and Torsion**: Modes of Cracking , Shear Transfer Mechanisms , Shear Failure Modes, Critical Sections for Shear Design , Influence of Axial Force on Design Shear Strength, Shear Resistance of Web Reinforcement, Compression Field Theory, Strut-and- Tie Model. Equilibrium Torsion and Compatibility Torsion, Design Strength in Torsion, Design Torsional Strength with Torsional Reinforcement. **11 Hours**

**Module 2: Redistribution of Moments in RC Beams**: Conditions for Moment Redistribution — Final shape of redistributed bending moment diagram — Moment redistribution for a two-span continuous beam— Advantages and disadvantages of Moment redistribution — Modification of clear distance between bars in beams ( for limiting crack width) with redistribution — Moment — curvature Relations of Reinforced Concrete sections . Curtailment of tension Reinforcement - code procedure — Numerical Example. **11 Hours**

**Module 3: Design of Reinforced Concrete Deep Beams**: Introduction — Minimum thickness -Steps of Designing Deep beams — design by IS 456 - Detailing of Deep beams. **10 Hours**

**Module 4: Behavior and Analysis of Compression Members**: Effective Length Ratios of Columns in Frames, Code Charts — Numerical Examples, Short Columns - Modes of Failure in Eccentric Compression, Axial Load - Moment Interaction equation, Interaction Surface for a Biaxial Loaded Column, Concept of Equilibrium approach and application to Non rectangular columns. Slender Column: Braced and Unbraced, Design Methods as per IS 456 — Strength Reduction and Additional Moment Method. **10 Hours**

**Module 5: Flat Slab Design**: Behavior of Slab supported on Stiff ,Flexible

and no beams , Equivalent Frame Concept, Proportioning of Slab Thickness, Drop Panel and Column Head, Transfer of Shear from Slab to column, Direct Design Method, Equivalent Frame Method — Design Examples. FE analysis and design of Slab Panels based on Wood-Armer equations. **10 Hours**

**Reference Books:**

[1] S. Pillai, DevdasMenon- Reinforced concrete design 3/ED 3rd Edition

[2] Varghese. P.C., Advanced Reinforced Concrete design, Prentice, Hall of India,

[3] Krishna Raju — "Advanced R.C. Design", CBSRD, 1986,

[4] Park R. and Paulay, T., Reinforced Concrete Structures, John Wiley and sons.

[5]Karve.S.R. and Shah V.L., Limit State theory and design of Reinforced Concrete, Pune Vidyarthi Griha Prakashan, Pune.

## 20PCDSE225 Analysis of Plates - Classical and FE Approach (4-0-0) 4

**Contact Hours: 52**

**Course Learning Objectives (CLOs):** The primary objective of this course is to learn classical methods in theory of plates pertaining to the analysis of solids. Focus will be given to the use of general relationships in the solution of plate bending problems. Solution to practical problems will be emphasized including integration with finite element analysis. The delivery of topics will be made through lecture classes.

**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | | Mapping to POs (1 to 3) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |
| CO-1 | Apply knowledge of mathematics, science, and engineering by developing the Equilibrium equations for plate element | **1** | **3** | |
| CO-2 | Formulate, analyze and solve two dimensional plate | **1** | **3** | |

| | | | | |
|---|---|---|---|---|
| | elements using strain energy approaches. | | | |
| CO-3 | Formulate, analyze and solve simply supported rectangular plate element | **1** | **3** | |
| CO-4 | Formulate Rectangular plates with different edge conditions | **1** | **3** | |
| CO-5 | Formulate, analyze and solve circular plate | **1** | **3** | |

| **POs** | PO-1 | PO-2 | PO-3 |
|---|---|---|---|
| **Mapping Level** | 3 | | 2 |

**Prerequisites**

1. Strength of Materials
2. Structural Analysis I & II

**Contents:**

**Module 1: Pure Bending of plates:** Introduction - Slope and curvature of slightly bent plates — Displacement strain relations, Strains in terms of displacements, strain-stress relations, expressions for moments. Small deflections of laterally loaded plates- stress resultants on a typical plate element, equations of equilibrium, expressions for vertical shears and boundary conditions. Strain energy in pure bending- Expression for total energy, Analysis of plates subjected to uniformly distributed load by energy method. **11 Hours**

**Module 2: Simply supported rectangular plates –** Double Fourier series expressions for loads, Navier's solution for simply supported plates subjected to udl, patch udl, point load and hydrostatic pressure. Bending of rectangular simply supported plates subjected to a distributed moment at a pair of opposite edges. **11 Hours**

**Module 3: Rectangular plates with different Edge conditions:** Levy's solution for rectangular plates – Analysis of rectangular plate subjected to UDL (i) two opposite edges simply supported and the other two edges clamped, (ii) three edges simply supported and one edge built-in and (iii) all edges built-in **10 Hours**

**Module 4: Circular Plates:** Differential equation for symmetrical bending of laterally loaded circular plates — uniformly loaded circular plates with and without central cutouts, with two different boundary conditions (simply supported

and clamped). Centrally loaded clamped circular plate. **10 Hours**

**Module 5: FE approach**: Finite Element Analysis of Thin Plate: Triangular Plate Bending Element, Rectangular Plate Bending Element, Finite Element Analysis of Thick Plate. **10 Hours**

**Reference Books:**

[1]Timoshenko and Krieger, "Theory of Plates and Shells", McGraw-Hill International Book Company
[2]Chandrashekara K, "Theory of Plates", University Press
[3]SSBhavikatti, " Theory of Plates and Shells", New Age International Publishers
[4]Robert D Cook et al, "Concepts and Applications of Finite Element Analysis", 3rd Edition, John Wiley and Sons, New York
[5]Szilard. R, "Theory and analysis of plates-classical and numerical Methods"
[6]Ugural A C, "Stress in Plates and shells", McGraw-Hill International Book Company

## 20PCDSE226 Reliability Analysis and Design of Structural Elements (4-0-0) 4

**Contact Hours: 52**

**Course Learning Objectives (CLOs):** Assessment of safety of structures is a very important task of structural engineers. The action and response are subjected to statistical variations and are probabilistic. The primary objective of this course is to learn different methods of evaluation of safety taking into account the variation of design parameters.

**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | | Mapping to POs (1 to 3) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |
| CO-1 | Summarize concepts and techniques of reliability and probability distributions | **1,3** | | |
| CO-2 | Define safety format or failure surface for a given action and | **1,3** | | |

| | | | | |
|---|---|---|---|---|
| | response along with their statistics. | | | |
| CO-3 | Compute reliability index, for the given design details | **1,3** | | |
| CO-4 | Arrive at mean value of a dominant design parameter for the target reliability index | **1,3** | | |
| CO-5 | Use simulation techniques to arrive at the statistics of design variables | **1,3** | | |

| **POs** | PO-1 | PO-2 | PO-3 |
|---|---|---|---|
| **Mapping Level** | 3 | | 3 |

**Prerequisites:**

1. Engineering Mathematics

**Contents:**

**Module 1: Concept of variability:** Applications of Statistical principles to deal with randomness in basic variables, statistical parameters and their significance, curve fitting, correlation and regression.

**10 Hours**

**Module 2: Description of various probability distribution:** Probability theory, binomial, Poisson, Normal, Log-normal, External distributions, Testing of Goodness of fit of distribution to the actual data using Chi-square method.

**11 Hours**

**Module 3: Basic structural reliability**: Random variables, continuous variables, discrete variable and computation of structural reliability.

**11 Hours**

**Module 4: Reliability methods:** Introduction, Basic variables and Failure surface, FOSM, Hasofer and Lind Method (AFOSM), determination of 'β' for present designs.

**10 Hours**

**Module 5: Simulation techniques and reliability based design**: Monte Carlo method, Applications, Reliability based design. Determination of partial safety factors, Safety checking formats.

**10 Hours**

**Reference Books:**

[1] Ang A.H.S and W.H. Tang, Probability concepts in Engineering planning and Design, John Wiley and sons, New York, Vol. I and II.

[2] Ranganthan R, Reliability Analysis and Design of Structures, Tata McGraw Hill publishing Co. Ltd., New Delhi.

[3] John B. Kennedy and Adam Neville, Basic Statistical Methods for Engineers and Scientists,

[4] Harper and Row Publishers, New York. Robert E. Melchers, Structural Reliability Analysis and Prediction, Wiley

## 20PCDSE227 Advanced Design of Steel Structures (4-0-0) 4

**Contact Hours: 52**

**Course Learning Objectives (CLOs):** This course covers the advanced principles of the design of hot-rolled and cold-formed steel structural members. Reference is made to the IS 800 and 811 standards, explaining the underlying theory for the provisions in these standards. The objectives are to provide students with advanced knowledge of steel structural design and confidence to apply the underlying principles to solve a wide range of structural steel problems. The delivery of topics will be made through lecture classes.

**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | | Mapping to POs (1 to 3) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |
| CO-1 | Analyze and Design of Laterally unrestrained beams | **1,3** | | |
| CO-2 | Analyze and Design of beams subjected to torsion and bending | **1,3** | | |
| CO-3 | Analyze and Design of Beam-column in frames | **1,3** | | |
| CO-4 | Analyze and Design of Beams | **1,3** | | |

| | | | | |
|---|---|---|---|---|
| | with web opening | | | |
| CO-5 | Analyze and Design of cold formed steel sections | **1,3** | | |
| CO-6 | Discuss, Analyze and Design of fire resistance steel structures | **1,3** | | |

| POs | PO-1 | PO-2 | PO-3 |
|---|---|---|---|
| **Mapping Level** | **3** | | **3** |

**Prerequisites:**

1. Strength of Materials
2. Design of steel structures

**Contents:**

**Module 1: Laterally Unrestrained Beams:** Lateral Buckling of Beams, Factors affecting lateral stability, IS 800 code provisions, Design Approach. Lateral buckling strength of Cantilever beams, continuous beams, beams with continuous and discrete lateral restraints, Mono- symmetric and non- uniform beams — Design Examples

**11 Hours**

**Module 2: Beams subjected to Torsion and Bending:** Shear Center and Warping, Uniform and Non-Uniform torsion, Concepts, Methods of evaluating the torsional effects, IS 800 Code provisions, Design examples: Rolled and Hollow Sections.

**11 Hours**

**Module 3: Beam- Columns in Frames:** Behavior of Short and Long Beam - Columns, Effects of Slenderness Ratio and Axial Force on Modes of Failure, Biaxial bending, Strength of Beam Columns, Sway and Non-Sway Frames, Strength and Stability of rigid jointed frames, Effective Length of Columns-, Methods in IS 800 – Examples

**10 Hours**

**Module 4: Steel Beams with Web Openings:** Shape of the web openings, practical guide lines, and Force distribution and failure patterns, Analysis of beams with perforated thin and thick webs, Design of castellated beams, Vierendeel girders

**10 Hours**

**Module 5: Cold formed steel sections and Fire resistance:** Techniques and properties, Advantages, Typical profiles, Stiffened and unstiffened elements, Local buckling effects, effective section properties, IS 811 code provisions-numerical examples, beam design, column design. Fire resistance level, Period of Structural Adequacy, Properties of steel with temperature, Limiting Steel temperature, Protected and unprotected members, Fire resistance ratings-Numerical Examples. **10 Hours**

**Reference Books:**

[1] N. Subramanian, Design of Steel Structures, Oxford, IBH.
[2] Duggal.S. K., Limit State Design of Steel structures. Tata McGraw-Hill.
[3] S.S.Bhavikatti Design of Steel Structures, by limit state method as per IS 800-2007, IK publication.

## 20PCDSE228 Design of Stack Tower and Water Storage Structural Systems (4-0-0) 4

**Contact Hours: 52**

**Course Learning Objectives (CLOs):**To illustrate the quintessential differences in the design of stack, tower and water storage structural systems with reference to other structural systems The delivery of topics will be made through lecture classes.

**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | | Mapping to POs(1 to 3) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |
| CO-1 | Analyze and Design of Steel Chimneys | **3** | **1** | |
| CO-2 | Analyze and Design of Transmission line towers | **3** | **1** | |
| CO-3 | Analyze and Design of Trestles | **3** | **1** | |
| CO-4 | Analyze and Design of water storage structures | **3** | **1** | |
| CO-5 | Analyze and Design of over-head tanks | **3** | **1** | |
| CO-6 | Analyze and Design of Steel | **3** | **1** | |

| | | | | |
|---|---|---|---|---|
| | Chimneys | | | |

| POs | PO-1 | PO-2 | PO-3 |
|---|---|---|---|
| Mapping Level | 2 | | 3 |

**Prerequisites:**

1. Strength of Materials
2. Design of steel structures

**Contents:**

**Module 1: Steel Chimneys:** Lining for chimneys — breach opening — Forces acting on steel chimneys including seismic forces — Analysis Design and Detailing of RC chimneys for different load combinations. Design of thickness of steel plate — Design of base plate — Design of anchor bolts — Design of foundation.

**11 Hours**

**Module 2: Transmission line towers of various shapes and member types:** Loads on towers — Analysis and Design of Steel transmission line towers. Design of Foundations

**11 Hours**

**Module 3: Trestles:** Analysis and design of Steel Trestles for vertical and horizontal loads

**10 Hours**

**Module 4: Water Storage structures:** Properties of un-cracked section — Calculation of thickness and reinforcement for Liquid retaining structure, Design and Detailing of underground, Ground Level

**10 Hours**

**Module 5: Overhead water tanks:** Circular, Rectangular on framed and Shaft type of Staging systems as per IS 3370 Parts 1 to 4

**10 Hours**

**Reference Books:**

[1] Ramachandra, Design of Steel structures Vol.1 and Vol. 2. Standard Publication
[2] S.K. Duggal, Design of Steel structures. Tata McGraw-Hill
[3] Vazirani & Ratwani, Steel structures, Vo1.III
[4] IS: 6533. Code of Practice for Design and Construction of steel chimneys.
[5] IS 802: Use Of Structural Steel in Overhead Transmission Line Towers — Code of Practice - Part 1 Material, Loads and Permissible Stresses

## 20PCDSE229 Seismic Resistant Design of Structural System (4-0-0) 4

**Contact Hours: 52**

**Course Learning Objectives (CLOs):**In this course, topics covered on Seismic hazard assessment, Earthquake effects on structures, Concepts of earthquake resistant design of earthen, masonry and RCC buildings are dealt with.

**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | | Mapping to POs (1 to 3) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |
| CO-1 | Interpret engineering seismology and Seismic hazard assessment. | **3** | **1** | |
| CO-2 | Evaluate earthquake forces and effect of earthquake on different types of structures. | **3** | **1** | |
| CO-3 | Differentiate the philosophy and principles of earthquake resistance design of structures. | **3** | **1** | |
| CO-4 | Illustrate Earthquake Resistance design of masonry and RCC buildings | **3** | **1** | |

| **POs** | PO-1 | PO-2 | PO-3 |
|---|---|---|---|
| **Mapping Level** | 2 | | 3 |

**Contents:**

**Module 1: Seismic Hazard Assessment-** Engineering Seismology, Definitions, Introduction to Seismic hazard, Earthquake phenomenon, Seismic tectonics and seismic zoning of India, Earthquake monitoring and seismic instrumentation, Characteristics of strong Earthquake motion, Estimation of Earthquake parameters, Micro zonation. **10 Hours**

**Module 2: Earthquake effects on structures**: Response to ground acceleration, response analysis by mode superposition, torsional response of buildings, response spectrum analysis, selection of design earthquake,

earthquake response of base isolated buildings, earthquake response of inelastic structures, allowable ductility demand Response Spectra / Average response Spectra, Design Response Spectra, Evaluation of earthquake forces (IS 1893 – 2002). Effect of earthquake on different types of structures – Lesson learnt from past earthquakes. **11 Hours**

**Module 3: Concepts of earthquake resistant design**- Structural Systems / Types of buildings, Causes of damage, Planning consideration/Architectural Concept (IS 4326–1993) (Do's and Don'ts for protection of life and property), Philosophy and principle of earthquake resistance design, Guidelines for Earthquake Resistant design. **11 Hours**

**Module 4: Earthquake Resistant Masonry Buildings** Earthquake Resistant low strength masonry buildings, Strength and Structural properties of masonry– Lateral load Design considerations. **10 Hours**

**Module 5: Earthquake Resistant Design of RCC Buildings**–Material properties–lateral load analysis design and detailing. Basic concepts of seismic base isolation and Seismic Isolation systems. **10 Hours**

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**Reference Books:**

[1] Chopra, A.K.-"Dynamics of structures", Prentice-Hall of India Pvt. Ltd. New Delhi.
[2] Clough, R.W. and Penzien J. - "Dynamics of Structures", McGraw Hill Book Co. New York
[3] S.K.Duggal -"Earthquake Resistant Design of Structures" Oxford publications New Delhi.

## 20PCDSE230 Advanced Structural Dynamics (4-0-0) 4

**Contact Hours: 52**

**Course Learning Objectives (CLOs):** The primary objective of this course is to learn advanced methods for solving problems in vibrations. Focus will be given to the use of general relationships in the solution of linear and non-linear problems. The course also addresses other sources of vibrations such as blast and water waves.



**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | | Mapping to POs (1 to 3) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |
| CO-1 | Analyze and solve dynamic response of MDOF system | **1,3** | | |
| CO-2 | Formulate, analyze and solve nonlinear structural dynamic | **1,3** | | |
| CO-3 | Define and describe random vibration | **1,3** | | |
| CO-4 | Formulate, analyze and solve blast loads on structures | **1,3** | | |
| CO-5 | Define and describe water waves and analyze response of structures to water waves | **1,3** | | |

| **POs** | PO-1 | PO-2 | PO-3 |
|---|---|---|---|
| **Mapping Level** | 3 | | 3 |

**Prerequisites:**

1. Structural dynamics

**Contents:**

**Module 1: Analysis of Dynamic Response of MDOF Systems by Direct Integration:** Basic concept of direct integration methods — central difference methods - Wilson - D Method - Newmark Method — Stability and accuracy of direct integration method.

**10 Hours**

**Module 2: Nonlinear Structural Response** — Classification of nonlinear analysis — Systems with nonlinear characteristics — formulation of incremental equations of equilibrium — numerical solution of nonlinear equilibrium equations for single degree freedom systems - linear acceleration step by step method, elastoplastic behavior, algorithm for the step by step solution for elastoplastic SDOF system. Newmark Method — Wilson - D - Method Response spectra — construction of a response spectrum, response spectrum for support disturbance, tripartite response spectra, response spectra for inelastic design. Non-liner Response of MDOF Systems — incremental equation of motion, Wilson-D method.

**11 Hours**

**Module 3: Introduction to Random Vibration** — Random functions, normal and Rayleigh's distribution, correlation, Fourier transform, spectral analysis, spectral density function, response to random excitation.

**10 Hours**

**Module 4: Blast Loads on Structure:** Sources of Blast Loads — shock waves — sound speed and Mach numbers. Shock pressure. Determination of blast loads — defining blast loads — structure loading. Strain rate effects — approximate solution technique for SDOF systems.

**10 Hours**

**Module 5: Basic Concepts of Water Waves** — Linear wave theory — dispersion equations — wave particle velocities- wave energies. Nonlinear waves- Stokes wave theory — Conidial Wave theory — stream function wave theory. Waves transformations — Shoaling - refraction — diffraction — dissipation —breaking. Wave statistics — significant wave — short term statistics — wave spectra — long term statistics. Wave information — wave measurements — Hind casts. **Response of Structures to Water Waves:** Morrison equation, force coefficient, linearized Morrison equation, inclined cylinders — transfer lift forces. Diffraction theory- scattering problem — wave forces on vertical walls — wave forces on a low vertical wall - wave forces on a rectangular structure.

**11 Hours**

**Reference Books:**

[1] Mario Paz, "Structural Dynamics, Theory and Computation", 2nd Edition, CBS Publisher and Distributors, New Delhi.
[2] Mukopadyaya, "Vibration, Dynamics and Structural Problems," Oxford IBH Publishers
[3] Ray W Clough and J Penzien, "Dynamics of Structures", 2nd Edition, McGraw-Hill, New Delhi. 1989.
[4] Joseph W Tedesco, William G McDougal, D. Allen Ross, " Structural Dynamics Theory and Applications" Publishers Addison Wesley Longman, Inc. Menlo Park, California 94025.

## 20PCDSE231 Design of Tall Structures (4-0-0) 4

**Contact Hours: 52**

**Course Learning Objectives (CLOs):** To summarize fundamental concepts for the design of tall structure and to present the influence of different loads on the tall structure. The course also aims at explaining the underlying theory for the provisions in IS standards.

**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | | Mapping to POs(1 to 3) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |
| CO-1 | Describe tall structures and the types of load acting on tall structures. | | **1** | |
| CO-2 | Explain dispersion of Lateral Forces, flooring system, wall panel system, and multi-story box system. | **3** | **1** | |
| CO-3 | Discuss different framing system and their comparison – drift and dynamic response of building | **3** | **1** | |
| CO-4 | Design of tall structure by approximate method | **3** | **1** | |
| CO-5 | Describe other latest tall structure framing system | **3** | **1** | |

| **POs** | PO-1 | PO-2 | PO-3 |
|---|---|---|---|
| **Mapping Level** | 2 | | 3 |

**Prerequisites:**

1. Strength of Materials
2. Structural Analysis I & II
3. Design of RC elements

**Course Contents:**

**Module 1:** Introduction to Tall Building in the Urban Context - The Tall Building and its Support Structure - Development of High Rise Building Structures - General Planning Considerations. Dead Loads – Live Loads-Construction Loads -Snow, Rain, and Ice Loads - Wind Loads-Seismic Loading – Water and Earth Pressure Loads - Loads - Loads Due to Restrained Volume Changes of Material - Impact and Dynamic Loads - Blast Loads -Combination of Loads.

**11 Hours**

**Module 2:** The vertical structure plane Dispersion of Vertical Forces- Dispersion of Lateral Forces – Optimum Ground Level Space - Shear Wall Arrangement -

Behavior of Shear Walls under Lateral Loading. The Floor Structure or Horizontal Building Plane Floor Framing Systems-Horizontal Bracing- Composite Floor Systems the High - Rise Building as related to assemblage Kits Skeleton Frame Systems – Load Bearing Wall Panel Systems - Panel – Frame Systems –Multi-storey Box Systems.

**10 Hours**

**Module 3:**Common high-rise building structures and their behavior under load The Bearing Wall Structure- The Shear Core Structure - Rigid Frame Systems-The Wall - Beam Structure: Interspatial and Staggered Truss Systems - Frame - Shear Wall Building Systems - Flat Slab Building Structures - Shear Truss – Frame Interaction System with Rigid - Belt Trusses - Tubular Systems-Composite Buildings - Comparison of High - Rise Structural Systems Other Design Approaches Controlling Building Drift Efficient Building Forms – The Counteracting Force or Dynamic Response.

**11 Hours**

**Module 4:**Approximate structural analysis and design of buildings Approximate Analysis of Bearing Wall Buildings the Cross Wall Structure - The Long Wall Structure The Rigid Frame Structure Approximate Analysis for Vertical Loading – Approximate Analysis for Lateral Loading - Approximate Design of Rigid Frame Buildings-Lateral Deformation of Rigid Frame Buildings The Rigid Frame - Shear Wall Structure – The Vierendeel Structure-The Hollow Tube Structure.

**10 Hours**

**Module 5:** Other high-rise building structure Deep - Beam Systems -High-Rise Suspension Systems – Pneumatic High -Rise Buildings - Space Frame Applied to High - Rise Buildings - Capsule Architecture.

**10 Hours**

**Reference Books:**

[1] Wolfgang Schuller - “High - rise building Structures", John Wiley and Sons, New York
[2] Bryan Stafford Smith and Alex Coull, “Tall Building Structures ", Analysis and Design, John Wiley and Sons, Inc., 1991.
[3] Coull, A. and Smith, Stafford, B. " Tall Buildings ", Pergamon Press, London, 1997.
[4] LinT.Y. and Burry D.Stotes, " Structural Concepts and Systems for Architects and Engineers ", JohnWiley, 1994.
[5] Lynn S.Beedle, “Advances in Tall Buildings”, CBS Publishers and Distributors, Delhi, 1996.
[6] Taranath.B.S.,“Structural Analysis and Design of Tall Buildings”, McGraw Hill,1998.

**20PCDSL204 Cad Lab—FE Analysis (0-0-3)2**

**Contact Hours: 35**

**Course Learning Objectives (CLOs):** In a professional design scenario, it is very important to use industry standard software in a Proficient manner besides knowing the theoretical concepts of structural analysis. The programming exercises help in understanding the implementation of algorithms into a program.

**Course Outcomes (COs):**

| **Description of the Course Outcome: At the end of the course the student will be able to:** | | **Mapping to POs (1 to 3)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Use industry standard software in a professional set up. | **2** | **1,3** | |
| CO-2 | Apply finite element modeling, specification of loads and boundary condition, performing analysis and interpretation of results for final design | **2** | **1,3** | |
| CO-3 | Develop customized design automation tools | **2** | **1,3** | |

| **POs** | PO-1 | PO-2 | PO-3 |
|---|---|---|---|
| **Mapping Level** | 2 | 3 | 2 |

**Contents:**

1. FE Analysis of Framed structures due to Seismic forces using modal dynamics
2. FE Analysis of Plane Stress and Plane Strain Problems
3. Flexural Behavior of Slab Panels with different aspect ratio and boundary conditions

4. FE Analysis of Slab panel resting on column supports- Drop Panels, Capitals

5. FE Analysis of Slab on Grade (Raft), Underpass, Bridge Structures

6. Programming exercises using C/VBA/VB/MATLAB for CST, LST and Rectangular Elements

* *Exercises 1to 5 on FE Analysis are aimed at using Industry Standard Software*

**References:**

[1]Timoshenko and Krieger, "Theory of Plates and Shells", McGraw-Hill International Book Company

[2] Chopra, A.K.-"Dynamics of structures", Prentice-Hall of India Pvt. Ltd. New Delhi.

[3] Clough, R.W. and Penzien J. - "Dynamics of Structures", McGraw Hill Book Co. New York

[4] Bathe.K.J, "Finite element procedures in Engineering Analysis" .PHI New Delhi

| 20PCDSL205 | Seminar | (0-0-2) 1 |
|---|---|---|

**Course Learning Objectives (CLOs):** Develop skills in searching technical literature, analyzing and evaluating it to compare the various approaches and prepare a written report and also presenting it orally.

**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | | Mapping to POs(1 to 3) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |
| CO-1 | Prepare reports and compile data. | | **2** | |
| CO-2 | Prepare presentations and communicate findings to the audience. | | **2** | |

| POs | PO-1 | PO-2 | PO-3 |
|---|---|---|---|
| Mapping Level | | 2 | |

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The student has to prepare, submit a seminar report and make a presentation on the Seminar topic allotted. The seminar shall be evaluated as internal assessment by a committee constituted by the HOD.

# Academic Program: PG

## Academic Year 2018-19

## Syllabus

# III & IV Semester M.Tech.

# COMPUTER AIDED DESIGN OF STRUCTURES

## Department of Civil Engineering


SHRI DHARMASTHALA MANJUNATHESHWARA COLLEGE OF ENGINEERING & TECHNOLOGY, DHARWAD – 580 002

**(An Autonomous Institution Approved by AICTE & Affiliated to VTU, Belagavi)**

**Ph**: **0836-2447465Fax: 0838-2464638 Web: www.sdmcet.ac.in**

# SDM College of Engineering & Technology, Dharwad

It is certified that the scheme and syllabus for III &IV semester M.Tech. Computer Aided Design of Structures is recommended by Board of Studies of Civil Engineering and approved by the Academic Council, SDM College of Engineering &Technology, Dharwad. This scheme and syllabus will be in force from the academic year 2018-19 till further revision.

Principal

Chairman BoS & HoD

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Date: 2023-02-08 20:45+05:30

SDM College of Engineering & Technology, Dharwad
Department of Civil Engineering

## COLLEGE VISION AND MISSION

VISION:

To develop competent professionals with human values

MISSION:

- To have contextually relevant curricula.
- To promote effective teaching learning practices supported by modern educational tools and techniques.
- To enhance research culture.
- To involve industrial expertise for connecting classroom content to real life situations.
- To inculcate ethics and impart soft-skills leading to overall personality development.

## DEPARTMENT VISION AND MISSION

VISION:

To be a Centre of excellence, practice state-of-art civil engineering education and developing high quality engineers to serve society.

MISSION:

The stated vision can be achieved through

- Development of robust curriculum to meet the expectations of industry.
- Interactive teaching-learning process with modern educational tools.
- Establishing synergy between teaching and research.
- Networking with industry.
- Interactive teaching-learning process with modern educational tools.
- Establishing synergy between teaching and research.
- Networking with industry.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

1. To provide proficiency in the basic principles and advanced courses of technology in Structural Engineering so that students are able to formulate, analyze and solve the societal problems for sustainable development related to structural Engineering.

2. To expose the students to the latest innovations and trends with a view to inculcate strong research orientation in structural engineering as well as in multidisciplinary streams.

3. To create a congenial environment that promotes learning, growth and imparts ability to work with inter-disciplinary groups in professional, industry and research organizations.

4. To produce Structural Engineers who integrate and build on the program's core curricular concepts in the pursuit of professional leadership, teamwork, life-long learning, and successful career advancement.

PROGRAMME OUTCOMES (PO):

PO1: An ability to independently carry out research/investigation and development work to solve practical problems

PO2: An ability to write and present a substantial technical report/document

PO3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

## Scheme of Teaching and Examination

## III Semester M. Tech.

| Course Code | Course Title | Teaching | | Examination | | | | |
|---|---|---|---|---|---|---|---|---|
| | | L-T-P (Hrs/Week) | Credits | CIE | Theory (SEE) | | Practical (SEE) | |
| | | | | Max. Marks | *Max. Marks | Duration in hours | Max. Marks | Duration in hours |
| 18PCDSC301 | Analysis and Design of Shell Roof Structures – Classical and FE Approach | 4-0-0 | 4 | 50 | 100 | 3 | | |
| 18PCDSExxx | Elective-7 | 4-0-0 | 4 | 50 | 100 | 3 | | |
| 18PCDSL302 /18PCDSExxx | Internship in Industry/R&D organization/ Elective 8 | ** Min 4 weeks during vacation after 2nd sem / 3-0-0 | 3 | 50/50 | -/100 | -/3 | 50/- | -/3 |
| 18PCDSL303 | *** Project phase -1 | 0-0-15 | 9 | 50 | | - | 50 | 3 |
| **Total** | | **11-0-15** | **20** | **200** | **200/300** | | **50** | |

**CIE**: Continuous Internal Evaluation **SEE**: Semester End Examination

**L**: Lecture **T**: Tutorials **P**: Practical

***SEE** for theory courses is conducted for 100 marks and reduced to 50 marks.

**** The students are expected to undergo training in industry for a period of four weeks during the vacation immediately after completion of II Semester examination. A faculty is to be allotted to guide the student. A committee consisting of three faculty members shall evaluate the work carried out and the knowledge the students have acquired. **OR The students can take one elective course if they do not undergo internship.**

***** Project phase-I: The students are expected to formulate the problem and carry out the intensive literature survey along with preliminary investigations supporting the project phase-II in IV semester.

| Course Code | Elective Courses |
|---|---|
| 18PCDSE325 | Design of Precast & Composite Structures |
| 18PCDSE326 | Advanced Mechanics of Materials |
| 18PCDSE327 | Advanced Design of Pre-Stressed Concrete Structures |
| 18PCDSE328 | Design of Substructures |
| 18PCDSE329 | Design of Structural Systems In Bridges |

**Scheme of Teaching and Examination**

**IV Semester M. Tech.**

| Course Code | Course Title | Teaching | | Examination | | | | |
|---|---|---|---|---|---|---|---|---|
| | | L-T-P (Hrs/Week) | Credits | CIE | Theory (SEE) | | Practical (SEE) | |
| | | | | Max. Marks | *Max. Marks | Duration in hours | Max. Marks | Duration in hours |
| 18PCDSL401 | Project Phase II | 0-0-24 | 22 | 100 | - | - | 100 | 3 |
| **Total** | | 0-0-24 | **22** | **100** | **-** | **-** | **100** | **-** |

**CIE**: Continuous Internal Evaluation **SEE**: Semester End Examination
**L**: Lecture **T**: Tutorials **P**: Practical
***** SEE for theory courses is conducted for 100 marks and reduced to 50 marks.
****** Project phase-II: The students are expected to work on a project for the full semester in an industry or an institution

**Detailed Syllabus**

**III Semester**

**18PCDSC301 Analysis and Design of Shell Roof Structures – Classical and FE Approach (4-0-0) 4**

**Contact Hours: 52**

**Course Learning Objectives (CLOs):** The primary objective of this course is to learn classical methods in theory of shell structures. Focus will be given to the use of general relationships in the solution of shell membrane and bending problems. Solution to practical problems will be emphasized including integration with finite element analysis.

**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | | Mapping to POs (1 to 3) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |
| CO-1 | Summarize and illustrate shell surfaces | **1** | **3** | |
| CO-2 | Formulate, analyze and design Membrane theory of cylindrical shells and spherical domes | **1** | **3** | |
| CO-3 | Formulate, analyze and design Membrane theory for shells of revolution | **1** | **3** | |
| CO-4 | Formulate, analyze and design | **1** | **3** | |

| | | | | |
|---|---|---|---|---|
| | Bending theory of cylindrical shells | | | |
| CO-5 | Formulate, analyze and design Folded plate roofs | **1** | **3** | |
| CO-6 | Formulate and Apply finite element method for shell element | **1** | **3** | |

| POs | PO-1 | PO-2 | PO-3 |
|---|---|---|---|
| **Mapping Level** | **3** | | **2** |

**Prerequisites:**

1. Strength of Materials
2. Structural Analysis I & II

**Contents:**

**Module 1: Module 1: Introduction to shells:** Classification of Shell Surfaces — Geometry, Shell Curvature, Geometrical developability. Thick and Thin Shells, Historical developments of shell theory, Load carrying Mechanism of shells, Advantages and disadvantages of shells.

11 Hours

**Module 2: Membrane Theory of Cylindrical Shells and Spherical Domes:** Cylindrical Shells: Elements, IS 2210 specifications, equations of equilibrium, Stresses in a Simply Supported Shell, Stress Resultants under Dead Load and Live Load for circular, cycloid, catenary, parabola and semi ellipse directrix. Spherical Domes: Notations, equations of equilibrium, expressions for stress resultants and ring tension for Dead, Live and Concentrated Load in domes with and without skylight, Proportioning and general detailing rules. Design Examples with and without skylight.

11 Hours

**Module 3: : Membrane Theory for shells of Revolutions:** Geometry of shell of revolutions, Equation of equilibrium for axi-symmetrically loaded shells, Solution of equation of equilibrium, Membrane Analysis and design of Conical shells, Hyperbolic Paraboloid

10 Hours

**Module 4: Bending Theory of Cylindrical Shells:** General bending theory, equations of equilibrium, Stress- Strain and Moment — Curvature relations. Analysis and Design of Cylindrical shells as per ASCE Manual No. 31.Design of Edge beams and Traverses. Rebar Detailing.

10 Hours

**Module 5: Folded Plate Roofs:** Types, Structural behavior- Slab and Plate Action, Analysis of Folded Plates: Stress distribution, Whitney and Simpsons method for analysis. Design Example: V Type and Trough Type, Detailing of Rebars.

**FE approach:** Shell elements, four and eight noded shell element and finite elements formulation

10 Hours

**Reference Books:**

[1] Timoshenko and Krieger, “Theory of Plates and Shells”, McGraw-Hill International Book Company
[2] P.C. Varghese, “Design of Reinforced Concrete Shells and Folded Plates, PHI
[3] S SBhavikatti, “ Theory of Plates and Shells”, New Age International Publishers
[4] Robert D Cook et al, “Concepts and Applications of Finite Element Analysis”, 3rd Edition, John Wiley and Sons, New York
[5]Chandrashekara K, “Theory of Plates”, University Press
[6] Ugural A C, “Stress in Plates and shells”, McGraw-Hill International Book Company

| 18PCDSE325 | Design of Precast & Composite Structures | (4-0-0) 4 |
|---|---|---|

**Contact Hours: 52**

**Course Learning Objectives (CLOs):** In this course, topics on Concepts and components of precast construction**,** Precast Systems**,** design of composite floors and beam elements are dealt.

**Course Outcomes (COs):**

| **Description of the Course Outcome: At the end of the course the student will be able to:** | | **Mapping to POs (1 to 3)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Explain the concepts and techniques of precast construction. | **1** | | |
| CO-2 | Design precast elements suitable for project specific requirements. | **1,3** | | |
| CO-3 | Design precast systems to ensure integrity and safety of structures. | **1** | | |
| CO-4 | Design composite floors and beam elements. | **3** | | |

| POs | PO-1 | PO-2 | PO-3 |
|---|---|---|---|
| **Mapping Level** | **3** | | **3** |

**Contents:**

**Module 1: Concepts and components of precast construction:** Need and types of precast construction, Modular coordination, basic module, planning and design modules, modular grid systems, National Building Code Specifications, Precast Elements- Hollow Core Slabs, TT, ST, Joists and Planks, Beams and Girders — R, L, I, IT, U shapes, Columns — Single Storey, Multi Storey (continuous), Wall Panels — Solid, Hollow core, Ribbed, Sandwich.

11 Hours

**Module 2: Design of precast elements:** Design Examples - Wall Panels, Hollow core slabs, Columns with corbels

11 Hours

**Module 3: Precast Systems:** Large panels, frames, Slab-column systems with walls, mixed. Connections in precast structures — Classification, Design considerations, Details- wall panel connection, column splices, Foundation connection, Beam, Slab. Handling and assemblage considerations, Structural integrity and avoidance of progressive collapse.

10 Hours

**Module 4: Composite Floors:** Structural Elements, Profiled Sheeting with concrete topping, Design method, Bending and Shear Resistance of Composite Slabs, Serviceability Criteria, Analysis for Internal forces and Moments, Design Steps

10 Hours

**Module 5: Composite Beams:** Elastic Behavior — No and Full interaction, Shear connectors, Load bearing Mechanism, Ultimate Load behavior of Composite beams, Stresses and deflection in service and vibration, Basic Design Considerations, Design Example of Simply Supported and Continuous Composite beams

10 Hours

**Reference Books:**


[1] Hass A.M. — Precast Concrete — Design and applications Applied Science, 1983.
[2] David Sheppard — "Plant cast, Precast and Prestressed concrete — McGraw Hill; 1989
[3] NBC— 2005 ( Part I to Part VII) BIS Publications, New Delhi, IS 15916-2011,IS 11447,IS6061 — Iand III
[4]R.P.Johnson: Composite Structure of Steel and Concrete (Volume 1), Blackwell Scientific Publication(Second Edition), U.K., 1994.
[5] IS: 11384-1985, Code of Practice for Composite Construction inStructural Steel and Concrete.
[6] INSDAG Teaching Resource Chapter 21 to 27: www.steel-insdag.org


| 18PCDSE326 | Advanced Mechanics of Materials | (4-0-0) 4 |
|---|---|---|

**Contact Hours: 52**

**Course Learning Objectives (CLOs):** The primary objective of this course is to learn classical methods in advanced mechanics of materials. Focus will be given to the use of general relationships in the solution of mechanics problems.

**Course Outcomes (COs):**

| **Description of the Course Outcome: At the end of the course the student will** | **Mapping to POs (1 to 3)** | | |
|---|---|---|---|
| | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |

| be able to: | | | | |
|---|---|---|---|---|
| CO-1 | Solve and analyze torsion of different cross sections | **3** | **1** | |
| CO-2 | Evaluate stress deflection of curved beams | **3** | **1** | |
| CO-3 | Define and explain thin wall beam and nonsymmetrical bending of straight beam | **3** | **1** | |
| CO-4 | Analyze and evaluate beams on elastic foundations | **3** | **1** | |
| CO-5 | Analyze and evaluate bents, frames, grids and beams circular in plan, types of beams with equally spaced supports | **3** | **1** | |

| POs | PO-1 | PO-2 | PO-3 |
|---|---|---|---|
| **Mapping Level** | **2** | | **3** |

**Prerequisites:**

1. Strength of Materials
2. Structural Analysis I & II

**Module1:Torsion**: Torsion of straight bars of Elliptic Cross-section– St.Venants semi-inverse method and Prandtl's function Approach– Membrane analogy– Torsion of a bar of narrow rectangular cross section Torsion of thin walled open cross sections– Torsion of thin walled tubes.

(11 Hours)

**Module2: Curved Beams**: Introduction, Circumferential stress in a curved beam, Radial stresses in curved beams, Correction for circumferential stresses in curved beams having I,T or similar cross sections, Deflections of curved beams, Statically indeterminate curved beams, Closed ring subjected to a concentrated load.

(11 Hours)

**Module3: Shear Center for Thin-Wall Beam Cross Sections**: Definition of shear center in bending Approximations employed for shear in thin-wall beam cross sections, Shear flow in thin-walled beam cross sections, Shear center for singly symmetric and unsymmetrical sections.

**Nonsymmetrical Bending of Straight Beams**: Symmetrical and nonsymmetrical bending, Bending stresses in beams subjected to nonsymmetrical bending, Deflections of straight beams subjected to non-symmetrical bending.

(10 Hours)

**Module4: Beams on Elastic Foundations**: General theory, Infinite beam subjected to concentrated load, Boundary conditions, Infinite beam subjected to a distributed load segment, Semi-infinite beam with different end conditions subjected to concentrated load and moment at its end-Short beams.

(10 Hours)

**Module5: Structures subjected to out of plane loading**: Analysis of simple bents, frames, grids and beams circular in plan– Cantilever beams, semicircular continuous beams with three equally spaced supports, circular beams with different number of equally spaced supports.

(10 Hours)

**Reference Books:**


[1]Arthur P. Boresi and Omar M. Sidebottom: "Advanced Mechanics of Materials "Fourth Edition, John Wiley & Sons, 1985

[2]James M. Gere and S.P.Thimoshenko: "Advanced Mechanics of Materials "Second Edition, CBS Publishers, New Delhi, 2000.

[3]Ugural .A. C. and Fenster. S.K "Advanced Strength of material and Applied Elasticity "Arnold Publishers, 1981.

[4]Junnarkar.S.B., "Mechanics of Structures ",Volume-III, Charotar Publications, Anand,


**18PCDSE327 Advanced Design of Pre-Stressed Concrete Structures (4-0-0) 4**

**Contact Hours: 52**

**Course Learning Objectives(CLOs):** Concept of shear and torsion in PSC. To study different types of composite beam and its behavior in flexural and shear. To discuss the precast bridge girders, segmental constructions and external prestressing.

**Course Outcomes (COs):**

| **Description of the Course Outcome: At the end of the course the student will be able to:** | | **Mapping to POs (1 to 3)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Design and Analyze Anchorage Zone stress in post-tensioned members | **1** | | **3** |
| CO-2 | Design and Analyze Shear and torsional resistance | **1** | | **3** |
| CO-3 | Design and Analyze Composite Beams | **1** | | **3** |
| CO-4 | Illustrate and evaluate Tension | **1** | | **3** |

| | | | | |
|---|---|---|---|---|
| | members and compression members Slab and grid floors | | | |
| CO-5 | Design and Analyze Precast elements, Railway sleepers | **1** | | **3** |

| POs | PO-1 | PO-2 | PO-3 |
|---|---|---|---|
| **Mapping Level** | **3** | | **1** |

**Prerequisites:**

1. Strength of Materials
2. Structural Analysis I & II

**Contents:**

**Module 1: Anchorage Zone stress in post-tensioned members-**Introduction to PSC, stress distribution in end block, investigations on anchorage zone stress, Magnel and Guyon's methods, comparative analysis, anchorage zone reinforcement.

11 Hours

**Module 2: Shear and torsional resistance-** Shear and principal stresses, ultimate shear resistance, design of shear reinforcement, torsion, design of reinforcement for torsion.

11 Hours

**Module 3: Composite Beams-**Introduction, types of composite beams, analysis for stress, differential shrinkage, serviceability limit state, design for flexural and shear strength

10 Hours

**Module 4: Tension members and compression members-**Introduction, ties, Columns, Short columns, long columns, biaxially loaded columns, pre-stressed concrete piles**.**
**Slab and grid floors-** Types of floor slabs, design of one way, two way and flat slabs.Distribution of prestressed tendons, analysis and design of grid floors.

10 Hours

**Module 5: Precast elements-**Introduction, pre-stressed concrete poles, manufacturing techniques, shapes and cross sectional properties, design loads, design principles**.**
**Railway sleepers-**classification and manufacturing techniques, design loads, analysis and design principles. Pre-cast bridge girders and segmental constructions, external pre-stressing.

10 Hours

**Reference Books:**


[1] Lin.T.Y and H.Burns, "Design of pre-stressed concrete structures"-John Wiley and sons,1982.

[2] N.Krishnaraju, "Pre-stressed concrete"- Tata McGraw-Hill,3rd edition,1995.

[3]P.Dayaratnam, "Pre-stressed concrete structures"-Oxford and IBH, 5th edition, 1991.

[4]G.S.Pandit and S.P.Gupta, "Pre-stressed concrete structures"-CBS Publishers, 1993.

[5]Guyon, "Pre-stressed concrete structures", Contractors Record books,1963.

[6] IS:1343:1980

| 18PCDSE328 | Design of Substructures | (4-0-0) 4 |
|---|---|---|

**Contact Hours: 52**

**Course Learning Objectives (CLOs):** To know the bearing capacity of soil and design parameters of substructures. Design of pile and special foundations.

**Course Outcomes (COs):**

| **Description of the Course Outcome: At the end of the course the student will be able to:** | | **Mapping to POs (1 to 3)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Explain and Illustrate Bearing capacity of soils | **1** | | **3** |
| CO-2 | Explain and Illustrate Design parameters for substructures | **1** | | **3** |
| CO-3 | Explain and Illustrate Pile foundations | **1** | | **3** |
| CO-4 | Explain and Illustrate Special foundations | **1** | | **3** |
| CO-5 | Explain and Illustrate Elements of soil dynamics and design of machine foundations | **1** | | **3** |

| POs | PO-1 | PO-2 | PO-3 |
|---|---|---|---|
| **Mapping Level** | **3** | | **1** |

**Prerequisites:**

1. Geotechnical Engineering
2. Structural Analysis I & II

**Contents:**

**Module 1: Bearing capacity of soils:** Generalized bearing capacity equation, field tests for bearing capacity and settlement estimation, settlement of shallow foundations-elastic and consolidation settlements, settlement estimation from penetration tests, settlement tolerance, allowable bearing pressure.

11 Hours

**Module 2: Design parameters for substructures:** factors influencing selection of depth of foundation, subgrade reaction, Winkler hypothesis and beams on elastic foundation, soil line method, foundations on expansive soils, geotechnical failure of foundations during earthquake-earth quake resistant design of shallow foundations, liquefaction and remedial measures

11 Hours

**Module 3: Pile foundations**-classification of pile foundation and general consideration of design, ultimate load capacity of piles, pile settlement, analysis of single pile and pile group, laterally loaded piles and ultimate lateral resistance, uplift resistance of piles and under reamed pile, pile load tests, design examples

10 Hours

**Module 4: Special foundations**-foundation for transmission line towers-necessary information, forces on tower foundation , general design criteria, choice and type of foundations, design procedure and design problems. soil-structure interaction in frame structures.

10 Hours

**Module 5: Elements of soil dynamics and design of machine foundations**- IS 2974: Part I to IV machine foundation system, block foundation, frame foundation, design criteria, tuning foundation, DOF of rigid block foundation, linear elastic spring, elastic half space analog, parameter influencing dynamic soil parameter, soil mass participation, vibration isolation system

10 Hours

**Reference Books:**


[1]Swamy Saran, "Analysis and Design of Substructures", 5th edition, Oxford and IBH Publishing co., Pvt, Ltd, New Delhi,1996.

[2] Swami Saran (1999), "Soil Dynamics and Machine Foundations", Galgotia publications pvt Ltd, New Delhi.

[3]Dr.B.C. Punmia, "Soil Mechanics and Foundation Engineering".Laxmi Publications,113, Golden House, Darya Ganj, New Delhi - 110002, India

[4] Varghese P.C., "Foundation engineering", Prentice hall of India, New Delhi

[5]Das B.M., "Principles of foundation Engineering", Thomson Brooks/ Cole Publishing Company, Singapore


| 18PCDSE329 | Design of Structural Systems In Bridges | (4-0-0) 4 |
|---|---|---|

**Contact Hours: 52**

**Course Learning Objectives (CLOs):** This course constitutes a transition from general building systems topics to specific applications within the context of structural engineering. It provides the foundation for advanced design and bridge analysis and integrates the finite element approach.

**Course Outcomes (COs):**

| **Description of the Course Outcome: At the end of the course the student will be able to:** | | **Mapping to POs (1 to 3)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Use the basic concepts in proportioning and design of | **1** | | **3** |

| | | | | |
|---|---|---|---|---|
| | bridges in terms of aesthetics, geographical location and functionality | | | |
| CO-2 | Assess the load flow mechanism and loads on bridges | **1** | | **3** |
| CO-3 | Design of Elevated bridge | **1** | | **3** |
| CO-4 | Design of underpass bridge | **1** | | **3** |
| CO-5 | Apply finite element method for Bridge element | **1** | | **3** |

| POs | PO-1 | PO-2 | PO-3 |
|---|---|---|---|
| **Mapping Level** | **3** | | **1** |

**Prerequisites:**

1. Strength of Materials
2. Structural Analysis I & II

**Contents:**

**Module 1: Introduction to bridge engineering Historical background of bridges and types**. Bridge aesthetics and proportioning. Bridge geometry. Conceptual design of various structural forms. Foundations with or without piles; abutments, retaining wall sand wing walls; columns and cap beams; bearings.

11 Hours

**Module 2: Loads on bridges (IRC6-2010)** Class 70 R, Class AA, Class A , Class B , Tracked Vehicle, Wheeled Vehicle, Load Combinations, Impact, Wind, Water Currents, Longitudinal Forces: acceleration, breaking and frictional resistance, Centrifugal forces, temperature, Seismic forces, Snow Load, Collision Loads. Load Combinations

11 Hours

**Module 3: Design of Elevated Bridges:** Solid slab bridges, Simple Girder bridges, PSC Girder Bridges

10 Hours

**Module 4: Design of Underpass -** Box Culverts

10 Hours

**Module 5: FE Concepts:** Discrete and Continuum models of Bridge Deck — Spine, Grillage, Surface models, Bridge Piers, Support and Loading conditions, Soil-Structure Interaction

10 Hours

**Reference Books:**

[1] Krishna Raju N " Design of Bridges," Oxford, IBH Publications New Delhi.
[2]JohnsonVictor, " Essential of Bridge Engineering," Oxford, IBH Publications, New Delhi
[3]Ponnuswamy, S., "Bridge Engineering", Tata McGraw Hill, 2008.
[4] IRC112 - 2011 Code of Practice for Concrete Road Bridges and Railway Board Codes
[5]Jagadeesh. T.R. and Jayaram. M.A., "Design of Bridge Structures", Prentice Hall of India
[6] Raina V.K." Concrete Bridge Practice" Tata McGraw Hill Publishing Company, New Delhi, 1991.
[7] IITK-RDSO GUIDELINES ON SEISMICDESIGN OF RAILWAY BRIDGES- Provisions withCommentary and Explanatory Examples , 2010

| 18PCDSL302 | Industrial Training | (4-Weeks) 3 |
|---|---|---|

**Course Learning Objectives (CLOs)**: To provide the structure and framework for learning outside of the classroom during training experience. The objective of training is to illustrate how a student will DO something and should be specific, strong and clear to provide an understanding of his/her needs and course they are pursuing.

**Course Outcomes (COs):**

| **Description of the Course Outcome: At the end of the course the student will be able to:** | | **Mapping to POs (1 to 3)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| **CO-1** | Experience of applying existing engineering knowledge in similar or new situations | 1,3 | 2 | |
| **CO-2** | Ability to identify when new engineering knowledge is required, and apply it | 1,3 | 2 | |
| **CO-3** | Ability to integrate existing and new technical knowledge for industrial application | 1,3 | 2 | |
| **CO-4** | Ability to demonstrate the impact of the internship on their learning and professional development | 1,3 | 2 | |
| **C0-5** | Understanding of lifelong learning processes through critical reflection of internship experiences. | 1,3 | 2 | |

| **POs** | **PO-1** | **PO-2** | **PO-3** |
|---|---|---|---|
| **Mapping Level** | 3 | 2 | 3 |

**Evaluation:**

1. Final internal evaluation of Industrial training - To be conducted by the internal guide of the college (After the completion of internship). **(50 marks).**

2. Viva-Voce on Internship Report- To be conducted internally is the internship guide (from the college) and external guide under whose supervision the student has carried out the internship **(50 marks).**

| 18PCDSL303 | Project phase - I | (0-0-15) 9 |
|---|---|---|

**Contact Hours: 120**

**Course Learning Objectives (CLOs):**
The students are expected to learn carrying out literature survey to locate the state of the art technology while formulating/defining the project problem in computer aided analysis and design of structures. The students are expected select a topic from an emerging area relevant to analysis and design of structures and/or other relevant branches and define the problem for the project work. The literature survey, visits, data collection, preliminary design, analysis etc. is to be done in this phase. The same work is to be continued in the next phase in IV sem.

**Course Outcomes (COs):**

| **Description of the Course Outcome: At the end of the course the student will be able to:** | | **Mapping to POs (1 to 3)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| **CO-1** | Carry out the literature survey to locate the state of the art technology in computer aided analysis and design of structures | 1,3 | 2 | |
| **CO-2** | Define/formulate the problem for the project work | 1,3 | 2 | |
| **CO-3** | Design, develop, analyze, test, interpret the results, fabricate, simulate, write code etc. relevant to his/her project work | 1,3 | 2 | |
| **CO-4** | Summarize the work and write a project report and present. | 2 | | |

| **PO's** | PO-1 | PO-2 | PO-3 |
|---|---|---|---|
| **Mapping Level** | 3 | 2.25 | 3 |

**Prerequisites:** Knowledge of both theory and practical courses learnt in all the previous Semesters and relevant value added information.

**Contents:**
1) The students are expected to locate the state of the art technology in computer aided analysis and design of structures through proper literature survey and select a topic from an emerging area relevant to structural engineering and/or other relevant branches and define the problem for

the project work. The literature survey, visits, data collection, preliminary design, analysis etc. is to be done in this phase.

2) Know the current challenges in analysis and design of structures and try suggesting solutions.

**Reference materials/books:**

Engineering books.
International reputed Journals.
Manuals and data sheets.
Software packages.
Previous project reports.
Product information brochures.
Interaction with academia and industrial experts.
Internet

## Project Phase-I Evaluation

- Presentation on formulating/defining the project problem, literature survey, visits, data collection, preliminary design, analysis etc. Will be evaluated for 100 marks by a committee formed by DPGC.

## IV Semester

| 18PCDSL401 | Project phase - II | (0-0-20)22 |
|---|---|---|

**Contact Hours: 200**

**Course Learning Objectives (CLOs):**

The students are expected to find out solutions individually in computer aided analysis and design of structures. They are expected to carry out the intensive literature survey to locate the state of the art technology in structural engineering. They must learn to formulate/define/locate real time problem for the project work. They will also learn to design, develop, analyze, test, interpret the results, fabricate, simulate, write code, and convert report in to papers for publication in journals to add value to the existing literature. They are also expected to acquire the skills of summarizing the work and writing a project report and present the same.

| **Description of the Course Outcome: At the end of the course the student will be able to:** | | **Mapping to POs (1 to 3)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | Carry out the literature survey to locate the state of the art technology in structural engineering. | 1,3,2 | | |
| CO-2 | Define/formulate/locate real time problem for the project work | 1,3 | | |
| CO-3 | Design, develop, analyze, test, interpret the results, fabricate, simulate, write code, prepare papers etc. | 1,3 | | |
| CO-4 | Summarize the work and write a project report and present the same | 2 | | |

| **PO's** | PO-1 | PO-2 | PO-3 |
|---|---|---|---|
| **Mapping Level** | 3 | 3 | 3 |

**Prerequisites:** Knowledge of both theory and practical courses learnt in all the previous Semesters and relevant value added information.

**Contents:**

1) The students are expected to locate the state of the art technology in his domain of structural engineering and select a topic from an emerging area relevant to computer aided analysis and design and define the problem for the project work. The literature survey, visits, data collection, preliminary design, analysis etc. is to be done in this phase.

2) Structure related analysis and design challenges and providing feasible solutions.

**Reference materials/books:**

1. Engineering books.
2. International reputed Journals.

3. Manuals and data sheets.
4. Software packages.
5. Previous project reports.
6. Product information brochures.
7. Interaction with academia and industrial experts.
8. Internet etc.

## Project Phase-II Evaluation

- Presentation on detailed design, implementation, validation, demonstration and report will be evaluated by internal guide for 100 marks.
- Final viva voce will be conducted by two examiners (Internal and an external member nominated by DPGC) for 100 marks.