## DEPARTMENT OF CIVIL ENGINEERING

*Scheme of Instruction*

*and*

*Syllabi of*

# B.E. (Civil Engineering)

### V & VI SEMESTER

# AICTE Model Curriculum

**2020-2021**

## UNIVERSITY COLLEGE OF ENGINEERING

**(AUTONOMOUS)**

## OSMANIA UNIVERSITY

**HYDERABAD – 500 007, TELANGANA**

*With effect from the Academic year 2020-2021*

# UNIVERSITY COLLEGE OF ENGINEERING

## Vision

The Vision of the Institute is to generate and disseminate knowledge through a harmonious blending of Science, Engineering and Technology. To serve the society by developing a modern technology in students' heightened intellectual, cultural, ethical and humane sensitivities, fostering a scientific temper and promoting professional and technological expertise.

## Mission

- To achieve excellence in Teaching and Research.
- To generate, disseminate and preserve knowledge.
- To enable empowerment through knowledge and information.
- Advancement of knowledge in Engineering, Science and Technology.
- Promote learning in free thinking and innovative environment.
- Cultivate skills, attitudes to promote knowledge creation.
- Rendering socially relevant technical services for the community.
- To impart new skills of technology development.
- To inculcate entrepreneurial talents and technology appreciation programmes.
- Technology transfer and incubation.

## DEPARTMENT OF CIVIL ENGINEERING

### Vision

To be as a leading academic department on pace with global standards and contribute to the regional growth and meet the Challenges of Civil Engineering Profession.

### Mission

- To produce highly competent and capable professionals to face the challenges and provide viable solutions to Civil Engineering problems
- Integration of their knowledge and skills to excel in the profession through continuous learning and contribute to the well-being of the society.
- To enhance the technical knowledge, research aptitude to serve the society in highly competent manner.

### Programme Educational Objectives (PEOs) for BE (Civil Engg.) Programme

| | |
|---|---|
| **PEO1** | Impart basic knowledge in the field of Civil Engineering. |
| **PEO2** | Develop skills to analyse and provide viable solutions to various Civil Engineering problems. |
| **PEO3** | Enhance communication skills and encourage team work. |
| **PEO4** | Prepare Civil Engineering professionals with zeal for research, life-long learning, and work for sustainable development of society with ethics. |

### Programme Outcomes (POs) for BE (Civil Engg.) Programme

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 modelling 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 project sand in multi disciplinary environments. |
| **PO12** | **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. |

**Program Specific Outcomes (PSOs) For BE (Civil Engg.) Programme**

Engineering Graduates will be able to:

| | |
|---|---|
| **PSO1** | **Analytical Skill:** Ability to plan, execute, manage, maintain and rehabilitate civil Engineering systems and processes. |
| **PSO2** | **Enterprising Skill:** Ability to become independent practitioners, consultant and entrepreneurs of Civil Engineering. |

# SCHEME OF INSTRUCTION

## B.E. (Civil Engineering)

## V – SEMESTER

| S.No. | Course Code | Course Title | Scheme of Instruction | | | | Cont-act hours/ week | Scheme of Examination | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | Dr | P | | CIE | SEE | |
| 1 | HS 901LA | Law in Civil Engineering | 2+1* | 0 | 0 | 0 | 3 | 30 | 70 | 2 |
| 2 | HS 501EG | Business Communication and Presentation Skills | 3 | 0 | 0 | 0 | 3 | 30 | 70 | 3 |
| 3 | PC 501CE | Soil Mechanics | 3 | 0 | 0 | 0 | 3 | 30 | 70 | 3 |
| 4 | PC 502CE | Water Resources Engineering | 3 | 0 | 0 | 0 | 3 | 30 | 70 | 3 |
| 5 | PC 503CE | Theory of Structures | 3 | 0 | 0 | 0 | 3 | 30 | 70 | 3 |
| 6 | PC 504CE | Concrete Technology | 3 | 0 | 0 | 0 | 3 | 30 | 70 | 3 |
| 7 | ES 501CE | Disaster Risk Management | 2 +1* | 0 | 0 | 0 | 3 | 30 | 70 | 2 |
| **Practicals** | | | | | | | | | | |
| 8 | PC 551CE | Soil Mechanics Laboratory | 0 | 0 | 0 | 2 | 2 | 25 | 50 | 1 |
| 9 | PC 552CE | Concrete Technology Laboratory | 0 | 0 | 0 | 2 | 2 | 25 | 50 | 1 |
| | | | **21** | **0** | **0** | **04** | **25** | 260 | 590 | **21** |

* Interactive Session

**Service Course: B.M.E.**

| S. No. | Course Code | Course Title | Scheme of Instruction | | | | Cont act hr/we ek | Scheme of Examination | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | **L** | **T** | **Dr** | **P** | | **CIE** | **SEE** | |
| 1 | MC 901 CE | Environmental Sciences | 2 | 1 | 0 | 0 | 3 | 30 | 70 | 0 |

*With effect from the Academic Year 2020 – 2021*

**HS 901LA**

# LAW IN CIVIL ENGINEERING

*Instruction: 2+1* Periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 2*

## Course Objectives

- To study the various types of practices of building bye laws and provisions
- To study the tenders, arbitration, legal requirements, labor and related legislations.
- Know the different types of Contracts in construction, arbitration legal aspects and its provision.

## Course Outcomes:

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

1. Understand the basics on applicability of building bye -laws.
2. Summaries the knowledge about General building requirements and services
3. Understand the basics on Infrastructure and Real Estate Engineering bye - laws
4. Associate the basic knowledge on different laws applicable to construction contracts.
5. Apply the basic knowledge on disputes and their resolution Mechanisms.

## UNIT – I

Practices of Building Bye –laws - l

Definitions - Jurisdiction and Applicability of the building bye laws - Building documentation - Development and part construction - Permission for Occupancy/ Part Completion Certificate - 111 G O guidelines in Telangana State- Flexible FAR Development norms and standards for hill towns Parking standard Specific premises Non-residential premises - Model Building Bye-laws- FTL bylaws - Farm houses.

## UNIT – II

Practices of Building Bye - laws - ll

General building requirements and safety provisions - Mezzanine Floor Store Room Garage Basement Chimneys Parapet Cabin Boundary Wall Septic Tanks Meter Rooms Staircase/Exit Requirements - Special Requirements of Low Income Housing - Space for Light and Ventilation - Joint Open Air Space - Provision of Podium for parking and landscaping - Building Services - Plumbing and Sanitary Services - Construction Site - Contents Model Building Bye-laws, 2016 - Temporary Camp Toilets - Special / Contingency Toilets - High Rise Peripheral Open Spaces including setbacks –terrace access and share of occupants -Parking Spaces - Building components - Inspection Alternative Materials, Methods of Design and Construction and Tests - Industrial Buildings (Factories, Workshops, etc.) - Educational Building (School/Colleges) - Assembly Building (Cinema, Theaters, etc.)

## UNIT – III

Infrastructure and Real Estate Engineering byelaws

Real Estate Scope - classification of real estate activities and peculiarities; Factors affecting real estate market; Role of Government in real estate market; Statutory provisions, Laws, rules, and regulation, land use controls in property development, registration and licensing requirements – environmental issues related to Real Estate Transactions. Role, Scope,

working characteristics and principal functions of real estate participants and stakeholders; real estate consultants and their activities, role and responsibilities of property managers; Code of ethics for Real Estate participants; - Real estate development - Real estate investment, Sources and related issues and RERA Laws and TDR acquisition, transfer and sale.

**UNIT – IV**

Contact law and conflict issues

Construction specifications and Standard specifications, development and interpretation - Contracts and management of Contracts - Types of engineering contracts- procurement philosophy - Definition and essentials of a Contract - Types of engineering contracts and its formulation -Preparation of tender documents – Issues related to tendering process – Awarding Contract - Provisions of Indian Contract Act,1872 – Breach of contract - Performance of Contracts- time of performance - Discharge of a Contract – Novation and Rescission of contracts - Classification of Contracts – variations in engineering Contracts – construction Contract documents – FIDIC Contracts – Infrastructure engineering and management - Laws related to construction industry - Labour welfare and safety laws – minimum Wages - Contract labour Compensation – Insurance and dispute settlement.

**UNIT – V**

Disputes and their resolutions Mechanisms

Concept of ADR – History and Reasons for the growth of ADR – Advantages of ADR – Legislative and Judicial Sanction for ADR – Important forms of ADR – Negotiation – Mediation - Conciliation - Arbitration –Ombudsman – Arbitration Agreement - Essentials - Rule of severability - Power of Court to refer parties to arbitration - Interim measures - Composition of Arbitral Tribunal - Number of arbitrators - Appointment of arbitrators - Grounds for challenge - Challenge procedure - Jurisdiction of Arbitral Tribunal - Conduct of Arbitral Proceedings, Equal treatment of parties - Determination of rules of procedure - Place of arbitration - Expert appointment by arbitral tribunal. Making of Arbitral Award and termination of proceedings - Form and contents of arbitral award. Recourse against Arbitral Award - Finality and Enforcement of Arbitral Awards – Appeals ,Conciliation - Appointment of Conciliator- Role of Conciliator- Commencement of conciliator proceedings, termination of conciliation proceedings.

**References:-**


1. Model Building Byelaws, Town and Country Planning Organization, Ministry of Urban Development., 2016, Available: http://www.indiaenvironmentportal.org.in/files/file/MODEL%20BUILDING%20BYE%20LAWS-2016.pdf
2. “Codes of Practice and Standard Specifications” of AP PWD, CPWD, MES etc.,
3. B.J. Vasavada, “Engineering Contracts and Arbitration”, 2nd Edition, Jubilee Publications, 1996.
4. G.T. Gajaria “Laws relating to Building and Engineer’s Contracts”, 1 st Edition, M.M. Tripathi Private Limited, Mumbai, 1985.
5. O.P. Malothra, The law and practice of Arbitration ALTERNATIVE AND DISPUTE RESOLUTION _ Law on contracts, methods on alternative dispute resolution. The arbitration and conciliation act 1996.

*With effect from the Academic Year 2020 – 2021*

**HS 501EG**

## BUSINESS COMMUNICATION AND PRESENTATION SKILLS

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*

**Course Objectives:** To expose the students to...

- To write effective and concise letters and memos and prepare informal and formal reports besides proofreading and editing copies of business correspondence.
- To use career skills that are needed to succeed, such as using ethical tools, working collaboratively, observing business etiquette, and resolving workplace conflicts, be able to develop, organize, and deliver an informative and persuasive presentation.
- To plan successfully for and participate in meetings and conduct proper techniques in telephone usage, e-mail effectively and efficiently and develop interpersonal skills by building positive interpersonal relationships in the work place that contribute to effective and satisfying personal, social and professional relationships, and utilize electronic presentation software.
- To understand the communication process and recall how networks and channels influence the communication process in organizations
- To manage and apply interviewing skills, to define and analyze the process of small group communication.

**Course Outcomes:** At the end of the course, the students would be equipped with the knowledge and skills relating to ...

1. Write effective and concise letters and *memos* and prepare informal and formal reports besides proofreading and editing copies of business correspondence.
2. Use career skills that are needed to succeed, such as using ethical tools, working collaboratively, observing business etiquette, and resolving workplace conflicts, be able to develop, organize, and deliver an informative and persuasive presentation.
3. Plan successfully for and participate in meetings and conduct proper techniques in telephone usage, e-mail effectively and efficiently and develop interpersonal skills by building positive interpersonal relationships in the work place that contribute to effective and satisfying personal, social and professional relationships, and utilize electronic presentation software.
4. Understand the communication process and recall how networks and channels influence the communication process in organizations
5. Manage and apply interviewing skills, to define and analyze the process of small group communication.

**UNIT I: Communication**: Nature, meaning, scope and importance of business communication, Process of communication, Barriers to communication, Types of communication (formal and informal, Oral and written), Verbal and Nonverbal Communication, Interpersonal communication

**UNIT II: Business Communication in professional life:** Prepare a simple power point presentation, Overcoming Obstacles, Business Correspondence, Persuading, Persuasive Presentations, Types of presentations Structure of presentations, Uses of aids like power point, Do's and Don'ts of presentation, Body language during presentations

**UNIT III: Effective Communication Skills:** How to enjoy conversation and build assertiveness and have great interactions for meaningful relationships (speak fearlessly)

**UNIT IV: Writing for Business Audiences**: Improving Writing Techniques, Revising and Proofreading Business Messages, E-Mail and Memorandums, Routine Letters and Goodwill Messages, Persuasive Messages, Problem solving and decision making, Informal Reports, Proposals and Informal Reports

**UNIT V**: **Professional Skills:** Interviews, Small Group Communication, Problem Solving and Decision Making, Leadership, Group Presentations, Case studies.

**Suggested Reading:**


1. E. Suresh Kumar et al., *Communication Skills and Soft Skills,* Pearson, 2011.
2. Sanjay Kumar and Pushp Lata, *Communication Skills, OUP, 2011.*
3. Kavita Tyagi and Padma Misra, *Professional Communication,* PHI, 2011.
4. Meenakshi Raman and Sangeeta Sharma, *Technical Communication: Principles and Practice, OUP, 2011.*

*With effect from the Academic Year 2020 – 2021*

**PC 501 CE**

# SOIL MECHANICS

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*

**Course Objectives:**

- Introduction of Particulate Mechanics
- Characterization and classification of soils based on laboratory and field experiments
- Understanding of Seepage, Strength and Compressibility characteristics of soils and learn the analysis of applications involving them

**Course Outcomes:**

1. Understanding of soils as a three-phase particulate medium. Ability to determine the index properties and based on them, ability to identify and classify the soils.
2. Learn the seepage characteristics of soils and gain competence in seepage analysis.
3. Gain knowledge of compressibility characteristics of the soils through compaction and consolidation processes. Gain competence to conduct the laboratory tests, analyse and apply these processes.
4. Learn shear strength characteristics of soils and gain competence to conduct the laboratory tests, analyse and apply these processes.
5. Ability to compute earth pressure, evaluation of stability of slopes. Adequate preparation for learning the analysis and design of foundation systems to be taught in the following semester

**UNIT - I**

**Origin & Classification of Soils:** Soil as a pseudo-elastic three phase particulate medium Physical Properties of soil: Weight ratios (Water content, Density, Unit weights, Specific Gravity); Volume ratios (void ratio, porosity, degree of saturation, relative density); Inter relationships, Laboratory tests for determination of Index properties. Classification and Identification of soils for general and engineering purposes as per IS: 1498-1970.

**UNIT - II**

**Soil Moisture States:** Held and Free moisture
**Capillarity in Soils:** Surface tension and capillary rise in soil, Capillary tension, Capillary pressure. pF value.
**Permeability of Soils:** Darcy's law for flow through soils - validity of Darcy's Law - Factors affecting permeability - Laboratory tests for determination of co-efficient of permeability (constant head, variable head permeability tests) - Field tests (Pumping in and pumping out tests) - Equivalent permeability of stratified soils.
**Seepage in Soils:** Seepage flow, seepage pressure - Flow nets - Locating phreatic line in a homogeneous earthen dam using Kogeny's parabola - Computation of seepage quantity.
**Stress in Soils:** Total, effective and neutral stress distribution in different ground conditions
**Quick Sand phenomena:** Critical Hydraulic gradient, Remedial measures.

**UNIT - III**

**Compaction Process:** Compaction Mechanism; factors affecting compaction. Laboratory determination of compaction characteristics - standard and modified Proctor tests - IS Light and Heavy compaction tests; Field surface compaction: compaction equipment, procedure, quality control.

**Consolidation Process:** Spring analogy - Void ratio and effective stress (e Vs log p) relationship - Terazaghi's theory of one dimensional consolidation - Assumptions and derivation of GDE- Computation of magnitude of settlement (using $C_c$, $m_v$ ) and rate of settlement ($c_v$ , Tv, d) classification based on OCR.

**UNIT - IV**

**Shear Strength:** Significance of Shear strength in soils - Mohr - Coulomb equation - shear parameters - Laboratory tests for determination of shear strength - Direct shear test, Tri-axial compression test, Un-confined compression test, Vane shear test, Factors affecting shear strength of cohesion-less and cohesive soils.

**UNIT - V**

**Earth Pressure:** States of earth pressure - Active, passive, at rest condition; Rankine's theory: Computation of active and passive earth pressure in c-less and cohesive soils; Coulomb's Wedge theory: Rehbhan's graphical solution: stability of earth retaining gravity wall.

**Slope stability:** Definition and classification of slopes -types of slope failure - Factors of safety with respect to cohesion, angle of shearing resistance, Height - Analysis of stability of slope using Swedish slip circle method and Taylor's stability number.

**Suggested Reading:**


1. Lambe, T.W. and Whitman, R.V., "*Soil Mechanics – SI Version* ", John Wiley & Sons Inc., NY, 2011.
2. Alam Singh, *Soil Engineering in Theory and Practice*, Asia Publishing House,1981.
3. Venkataramaiah, C., "*Geotechnical Engineering",* New Age Publishers, 2006.
4. Murthy, V.N.S., "*Soil Mechanics and Foundation Engineering*". Dhanpat Rai & Sons, 2006.
5. Arora, K.R., "*Soil Mechanics and Foundation Engineering*", Standard Publishers Distributors, revised and enlarged sixth edition, 2007.
6. Das, B. M., *"Advanced Soil Mechanics"*, Taylor and Francis. 7$^{th}$Edition (2008).
7. IS: 2720 (Relevant Parts), "Laboratory Tests on Soils", Bureau of Indian Standards.
8. IS: 1498-1970, "Classification and Identification of Soils for General and Engineering purposes", Bureau of Indian Standards.

*With effect from the Academic Year 2020 – 2021*

**PC 502 CE**

# WATER RESOURCES ENGINEERING

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*

**Course Objectives:**

- Providing awareness about water rights and water management principles
- Providing Knowledge regarding the fixation gravity dams dimension and fixing various levels in reservoirs
- Imparting basic concepts of planning for hydro power projects

**Course Outcomes:**

1. Ability to design and fix up reservoir systems and levels.
2. Understand Gravity principle of design of dams and their design
3. Capability to understand the seepage through Earthen dams
4. Understand various failure of tank systems and also ability to design
5. Comprehend various components of Hydro power stations

**UNIT - I**

*Water Resources Projects:* Single and multipurpose projects, general principles of irrigation water rates, components of water allocation systems, riparian rights, groundwater rights, environmental and water quality management aspects of reservoir system operations.
*Storage works:* Purpose, selection of site, zones of storage, computation of storage capacity, fixation of different levels of reservoirs (LWL, FRL, MWL), evaporation reduction techniques.

**UNIT - II**

*Dams:* Classification of dams, selection of site for a dam, physical factors governing the selection of types of a dam.
Gravity dams : Forces acting on a gravity dam, modes of failure and criteria for structural stability of gravity dams, principal and shear stresses, gravity method of stability analysis, elementary and practical profiles of a gravity dam, high and low gravity dams, functions, and types of galleries in gravity dams, foundation treatment for gravity dams.

**UNIT - III**

*Earth dams:* Types of earth dams, of failure of earth dams, criteria for the safe design of an earth dam, computation of seepage from flow net, phreatic line in an earth dam (for homogeneous sections with and without filter cases), design of earth dams to suit available materials, embankment and foundation seepage control measures.

**UNIT - IV**

*Tank irrigation:* Types, site selection, causes for the failure of tank weirs, design of tank weirs, and general specifications for the construction of tank weirs.
*Spillways:* Different types of spillways, energy dissipation below spillways, different types of spillway crest gates, stilling basin appurtenances (descriptive details only).

**UNIT - V**

Hydro-power: Comparison of hydro power with thermal power, classification of hydro power plants, definition of various terms, principal components of hydro-electric power plants (Forebay, intake structure, penstock & surge tank), economical diameter of penstock.

Power house: Substructure and super structure of a power house, merits and demerits of an underground power house, fixation of dimensions of a power house.

**Suggested Reading:**


1. Wurbs, R A. and James, W.P., *Water Resources Engineering*, Prentice-Hall ofIndia, New Delhi, 2002.
2. U.S. Bureau of Reclamation, *Design manual for concrete gravity dams*, Denver, 1976
3. U. S. Army Corps of Engineers, *Engineering and Design*, CECW-ED Publication, 1995
4. Punmia B.C. and Pande Lal B.B., *Irrigation and Water Power Engineering,* Lakshmi Publishers, 1993.
5. Garg *S.K.*, *Irrigation Engineering and Hydraulic Structures,* Standard Book House, 2010
6. M.M. Dandekar and K.N. Sharma, "*Water Power Engineering* 2nd Edition, Vikas Publishing House, Noida, U.P. 2013
7. R.K. Sharma and T.K. Sharma "*A Text book of Water Power Engineering,* S. Chand and Company Pvt. Ltd, New Delhi, 2016

*With effect from the Academic Year 2020 – 2021*

**PC 503CE**

# THEORY OF STRUCTURES

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*

**Course Objectives:**

- Understand the advantage of statically indeterminate structure over the statically determinate structure.
- Understand basic methods for the analysis of statically indeterminate beams and frames and know the difference between different methods.
- Evaluate the displacements and redundant forces using energy principles.
- Identify the various straining action in arches and analyze them with varying degrees of indeterminacy

**Course Outcomes:**

1. Solve statically indeterminate beams and portal frames using classical methods
2. Sketch the shear force and bending moment diagrams for different loading condition for indeterminate structures.
3. Calculate the deflections in beams and pin jointed trusses.
4. Analyze the three hinged and two hinged arches.
5. To analyze multi storied frames using approximate methods

**UNIT - I**

**Slope Deflection Method:** Application of the method to continuous beams with and without sinking of supports, single bay - portal frames (Degree of freedom not exceeding three), loading on each span may be point load(s) or uniformly distributed load on whole span, shear force and bending moment diagrams.

**UNIT - II**

**Moment Distribution Method:** Application of the method to continuous beams with and without sinking of supports, portal frames (static indeterminacy not exceeding three), loading on each span may be point load(s) or uniformly distributed load on whole span, shear force and bending moment diagrams.

**UNIT - III**

**Kani's Method:** Application of the method to continuous beams with and without support sinking, portal frames (static indeterminacy not exceeding three), and loading on each span may be point load(s) or uniformly distributed load on whole span, shear force and bending moment diagrams.

**UNIT - IV**

**Approximate Method of Analysis**.

Reinforced concrete portal frames: Introduction - Analysis and design of rectangular portal frames for vertical loading – Design of hinges.

Multi-storied building frames: Analysis and design due to vertical loads by substitute frame method - Analysis and design by portal method, cantilever method and factor method.

**UNIT - V**

**Elastic Theory of Arches:** Eddy's theorem, three hinged parabolic and segmental arches, determination of horizontal thrust, bending moment, normal thrust and radial shear for static loading, influence lines for horizontal thrust, bending moment, normal thrust and radial shear. **Two hinged arches:** parabolic and segmental, determination of horizontal thrust, bending moment, normal thrust and radial shear for static loading.

**References:**


1. D.S. Prakash Rao, *Structural Analysis- A Unified Approach*, University Press, 1996
2. B.C. Punmia and A.K. Jain, *Theory of structures*, Laxmi Publications, New Delhi, 2004.
3. Pandit, G .S., S. P. Gupta and R. Gupta, *Theory of Structures*, Vol.l, Tata McGraw Hill, New
   Delhi, 1999.
4. S.B. Junarkar, *Mechanics of Structures* (Vol. 1 &2), Charotar Publishing House Anand, 1992.
5. C.S.Reddy, *Basic Structural Analysis*, Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
6. *Analysis of Structur*es – Vol. I &II by Bhavikathi, Vikas publications.
7. *Analysis of structures* – Vol. I & II by Vazirani & Ratwani – Khanna publications.

**PC 504CE**

# CONCRETE TECHNOLOGY

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*

**Course Objectives:**

- Understand the characteristics and behavior of the concrete
- Describe design aspects of mix design using different methods
- Impart knowledge regarding the different types of special concretes

**Course Outcomes:**

1. Learn hydration of cement and tests on properties of cement and aggregates.
2. Comprehend the properties and testing of concrete in fresh and hardened state.
3. Understand the shrinkage and creep mechanisms, curing and durability of concrete.
4. Design concrete mixes by various methods.
5. Familiarize with the types of admixtures, and applications of special concretes.

**UNIT - I**

**Constituents of Concrete:**

**Cement:** Types of cements and their composition- manufacture of Portland cement-hydration of cement and hydration product, Structure of hydrated cement-heat of hydration, Gel theories, tests on properties of cements.

**Aggregate:** Classification of aggregates, particle shape and texture, bond strength of aggregates and its influence on strength of concrete, porosity, absorption and moisture content and their inf1uence, soundness of aggregate, alkali aggregate reaction, sieve analysis and grading of aggregate, tests on properties of aggregates.

**Properties of Fresh Concrete**: Mixing and batching, workability, factors effecting workability, various test procedures, segregation and bleeding, vibration of concrete, types of vibrators and their influence on composition, analysis of fresh concrete.

**UNIT - II**

**Properties of Hardened Concrete**: Strength of concrete, water cement ratio, Gel space ratio, effective water in the mix, short term and long term properties of concrete, test and procedure, influence of various parameters on strength of concrete, relationship between various mechanical strengths of concrete, curing of concrete, maturity concept, influence of temperature on strength of concrete, stress-strain curves for concrete, durability of concrete.

**Strength of Concrete -** Shrinkage and temperature effects - creep of concrete - permeability of concrete - durability of concrete - Corrosion - Causes and effects - remedial measures- Thermal properties of concrete - Micro cracking of concrete.

**UNIT - III**

**Mix Design of Concrete**: A basic consideration, process of mix design, factors influencing mix proportions-mix design by ACI method and IS code method, design of high strength concrete, quality control, various methods of mix design, IS code method, British and ACI methods.

**UNIT - IV**

**Admixtures used in Concrete:** Classification of admixtures. Chemical and mineral admixtures. Influence of various admixtures on properties of concrete. Admixtures used in preparation of self-compacting concrete. Applications, concept of ready mix concrete, fly ash concrete – properties and proportion of fly ash, applications, silica fume, rice husk ash concrete.

**UNIT - V**

**Special Concrete**: High strength concrete, ferro cement mass concrete, light weight concrete, high density concrete, poly-polymer modified concrete, pre-stressed concrete, self-consolidating concrete, cellular concrete, nano concrete, recycled aggregate concrete, geo polymer concrete, their specialties and applications, Fiber reinforced concrete: Need for fiber reinforced concrete (FRC), Mechanism of FRC, types of Fibers, Fiber shotcrete.

**Suggested Reading:**


1. Mehta, P.K. and Paulo, J. M. M. "*Concrete Microstructure-properties and Material*. " McGraw-Hill Publishers,1997.
2. Neville, A.M. and Brooks, J.J. "*Concrete Technology*" Pearson Education Ltd., India, New Delhi, 2003.
3. Shetty, M.S. "*Concrete Technology, Theory & Practice*." S.Chand and Co. Pvt., Ltdz, 2004.
4. Krishna Raju, N. "*Design of concrete mix*. "CBS Publishers, 1985.
5. Gambhir, M.L. "*Concrete Technology*." Tata McGraw Hill, 2004.
6. Santha Kumar, A.R. (2007). "*Concrete Technology*." Oxford University press, New Delhi.
7. Remedios, A.P. (2008). "*Concrete Mix Design hand book*." Himalya Publishing House, Hyderabad.

*With effect from the Academic Year 2020 – 2021*

**ES501CE**

## DISASTER RISK MANAGEMENT

*Instruction: 2+1* periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 2*

**Course Objectives:**

- To offer basic conceptual understanding of natural & man-made hazards and different related aspects.
- To develop understanding and the knowledge of the universal strategy for disaster reduction
- To ensure abilities and skills to analyze potential effects of disasters and of the strategies and methods to deliver public health response to avert these effects.
- To encourage the use scientific knowledge and innovations for disaster risk reduction (DRR) plans and policies.

**Course Outcomes:**

1. Knack to link hazards, risk, vulnerability, differential impacts and capacity building to the life and property loss during disasters and its impacts on the society and sustainability.
2. Ability to understand various aspects of natural and man-made hazards and emerging trends
3. Acquaintance with different steps involved in disaster risk reduction (DRR) and international initiatives for prevention, mitigation and preparedness.
4. Aptitude to appreciate the national policy and role of individuals, communities, and government organizations in disaster management.
5. Ability to identifying current technological constraints and hazard specific solutions, particularly civil engineering construction codes and low impact development techniques etc.

### UNIT I: UNDERSTANDING DISASTERS

Definitions and Terminologies used in the field of Disaster Risk Management (i.e. Hazard, Risk, Vulnerability, Resilience, and Capacity Building). Differential impacts of Disasters in context of Gender, Age, Social Status, Location, Prosperity, Disabilities. Disaster-Development Nexus: Impact of Development projects such as dams, embankments, changes in Land-use etc.

### UNIT II: CATEGORIES of HAZARDS AND NEW TRENDS

Classification, Causes, Consequences and Controls of (i) Geophysical Hazards-Earthquakes, Landslides, Tsunami; (ii) Weather related Hazards- Meteorological (Cyclones, Storm-surge and Lighting), Hydrological (Floods, Droughts, Avalanches) and Climatological (Wildfire, Cold & Heat Waves); (iii) Biological Hazards-Epidemic & Pandemics with emphasis on COVID-19; (iv) Technological Hazards; (v) Man-made Hazards-Structural Failure, Fire, Transportation accidents, Terrorism and Wars. Emerging Disasters- Urban Areas, Climate Change. Regional and Global Trends-loss of life & Property in various hazards

**UNIT III: DISASTER MANAGEMENT CYCLE AND OPERATIONAL FRAMEWORK**

Disaster Management Cycle. (i) **Pre-Disaster** – Risk Assessment and Analysis, Risk Mapping, zonation and Micro-zonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development; Awareness; (ii) **During Disaster** – Evacuation – Disaster Communication – Search and Rescue– Emergency Operation Centre – Incident Command System – Relief and Rehabilitation (iii) **Post-disaster** – Damage and Needs Assessment, Restoration of Critical Infrastructure – Early Recovery – Reconstruction and Redevelopment. Paradigm Shift in Disaster Management: International Decade for Natural Disaster Reduction; Yokohama Strategy; Hyogo Framework of Action.

**UNIT IV: DISASTER RISK MANAGEMENT PRACTICES IN INDIA**

Disaster Profile of India, Mega Disasters of India and Lessons Learnt in context of civil engineering. Relevance of indigenous knowledge, appropriate technology and local resources. Disaster Management Act 2005 – Institutional and Financial Mechanism. National Policy on Disaster Management. National Guidelines and Plans on Disaster Management. Role of Government, Non-Government Agencies and Inter-Governmental Organizations at various levels

**UNIT V: PROSPECTIVES OF SCIENCE AND TECHNOLOGY IN DISASTER RISK REDUCTION**

Geo-informatics in Disaster Management (RS, GIS, GPS and RS). Disaster Communication System (Early Warning and Its Dissemination). Disaster Safe Designs and Constructions: Seismic performance examination of RCC Buildings; Retrofitting of vulnerable buildings; Construction of earthquake resistant buildings following proper BIS codes. Flood management at basin scale. Structural and Non Structural Mitigation of Disasters. Science & Technology Institutions for Disaster Management in India.

**Suggested Books/ Material/ References:**


1. Coppola D P, 2007. Introduction to International Disaster Management, Elsevier Science (B/H), London.
2. Manual on natural disaster management in India, M C Gupta, NIDM, New Delhi
3. An overview on natural & man-made disasters and their reduction, R K Bhandani, CSIR, New Delhi
4. World Disasters Report, 2009. International Federation of Red Cross and Red Crescent, Switzerland
5. Disasters in India Studies of grim reality, Anu Kapur & others, 2005, 283 pages, Rawat Publishers, Jaipur
6. 10 Disaster Management Act 2005, Publisher by Govt. of India
7. Publications of National Disaster Management Authority (NDMA) on Various Templates and Guidelines for Disaster Management
8. National Disaster Management Policy, 2009, GoI

*With effect from the Academic Year 2020 – 2021*

**PC 551 CE**

# SOIL MECHANICS LABORATORY

*Instruction: 2 periods per week* Duration of SEE*: 3 hours*
*CIE: 25 marks* *SEE: 50 marks*
*Credits: 1*

**Course Objectives:**

- Expose the students to different types of soils
- Experience the concepts of soil mass, soil solids, and soil structure.
- Understand the laboratory test procedures and appreciate the suitability of each test.
- Make the students to relate theoretical concepts in doing lab tests.

**Course Outcomes:**

1. Ability to process soil sample and prepare test specimen simulating the in-situ conditions
2. Competence to launch the specimen, fix the instrumentation, perform the test and to record the observations.
3. Ability to analyses the data, find the test results, make critical observation on appropriateness of the result and its application
4. Greater insight in to the soil behavior and hence enhanced understanding of soil mechanics
5. Ability to model a field application in the laboratory to take up research

## I. DETERMINATION OF INDEX PROPERTIES:

Determination of

1. Specific Gravity of soil solids using
    a. Density bottle method
    b. Pycnometer method
2. Water content using
    a. Oven drying method
    b. Pycnometer method
3. Liquid and Plastic limit
4. Sieve Analysis
5. Classification of Soils as per IS:1498-1970
6. Field Density using Sand Replacement Method

## II. DETERMINA TION OF ENGINEERING PROPERTIES:

Determination of

7. Compaction Characteristics using
    a. IS Light Compaction Test
    b. IS Heavy Compaction Test
    c. Compare and find the effect of Compaction Effort on Compaction mechanism
8. Co-efficient of Permeability by

a. Constant Head Permeameter test
b. Variable Head Permeameter test

9. Shear strength parameters by
    a. Direct Shear Test
    b. Unconfined Compression Test
    c. Vane Shear Test
10. California Bearing Ratio (CBR) value

## III. DEMONSTRATION OF TEST PROCEDURE:

11. Consolido meter test
12. Tri-axial compression Test
13. Laboratory Plate Load Test
14. Reverse Osmosis Test
15. Quick Sand Model
16. Cyclic Tri-axial Test Facility

**Suggested Reading:**


1. IS: 2720 (Relevant Parts), “Laboratory Tests on Soils”, Bureau of Indian Standards.
2. Lambe, T.W., "*Soil Testing for Engineers*”, Wiley Eastern Ltd., New Delhi, 1969.

*With effect from the Academic Year 2020– 2021*

**PC 552CE**

## CONCRETE TECHNOLOGY LABORATORY

*Instruction: 2 periods per week* Duration of SEE*: 3 hours*
*CIE: 25 marks* *SEE: 50 marks*
*Credits: 1*

**Course Objectives:**

- Determine behavior of materials through physical tests.
- Infer suitability of materials in construction.
- Able to prepare concrete as per the standards

**Course Outcomes:** will be able

1. To determine the properties of constituents of concrete..
2. Design and prepare concrete mix using Indian Standard method.
3. To identify the fresh and hardened properties of concrete.
4. Assess characteristic of concrete using Non destructive testing methods.
5. To correlate experimental results between non destruction and destruction method.

1. (a) Determination of Specific gravity of cement
   (b) Determination of unit weight / bulk density of cement

2. Determination of normal consistency of cement

3. (a) Determination of initial setting time of cement
   (b) Determination of final setting time of cement

4. (a) Preparation of mortar cubes for compressive strength
   (b) Tests on mortar cubes for compressive strength

5. Fineness of cement by sieving and by air permeability method

6. (a) Determination of specific gravity of fine aggregate
   (b) Determination of bulk density of fine aggregate

7. (a) Determination of specific gravity of coarse aggregate
   (b) Determination of bulk density of coarse aggregate

8. Tests on bulking of sand
   (a) Laboratory method (b) Field method

9. Determination of fineness modulus of fine aggregate

10. Determination of fineness modulus of coarse aggregate

11. Test son workability of concrete
    (a) Slump (b) Compaction factor

12. Tests on hardened concrete
    (a) Compressive strength (b) Flexural strength

13. Non-destructive testing of concrete structures demonstration of rebound hammer, UPV System, profometer corrosion meter and IR method

**Suggested Reading:**


1. Mehta, P.K. and Paulo, J. M. M. "*Concrete Microstructure-properties and Material*." McGraw-Hill Publishers,1997.
2. Neville, A.M. and Brooks, J.J. "*Concrete Technology*" Pearson Education Ltd., India,
   New Delhi, 2003.
3. Shetty, M.S. "*Concrete Technology, Theory & Practice*." S. Chand and Co. Pvt., Ltd, 2004.
4. Krishna Raju, N. "*Design of concrete mix*. "CBS Publishers, 1985.
5. Gambhir, M.L. "*Concrete Technology*." Tata McGraw Hill, 2004.
6. Santha Kumar, A.R. (2007). "*Concrete Technology*." Oxford University press, New Delhi.
7. Remedios, A.P. (2008). "*Concrete Mix Design handbook*." Himalya Publishing House, Hyderabad.

*With effect from the Academic Year 2020– 2021*

**Mandatory Course (Non-Credited)**

**MC 901 CE**

# ENVIRONMENTAL SCIENCES

*Instruction: 3 periods per week* Duration of SEE*: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 0*

**Course Objectives:**

- Comprehend the need of environmental science, ethics and issues
- Illustrate the characteristics and functions of ecosystem
- Understand the concepts of Biodiversity and its conservation needs
- Study various environmental pollution effects, prevention and control acts

**Course Outcomes:**

1. Application of awareness on environmental Issues for sustainable society
2. Acquaintance with utilization of various natural resources and ecosystems
3. Ability in conserving and protecting the biodiversity
4. Knowledge of social and environment related issues and their preventive measures

**UNIT – I**

**Multidisciplinary nature of Environmental studies:** Definition, scope and importance, Need for public awareness.

Environmental ethics: issues and possible solutions. Population growth. Sustainable development and SDGs. Current Environmental Issues: global warming and Climate change, acid rain, ozone layer depletion. Environment protection Acts. Environment and human health

**UNIT – II**

**Natural Resources:** Renewable and nonrenewable resources: Natural resources and associated problems Forest resources, Water resources, Mineral Resources, Water conservation, Food Resources Energy Resources.

Land Resources: Land as a resource, land degradation, soil erosion, and desertification Role of individual in conservation of natural resources, Equitable use of resources for sustainable life styles.

**UNIT – III**

**Ecosystems:** Concept of an ecosystem Structure and function of an ecosystem, Producers, consumers, decomposers. Energy flow in the eco systems. Ecological succession, Food chains, food webs and ecological pyramids.

Introduction, types, characteristic features, structure and functions: Terrestrial ecosystem, Forest ecosystem, Grass land ecosystem, Desert ecosystem. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

**UNIT – IV**

**Biodiversity and its Conservation:** Introduction-Definition: genetics, species and ecosystem diversity. Biogeographically classification of India, Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local level. India as a mega diversity nation.

Hot-spots of biodiversity, Threats to biodiversity: habitats loss, poaching of wild life, man wildlife conflicts. Endangered and endemic spaces of India, Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity, Wildlife conservation and protection act, Forest conservation and protection act

**UNIT – V**

**Environmental Pollution:** Definition, Causes, effects and control measures - Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards,

Air (prevention and control of pollution) Act, Water (prevention and control of pollution) Act Solid waste Management: Causes, effects and control measures of urban and industrial wastes Role of an individual's, communities and NGOs in prevention of pollution

**Suggested Reading:**


1. Gilbert, M. Masters, "Introduction to Environmental Engineering and Science", Prentice-Hall of India Pvt. Ltd., New Delhi, 1995.
2. Textbook of Environmental studies, Erach Bharucha, UGC.
3. Hammer. M J. and Hammer. MJ. Jr., Water and Wastewater Technology.
4. Prentice-Hall of India Pvt. Ltd., New Delhi. 1998
5. Fundamental concepts in Environmental Studies, D D Mishra, S Chand & Co Ltd.
6. Sasi Kumar, K. and Sanoop Gopi Krishna., Solid waste Management, Prentice-Hall of India Pvt. Ltd., New Delhi, 2009

*With effect from the Academic Year 2020 – 2021*

# SCHEME OF INSTRUCTION

## B.E. (Civil Engineering)

## VI - SEMESTER

| S. No. | Course Code | Course Title | Scheme of Instruction | | | Contact hr/week | Scheme of Examination | | Credits |
|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | | CIE | SEE | |
| 1 | PC 601CE | Environmental Engineering | 3 | 0 | 0 | 3 | 30 | 70 | 3 |
| 2 | PC 602CE | Design of Steel Structures | 3+1 | 0 | 0 | 3 | 30 | 70 | 3 |
| 3 | PC 603CE | Foundation Engineering | 3 | 0 | 0 | 3 | 30 | 70 | 3 |
| 4 | PC 604CE | Transportation Engineering | 3 | 0 | 0 | 3 | 30 | 70 | 3 |
| 5 | **Professional Elective – I** | | 3 | 0 | 0 | 3 | 30 | 70 | 3 |
| | PE 611 CE | Design of Irrigation Structures | | | | | | | |
| | PE 612 CE | Air and Noise Pollution | | | | | | | |
| | PE 613 CE | Pavement Construction and Management | | | | | | | |
| 6 | **Professional Elective – II** | | 3 | 0 | 0 | 3 | 30 | 70 | 3 |
| | PE 621 CE | Advanced Design of Concrete Structures | | | | | | | |
| | PE 622 CE | Ground Improvement Techniques | | | | | | | |
| | PE 623 CE | Finite Element Techniques | | | | | | | |
| 7 | **Professional Elective-III** | | 3 | 0 | 0 | 3 | 30 | 70 | 3 |
| | PE 631 CE | Structural Analysis | | | | | | | |
| | PE 632 CE | Pre-Stressed Concrete | | | | | | | |
| | PE 633 CE | Geospatial Techniques | | | | | | | |
| 8 | **Open Elective – I** | | 3 | 0 | 0 | 3 | 30 | 70 | 3 |
| **Practicals** | | | | | | | | | |
| 9 | PC 651CE | Environmental Engg. lab | 0 | 0 | 2 | 2 | 25 | 50 | 1 |
| 10 | PC 652CE | Transportation Engg. Lab | 0 | 0 | 2 | 2 | 25 | 50 | 1 |
| 11 | PW 961 CE | Summer Internship | 6 Weeks, Evaluation will be done in the VII-Sem. | | | | | | |
| Interactive Session | | | | | | | | | |
| | | | **24** | **-** | **04** | **28** | 290 | 660 | **26** |

| **Open Elective-I** | | | | | |
|---|---|---|---|---|---|
| **S. No.** | **Course Code** | **Course Title** | **S. No.** | **Course Code** | **Course Title** |
| 1 | OE601BM | Engineering Applications in Medicine | 4 | OE604EC | Principles of Electronic Communication |
| 2 | OE602CE | Disaster Management | 5 | OE605ME | 3D Printing Technology |
| 3 | OE603EC | Electronic Instrumentation | 6 | OE606ME | Finite Element Method |

*With effect from the academic year 2020-2021*

**PC 601 CE**

# ENVIRONMENTAL ENGINEERING

*Instruction: 3 periods per week* Duration of SEE*: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*

**Course Objectives:**

- Introduction to the basic concepts and requirements of environmental engineering
- Knowledge about different sequential unit operations of water and wastewater treatment processes
- Inputs on engineering principles for analyzing various environmental issues
- Awareness towards the sustainability of standards forwater resources

**Course Outcomes:**

| | |
|---|---|
| 1 | Aptitude to plan for protected water supply system needs and requirements |
| 2 | Ability to design sequential unit operations in water treatment plants |
| 3 | Acquaintance with collection procedures and design of sewerage systems |
| 4 | Capacity to design for the safe disposal of wastewater and its reuse |
| 5 | Knack to analyze, execute and maintain standards for sustainable development of the society |

**UNIT-I**

Water Supply: Need for planned water supply schemes, water demand for industrial and agricultural water requirements, sources of water, water quality requirements for different beneficial uses, population forecast, water treatment through aeration, coagulation flocculation, and sedimentation.

**UNIT – II**

*Water Treatment:* Filtration, Disinfection, and Softening, methods of layout of distribution pipes, design of distribution by Hardy Cross method for simple net works, various types of pipes and valves used in water supply systems.

**UNIT – III**

*Sewage:* Domestic and storm water, Quantity of Sewage, Sewage flow variations.
*Conveyance of sewage*: Sewers shapes, design of sewerage systems, operation and maintenance of sewers, sewage pumping, sewer appurtenances

**UNIT-IV**

*River cleaning plans*: Self purification of streams, BOD and COD concepts, wastewater treatment, aerobic and anaerobic treatment system, suspended and attached growth systems, quality requirements of recycled water for various purposes. Principles of Septic Tank

**UNIT-V**

*Advanced Waste Water Treatment (WWT) concepts:* Theory and design concepts of Activated Sludge process, Mechanically Aerated Lagoons, Sequencing Batch Reactor (SBR), waste stabilization ponds, basic concepts of bio-remediation**.**

**Suggested Reading:**


1. Fair, G. M. and Geyer, J. C. *Water and Wastewater Engineering, vol. I and II*, John Wiley & Sons, Inc., New York, 1954
2. Hammer, M.J. and Hammer, M.J. Jr., *Water and Wastewater Technology*, Prentice-Hall of India Pvt. Ltd., New Delhi, 1998
3. Metcalf & Eddy, *Wastewater Engineering, treatment, disposal, and reuse*, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1995
4. Norris, Robert, *Handbook of Bioremediation*, CRC Press, 1993.

## PC 602CE

# DESIGN OF STEEL STRUCTURES

*Instruction: 3+1 periods per week* Duration of SEE*: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*

**Note:** All relevant latest IS codes necessary for this course may be referred (i.e. IS 800-2007 etc)

**Course Objectives:**

- Know the IS codal provisions as applicable for the designs.
- Understand the material behavior and basics of design of steel structures.
- Learn the design of various members along with the connections.
- Explain the design principles of roof trusses.

**Course Outcomes:**

1. Knowledge of IS codal provisions and basics of design of steel structures
2. Able to design of different types of connections.
3. Equipped to design of tension, compression members.
4. Capable of designing beams for different conditions and column bases.
5. Able to design of roof trusses.

**UNIT-I**

**Materials and Specifications:** Chemical composition of steel, types of Structural Steel, Residual stresses, Stress Concentration.

**Basis of Structural Design:** Codes and Specifications, Design Philosophies, working Stress Method, Limit State Method.

**Loading and Load Combinations:** Characteristic Loads, Dead Loads, Imposed Loads, Earthquake Loads, Wind Loads and Load Combinations. Partial safety factors for materials and loads.

**Bolted Connections (Limit state method):** Bolted Connections, Behavior of Bolted Joints, Design Strength of Ordinary Black Bolts, Design Strength of High Strength Friction Grip Bolts, Pin Connections, Simple Connections and Eccentric Connections.

**Welded Connections (Limit State Method):** Advantages of Welding, Types of Welds and Joints, Simple Connections and Eccentric Connections.

**UNIT-II**

**Design of Tension Members (Limit State Method):** Types of Tension Members, Design of Strands, Slenderness Ratio, Modes of Failure, Factors Effecting Strength of Tension Members, Design of Tension Members (Angles, Other sections and Rods), Lug Angles, Tension Member Splice.

**UNIT-III**

**Design of Compression Members** (Limit state method): Introduction, Possible Failure Modes, Behavior of Compression Members, Elastic Buckling of Slender Compression Members, Behavior of Real Compression Members, Sections of Compression Members, Effective Length, Design of Compression Members with Single Section and Built-up Sections (Symmetric in both directions), Lacing and Battening, Column Splices.

Design of Column Bases (Limit state method): Design of Slab Base and Gusseted Base for Columns.

**UNIT-IV**

**Design of Beams** (Limit state method): Types of Beams, Section Classification, Lateral Stability of Beams, Buckling of Real Beams, Behavior of Beams in Bending, Design of Laterally Supported and Unsupported Beams, Design of Compound Beams, Shear Strength of Beams, Maximum Deflection, Web Buckling and Web Crippling, Biaxial Bending and Unsymmetrical Bending.

**UNIT- V**

**Design of Roof Trusses** (Limit state method): Types of Trusses, End Bearings, Spacing of Trusses and Purl ins, Estimation of Loads with different Roof Coverings, Self-weight of Truss, Wind Effects, Design of Purlins for Dead Load, Imposed Load and Wind Loads. Detailed Design of Roof Trusses including Joints and Supports (only Angular Trusses).

**References**:


1. Subramanian. N, *Design of Steel Structures*, Oxford University Press, 2008.
2. Duggal S.K., *Design of Steel Structures*, Tata McGraw Hill Publishing, 2009.
3. Shiyekar M.R., *Limit State Design in Structural Steel*, PHI Learning Pvt. Ltd., 2010.
4. Bhavikatti, S.S., "*Design of Steel Structures*", I.K. International Publishing House Pvt. Ltd. 2010.

*With effect from the Academic Year 2020 – 2021*

**PC 603 CE**

# FOUNDATION ENGINEERING

*Instruction: 3 periods per week* Duration of SEE*: 3 hours*

*CIE: 30 marks* *SEE: 70 marks*

*Credits: 3*

**Course Objectives:**

- Learn the definition, necessity, types and suitability of different foundation systems.
- Understand the procedures of Geotechnical design of foundations
- Understand the necessity and usage of different foundation construction related aspects
- Learn about different methods of geotechnical investigations and its role in selection and design of foundations

**Course outcomes:**

1. Ability to compute distribution of increment in vertical stress in soil medium due to applied loads using mathematical theories
2. Competence to plan and perform Geotechnical Investigations to characterize the ground and ability to decide the ideal type of foundation.
3. Competence to analye and estimate the safe bearing capacity of shallow foundations, to perform settlement analysis and to take up geotechnical design of shallow foundations
4. Ability to analyze pile foundations and to estimate the carrying capacity of single and group of piles. Knowledge of Caissons, Machine foundations.
5. Ability to practice Foundation Engineering with ethics and life long learning.

**UNIT - I**

**Stress distribution in Soils**: Boussinesq's theory – Computation of increment in vertical stress due to application of a point load (its distribution on horizontal, vertical planes), uniformly distributed circular and rectangular areas –Pressure bulb – Significant depth - Construction and use of Newmark's chart – Westergaard's theory – Validity of elastic theories – Contact pressure distribution.

**UNIT - II**

**Introduction to Foundations**: Functional requirements – types – differentiation of shallow and deep foundations – suitability

**Safe Bearing Capacity of Shallow foundations**: Definitions - (a) Based on theories – Types of shear failures - Terazaghi's theory for safe bearing capacity of shallow foundations – Effect of type of shear failure / shape of the footing / water table – Provisions of IS : 6403-1981 (b) Based on field tests : Plate load test / Standard Penetration test.

**Allowable bearing Capacity of Shallow foundations**: Settlement Analysis – Total settlement – Elastic settlement – Consolidation settlement (ultimate & after any given period

– correction for construction period) – Permissible uniform & differential settlements – Proportioning of footings.

**UNIT - III**

**Pile Foundations**: Necessity – types based on load transfer mechanism / material / method of installation / functional use – Estimation of vertical load carrying capacity of a single pile – static formulae / Dynamic formulae / Pile load tests – Cyclic pile load test for separation of total capacity in to bearing and friction components – Pile groups – necessity – efficiency of Pile groups - estimation of group capacity – Settlement analysis of individual and group of Piles - Negative Skin friction – Concept of Piled raft foundation.

**UNIT – IV**

**Caissons**: Necessity – types – Essential components of open (well) / box (floating) / Pneumatic caissons - suitability – Sinking of caissons – correction for tilt & shift – Scour analysis – Fixing depth of Caisson – Provisions of IS:3955 and IRC:78.

**Machine foundations**: Differentiation with static foundations – vibration characteristics (frequency / amplitude/ resonance) – types of machines and machine foundations – additional design requirements

**Geotechnical Investigations**: Necessity – Principles of exploration - objectives – Soil profile – collection of disturbed & undisturbed soil samples – samplers & quality of samples - methods – Trial pit / Bore hole method – Log of bore hole details

**UNIT – V**

**(A) Foundation construction related aspects** :

**Timbered / braced excavations:** Necessity - methods – suitability – distribution of pressure – reaction of struts.

**Dewatering**: Necessity – methods – sumps (ditches) / well point system (single /multi-stage) / deep well system / elector-osmonsis method – merits & demerits – suitability

**Coffer dams**: necessity – types – suitability

**(B) Foundation repair related aspects**

**Grouting :**Uniqueness – Aspects – Grout Materials – Groutability ratio – Classification of grout materials – Application of grouting in enhancement of bearing capacity and stability of foundations.

**Underpinning**: Necessity – methods (pin / pile) - suitability

**(C) Introduction to Ground Improvement Techniques –** Improvement of Cohesionless and Cohesive grounds –Classification –Functions – Application of **Geosynthetics**.

**Suggested Reading :**


1. Bowles, E. (2012). "*Foundation analysis and Design*", McGraw-Hill Publications.
2. Das, B.M. (2012). "*Principles of Foundation Engineering*", Sengrece Publications.
3. Arora, K.R. (2012). "*Soil Mechanics & Foundation Engineering*" Standard Publications.
4. Verghese, P.C. (2012). "*Foundation Engineering*", PHI Publications.
5. Purushotham Raj, N (2016), "Ground Improvement Techniques", Laxmi Publications.
6. Relevant Indian Standards

**PC 604CE** *With effect from the Academic Year 2020 – 2021*

# TRANSPORTATION ENGINEERING

*Instruction: 3 periods per week* Duration of SEE*: 3 hours*

*CIE: 30 marks* *SEE: 70 marks*

*Credits: 3*

**Course Objectives:**

- Emphasize the significance of geometric design of highways with specifications and standards
- To describe basic techniques for collecting and analysing traffic data, diagnosing problems.
- To impart knowledge on pavement materials
- Create awareness on Flexible pavement design
- Impart knowledge on Rigid pavement design

**Course Outcomes:**

1. Assimilation of the various concepts of Highway geometric design
2. Application of concepts related to traffic engineering
3. Knowledge related to selection of pavement materials
4. Able to design flexible pavements
5. Design the rigid pavements

**UNIT-I**

**Highway development and planning-**Classification of roads, road development in India, Current road projects in India; highway alignment and project preparation.

**Geometric design of highways**- Introduction; highway cross section elements; sight distance, design of horizontal alignment; design of vertical alignment; design of intersections, problems

**UNIT-II**

**Traffic Engineering & control**- Traffic Characteristics, traffic engineering studies, traffic flow and capacity, traffic regulation and control; Type of road markings & Signs; design of design of signals, capacity analysis and design of rotary intersections, parking facilities; accident studies; highway lighting; problems.

**UNIT-III**

**Pavement materials**- Materials used in Highway Construction; desirable properties, tests, requirements for different types of pavements: Soils, Stone aggregates, bituminous binders, bituminous paving mixes, introduction to Marshall Mix method, Portland cement, types of and cement concrete: desirable properties, tests on cement and hardened concrete, requirements for different types of pavements. Problems.

**UNIT IV**

**Flexible Pavements**-Types of pavements and factors affecting design of flexible pavement, performance; stresses in flexible pavements; design of flexible pavements as per IRC:37-2018; Surface and Sub-surface drainage systems, Thickness design problems. Distresses in flexible pavement, causes and performance indicators.

**UNIT-V**

**Rigid pavements**- components and functions; factors affecting design stresses in rigid pavements; types of joints, design of concrete pavements as per IRC: 58-2015; Design of dowel bars and tie bars, Distresses, causes and performance of CC pavements. Design problems.

**Suggested Reading:**


1. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, 'Highway Engineering', Revised 10th Edition, Nem Chand & Bros, 2017.
2. Fred L. Mannering, Scott S. Washburn, Walter P. Kilareski,'Principles of Highway Engineering and Traffic Analysis', 4th Edition, John Wiley.
3. Paul H. Wright and Karen K. Dixon, Highway Engineering, 7th Edition, Wiley Student Edition, 2009.
4. R. Srinivasa Kumar, 'Transportation Engineering', Universities Press, 2020.
5. IRC: 37 (2018), 'Guidelines for the design of flexible pavements', Indian Roads Congress, New Delhi.
6. IRC: 58 (2015), 'Guidelines for the design of plain jointed rigid pavements', Indian Roads Congress, New Delhi.

*With effect from the academic year 2020-2021*

**PE 611 CE**

# DESIGN OF IRRIGATION STRUCTURES

**(PROFESSIONAL ELECTIVE-I)**

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*

**Course Objectives:**

- To describe design aspects of different types of weirs and regulatory systems
- To provide design based on seepage theory for weirs and barrage structures
- To impart knowledge regarding the alluvium principles and silt theory in canals

**Course Outcomes:**

1. Ability to design the design of flooring based on seepage theory
2. Understand creep theories and design components of diversion head works
3. Capability to design canals based on Alluvium principles
4. Understand importance and design aspects of canal falls
5. Comprehend various cross drainage works

**UNIT-I**

*Weirs:* Components of diversion head works, types of weirs – fixation of still level of head sluice, scouring sluice and crest level of weir, afflux and top level of flood banks, design of vertical drop and sloping glacis weir, design for surface flow and sub - surface flow, length, level and thickness of downstream apron, upstream and downstream cutoffs, protection works.

**UNIT – II**

*Seepage forces:* Causes of failure of structures on permeable foundations, piping, rupture of floor, undermining, remedial measures, computation of uplift forces by Bligh's theory, Khoshla's theory, analytical method and significance of exit gradient.

**UNIT-III**

*Canals:* Alignment, classification of alluvium canals and their functions, Regime concept of Kennedy's and Lacey's theories, design of canals based on Kennedy's and Lacey's method, use of Garrett's diagrams for the design of canals, lining of canals, methods of lining and design of lined canals.

**UNIT- IV**

*Canal falls:* Definition, location, types of falls, design principles of trapezoidal notch fall, vertical drop fall, glacis fall.

Regulators and modules: Head regulator and cross regulators, canal escapes, canal outlets and modules-proportionality, sensibility and flexibility.

**UNIT- V**

*Cross drainage works:* Definition, classification, design principles of aqueducts, syphon aqueducts, canal syphons, super passages, inlets and outlets-selection of cross drainage works.

**Suggested Reading:**


1. B.C. Punmia and Pande B.B. Lal, *Irrigation and Water Power Engineering*, Standard Book House, 1991.
2. S.K. Garg, *Irrigation and Hydraulic Structures*, Khanna Publishers, 1993.
3. Modi P.N., *Irrigation and Water Resources and Water Power Engineering,* Standard Book House, 1983.
4. S. K. Sharma "*Irrigation Engineering & Hydraulic Structures*" S. Chand Publishers, New Delhi 2016.
5. Punmia, B.C., Pande B. and Lal, B, Ashok Kumar Jain & Arun Kumar Jain., *'Irrigation and Water Power Engineering'*, Laxmi Publishers, 2003.

*With effect from the academic year 2020-2021*

**PE 612 CE**

# AIR AND NOISE POLLUTION

**(PROFESSIONAL ELECTIVE-I)**

*Instruction: 3 periods per week* Duration of SEE*: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*

**Course Objectives:**

- Study the sources and effects of air pollution on various components of biosphere
- Plan strategies to control, reduce and monitor Air Pollution
- Conversant with basics of Noise and Air quality standards

**Course Outcomes:**

| | |
|---|---|
| 1 | Ability to classify and understand the sources and effects of Air Pollutants |
| 2 | Competence to collect and analyze air pollutants |
| 3 | Application of the basic models of Air quality to the regions of interest. |
| 4 | Understanding the pollution control mechanisms using classical methods |
| 5 | Ability to comprehend the basics of Noise pollution and its effects |

**UNIT-I**

*Sources and Effects of Air Pollutants*: Sources, classification, combustion processes and pollutant emission, effects on health, vegetation, materials and atmosphere, reactions of pollutants in the atmosphere and their effects – Smoke, smog.

**UNIT – II**

*Sampling and Analysis:* Air sampling and pollution measurement methods, principles and instruments, Ambient air quality and emission standards, Air pollution indices.

*Indoor Air Quality Management*: Sources, types and control of indoor air pollutants.

**UNIT – III**

*Air Quality Models:* micrometeorological processes, wind rose diagram, dispersion, coefficients and stability classes, Gaussian and dispersion model, stack height computation, regional air quality models, source inventories and significance.

**UNIT-IV**

*Concepts of Pollution Control:* Particulate emission control - settling chambers, cyclone separation, Wet collectors, scrubbing, fabric filters, electrostatic precipitators, selection criteria for equipment, Removal of gaseous pollutants by adsorption, absorption, reaction and other methods.

**UNIT-V**

*Noise pollution:* Basics of acoustics and specification of sound; sound power, sound intensity and sound pressure levels; plane, point and line sources, multiple sources; outdoor and indoor noise propagation; psychoacoustics and noise criteria, effects of noise on health, annoyance rating schemes.

**Suggested Reading:**


1. Rao M.N., and Rao H. V. N., *Air Pollution Control*, Tata McGraw Hill, New Delhi, 1996.
2. Anjaneyulu, D., *Air Pollution and Control Technologies*, Allied Publishers, Mumbai, 2002.
3. Rao, C.S. *Environmental Pollution Control Engineering*, Wiley Eastern Ltd., New Delhi, 1996.
4. Peavy S.W., Rowe D.R. and Tchobanoglous G. *Environmental Engineering*, McGraw Hill, New Delhi, 1985.
5. B.C. Punmia. Arun Kumar Jain & Ashok Kumar Jain "Waste Water Engineering (Including Air Pollution)" M/S Laxmi Publishers, 2011.
6. M. Anji Reddy, "Environmental Impact Assessment Theory and Practice" BS Publications, Hyderabad, 2017.

*With effect from the Academic Year 2020 – 2021*

**PE 613 CE**

## PAVEMENT CONSTRUCTION AND MANAGEMENT
**(PROFESSIONAL ELECTIVE-I)**

*Instruction: 3 periods per week* Duration of SEE*: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits : 3*

**Course Objectives:**

- To introduce the concepts related to pavement construction
- The students are expected to understand the principles and techniques of various methods of pavement construction.
- Understand the methods and techniques for pavement evaluation and management systems

**Course Outcomes:**

Students who successfully complete this course will be able to:

1. Plan and control construction related activities.
2. Gain knowledge about different methods and techniques of base, sub base and drainage construction.
3. Understand bituminous pavement construction procedure
4. Understand cement concrete pavement construction procedure
5. Able to perform pavement evaluation and maintenance.

**UNIT-1**

Flexible Pavement Construction: Earthwork, compaction and construction of embankments, specifications of materials, construction methods and field control checks for various types of flexible pavement materials in sub base, base, binder and surface course layers and their choice

**UNIT-II**

Cement Concrete Pavement Layers: Specifications and method of cement concrete pavement construction; Construction of interlocking block pavements, Quality control tests; Construction of various types of joints;

**UNIT-III**

Soil Stabilized Pavement Layers: Principles of gradation/proportioning of soil aggregate mixes and compaction; Design factors, mix design, construction control and quality control checks for mechanical, soil-cement, soil-bitumen and soil-lime stabilization methods. Use of additives, Numerical problems on mix design and applications

**UNIT-IV**

Pavement Evaluation - Pavement Distress - Functional and structural condition of pavements, Pavement distress survey, Functional condition evaluation of pavements- Roughness, Skid Resistance. Structural evaluation of pavements - nondestructive testing, Benkelman beam and Falling Weight Deflectometer, Pavement strengthening based on deflection as per IRC, Maintenance and rehabilitation techniques

**UNIT-V**

Pavement Management Systems - Pavement Management Systems- Components, structure, data requirements, Project level and Network level needs, Pavement performance prediction – concepts, modelling techniques– AASTHO, CRRI and HDM models, Budget forecasting for maintenance and rehabilitation, Ranking and optimization methodologies, life cycle costing,

**Suggested Reading**


1. 'Highway Engineering', Paul H.Wright, Karen K.Dixon, John Wiley& Sons,.7th edition.2004.
2. 'The Asphalt Handbook', MS-4, Asphalt Institute, Maryland, 1989.

*With effect from the Academic Year 2020 – 2021*

**PE 621 CE**

# ADVANCED DESIGN OF CONCRETE STRUCTURES
**(PROFESSIONAL ELECTIVE-II)**

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*

**Course Objectives:**

- Understand the design procedures for columns and footings.
- To know the design and detailing of flat slab and ribbed slab.
- Understand the design procedures and detailing of retaining walls.
- To be able to design the different types of water tanks.
- Be able to understand the IRC Loadings for design of bridges.

**Course Outcomes:**

1. Able to design columns and footing as per IS code
2. To design and detail flat and ribbed slabs for given loads.
3. To design Retaining wall check the stability of the same.
4. Equipped to design different types of water tanks
5. To determine the loads on bridges based on IRC codes

**UNIT - I**

Introduction to Columns and footings, Definition, IS codes. Elastic design and detailing of combined rectangular footings.

**UNIT - II**

**Design of Ribbed slabs and Flat slabs: Introduction to ribbed and flat slabs,** Analysis of the Slabs for Moment and Shears, Ultimate Moment of Resistance, Design for shear, Deflection, Arrangement of Reinforcements. Flat slabs: IS specifications and general notes on flat slabs Direct design method – Distribution of moments in column strips and middle strip-moment and shear transfer from slabs to columns – Shear in Flat slabs-Check for one way and two way shears – Introduction to Equivalent frame method. Limitations of Direct design method, Distribution of moments in column strips and middle strip.

**UNIT - III**

**Retaining Walls-**the different types of Retaining Walls. Proportioning the retaining walls Determining the Lateral earth pressure on Retaining walls. Perform the Stability checks: overturning, sliding, bearing capacity, and settlement. Elastic design and detailing of retaining walls-cantilever and counter fort types.

**UNIT - IV**

Types of water tanks, Definition, IS codes. Elastic design and detailing of rectangular and circular, ground and over head tanks including Intze tanks. Design of staging.

**UNIT - V**

**Bridges:** Introduction to Bridges, Classification of Bridges, Recent advances in Bridge Engineering,. IRC loading – impact factor – effective width method and Pigeaud's method. Elastic design and detailing of (i) R.C. Slab bridges and (ii) T-beam bridges for IRC loadings.

**Suggested Reading**


1. Krishna Raju, N. (2009). "Structural Design and Drawing (third Edition)." Universities press.

2. Punmia, B. C., Jain, A.K and Jain, A. K. (2006). "RCC designs (Reinforced concrete structures). Laxmi publications ($10^{th}$ edition).

3. Phatak,(1990). "Bridge Engineering." Satya Prakashan Publishers.

4. Johnson D. Victor. (2006). "Essentials of Bridge Engineering." Oxford &IBH Publishers, Pvt.Ltd., New Delhi.

5. **Note:** All latest relevant IS codes necessary for teaching this course may be introduced and referred in detail by the Faculty Concerned.

6. IS: 456: 2000, Code of Practice for Plane and Reinforced Cement Concrete.

7. SP 16, SP 34.

8. IS 3370 Part I to Part IV.

*With effect from the Academic Year 2020 – 2021*

**PE 622 CE**

# GROUND IMPROVEMENT TECHNIQUES
**(PROFESSIONAL ELECTIVE-II)**

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*

## Course Objectives

- To understand the objectives, necessity and scope of ground improvement techniques
- To learn different methods of in situ densification of cohesive, cohesionless soils
- To learn the classification, functions and applications of Geosynthetics in ground improvement
- To learn the process of identification of necessity for ground improvement, finding alternative methods and recommendation of the ideal technique through case studies

## Course Outcomes

1. Ability to understand the necessity of ground improvement and evaluation of potential of a ground for improvement
2. comprehensive understanding about the improvement of in-situ cohesive soils as well as Cohesion less soils
3. Knowledge of Grouting & other soil stabilization methods and competence to apply them for ground improvement
4. Ability to understand and implement the Geosynthetic applications
5. Competence to analyse an in-situ ground, identification of ground improvement techniques feasible, selection of the ideal method, its implementation and evaluation of improvement level

## UNIT - I

**Introduction :** Objectives and necessity of Ground Improvement – Formation of Rock and soils – Alteration of ground after its formation – Reclaimed soils – Types and distribution of Soils in India - marine, black cotton soils (expansive), lateritic, alluvial, desert, peaty Soils etc - Ground improvement potential – Geotechnical processes.

## UNIT - II

**Surface Compaction methods**: Compaction Mechanism - moisture density relationship – Factors affecting compaction – Laboratory evaluation of Compaction Characteristics – Field Surface Compaction Methods – Compaction procedure – Specification – Quality Control aspects.

**In-situ Densification of Cohesionless Soils:** Necessity for Deep compaction – Vibration methods – Vibro-compaction methods (Blasting, Vibratory probe, Dynamic compaction / heavy tamping), Vibro-displacement Methods (Displacement Piles, Sand Compaction Piles), vibro-replacement cum displacement methods (Vibro-floatation, Stone Columns).

## UNIT - III

**In-situ Densification of Cohesive Soils:**
Drainage methods – Methods of dewatering systems - selection of pumps and accessories

Pre-compression methods – Concept & benefit of pre-compression -consolidation of Clayey soils – Pre-loading technique – consolidation acceleration methods - consolidation aided with vertical drains – Sand Drains - Pre-fabricated vertical drains, Consolidation by Electro-osmosis and vacuum compression methods - Compression monitoring.

**UNIT - IV**

**Grouting:** Aspects of grouting – Types of grout materials – Classification based on Groutability Ratio - grouting procedure – Applications of grouting in ground improvement.

**Soil Stabilisation:** Types and suitability of stabilization methods - Mechanical, Cementing methods – Aggregants and dispersants – Stabilization procedure – quality control in Soil Stablization.

**UNIT - V**

**Geo-Synthetics:** Classification of Geosynthetics – Functions and applications – Concept of design by function.

**Reinforced Soil Walls** – Components of a RSW – Types of facia – Types of Reinforcement & factors influencing the selection - Design of RSW – construction procedure - Gabions.

**Suggested Reading:**


1. H.R. Hausmann, (2013), *Principles of Ground Modification,* Mc-Graw Hill Publications.
2. P.Nicholson, (2015), *Soil Improvement and Ground Modification Methods,* Butterworth-Heinemann Ltd.
3. Purushotham Raj, (2016), *Ground Improvement Techniques*, Laxmi Publications.
4. R.M.Koerner, (2012), *Designing with Geosynthetics Vol-1&2*, Prentice Hall Inc.
5. Indrarathna, Chu, Cholachat, (2015), *Ground Improvement Case Histories*, Butterworth-Heinemann Publications.

*With effect from the Academic Year 2020 – 2021*

**PE 623 CE**

## FINITE ELEMENT TECHNIQUES
**(PROFESSIONAL ELECTIVE-II)**

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*

**Course Objectives:**
- Analysis of discontinuous problems of structural mechanics can be handled.
- Methods to solve 2-D and 3-D problems of structural analysis are introduced.
- All kinds of loads, material properties and analysis types can be handled.
- The method is primarily, a high-end computer oriented numerical analysis tool and it has a scope to be used as an interdisciplinary subject.

**Course Objectives:**
1. Able to solve the problems of plane strain and plane stress.
2. Analyse and calculate different parameters related to 1-D and 2-D elements.
3. Analyse Isoparametric elements by different numerical methods.
4. To formulate governing equations using weight residual methods.
5. To analyse 3-DFEM problems using software packages.

**UNIT - I**

**Introduction to FEM:** Types of Problems – Types of Materials – Elastic / Inelastic situations – Types of forces: Body forces / Surface Traction / Point loads – Deformable bodies – Types of Deformations – Homogeneous / Non homogeneous Problems – Equations of equilibrium for elastic 2-D / 3-D continua - Equilibrium equations for 2-D / 3-D boundary elements – Boundary conditions – Strain-displacement relation for 2-D / 3-D – Stress-strain relation for 2-D / 3-D – Plane stress / Plane strain problems.

**Virtual Work Formulation:** Application to problems of plane trusses with static indeterminacy not exceeding three.

**Finite Difference Method with Central Differences:** Solving ODE's and PDE's with central differences. Application to beam and plate bending problems of simple geometry.

**UNIT - II**

**Variational Formulation: Finite** Element Formulation - Stationarity of Functional – Given the Functional or Differential equation – Number of elements limited to two.

**1-D Elements:** Strain-displacement relation matrix / stiffness matrix / Minimum Potential Energy Approach / Rayleigh-Ritz Method / introduction to natural coordinates / stiffness matrix of second order bar element / Axial bar subjected to point loads, body forces and surface traction forces / Problems with kinematic indeterminacy not exceeding two.

**2-D Triangular Elements:** Displacement models / criterion for convergence / geometric invariance / conforming and non conforming elements - 3-node triangular elements (CST) / determination of strain-displacement matrix / area coordinates-shape functions / determination of element stiffness and load matrices, assembling global stiffness and load matrices / Problems with kinematic indeterminacy not exceeding three.

**2$^{nd}$ Order Triangular elements:** Shape functions – degradation technique / strain-displacement matrix / Expression for stiffness matrix / Load matrices due to body forces and surface traction.

**UNIT - III**

**Iso-parametric Elements:**

**Quadrilateral elements:** Construction of shape functions using natural coordinates/Strain-displacement matrices/Load matrices for body force and surface traction/Expressions for stiffness matrix, load matrices for 4-noded quadrilateral elements/ Gauss Quadrature of numerical integration / Problems with rectangular elements, kinematic indeterminacy not exceeding three.

**$2^{nd}$ Order Quadrilateral Elements:** - Determination of shape functions for $2^{nd}$ order quadrilateral elements and for elements of with serendipity / Strain-displacement matrices / Load matrices for body force and surface traction.

**UNIT - IV**

**Method of Weighted Residuals:**

**Galerkin's Method of Weighted Residuals:** Application to problems of mathematics / structural engineering, number of trial functions not exceeding two.

**Galerkin's Finite Element Method:** Weak form of Trial Function - Application to problems of mathematics / structural engineering, number of elements limited to two.

**UNIT - V**

**Axi-symmetric Problems:** Strain-displacement relationship/stress-strain relationship / determination of stiffness matrix for 3-noded ring element and load matrices for body force and surface traction/ Problems with kinematic indeterminacy not exceeding three for 3-noded ring elements only.

**Tetrahedron elements:** Volume coordinates, Strain-displacement matrix, stiffness matrix, load matrices due to body force and surface traction/ introduction to Hexahedron (brick) elements.

**Introduction to MSC Nastran:** Illustration on different modules of Nastran / Structural engineering applications of the package/Creation of a simple 1-D model, 2-D model and a 3-D model/ analysis and post processing of the results.

**Suggested Reading:**


1. Cook, R. D. (1981). "Concepts and Application of Finite Element Analysis", John Wiley and Sons.
2. Zienkiewicz, O. C. And Taylor, R. L, (1989). "The Finite Element Method", Vol.1, McGraw Hill Company Limited, London.
3. Reddy, J. N, (1993). "An Introduction to the Finite Element Method", McGraw Hill, New York.
4. Chandrupatla, T. R. And Belegundu, A. D, (2001). "Introduction to Finite Elements in Engineering", Prentice Hall of India, New Delhi.
5. Seshu. P, (2003). "Finite Element Analysis", Prentice Hall of India Private Limited, New Delhi.
6. David V. Hutton, (2005). "Fundamentals of Finite Element Analysis", Tata McGraw-Hill Publishing Company Limited, New Delhi.

*With effect from the Academic Year 2020 – 2021*

**PE 631 CE**

# STRUCTURAL ANALYSIS
**(PROFESSIONAL ELECTIVE-III)**

*Instruction: 3+1 periods per week* Duration of SEE*: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*

**Course Objectives:**

- Understand the analysis of structural elements subjected to moving loads & the analysis of road/railway bridges and gantry girders.
- Explain the concepts involved in the analysis of suspension cable bridges.
- Illustrate the matrix methods of structural analysis for computer applications.

**Course Outcomes:**

1. Sketch ILD for bending moment and shear force, for determinate girders for different position of loading system and for different sections of girder
2. Analyse cable suspension bridges along with three hinged stiffening girder for static loads.
3. Calculate the bending moment and shear force and sketch the BMD and SFD for redundant members using force and displacement methods
4. Analyse redundant members using direct stiffness method
5. Analyse the redundant beams and frames by using software packages

**UNIT - I**

**Moving loads:** Influence line for support reaction, bending moment and shear force at any location for simple beams. Determination of maximum bending moment and shear force for moving load systems on simply supported girders.

**Curves of maximum bending moment and shear force:** for simply supported girders traversed by (l) single point load, (2) two point loads, (3) uniformly distributed-load longer/shorter than span, enveloping parabola and EUDLL.

**UNIT - II**

**Moving loads on** trusses / **girders:** Influence lines for forces in members of statically determinate plane framed structures under moving loads for Warren girder, Pratt truss, and Curved flange truss.

**Suspension bridges:** Stresses in suspended loaded cables, length of cable, simple suspension bridge with 3-hinged stiffening girders for static load, Influence lines for horizontal and vertical
components of tension in the cable, tension in the cable, bending moment and shear force.

**UNIT - III**

**Flexibility Matrix Method:** Determination of Static and kinematic indeterminacy - Equilibrium and compatibility conditions-Principles of superposition, Application of Flexibility Matrix Method to continuous beams, plane trusses, plane frames and ortho grid structures (Static indeterminacy not exceeding three) - Effect of temperature, Lack of fit and Pre-stressing forces

**UNIT - IV**

**Stiffness Matrix Method:** Application of Stiffness Matrix Method to continuous beams, plane trusses, plane frames and ortho grid structures (Degree of freedom not exceeding three). Construction of stiffness matrix for frames - Direct Method.

**UNIT - V**

**Direct Element Method:** Development of stiffness matrices for bar, truss and beam elements. Application of direct element method to problems of axially loaded bars, continuous beams, plane trusses and plane frames to obtain joint displacements and member end forces. Developing shear force and bending moment diagrams. Introduction to software package STAAD Pro.

**Suggested Reading:**


1. S.B. Junarkar and Shah, *"Mechanics of structures"*, Charotar Pub, House, 2001
2. D.S. Prakash Rao, "*Structural Analysis - a Unified Approach"*, University Press, 1991
3. B.C. Punmia and A.K. Jain, "*Theory of structures"*, Laxmi Publications, New Delhi, 2004.
4. Pandit, G .S., S. P. Gupta and R. Gupta, *"Theory of Structures," Vol. I* , Tata McGraw Hill, New Delhi, 1999.
5. J. M. Gere & William Weaver, "*Matrix Analysis of Framed Structures"*, 2nd Ed., D Van Nostand, New Jersey, 1980.

*With effect from the Academic Year 2020 – 2021*

**PE 632 CE**

# PRESTRESSED CONCRETE
**(PROFESSIONAL ELECTIVE-III)**

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*

**Course Objectives:**

- Understand the basic concept of prestressed concrete and materials used.
- Learn the analysis prestress and load balancing concept.
- Study the flexural and shear design of prestressed concrete beam sections.
- Know the concepts of deflections and end blocks of prestressed concrete sections.

**Course Outcomes:**

1. Apply the concept of prestressing and determine the losses of prestress.
2. Analyze the prestressed concrete beam and suggest the cable profile for beam.
3. Design the prestressed concrete beam for flexure and shear.
4. Analyze the prestressed continuous beam and determine the concordant cable profile.
5. Estimate the deflection of a prestressed concrete beam and design the end block.

**UNIT - I**

**Introduction to prestressed concrete:** Historical development, principles of prestressed concrete. Definition, classification and systems of prestressing. Materials for prestressed concrete.

**Loss of prestress:** Losses of prestress in pre-tensioned and post-tensioned members.

**UNIT - II**

**Analysis of prestress:** Basic assumptions, analysis of prestress, resultant stress, pressure line, kern points, cable profiles, load balancing concept, stress diagrams for prestress, dead load and live load.

**UNIT - III**

**Simply supported continuous beams:** concordant cable profile, analysis of continuous prestressed concrete beams.

**Design of sections:** Flexural strength design of rectangular, I and T sections using IS code provisions.

**UNIT - IV**

**Design for shear:** Basic concept of shear design, shear failure, flexural shear failure, shear compression failure, shear tension failure, shear strength of beams (a) unfrocked in flexure and (b) cracked in flexure.

**UNIT - V**

**Deflections:** Necessity of deflection estimation, limitations of deflections. Deflections of pre-stressed concrete beams with uniformly distributed and point loads.

**End Block:** Types of end blocks and Importance of end block, Analysis and design of end block by Guyon method and IS method for not more than two cables.

**Suggested Reading:**


1. T.Y. Lin and N.H. Burns, *Design of prestressed concrete structure*, Jon Wildy and sons, 1982.
2. A.H. Nilson, *Design of prestressed concrete*, John Wiley and Sons, 1982.
3. N. Krishna Raju, *Design of prestressed concrete structure*, Tata McGraw Hill Book Co., 1996.
4. G.S. Pandit and S.P. Gupta, *Prestressed Concrete*, CBS Publishers, 1995.

*With effect from the Academic Year 2020 – 2021*

**PE 633 CE**

# GEOSPATIAL TECHNIQUES
**(PROFESSIONAL ELECTIVE-III)**

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 mark*
*Credits: 3*

**Course Objectives:**

- Description about various spatial and non-spatial data types, and data base management techniques.
- Development of the concepts and professional skills in utility of geospatial techniques.
- Enhancement of knowledge of geospatial techniques to field problems.

**Course Outcomes:**

1. Ability to apply the Geospatial Techniques to select appropriate coordinates and steps of GIS.
2. Perform spatial data analysis and data management to apply to GIS.
3. Analyze a digital elevation model of land surface terrain to derive watersheds and stream networks.
4. Perform digital image analysis to extract data from the remote sensing images for Civil Engineering applications
5. Understand the concept of the remote sensing techniques for the field and its application to Civil Engineering

**UNIT I**

Introduction: Basic concepts, socio economic challenges, fundamentals of geographical information systems (GIS), history of geographical information system, components of geographical information systems.

*Projections and Coordinate Systems:* Map definitions, representations of point, line, polygon, common coordinate system, geographic coordinate system, map projections, transformations, and map analysis.

**UNIT II**

Data Acquisition and Data Management*:* Data types, spatial, non spatial (attribute) data, data structure and database management, data format, vector and raster data representation, object structural model filters and files data in computer, key board entry, manual digitizing, scanner, aerial photographic data, remotely sensed data, digital data, cartographic database, digital elevation data, data compression, data storage and maintenance, data quality and standards, precision, accuracy, error and data uncertainty.

*Data Processing:* Geometric errors and corrections, types of systematic and non systematic errors, radiometric errors and corrections, internal and external errors.

**UNIT III**

Data Modeling: Spatial data analysis, data retrieval query, simple analysis, recode overlay, vector data model, raster data model, digital elevation model, cost and path analysis, knowledge based system.

*GIS Analysis and Functions:* Organizing data for analysis, analysis function, maintenance and analysis of spatial data, buffer analysis, overlay analysis, transformations, conflation, edge matching and editing, maintenance and analysis of spatial and non spatial data

**UNIT IV**

Applications of GIS: Environmental and natural resource management, soil and water resources, agriculture, land use planning, geology and municipal applications, urban planning and project management, GIS for decision making under uncertainty, software scenario functions, standard GIS packages, introduction to Global Positioning Systems (GPS) and its applications.

**UNIT V**

Introduction to Remote Sensing: General background of remote sensing technology, objectives and limitations of remote sensing, electro-magnetic radiation, characteristics, interaction with earth surface and atmosphere, remote sensing platforms and sensors, satellite characteristics, digital image processing, IRS series and high resolution satellites, software scenario functions, remote sensing applications to watershed modeling, environmental modeling, urban planning and management.

**Suggested Readings:**


1. Burrough, P. A., and McDonnell R. A. (1998), 'Principles of Geographical Information Systems', Oxford University Press, New York
2. Choudhury S., Chakrabarti, D., and Choudhury S. (2009), 'An Introduction to Geographic Information Technology', I.K. International Publishing House (P) Ltd, New Delhi
3. Kang-tsung Chang. (2006), 'Introduction to Geographical information Systems', Tata McGraw-Hill Publishing Company Ltd., Third Edition, New Delhi
4. Lilys and T.M., and Kiefer R.W. (2002), 'Remote Sensing and Image Interpretation', John Wiley and Sons, Fourth Edition, New York
5. Sabins F.F. Jr. (1978), 'Remote Sensing Principles and Interpretations', W.H. Freeman and Company, San Francisco
6. Tor Bernhardsen. (2002), 'Geographical Information System', Wiley India (P) Ltd., Third Edition, New Delhi
7. Hoffman-Wellenh of, B, et al. (1997), 'GPS Theory and Practice', Fourth Edition, Springer Wein, New York.

*With effect from the academic year 2020-2021*

**PC 651 CE**

## ENVIRONMENTAL ENGINEERING LABORATORY

*Instruction: 2 periods per week* Duration of SEE*: 3 hours*
*CIE: 25 marks* *SEE: 50 marks*
*Credits: 1*

**Course Objectives:**

- Introduction to characterization of water and wastewater
- Knowledge of experiments for water quality assessment
- To verify the efficacy of some water treatment processes

**Course Outcomes:**

1. Knack to interpret and analysis the experimental data
2. Ability to apply the laboratory results for providing technical solutions
3. Capacity to write a technical report based on the experimental results

## LIST OF EXPERIMENTS

1. a) Determination of total dissolved solids
   b) Determination of total suspended solids
   c) Determination of fluorides
2. Determination of total hardness
3. Determination of alkalinity
4. Determination of chlorides
5. Determination of sulphates
6. Determination of MPN
7. Determination of residual chlorine
8. Determination of optimum alum dosage
9. Determination of BOD
10. Determination of COD

**PC652CE**

## TRANSPORTATION ENGINEERING LABORATORY

*Instruction: 2 periods per week* Duration of SEE*: 2 hours*
*CIE: 25 marks* *SEE: 50 marks*
*Credits: 1*

**Course Objectives:**

- Know the properties of various materials
- Create awareness about various traffic studies
- Impart knowledge on mix design of bitumen

**Course Outcomes:**

1. Characterize the pavement materials.
2. Perform quality control tests on pavement material and pavements
3. Conduct traffic studies for estimation of traffic flow characteristics

A) **Tests on Bitumen:**
   1) Penetration test
   2) Ductility test
   3) Softening point test
   4) Specific Gravity test
   5) Viscosity test,
   6) Flash and Fire point test

B) **Tests on Aggregate:**
   1) Aggregate Crushing test,
   2) Los Angles Abrasion test,
   3) Aggregate Impact test,
   4) Shape test,
   5) Specific gravity and Water Absorption,
   6) Soundness

C) **Experiments on Traffic:**
   1) Traffic Volume study
   2) Spot speed study
   3) Speed and delay study
   4) Origin & Destination study

D) **Miscellaneous Tests (Demo):**
   1) Marshall Stability,
   2) Bitumen Extraction
   3) Stripping test
   4) DCP test

**Suggested Reading:**

1. Khanna SK and Justo CEG, 'Highway material testing' (Lab manual), Nem Chand & Bros
2. Relevant IS and IRC Codes of practice
3. Relevant ASTM and AASHTO codes of practice

*With effect from the academic year 2020-21*

**OE601BM**

## ENGINEERING APPLICATIONS IN MEDICINE
## (Open Elective-I)

*Instruction: 3 periods per week* Duration of SEE*: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*

**COURSE OBJECTIVES:**

- To make the students gain basic knowledge of Human Physiology.
- To make the students learn the applications of various branches of engineering in Medicine.

**COURSE OUTCOMES:** Upon the completion of the course, the students will be able to:

1. Describe the major organ systems of the human body
2. Understand the concepts of bioelectricity and medical instruments
3. Apply solid and fluid mechanics principles to joints and blood flow respectively
4. Learn the need and applications of BCI
5. Analyze and choose proper biomaterial for various applications

**UNIT-I**

Evolution of Modern healthcare, Major organ systems- Cardiovascular, Respiratory, Nervous, Skeletal, Muscular. Homeostasis. Physiological signals and their diagnostic importance.

**UNIT-II**

Bioelectricity-Excitable cells, Resting potential, Action potential, Accommodation, Strength-Duration Curve, Propagation of impulses in myelinated and unmyelinated nerves.
Medical Instrumentation System-Functions, Characteristics, Design Challenges.
Signal Processing-QRS detection.

**UNIT-III**

Solid mechanics-Analysis of muscle force and joint reaction force for the limb joints.
Fluid mechanics-Factors governing and opposing blood flow, Wind-Kessel model, Application of Hagen-Poiseuille flow to blood flow.

**UNIT-IV**

Brain-Computer Interface: Brain signals for BCIs, Generic setup for a BCI, Feature extraction and Feature translation involved in BCIs. Typical applications-Word forming, Device control.

**UNIT-V**

Materials and Tissue Replacements-Types of Biomaterials- Metals, Polymers, Ceramics and Composites and their applications in Soft and Hard tissue replacements. Implants-Manufacturing process, Design, fixation.

**Suggested Reading:**


1. John Enderle, Susan M. Blanchard and Joseph Bronzino, *Introduction to Biomedical Engineering*, Second Edition, Elsevier, 2005.
2. Ozkaya, Nordin. M, *Fundamentals of Biomechanics*, Springer International Publishing, 4th Edition, 2017.
3. Khandpur R.S., *Handbook of Biomedical Instrumentation*, Tata McGraw Hill, 2016.
4. John G.Webster, *Medical Instrumentation: Application and Design*, John Wiley and Sons Inc., 3rd Ed., 2003.

*With effect from the academic year 2020-21*

**OE602 CE**

# DISASTER MANAGEMENT
## (Open Elective-I)

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*

**Course Objectives:**

- To introduce basic conceptual understanding of natural & man-made hazards and different contextual aspects.
- To develop the knowledge and understanding of the International and national strategy for disaster reduction (UN-ISDR)
- To ensure skills and abilities to analyze potential effects of disasters and of the strategies and methods to deliver public health response to avert these effects.
- To promote the use of science and technology for implementing the disaster risk reduction (DRR) plans and policies.

**Course Outcomes:**

1. Aptitude to link hazards, risk, vulnerability, differential impacts and capacity building to the life and property loss during disasters and its impacts on the society and sustainability.
2. Ability to understand various aspects of natural and man-made hazards and emerging trends
3. Acquaintance with different steps involved in disaster risk reduction (DRR) and international initiatives for prevention, mitigation and preparedness.
4. Knack to appreciate the National Policy and Role of individuals, communities, and government organizations in disaster management.
5. Capacity to identifying current technological constraints and hazard specific solutions, particularly construction codes etc.

**UNIT I: INTRODUCTION TO DISASTER**

Understanding the Concepts, Definitions and Terminologies used in the field of Disaster Management (i.e. Hazard, Risk, Vulnerability, Resilience, and Capacity Building); Differential impacts of Disasters in terms of Gender, Age, Social Status, Location, Prosperity, Disabilities; Disaster- Development Nexus.

**UNIT II: TYPES of HAZARDS AND EMRGING TRENDS**

Classification, Causes, Consequences and Controls of: Geophysical hazards-Earthquakes, Landslides, Tsunami; Weather related hazards- Meteorological (Cyclones, and Storm-surge), Hydrological (Floods, Droughts, Avalanches), Climatological (Wildfire, Cold & Heat Waves); Biological hazards-Epidemic & Pandemics; Technological hazards-Chemical, Industrial, Nuclear; Man-made hazards-Structural Failure, Fire, Transportation accidents, Terrorism and Wars; Emerging Disasters- Urban Areas, Climate Change; Regional and Global Trends-loss of life & Property in various hazards

**UNIT III: DISASTER MANAGEMENT CYCLE AND INTERNATIONALFRAMEWORK**

Disaster Management Cycle: **Pre-Disaster** – Risk Assessment and Analysis, Risk Mapping, zonation and Micro-zonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Building; Awareness; **During Disaster** –

Evacuation – Disaster Communication – Search and Rescue– Emergency Operation Centre – Incident Command System – Relief and Rehabilitation; **Post-disaster** – Damage and Needs Assessment, Restoration of Critical Infrastructure – Early Recovery – Reconstruction and Redevelopment; Paradigm Shift in Disaster Management: International Decade for Natural Disaster Reduction; Yokohama Strategy; Hyogo Framework of Action

**UNIT IV: DISASTER RISK MANAGEMENT IN INDIA**

Disaster Profile of India – Mega Disasters of India and Lessons Learnt; Disaster Management Act 2005 – Institutional and Financial Mechanism; National Policy on Disaster Management; National Guidelines and Plans on Disaster Management; Role of Government (local, state and national), Non-Government and Inter-governmental Agencies

**UNIT V: TECHNOLOGICAL APPROACHES TO DISASTER RISK REDUCTION**

Geo-informatics in Disaster Management (RS, GIS, GPS and RS); Technological in Disaster Communication System (Early Warning and Its Dissemination), rescue and restoration of services; Disaster Safe Designs and Constructions; Application of technology and innovations for Structural and Non Structural Mitigation; Science & Technology Institutions for Disaster Management in India

**Suggested Reading:**


1. Coppola D P, 2007. Introduction to International Disaster Management, Elsevier Science (B/H), London.
2. Manual on natural disaster management in India, M C Gupta, NIDM, New Delhi
3. An overview on natural & man-made disasters and their reduction, R K Bhandani, CSIR, New Delhi
4. World Disasters Report, 2009. International Federation of Red Cross and Red Crescent, Switzerland
5. Disasters in India Studies of grim reality, Anu Kapur& others, 2005, 283 pages, Rawat Publishers, Jaipur
6. 10 Disaster Management Act 2005, Publisher by Govt. of India
7. Publications of National Disaster Management Authority (NDMA) on Various Templates and Guidelines for Disaster Management
8. National Disaster Management Policy, 2009, GoI

*With effect from the academic year 2020-21*

**OE 603 EC**

# ELECTRONIC INSTRUMENTATION
## (Open Elective-I)

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*

**Course Objectives:**

- To familiarize with various measurement parameters and Standards of measurement.
- To learn the working principles of various types of Microphones and Hygrometers.
- To understand the operation and applications of CRO.
- To understand about the operation of various transducers.
- To understand the importance of biomedical instrumentation and Virtual instrumentation.

**Course Outcomes:**

1. Analyze the various characteristics of measurement parameters and Standards of measurement.
2. Evaluate the operation and application of microphones
3. Use the CROs for various applications and explore its features.
4. Explore various types of Transducers and their characteristics.
5. Analyze the operation of various biomedical instruments and the features of Virtual Instrumentation.

**UNIT – I**

**Measurement parameters:** History of instrumentation. Error in Measurement, Types of Errors, Statistical analysis of errors, Limiting errors, Standards of measurement, IEEE and ISO standards.

**UNIT – II**

**Microphones and Hygrometers:** Microphones: Microphones and their types, Humidity measurement, resistive, capacitive, aluminum-oxide and crystal Hygrometer types – Operation and applications.

**UNIT – III**

**CRO:** Basic Principle of CRT, its features, Block diagram and operation of CRO, Oscilloscope Controls, Waveform display, Measurement of frequency and Phase using Lissajous method, Applications and Advantages of CRO.

**UNIT –IV**

**Transducers:** Introduction, Electrical Transducer, Factors for Selecting a Transducer, Active and Passive Transducers, Operation and applications of Resistive transducers, Strain gauges and Thermistors.

**UNIT –V**

**Biomedical and Virtual Instrumentation:** Biomedical instrumentation, Bio-potential electrodes, Principles of operation and applications of ECG, EEG, EMG, X-ray machines, CT scanners and Introduction to virtual instrumentation.

**Suggested Reading:**


1. Albert D.Helfrick and William D.Cooper, *"Modern Electronic Instrumentation and Measurement Techniques",* Prentice-Hall of India Private Limited, New Delhi, 1996.

2. H S Klasi, *"Electronic Instrumentation", Tata* McGraw-Hill Company Limited, New Delhi, 2004.

3. David A.Bell, *"Electronic Instrumentation and Measurements",* 2nd Edition, Prentice-Hall of India Private Limited, New Delhi, 1994.

4. R.S.Khandpur, *"Handbook of biomedical Instrumentation",* Tata McGraw- Hill publishing company Limited, New Delhi, 2000.

*With effect from the academic year 2020-21*

**OE 604EC**

**PRINCIPLES OF ELECTRONIC COMMUNICATION SYSTEMS**
**(Open Elective-I)**

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 Marks* *SEE: 70 Marks*
*Credits: 3*

**Course Objectives:**

- Provide an introduction to fundamental concepts in the understanding of communications systems.
- Provide an introduction to network model and some of the network layers including physical layer, data link layer, network layer and transport layer.
- Provide an introduction to the evolution of wireless systems and current wireless technologies.

**Course Outcomes:** Student will be able to

1. Understand the working of analog and digital communication systems
2. Understand the OSI network model and the working of data transmission
3. Understand the concepts of modulation and demodulations
4. Understand the evolution of communication technologies from traditional telephony systems to modern wireless communication systems.
5. Understand the principles of optical communications systems

**UNIT- I**

**Introduction to communication systems:** Electromagnetic Frequency Spectrum, Signal and its representation, Elements of Electronic Communications System, Types of Communication Channels, Signal Transmission Concepts-Baseband transmission and Broadband transmission, Communication parameters-Transmitted power, Channel bandwidth and Noise, Need for modulation Signal Radiation and Propagation-Principle of electromagnetic radiation, Types of Antennas, Antenna Parameters and Mechanisms of Propagation.

**UNIT- II**

**Analog and Digital Communications:** Amplitude modulation and demodulation, FM modulation and demodulation, Digital converters, Digital modulation schemes – ASK, FSK, PSK, QPSK, Digital demodulation.

**UNIT- III**

Data Communication and Networking: Network Models, OSI Model, Data Link Layer – Media Access control, Ethernet, Network Layer – Internet Protocol (IPv4/IPv6), Transport Layer – TCP, UDP.

**UNIT- IV**

**Telecommunication Systems:** Telephones, Telephone system, Paging systems, Internet Telephony. Optical Communications: Optical Principles, Optical Communication Systems, Fiber –Optic Cables, Optical Transmitters & Receivers, Wavelength Division Multiplexing.

**UNIT- V**

**Wireless Communications**: Evolution of Wireless Systems: AMPS, GSM, CDMA, WCDMA, And OFDM. Current Wireless Technologies: Wireless LAN, Bluetooth, PAN and ZigBee, Infrared wireless, RFID communication, UWB, Wireless mesh networks, Vehicular adhoc networks.

**Suggested Readings:**


1. Louis E. Frenzel, "*Principles of Electronic Communication Systems*", 3e, McGraw Hill publications, 2008.

2. Behrouz A. Forouzan, *"Data Communications and Networking",* 5e TMH, 2012.

3. Kennady, Davis, "*Electronic Communications systems*", 4e, TMH, 1999.

*With effect from the academic year 2020-21*

**OE605ME**

# 3D PRINTING TECHNOLOGY
## (Open Elective-I)

*Instructions: (3L) hrs per week* *Duration of SEE: 3hours*
*CIE: 30 Marks* *SEE: 70 Marks*
*Credits: 3*

**Course Objectives:**

- To understand the fundamental concepts of 3D Printing, its advantages and limitations.
- To know the working principle, advantages, disadvantages and applications of liquid, solid and Powder based 3D Printing Technologies.
- To know the various types of STL file errors and other data formats used in 3D Printing Technology.
- To know the features of various 3D Printing software's.
- To know diversified applications of 3D Printing Technologies.

**Course Outcomes:** At the end of the course the student will be able to:

1 Interpret the features of 3D Printing and compare it with conventional methods.
2 Illustrate the working principle of liquid, solid and powder based 3D Printing Technologies.
3 Identify various types of errors in STL file and other data formats used in 3D Printing Technology.
4 Select suitable software used in 3D Printing Technology.
5 Apply the knowledge of various 3D Printing technologies for developing innovative applications.

**UNIT-I**

**Introduction:** Prototyping fundamentals: Need for time compression in product development, Historical development, Fundamentals of 3D Printing, 3D Printing Process Chain, Advantages and Limitations of 3D Printing, 3D Printing wheel, Commonly used Terms, Classification of 3D printing processes, Fundamental Automated Processes: Distinction between 3D Printing and Conventional Machining Processes.

**UNIT-II**

**Liquid-based 3D Printing Systems:** Stereo Lithography Apparatus (SLA): Models and specifications, Process, working principle, photopolymers, photo polymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages, Case studies. Polyjet: Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies

**Solid-based 3D Printing System:** Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

**UNIT-III**

**Powder Based 3D Printing Systems**: Working principle, Specifications, Materials used, Process, Applications, Advantages and Disadvantages, Case studies of the following 3D Printing Technologies like Selective laser sintering (SLS), Selective Laser Melting (SLM) and Direct Metal Laser Sintering (DMLS), Laser Engineered Net Shaping (LENS), Electron Beam Melting (EBM),

**UNIT-IV**

**3D Printing Data Formats & Software**: STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs: Generic Solution, Other Translators, Newly Proposed Formats. 3D Printing Software's Features: Magics, Mimics, Solid View, View Expert, 3 D Rhino, 3 D doctor, Flash Print, Object Studio, Cura, ITK Snap, 3-matic, Simplant, 3-matic, Simplant, MeshLab, Ansys for Additive Manufacturing.

**UNIT-V**

**Applications of 3D Printing** : Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Electronic Industry, Jewellery Industry, Coin Industry, GIS application, Arts and Architecture. RP Medical and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization of Biomolecules. Biopolymers, Packaging, Disaster Management, Entertainment and Sports industry.

**Suggested Readings:**


1. Chee Kai Chua and Kah Fai Leong, "3D Printing and Additive Manufacturing Principles and Applications" Fifth Edition, World scientific

2. Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing- Ian Gibson, David W Rosen, Brent Stucker, Springer, Second Edition, 2010.

3. Rapid Prototyping & Engineering Applications – Frank W.Liou, CRC Press, Taylor & Francis Group, 2011.

4. Rafiq Noorani, Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley& Sons, 2006.

5. NPTEL Course on Rapid Manufacturing. https://nptel.ac.in/courses/112/104/112104265/

*With effect from the academic year 2020-21*

**OE606ME**

# FINITE ELEMENT METHOD
## (Open Elective-I)

*Instructions: (3L) hrs per week* *Duration of SEE: 3hours*
*CIE: 30 Marks* *SEE: 70 Marks*
*Credits: 3*

**Course Objectives:**

- To understand the theory and application of the finite element method for analyzing structural systems.
- To learn Approximation theory for structural problems as the basis for finite element methods.
- To learn formulations for a variety of elements in one, two, and three dimensions. Implementations of element formulations will be examined using Matlab.
- To understand modeling and analysis of structures using planar, solid, and plate elements

**Course Outcomes:** Upon successful completion of this course, the student will be able to:

1 Demonstrate a basic understanding of the concepts, mathematical formulation and numerical implementation.
2 Demonstrate the ability to invoke appropriate assumptions, select proper elements and develop FEA models that adequately and efficiently represent physical systems.
3 Underlying the FEA as applied to solid mechanics.
4 Solve 2D vector variable problems and analyze higher order elements and its applications.
5 Create his/her own FEA computer programs using Matlab to solve simple engineering problems.

**UNIT I:** INTRODUCTION
Historical Background – Mathematical Modeling of field problems in Engineering – Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems– Weighted Residual Methods – Variational Formulation of Boundary Value Problems – Ritz Technique – Basic concepts of the Finite Element Method.

**UNIT II:** ONE-DIMENSIONAL PROBLEMS
One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors- Assembly of Matrices – Solution of problems from solid mechanics and heat transfer. Longitudinal vibration frequencies and mode shapes.

**UNIT III**: TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS
Second Order 2D Equations involving Scalar Variable Functions – Variational formulation – Finite Element formulation – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems – Thermal problems – Torsion of Non circular shafts –Quadrilateral elements – Higher Order Elements.

**UNIT IV:** TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS
Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Body forces and temperature effects – Stress calculations – Plate and shell elements.

**UNIT V:** ISOPARAMETRIC FORMULATION
Natural co-ordinate systems – Isoparametric elements – Shape functions for iso parametric elements – One and two dimensions – Serendipity elements – Numerical integration and application to plane stress problems – Matrix solution techniques – Solutions Techniques to Dynamic problems – Introduction to Analysis Software.

**Suggested Reading:**


1. Tirupathi R. Chandraputla and Ashok, D. Belgundu "Introduction to Finite Elements in Engineering" , Pearson Education, 2002, 3rd Edition.

2. Rao S.S., "The Finite Element Methods in Engineering", pergam on Press, 1989.

3. Segerlind, L.J. "Applied Finite Element Analysis", Wiley Publication, 1984.

4. Reddy J.N., "An Introduction to Finite Element Method", Mc Graw-Hill Company, 1984.

*With effect from the academic year 2020-21*

**PW 961 CE**

# SUMMER INTERNSHIP*

*Instruction: 6 weeks* *CIE: 50 marks*
*Credits: 2*

**Course Objectives:**

- To expose the students in understanding the real-life practical problems and technologies.
- To provide an opportunity to integrate various aspects of learning reference of practical problems.
- To enhance the confidence of the students by interaction with field professionals

**Course Outcomes:** Student will be

1. Able to design or develop a simple software suitable to industry
2. Able to complete the task or realize a prespecified target within a limited scope.
3. Able to learn to find alternate viable solutions for a given problem based on criteria.
4. Able to learn new software suitable for Civil Engineering problems.
5. Ability to learn field constraints and also documentation of technical report.

Summer Internship is introduced as part of the curricula to encourage students to work on problems of interest to industries or in a consulting organization. A batch of two or three students will be attached to Industry/ R & D Organization / National Laboratory / Consultants / Project offices/ Executing Agencies /Departments/ Private Builders for a period of SIX weeks. This will be during the summer vacation followed after the completion VI semester course. Faculty member (s) will be acting as an internal guide(s) for the batches to mentor and monitor the progress and also interacts with the Industry guide (s) as per the need.

After the completion of the internship, students need to submit a brief technical report on the project executed and present the work through a seminar talk to be organized by the Department. Award of sessional are based on the performance of the student at the work place and will be judged by internal guide (s) (25 Marks) followed by presentation before the committee constituted by the Department (25 Marks). One faculty member will coordinate the overall activity of Summer Internship.

***Students have to undergo summer internship of 6 Weeks duration at the end of semester VI and the credits will be awarded after evaluation in VII semester.**