Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institute of Information Technology, Pune-48

(An Autonomous Institute affiliated to Savitribai Phule Pune University)

Syllabus for

T.Y.B. Tech.

Civil Engineering (Pattern 2018)

Department of Civil Engineering

Vision:

Excellence in Civil Engineering Education

Mission:

M1: Make competent Civil Engineers with high level of professional, moral and ethical values

M2: Impart highest standards in theoretical as well as practical knowledge and skill set

M3: Establish Center of Excellence in major areas of Civil Engineering to respond to the current and future needs of the industry, higher studies as well as research

PROGRAM EDUCATIONAL OBJECTIVES

PEO 1: Graduates will have successful career in the field of Civil Engineering

PEO 2: Graduates will respond to growing demands of society through professional and ethical practices

PEO 3: Graduates will pursue lifelong learning including higher studies in the field of Civil Engineering

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **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.
3. **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.
4. **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.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **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.
7. **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.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **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.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **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 (PSO):

PSO1: Engineering graduates will be able to plan and execute the activities of construction projects

PSO2: Engineering graduates will be able to analyze and design components of Civil Engineering Systems.

Department of Civil Engineering

T.Y. B. TECH (CIVIL ENGINEERING), SEMESTER V (PATTERN 2018)

Course Code	Course Title	Course Type	Teaching Scheme			Examination Scheme					Total	Credits
			L	T	P	CIE	ISE	SCE	ESE	PR/OR/TW		
CVUA31181	Quantity Surveying, Contracts and Tenders*	TH	3	-	2	20	30	20	30	25	125	4
CVUA31182	Structural Design and Drawing – I*	TH	3	-	2	20	30	20	30	25	125	4
CVUA31183	Professional Elective-I	TH	3	-	-	20	30	20	30	-	100	3
CVUA31184	Foundation Engineering	TH	3	-	-	20	30	20	30	-	100	3
CVUA31185	Hydrology and Water Resources Engineering	TH	3	-	2	20	30	20	30	25	125	4
CVUA31186	Transportation Engineering	CE	2	-	2	-	-	50	-	25	75	3
M3	Mandatory course	AU	-	-	-	-	-	-	-	-	-	-
	Total	-	17	0	8	100	150	150	150	100	650	21

***Course has Oral Examination**

Professional Elective I

1. CVUA31183A: Construction Management
2. CVUA31183B : Solid Waste Management
3. CVUA31183C: Systems Approach in Civil Engineering

Mandatory Course:

Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Traditional Knowledge, Online certification course (minimum two weeks).

BoS Chairman Dean Academics Director

T.Y. B. TECH (CIVIL ENGINEERING), SEMESTER VI (PATTERN 2018)

Course Code	Course Title	Course Type	Teaching Scheme			Examination Scheme					Total	Credits
			L	T	P	CIE	ISE	SCE	ESE	PR/ OR/ TW		
CVUA32181	Professional Elective II*	TH	3	-	2	20	30	20	30	25	125	4
CVUA32182	Professional Elective III	TH	3	-	2	20	30	20	30	25	125	4
CVUA32183	Environmental Engineering*	TH	3	-	2	20	30	20	30	25	125	4
ES32184CV	Professional Practice, Law and Ethics	TH	3	-	-	20	30	20	30	-	100	3
IOEUA32185	Open Elective I	TH	3	-	-	20	30	20	30	-	100	3
CVUA32186	Structural Design and Drawing – II	CE	2	-	2	-	-	50	-	25	75	3
M3	Mandatory Course	AU	-	-	-	-	-	-	-	-	-	-
		-	17	0	8	100	150	150	150	100	650	21

***Course has Oral Examination**

Professional Elective-II:

CVUA32181A: Dams and Hydraulic Structures

CVUA32181B: Advanced Surveying

CVUA32181C: Advanced Concrete Technology

Professional Elective-III

CVUA32182A: Irrigation and Drainage

CVUA32182B: Infrastructure Engineering

CVUA32182C: Structural Dynamics and Earthquake Engineering

Open Elective-I:

IOEUA32185A: Information and Cyber Security
IOEUA32185B: Automotive Electronics
IOEUA32185C: Industrial Engineering
IOEUA32185D: Artificial Neural Network in Engineering
IOEUA32185E: Social Media Analytics

Mandatory Course: Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Traditional Knowledge, Online certification course (minimum two weeks).

BoS Chairman Dean Academics Director

Semester – I

Quantity Surveying, Contracts and Tenders (CVUA31181)

Teaching Scheme	**Examination Scheme**						
Credits: 4 Lecture (L): 3 hrs./week Tutorial (T): 0 hr./week Practical (P): 2 hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	25	-	125

Course Objective(s):

1. To make the students aware of types of estimates, its rates and valuation of a project.
2. To introduce Tendering & Contracting procedures.

Course Outcomes:

Upon completion of the course, students will be able to

1. **Explain** types of estimates and its related terms and **prepare** an approximate estimate of civil engineering projects
2. **Prepare** a detailed estimate of a framed structure building as per IS 1200 and load bearing structure using PWD & Centre Line Methods
3. **Draft** technical specifications for item of work to be performed for a civil engineering project and **compute** their respective cost rates
4. **Explain** valuation, types of values and **prepare** a valuation Report on O-1 Format by applying Rental Basis, Land & Building basis, Direct Comparison Method, Profit based method, Belting of Land, Development method of valuation
5. **Explain** tendering procedure
6. **Draft** objectives and conditions of Contracts

Unit I – Introduction and Approximate Estimates

Introduction to estimates and related terms: Definition of estimation and valuation. Significance (application) of the Course. Purpose of estimation. Type of estimates, data required for estimation as a pre-requisite. Meaning of an item of work and enlisting the items of work for different Civil Engineering projects. Units of measurement. Mode of measurement of building items/ works. Introduction to components of estimates: face sheet, abstract sheet (BOQ), measurement sheet, Rate Analysis, lead statement. Provisional sum& prime cost items, contingencies, work charge establishment, centage charges. Introduction to D. S. R.

Approximate Estimates: Meaning, purpose, methods of approximate estimation of building & other civil engineering projects like roads, irrigation/ water supply, sanitary engineering, electrical works. (Theory & Numerical).

Unit II– Taking out quantities & Detailed estimate

Detailed estimates: Factors to be considered while Preparing Detailed Estimate, Detailed estimate of R.C.C framed structures using IS 1200, Concept of Estimation of Load Bearing Structure (PWD & Centre Line Method).

Bar Bending Schedule: Preparing Bar Bending Schedule for all RCC members of building.

Unit III – Specifications and Rate Analysis

Specifications: Meaning & purpose, types. Drafting detailed specifications for materials, quality, workmanship, method of execution, mode of measurement and payment for major items like, excavation, stone/ brick masonry, plastering, ceramic tile flooring, R.C.C. work.

Rate Analysis: Meaning and factors affecting rate of an item of work, materials, sundries, labour, tools & plant, overheads & profit. Task work or out turn, factors effecting task work. Working out Rate Analysis for the items mentioned in specifications above.

Unit IV – Valuation

Valuation: Purpose of valuation. Meaning of price, cost, and value. Factors affecting Value.

Types of value: Fair Market Value, Book Value, Salvage, Scrap Value, Distressed Value and Sentimental Value. Concept of free hold and lease hold property. Estimation versus valuation. Methods of depreciation & obsolescence, Sinking Fund, Years Purchase.

Methods of Valuation of Building: Rental Basis, Land & Building basis, Direct Comparison Method, Profit based method, Belting of Land, Development method

Unit V– Tendering

Tenders: Definition. Methods of inviting tenders, tender notice, tendering procedure, Pre and post qualification of contractors, tender documents. 3 bid/ 2 bid or single bid system. Qualitative and quantitative evaluation of tenders. Comparative statement, Pre-bid conference, acceptance/ rejection of tenders. Various forms of BOT &Global Tendering, E-tendering. (A mockup exercise of preparation, submission, opening of tender documents is suggested).

Unit VI – Contracts

Contracts: Definition, objectives & essentials of a valid contract as per Indian Contract Act (1872), termination of contract. Types of contracts: only lump sum, item rate, cost plus. Conditions ofcontract: FIDIC document, standard contract conditions published by MOS and PI.

Conditions of contract: General and Specific conditions. Condition regarding EM, SD, time as an essence of contract. Important conditions regarding addition, alteration, extra items, testing of materials, defective work, subletting, powers delegated to Engineer in charge regarding the above aspect, defect liability period, retention money, interim payment or running account bills, advance payment, secured advance, final bill. Settlement of disputes viz. dispute resolving board, arbitration, concept of partnering. Liquidated damages, termination of contract.

Term Work

Term Work: The following exercises should be prepared and submitted:

1. Report on contents, use of current DSR & Drafting detailed specification for major items of works.
2. Working out quantities using C-L and PWD method for a small single storied load bearing structure up to plinth and Preparing Abstract Sheet using DSR(Regional)
3. Detailed Estimate of a single storied R.C.C framed building using D.S.R.
4. Working out quantities of steel reinforcement for a column footing, a column, a beam and a slab by preparing bar bending schedule.
5. Working out rate analysis for the items as in the specifications of Assignment No. 1.
6. Preparing Valuation of a Residential building and writing report using O-1 form.
7. Estimating quantities for any one of the following using appropriate software. a) A Factory Shed of Steel Frame b) Underground Water Tank c) Pipe Culvert d) Road / Railway Track/ Runway
8. Drafting of tender notice, Preparation of Schedule A & B and Conditions of Contract regarding

time, labour payment, damages for RCC Framed Structure (Assignment No. 3) and collecting minimum of 3 tender notices of Civil Engineering Works.

Oral Examination: Based on the Term Work. Site visit to Meteorological station/Water Research Center/Dam/Diversion works/Canal

Review of any one case study of failure of hydraulic structure from the published literature or patent related to Hydraulic structures (in a group of five students).

Textbooks:

1. Estimating and Costing in Civil Engineering: Theory and Practice: B.N Dutta - S. Dutta & Company, Lucknow.
2. Estimating and Costing: R. C. Rangwala - Charotar Publ. House, Anand.
3. Estimating, Costing Specifications & valuation in Civil Engineering: M. Chakraborty

Reference books:

1. Theory and Practice of Valuation: Dr. Roshan Namavati, Lakhani Publications.
2. Valuation Principles and Procedures: Ashok Nain, Dewpoint Publ.
3. Laws for Engineers: Dr. Vandana Bhat and Priyanka Vyas –Published by PRO- CARE,5/B, /Sagarika Society, Juhu Tara Road, Juhu, Santacruz(W), Mumbai-400049 procure@technolegal.org).
4. B.S. Patil, Legal Aspects of Building and Engineering Contracts, 1974

Handbooks:

1. Standard Contract Clauses for Domestic Bidding Contracts: Ministry of Statistics and Program Implementation, Government of India.
2. FIDIC Document: Federation International Des Ingenieurs Conseils i.e. International Federation of Consulting Civil Engineers, Geneva, Switzerland.
3. Indian Practical Civil Engineers 'Handbook: P. N. Khanna, UBS Publish. Distributor, Pvt. Ltd. (UBSDP).

I.S. Codes:

1. IS 1200 (Part 1 to 25): Methods of Measurement of Building & Civil Engg.Works.
2. IS 3861-1966: Method of Measurement of Areas and Cubical Contents of buildings.
3. D. S. R. (District Schedule of Rates) for current year.
4. PWD Redbooks, Vol 1 & 2.

e – Resources: nptel.iitm.ac.in

Structural Design and Drawing - I (CVUA31182)

Teaching Scheme	**Examination Scheme**						
Credits: 4 Lecture (L): 3 hrs./week Tutorial (T): 0 hr./week Practical (P): 2 hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	25	-	125

Course Objectives:

1. To develop the ability to understand the behavior and basic concepts in design of various members of reinforced concrete structures subjected to combination of different loads based on provisions of Indian Standard code, and the prestressed concrete, prestress losses and to evaluate the resultant stress in prestressed concrete section.

Course Outcomes:

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

1. **Understand** the composite action of reinforced concrete, design philosophies and explain the behavior of reinforced concrete section under flexure.
2. **Analyze** and **design** singly, doubly and flanged reinforced concrete section subjected toflexure using Limit State Method as per guidelines given in Indian Standard Code.
3. **Analyze** and **design** reinforced concrete section subjected to shear, torsion and bond using Limit State Method as per guidelines given in Indian Standard Code.
4. **Design** one way and two way reinforced concrete slabs and dog legged staircase using Limit State Method as per guidelines given in Indian Standard Code.
5. **Design** reinforced concrete short column and isolated column footing subjected to gravity loads using Limit State Method as per guidelines given in Indian Standard Code.
6. **Understand** basic concepts, prestressing systems, applications, prestress losses of prestressed concrete section and calculate the resultant stress in prestressed concrete section subjected to flexure using stress concept at transfer of prestressing force and at service condition.
7. **Demonstrate** the ability to develop structural drawings for R.C.C. framed structure using modern engineering tools individually and / or through a teamwork.

Unit I – Introduction to reinforced concrete (RC) and limit state method

Introduction to R. C. (composite action). Role of structural designer, Structural properties of concrete and steel. Behavior of concrete under compression (stress-strain curve) and tension, and steel under tension. Design philosophies. Classification of limit states. Limit state of serviceability: IS code recommendation for limit state of deflection, cracking and fire. Characteristic strengths and loads. Loads and load combinations. Partial safety factors. Stability of a structure and codeprovisions (Actions on a structure, failure behavior and safety).

Analysis of R. C. section under flexure – assumptions, strain, and stress variation across the section. Behavior of R. C. section under flexure (under reinforced, Balanced, and over reinforced sections).

Unit II– Design for flexure using LSM

Design parameters for rectangular R.C. section, Moment of resistance of rectangular under reinforced singly, doubly, and flanged R. C. section.
Design for flexure: Design of rectangular under reinforced singly, doubly, and flanged RC section using LSM.

Unit III – Design for shear, torsion, and bond

Modes of cracking. Shear transfer mechanism. Shear failure modes. Nominal shear stress. Critical sections for shear design. Shear resistance of RC section. Design of RC section subjected to shear as per Indian Standard Code.
Behavior of RC member under torsion. Torsional shear stress. Need for torsional reinforcement. Indian Standard Code provisions for design RC member subjected to torsion. Concept and types of bond. Bond development mechanism. Bond failure mechanism. Check for adequacy of bond as per Indian Standard Code requirements.

Unit IV – Design of slabs and staircases

Design and reinforcement detailing of one-way slabs (Simply supported, cantilever and continuous) and dog legged staircase using Indian Standard code.
Design and reinforcement detailing of two-way slabs using Indian Standard code. Distribution of slab load on beams.

Unit V– Design of column and column footing

Column: Introduction, Indian Standard code requirements for design and reinforcement detailing of short column. Design and reinforcement detailing of short column for axial load, uni-axial and bi- axial bending using interaction curves
Isolated column footing: Soil pressure distribution under isolated footing. General design considerations for isolated footing slab for flexure, shear, bearing and bond. Design and reinforcement detailing of isolated column footing using Indian Standard code.

Unit VI – Introduction to prestressed concrete

Basic concept and general principle of prestressed concrete. Materials used in prestressed concrete. Need for high strength materials. Prestressing systems. Advantages, disadvantages, and application of prestressed concrete.
Concepts of prestressing: Stress, strength, load balancing. Resultant stress at a prestressed concrete section flexure at transfer of prestressing force and at service condition. Introduction to loss of prestress. Total permissible losses. Methods to reduce prestress losses.

Term Work

1. Design G + 1 (2 bay 2 storied) RC building covering all types Slabs, Beams, Columns, Footings and Staircase.
2. Design of all plinth and ground beams.
3. Design of all slabs, beams of first floor.
4. Design of three types columns for, (a) axial load, (b)axial load + uniaxial BM, (c)axial load +biaxial BM), from terrace level to footing. Give detailed load calculations.
5. Design any one element using spreadsheet / any software.
6. Report on one Site Visit (Building under construction).

Note:

a. Complete the practical work in a group with maximum number of students per group limiting to four.
b. Reinforcement details should be developed as per SP - 34.
c. Reinforcement details should be drawn using any drafting software (e.g. AutoCAD).
d. Develop minimum four full imperial size sheets showing details of structural plan at plinth, first floor and terrace level, reinforcement details of slabs, beams, staircases, column and column footing.

Textbooks:

1. Reinforced Concrete Design, S. Pillai and Devdas Menon, Tata McGraw Hill, New Delhi.
2. Comprehensive Design of R.C. Structures, Punmia, Jain and Jain, Standard Book House, New Delhi.
3. Reinforced Concrete Volume II, Dr. H. J. Shah. Charotar Publishing House Pvt. Limited.
4. Prestressed Concrete- N. Krishna Raju – Tata Mc Graw Hill Publication Co.

Reference books:

1. Illustrated Design of Reinforced Concrete Buildings (G+3), Dr. V. L. Shah and Dr. S.R.
2. Karve, Structures Publications, Pune. Illustrated Reinforced Concrete Design, Dr. V. L. Shah and Dr. S.R. Karve, Structures Publications, Pune.
3. Design of Prestressed concrete structures - T. Y. Lin, John Wiley Publishers.

Reference codes and standards

1. IS: 456-2000: Plain and Reinforced Concrete – Code of Practice, BIS, New Delhi.
2. SP 34 – Handbook on Concrete Reinforcement and detailing
3. SP 16 – Design Aids for Reinforced concrete to IS 456:1980 Code Book.
4. IS 1343:2012 – Prestressed Concrete– Code of Practice, BIS, New Delhi.

Professional Elective - I
Construction Management (CVUA31183A)

Teaching Scheme	**Examination Scheme**						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): 0 hr./week Practical (P): 0 hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Course Objectives:

1. To understand role of construction industry in infrastructure development.
2. To demonstrate the use of work study charts and conduct time studies.
3. Use of mathematical models for risk assessment and materials management.
4. To study the legal concepts within which construction contracts are establish, documents and contract administration
5. To enhance knowledge about construction equipment's this can be used effectively.
6. To study the concepts of Information systems and their applications.

Course Outcomes: Upon completion of the course, students will be able to

1. Explain construction management, BOT, BOLT techniques, P M consultants and project investments
2. Implement work study and value engineering for construction project
3. Understand the financial issues of determining the monetary resources needed by a business, the sources and uses of funds, the benefits and risk management
4. Explain Processes in material management, EOQ model and construction contracts
5. Identify construction equipment and apply depreciation and replacement analysis
6. Understand the role of management information systems in construction management

Unit I – Overview of construction sector

Introduction of construction management, necessity and applications, Role of construction industry in infrastructure development, BOT and BOLT techniques.
Project overruns and means to combat them, generation and identification of project investment opportunities, project management consultants – role, types, selection and appointment process.

Unit II– Work study and value engineering

Work Study: Definition, Objectives, basic procedure, method study and work measurement, work study applications in Civil Engineering. Method study – Definition, Objective, Procedure for selecting the work, recording facts, symbols, flow process charts, multiple activity charts, string diagrams. Work measurement, Time and motion studies, Concept of standard time and various allowances, time study, equipment performance rating. Activity sampling, time-lapse photography technique, Analytical production studies. Meaning of value, value analysis, value engineering and value management, energy resources, consumption patterns, energy cost escalation and its impact.

Unit III – Financial aspects and Risk Management of construction projects

Capital investments: importance and difficulties, means of finance, working capital requirements, project cash flow projections and statements, project balance sheet, profit loss account statements.
Introduction, principles, types, origin, risk control, use of mathematical models: sensitivity analysis, break even analysis, simulation analysis, decision tree analysis, risk identification, analysis and mitigation of project risks, role of insurance in risk management.

Unit IV – Materials management and contracts

Materials flow system, role of materials management in construction management and its linkage with other functional areas, vendor networking, buyer-seller relationships, E material codification and classification, concept of logistics and supply chain management. Inventory models- EQQ models with variations.
Introduction- Definition-Essential ingredients of tender- principles to be followed in the consideration and acceptance of tenders. bid cycle, tender and contract documents, contract conditions, study of contract documents of State PWD and CPWD. Standard agreements. Indian Contract Act 1872; Need, provisions, scope for modifications /improvement. Rules of interpretation of contracts. Introduction to legal terms used in construction contracts.

Unit V– Equipment Management

Introduction to construction Equipment's, Identification, Planning of equipment – Selection of Equipment Equipment Management in Projects - Maintenance Management
Equipment cost – Operating cost – Cost Control of Equipment - Depreciation Analysis – Replacement of Equipment- Replacement Analysis**.**

Unit VI – Management Information system

Introduction to Management Information systems (MIS) Overview, Definition. MIS and decision support systems, Information resources, Management subsystems of MIS. Management information system structure based on management activity whether for Operational control, management control or strategic planning. role of ERP in materials management – material resource information systems

Textbooks:

1. Projects – Planning, Analysis, Selection, Implementation and Review, Prasanna Chandra, Tata McGraw Hill Publications.
2. Total Project Management – The Indian Context – P. K. Joy, MacMillian Publications
3. Materials Management–Gopalkrishnan&Sunderasan, Prentice Hall Publications.
4. Management –Principal, process, and practices by Bhat – Oxford University Press.
5. Financial management by Shrivastava- Oxford University Press
6. Management Information Systems – Gordon B. Davis, Margrethe H. Olson – Tata McGraw Hill Publ. Co.
7. Construction Equipment's & its Management: S.C Sharma, Khanna Publication

Reference books:

1. Project Management—Khatua—Oxford University
2. Construction Project Management-Planning, Scheduling and Controlling by K. K.Chitkara, Tata McGraw Hill Publishing Company, New Delhi.
3. Construction Management and Planning by B. Sengupta and H Guha, Tata McGraw Hill Publishing Company, New Delhi.
4. The Essentials of Project Management by Dennis Lock, Gower Publishing Ltd. UK.
5. Construction Planning Methods & Equipment: Puerifoy –Tata MC Graw Hill
6. Essentials for Decision Makers by Asok Mukherjee, Scitech Publication, New Delhi.
7. Total Quality Management - Dr. S. Rajaram and Dr. M. Sivakumar—Biztantra
8. Total Engineering Quality Management – Sunil Sharma – Macmillan India Ltd.

Construction Management practice and contract management practice- Dr. V. K. Raina, 2nd Edition, SPD publications, New Delhi.

Professional Elective - I
Solid Waste Management (CVUA31183B)

Teaching Scheme	Examination Scheme						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): 0 hr./week Practical (P): 0 hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Course Objectives:

1. To increase the awareness among the students regarding Solid Waste, Solid Waste Management & Indian Scenario.
2. To know Solid Waste Generation Rate & Transfer Station.
3. To prepare students with an ability to understand Waste Processing Techniques & Material Recovery and Recycling.
4. To impart basics of biomedical and Hazardous waste management system

Course Outcomes: Upon completion of the course, students will be able to

1. Understand Solid Waste Management System with Indian Scenario
2. Describe the solid waste generation rate, storage, its collection along with transfer station and design of Waste Collection System.
3. Explain Waste Processing Techniques in the form of its Purpose, Mechanical volume & size reduction, component separation techniques and describe Material Recovery, Recycling system
4. Explain Composting of Solid Waste in the form of stages, technologies, types and design landfill facility
5. Explain the Biomedical Waste and Understand the Biomedical Waste legislation in India
6. Use the hazardous waste treatment technologies to design hazardous waste disposal sites

Unit I – Solid Waste, Solid Waste Management & Indian Scenario

Solid Waste: Sources, Types, Composition, Quantities, Physical, Chemical and Biological properties. Solid Waste Management: Objectives, Functional elements, Environmental impact of mismanagement, Factors affecting. Indian Scenario: Present scenario and measures to improve system for different functional elements of solid waste management system, Legislative provisions.

Unit II – Solid Waste Generation Rate & Transfer Station

Solid Waste Generation Rate: Definition, Typical values for Indian cities, Factors affecting. Storage and collection: General considerations for waste storage at source, Collection components, Types of collection systems.
Transfer station: Meaning, Types, Capacity, Location and Viability. Waste – Collection system design, Transportation of solid waste: Means and methods, Routing of vehicles

Unit III – Waste Processing Techniques & Material Recovery and Recycling

Waste Processing Techniques: Purpose, Mechanical volume and size reduction, componentSeparation techniques. Material Recovery and Recycling: Objectives, Recycling program elements, Commonly recycled materials and processes Energy recovery from solid waste: Parameters affecting, Fundamentals of thermal processing, Biomethanation, Pyrolysis, Incineration, Refuse derived fuels, Planning and design of incineration facility, Energy recovery.

Unit IV- Composting of Solid Waste & Landfills

Benefits, Processes, Stages, Technologies, Factors affecting, Properties of compost. Vermicomposting Site selection, Types, Principle, Processes, Land filling methods, Leachate and landfill gas management, Design of a landfill facility

Unit V - Biomedical Waste

Generation, identification, storage, collection, transport, treatment, common treatment and disposal, occupational hazards, and safety measures. Biomedical waste legislation in India.

Unit VI – Hazardous waste treatment technologies

Details related to hazardous waste, basel convention in detail with basil agreement. Following rules and sign for handling hazardous waste. Hazardous waste landfills: site selection, design, and operation-remediation of hazardous waste disposal sites. sampling and characterization of solid wastes; tclp tests and leachate studies.

Textbooks:

1. Bhide. A.D. And Sundaresan. B.B, *"Solid Waste Management",* Indian National Scientific Documentation Centre, 1st Edition, 1983.
2. CPHEEO, "Manual on Municipal Solid waste management", Central Public Health and
3. Environmental Engineering Organization, Government of India, New Delhi, 2000
4. George Tchobanoglous, "Integrated Solid Waste Management", Tata McGraw-Hill Publishing
5. Company Limited, 1st Edition, 1993

Reference books:

1. Vesilind, Worrell, and Reinhart, "Solid Waste Engineering", Cengage Learning India Pvt. Ltd.,
2. G. Masters, "Introduction to Environmental Engineering and Science", Pearson Education, 2004
3. Peavy, Rowe and Tchobanoglous, "Environmental Engineering", Tata McGraw-Hill Publishing
4. Company Limited, 1st Edition, 1985.
5. Wastewater Engineering Metcalf Eddy McGraw Hill Publications

Professional Elective - I
Systems Approach in Civil Engineering (CVUA31183C)

Teaching Scheme	**Examination Scheme**						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): 0 hr./week Practical (P): 0 hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Course Objectives:

1. To introduce the students of Civil Engineering the concept of system approach and optimization Techniques.
2. To make students familiar with linear and nonlinear optimization Problems
3. To introduce students to stochastics as well as dynamic programming

Course Outcomes: Upon completion of the course, students will be able to

1. Understand basics of SACE and perform sequencing of n jobs over 2,3 m machine
2. Implement Dichotomous, Fibonacci, Golden section methods to solve unconstrained nonlinear univariate problems, gradient techniques for Multivariate problems and Lagrange Multiplier Techniques for constrained optimization problems
3. Solve queuing problems using (M/M/1): (FCFS//) model and perform Monte Carlo simulation
4. Use dynamic programming to solve multistage decision processes of multi-project investment and pipeline laying
5. Formulate and solve linear programming problems using simplex, Big M, Two phase and duality methods
6. Solve transportation and assignments problems using linear programming techniques

Unit I – Introduction to systems approach

Introduction to System approach, Operations Research and Optimization Techniques, Use of systems approach in Civil Engineering, Methods, Introduction to Linear and Nonlinear programming methods (with reference to objective function, constraints), Local & Global optima, unimodal function, convex and concave function , Sequencing– n jobs through 2, 3 and M machines.

Unit II– Non-Linear programming

Single variable unconstrained optimization: Sequential Search Techniques-Dichotomous, Fibonacci, Golden section, Multivariable optimization without constraints-The gradient vector and Hessian Matrix, Gradient techniques, steepest ascent/decent technique, Newton's Method. Multivariable optimization with equality constraints - Lagrange Multiplier Technique

Unit III – Stochastic Programming

Queuing Theory : elements of Queuing system and its operating characteristics, waiting time and ideal time costs, Kendall's notation, classification of Queuing models, single channel Queuing theory : Model I (Single channel Poisson Arrival with exponential services times, Infinite population (M/M/1): (FCFS//), Simulation : Monte Carlo Simulation.
Unit IV – Dynamic Programming
Multistage decision processes, Principle of optimality, recursive equation, Applications of D.P.
Unit V– Linear Programming (A)
Formulation of Linear optimization models for Civil engineering applications. The simplex method, Method of Big M, Two phase method, duality
Unit VI – Linear Programming (B)
The Transportation Model and its variants, Assignment Model, and its variants.
Continuous Internal Evaluation
Assignments: 1. One exercise/assignment on each unit. Out of this any one exercise/assignment to be solved using Computer 2. One exercise on formulation of a problem applicable to any field of Civil Engineering, requiring use of LP/ NLP/ DP. Formulation of objective function and constraints (No solution)
Textbooks: 1. Engineering Optimization by S.S.Rao 2. Operations Research by Hamdy A. TaHA 3. Quantitative Techniques in Management by N.D. Vohra (McGraw Hill) Operations Research by Premkumar Gupta and D.S.Hira, S. Chand Publications (2014).
Reference books: 1. Topics in Management Science by Robert E. Markland (Wiley Publication) 2. An Approach to Teaching Civil Engineering System by Paul J. Ossenbruggen A System Approach to Civil Engineering Planning & Design by Thomas K. Jewell (Harper Row Publishers)
e-Resources: 1. Mathematical Model for Optimization (MMO Software) 2. nptel.iitm.ac.in/courses/webcourse-contents/IISc-Bang/OPTIMISATION METHODS/New-index1.html

Foundation Engineering (CVUA31184)

Teaching Scheme	**Examination Scheme**						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): 0 hr./week Practical (P): 0 hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Course Objectives:
To inculcate necessary geotechnical engineering skills to analyze and design shallow and deep foundation systems under different loading and soil conditions.

Course Outcomes: Upon completion of the course, students will be able to

1. Describe field tests on soil and interpret the data
2. Determine bearing capacity of the soil for design of shallow foundation
3. Explain consolidation process in soil and calculate consolidation settlement by using data of consolidation test
4. Analyze and design pile foundation using field and laboratory data
5. Describe coffer dams and identify properties of problematic black cotton soil
6. Explain the mechanism of soil reinforcement and effect of ground motion on foundation design

Unit I – Subsurface investigations for foundation

Purpose, Objectives, and planning of subsurface exploration. Methods of Investigation: Trial pits, borings, depth & number of exploration holes, core recovery, RQD, Core Log. Geophysical methods. Disturbed and undisturbed sampling, types of samplers, degree of disturbance of a sampler. Field tests - SPT, DCPT, SCPT and Pressure meter test.

Unit II– Bearing capacity of Shallow Foundation

Basic definitions, Modes of shear failure, Bearing capacity analysis- Terzaghi's, Hanson's, Meyerhof's, Skempton's and Vesics equations. IS code method - Rectangular and Circular Footings. Bearing Capacity evaluation- Plate Load Test and SPT, Housel's perimeter shear concept. Bearing capacity of layered soil. Effect of water table on bearing capacity. Effect of eccentricity. Presumptive bearing capacity.

Unit III – Settlement and Consolidation

Introduction to concept of settlement Causes of settlement. Contact pressure. Allowable settlement, Differential settlement - I.S. criteria, Types - Elastic settlement, consolidation settlement. Use of Plate load test and SPT in settlement analysis.
Introduction to concept of consolidation, spring analogy, Terzaghi's consolidation theory, Laboratory consolidation test, Determination of coefficient of consolidation- Square root of time fitting method and logarithm of time fitting method. Time factor. Introduction of Normal consolidation, Over consolidation and Pre-consolidation pressure.

Unit IV – Deep Foundations

Introduction, Pile classification, Pile installation techniques. Load carrying capacity of pile by static method, Dynamic Methods-Engineering news formula and Modified ENR formula. Pile load test and Cyclic Pile load test. Group action-Field rule, Rigid block method. Negative skin friction. Settlement of pile group incohesive soil by approximate method. Piers and Caissons- Definition, Types and uses. Well foundation: components, sand island method.

Unit V – Cofferdams and Foundation on Black Cotton Soils

Cofferdam uses and features. Characteristics of black cotton soil, swelling potential and its evaluation methods, engineering problems, Swelling pressure measurement, Foundations on black cotton soil: design principles, Construction techniques in B.C soils, under reamed piles- Design principles. Stone columns, prefabricated vertical drains, preloading technique, and vibroflotation technique.

Unit VI – Soil Reinforcement and Earthquake Geotechnics

Basic components and Mechanism of reinforced soil. Geosynthetics: type's, functional properties, and requirements. Geosynthetics applications in Civil Engineering.
Earthquake Terminology, Sources of earthquakes. Seismic waves, Location of earthquakes, Size of earthquake, Characteristics of Strong ground motion, Seismic hazards- liquefaction, Effect of liquefaction, Evaluation of liquefaction susceptibility, liquefaction hazard mitigation.

Textbooks:

1. Soil Mechanics and Foundation Engineering by Dr. B.C. Punmia, Laxmi Publications
2. Dr. B. J. Kasmalkar, "Foundation Engineering", Pune Vidyarthi Griha Prakashan, Pune
3. Principles of Soil Mechanics and Foundation Engineering by V.N.S. Murthy, UBS Publishers

Reference books:

1. Soil Mechanics—T. William Lambe--Wiley
2. J. E. Bowels, "Foundation Analysis and Design", McGraw-Hill
3. Foundation Engineering—P. C. Varghese--- PHI Learning Pvt. Ltd.
4. Soil Mechanics and Foundation Engineering- V. N. S Murthy, Marcel Dekker, Inc. Newyork..
5. Soil Mechanics & Foundation Engineering—Rao--Wiley
6. A. K. Arora, "Soil Mechanics and Foundation Engineering", Standard Publishers,2009.
7. Engineering in Rocks for Slopes. Foundations and Tunnels—T Ramamurthy—PHI Learning
8. Geotechnical Engineering by Conduto, PHI, New Delhi.
9. Foundation Design Manual: N V Nayak, Dhanpat Rai Publications.
10. International Steven Kramer, "Geotechnical Earthquake Engineering", Prentice Hall Publications.
11. Practical Handbook of Grouting : Soil-Rock and Structures---James Warner—Wiley

Hydrology & Water Resources Engineering (CVUA31185)

Teaching Scheme	**Examination Scheme**						
Credits: 4 Lecture (L): 3 hrs./week Tutorial (T): 0 hr./week Practical (P): 2 hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	25	125

Course Objectives:

1. To get exposure to hydrology
2. To apply hydrological principles to calculate runoff
3. To understand the concepts of irrigation and water requirement of crops
4. To get exposure to groundwater hydrology
5. To understand demand and supply of water resources from reservoir planning perspective
6. To determine forces acting on gravity dam and check stability of gravity dam, earthen dam and design ogee spillway
7. To determine the design discharge and design the canals using Lacey's theory and Kennedy's theory

Course Outcomes: Upon completion of the course, students will be able to:

1. **Explain** hydrologic cycle and **analyze** precipitation, infiltration, evaporation, transpiration and evapotranspiration
2. **Explain** Rainfall-Runoff relationship and **compute** peak flood using unit hydrograph method, rational method and flood frequency analysis.
3. **Explain** concepts of groundwater movement and storage, and **estimate** well yields under steady flow condition
4. **Compare** methods of irrigation and **estimate** water requirement of crops and capacity, useful life of a Reservoir
5. **Analyze** the stability of gravity dams and Earthen dams against overturning and sliding and **design** the ogee spillway
6. **Design** canals in alluvial soil using Lacey's theory and Kennedy's theory and **explain** cause, effect and remedial measures of water-logging

Unit I – Hydrology

Introduction: Hydrologic cycle, application of hydrology.
Precipitation: forms and types of precipitation, measurement, analysis of precipitation data, mass rainfall curves, intensity-duration curves, concepts of depth-area-duration analysis, computation of mean rainfall. Evaporation and Infiltration: elementary concepts, factors affecting, measurement of evaporation, transpiration, evapotranspiration (consumptive use) and infiltration (Horton's method and infiltration indices)
Stream Gauging: Selection of site, various methods of discharge measurement (velocity-area method, dilution method, slope-area method).

Unit II– Runoff & Floods
Runoff: Factors affecting runoff, rainfall-runoff relationships, runoff hydrograph, unit hydrograph, theory, S-curve hydrograph, use of unit hydrograph. **Floods**: Estimation of peak flow, rational formula and other methods, frequency of point rainfall and plotting position, flood frequency analysis Gumbel's method, design floods.
Unit III – Ground Water Hydrology
Occurrences and distribution of ground water, specific yield of aquifers, movement of ground water, Darcy's law, permeability, safe yield of basin. Hydraulics of wells under steady flow condition in confined and unconfined aquifers, specific capacity of well.
Unit IV – Irrigation
Introduction: definition, functions, advantages and necessity, methods of irrigation, surface irrigation, subsurface irrigation, micro-irrigation, lift irrigation **Water Requirements of Crops**: Soil moisture and crop water relationship, factors governing consumptive use of water, principal Indian crops, their season and water requirement, crop planning, agricultural practices, calculations of canal and reservoir capacities – duty, delta, irrigation efficiency. **Reservoirs**- Types, capacity of reservoirs, yield of reservoir, reservoir regulation, sedimentation, economic height of dam, selection of suitable site.
Unit V– Dams, Spillways and Reservoir
Dams and spillways - embankment dams: Classification, design considerations. Gravity dams: forces on gravity dams, causes of failure, stress analysis, elementary and practical profile. **Spillways**: components of spillways, types of gates for spillway crests.
Unit VI – Distribution systems
Canal systems, alignment of canals, canal losses, estimation of design discharge. Design of channels-rigid boundary channels, alluvial channels, Kennedy's and Lacey's theory of regime channels. Canal outlets: non-modular, semi-modular and modular outlets. Water logging: causes, effects and remedial measures. Lining of canals, types of lining. Drainage of irrigated lands: necessity, methods.
Term Work
Term work will consist of a journal giving the detailed report on assignments performed and visit report. **(any 8)** 1. Analysis of rainfall data (Double mass curve technique/missing rainfall data) 2. Marking catchment area on a topo-sheet and working out average annual precipitation and determining yield by various methods. 3. Analytical method of measurement of infiltration 4. Determination of peak flood discharge in a basin using unit hydrograph technique

5. Flood frequency studies using Gumbel's extreme value distribution
6. Determination of storage capacity of a reservoir using mass curve of inflow and outflow.
7. Application of HEC-RAS for Hydrologic routing
8. Stability analysis of gravity dam
9. Stability analysis of zoned earthen dam
10. Design of profile of spillway and energy dissipation device below the spillway
11. Design of unlined/ lined canal
12. Site visit to Meteorological station/Water Research Center/Dam/Diversion works/Canal
13. Review of any one case study of failure of hydraulic structure from the published literature or patent related to Hydraulic structures (in a group of five students).

Textbooks:

1. Engineering hydrology – K. Subramanyam Tata McGraw Hill.
2. Hydrology – Dr. P. Jaya Rami Reddy – University Science
3. Irrigation, Water Resources, and waterpower engineering- P. N. Modi, Standard Book House.
4. Irrigation Engineering - S. K. Garg, Khanna Publishers
5. Irrigation and Waterpower Engineering - Punmia B.C. - Laxmi Publication

Reference books:

1. Irrigation Engineering - Bharat Singh
2. Theory & design of irrigation structures Vol.I, II, III Varshney Gupta and Gupta Nemchand and brother's publication
3. Groundwater Hydrology, 3ed—Todd--Wiley
4. Irrigation and waterpower Engineering - Dr. Punmia and Dr. Pande, Standard Publisher
5. Elementary Engineering Hydrology-M.J.Deodhar-Pearson Education
6. Engineering Hydrology. –Ojha—Oxford University Press
7. Irrigation Engineering-Raghunath--Wiley
8. Water Management – Jasapal Singh, M.S.Achrya, Arun Sharma – Himanshu Publication.
9. Design Textbook in Civil Engineering: Volume Six: Dams- Leliavsky, Serge – Oxford and IBH Publishing Co. Pvt. Ltd., 1981.
10. Roller Compacted Concrete Dams- MehrotraV.K- Standard Publishers Distributors, Delhi.

I.S. Codes:

1. I.S. 8605 – 1977 (Reaffirmed 1998), Code of practice for construction of masonry in dams, third reprint, July 1999, B.I.S. New Delhi.
2. I.S. 6512-1984 (Reaffirmed 1998), Criteria for design of solid gravity dams, first revision, first reprint, September 1998, B.I.S. New Delhi.
3. I.S. 457 – 1957 (Reaffirmed, 2005), Code of practice for general construction of plain and reinforced concrete for dam and other massive structures, sixth reprint, January 1987, B.I.S. New Delhi.
4. I.S. 10135 – 1985, Code of practice for drainage system for gravity dams, their foundations, and abutments, first revision, B.I.S. New Delhi.
5. I.S. 14591 – 1999, Temperature control mass concrete for dams – guidelines, B.I.S.
6. I.S. 11223 – 1985 (Reaffirmed 2004), Guidelines for fixing spillway capacity, edition 1.2 (1991-09), B.I.S. New Delhi.
7. I.S. 6934 – 1998 (Reaffirmed 2003), Hydraulic design of high ogee overflow spillways – recommendations, first revision, B.I.S. New Delhi.
8. I.S. 11155- 1994, Construction of spillways and similar overflow structures – Code of practice, B.I.S. New Delhi.
9. I.S. 5186 – 1994, Design of chute and side channel spillway – criteria, first revision, B.I.S. New Delhi.

10. I.S. 10137- 1982 (Reaffirmed 2004), Guidelines for selection of spillways and energy dissipaters, B.I.S. New Delhi.
11. I.S. 4997 – 1968 (Reaffirmed 1995) Criteria for design of hydraulic jump type stilling basins with horizontal and sloping apron, sixth reprint, January 1998, B.I.S. New Delhi.
12. I.S. 7365-1985, Criteria for hydraulic design of bucket type energy dissipaters, first revision, B.I.S. New Delhi.

Department of Civil Engineering

Transportation Engineering (CVUA31186)

Teaching Scheme	**Examination Scheme**						
Credits: 3 Lecture (L): 2 hrs./week Tutorial (T): 0 hr./week Practical (P): 2 hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	-	-	50	-	-	25	75

Course Objectives:
To provide broad awareness to the students to deal with traffic issues including safety, planning, design, operation, and control

Course Outcomes: Upon completion of the course, students will be able to:

1. Explain the fundamentals of highway planning, development and Design highway geometrics
2. Understand the traffic parameters of a highway and Determine the properties of highway materials as per IS, IRC, MORTH to design the mix for rigid and flexible pavement
3. Understand the design steps of pavement as per IRC 37 and IRC 58
4. Explain the types of pavement construction and modern trends in highway engineering

Unit I - Highway Development & Planning and its Geometric design

History, Development Plans, Classification of roads, Road Patterns, road development in India - Vision 2021 & Rural Road Development Vision 2025, Current road projects in India; highwayalignment and highway project report preparation (Planning surveys & Master Plans based on saturation system).
Highway cross section elements; sight distance, design of horizontal alignment; design of vertical alignment; design of intersections, problems, Highway drainage, Importance of highway drainage, subsurface and surface drainage systems.

Unit II– Traffic engineering and Pavement materials

Traffic Characteristics, traffic engineering studies, traffic flow and capacity, traffic regulation and control devices (signs, signals, islands, road markings); Accident studies, types of road intersections; parking studies; highway lighting.
Materials used in Highway Construction and related tests - Soil subgrade and CBR Test, Stone aggregates, bituminous binders, bituminous paving mixes, viscosity based gradation of bitumen, Modified Bitumen (Cutbacks, Emulsions, Crumbed Rubber Modified Bitumen – CRMB, Polymer Modified Bitumen-PMB, Foamed Bitumen), Marshall Stability Mix Design and Test (All 5 test parameters).

Unit III – Pavement Design

Introduction; flexible pavements – Computation of design traffic (Vehicle Damage Factor VDF, Lane distribution factor LDF, Traffic growth rate); stresses in flexible pavements; design guidelines for flexible pavements as per IRC 37-2012 (steps only); rigid pavements- components and functions; factors affecting design; stresses in rigid pavements (ESWL); design guidelines for concrete pavements as per IRC 58-2015 (steps only); joints in CC pavements, problems

Unit IV – Pavement Construction and Modern Trends

Pavement Construction: Construction process of GSB, WBM, WMM; Cemented base, Introduction to bituminous works such as prime coat, tack coat, seal coat, Built-up Spray Grout (BSG), Asphaltic Concrete (AC) or Bituminous Concrete (BC), Bituminous Macadam (BM), Dense Bituminous Macadam
(DBM) and premix carpet, Dry lean Concrete (DLC), Pavement Quality Concrete (PQC).

Modern Trends in Highway Materials, Construction & Maintenance: Mastic Asphalt, Cold Mix Asphalt Technology, Warm Mix Asphalt Technology, Recycled/Reclaimed Asphalt Pavement (RAP) (Manual Series - 2), Concept of Super pave Mix Design (Super pave Series 2), Non-Destructive Evaluation of Pavements (Falling Weight Deflectometer FWD).

Term work shall consist of the following:

A. Practicals:

I. Tests on Aggregate (Any Five):

1. Aggregate Impact and Crushing Value Test
2. Los Angeles Abrasion Test
3. Shape Test (Flakiness Index and Elongation Index)
4. Specific Gravity and Water Absorption Test by basket method
5. Stripping Value Test
6. Soundness Test

II. Tests on Bitumen (Any Five + No. 8 compulsory):

1. Penetration Test
2. Ductility Test
3. Viscosity Test
4. Softening Point Test
5. Flash Point & Fire Point Test
6. Specific Gravity Test
7. Bitumen Extraction Test
8. Marshall Stability Test

B. Technical visits to Hot mix plant with detailed report

Textbooks:

1. Principles of Highway Engineering and Traffic Analysis (4^{th} edition) - F. L. Mannering, Scott S. Washburn, Wiley India
2. 2. Highway engineering – S.K. Khanna and C.E.G. Justo, Nem Chand and Brothers, Roorkee Principles and practices of Highway engineering –Dr. L.R. Kadiyali, Khanna

Reference books:

1. A Course in Highway Engineering – S.P. Bindra, Dhanpat Rai and Sons, Delhi.
2. Principles of Transportation Engineering – G.V. Rao Tata MacGraw Hill Publication
3. Highway Engineering – Rangawala, Charotar publishing House, Anand 388001 (Gujrat)
4. Principles of Transportation Engineering – Partha Chakraborty, Animesh Das, Prentice Hall of India Pvt. Ltd., New Delhi.

Highway & Bridge Engineering – B.L. Gupta, Amit Gupta Standard publishers Distributors, Delhi.

Handbooks:

1. Handbook of Road Technology- Lay M.G., Gorden Breach Science Pub. New York

Civil Engineering Handbook-Khanna S.K.

Codes:

1. I.S. 1201 TO 1220-1978, IS 73, IS 2386 PART I to V
2. I.R.C. 58, IRC37

Specifications for Road and Bridge works (MORTH)-IRC, New Delhi.

e – Resources:

1. www.nptel.iitm.ac.in/courses/iitkanpur
2. www.cdeep.iitb.ac.in/nptel

www.fhwa.dot

Semester II

Department of Civil Engineering

Professional Elective – II
Dams and Hydraulic Structures (CVUA32181A)

Teaching Scheme	**Examination Scheme**						
Credits: 4 Lecture (L): 3 hrs./week Tutorial (T): 0 hr./week Practical (P): 2 hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	25	-	125

Course Objectives:

1. To make the students aware of types of dams, spillways, canals, and their suitability along with their hydraulic design
2. To give students clarity about the hydraulic structures allied to the dams as well as canals along with their suitability and hydraulic design

Course Outcomes: Upon completion of the course, students will be able to:

1. **Classify** dams based on purpose, hydraulic action, structural action, materials, size of project and Explain working of instrumentation, equipment for dam safety, socio-economic problems associated with construction of large dams, terms related to layout of hydropower generation
2. **Explain** components of Gravity dams with forces acting on it and perform its stability analysis
3. **Classify** Spillways and Spillway gates based on operation, provision of gates, main features, function, mechanism of gates respectively and Design Ogee spillway along with Energy dissipater
4. **Classify** Earth dams based on materials, its methods of construction, components and Check stability of homogeneous, non- homogeneous earthen dams
5. **Describe** functions of components of diversion roadworks, cross- drainage works and Analyze flow below weir in permeable foundation using Khosla's Theory
6. **Design** of lined Canals on Alluvial beds by Kennedy's, Lacey's theory and Explain working and necessity of canal structures, river training works

Unit I – Introduction

Review of basic concepts from fluid mechanics, Need & historical development of dams, important terms related to dams, Classification of dams: Based on purpose, hydraulic action, structural action, materials, and size of project. Factors governing the selection of type of dam, Selection of site for a dam, Environmental and socio-economic issues related to large dams and small dams. Displacement and rehabilitation, Dams and climate change. Overview of the instrumentation and equipment for various measurements related to dam safety. hydropower generation: Necessity, Important Terms related to Hydropower, layouts.

Unit II– Gravity Dams

Introduction, Components of gravity dam, Forces acting on gravity dam, Seismic analysis of dam, Terms related to seismic analysis, Determination of Seismic forces, Effects of horizontal and vertical earthquake acceleration, Combinations of loading for design, Stress analysis in gravity dam (Only concept, no derivations), Vertical or normal stress, Principal stresses, Shear stress, Middle third rule, Modes of failure of gravity dam, Elementary profile of gravity dam, Concepts of low and high gravity dams**.**

Unit III – Spillways and Gates for Dams

Introduction: Need and location of spillway, Different key levels (heads) of spillway, Components of spillway: Approach channel, Control structure, Discharge channel, Energy dissipation device, Tail channel. Classification of spillways: Based on operation, based on provision of gates, based on main features (Straight drop spillway, Free overflow spillway, Saddle spillway, Side channel spillway, Ogee spillway, Chute or open channel or trough spillway, Shaft or morning glory spillway, Siphon spillway, Conduit or tunnel spillway, Stepped spillway. Design of Ogee spillway: shape of the crest, spillway profile on upstream and downstream. Energy dissipation below spillway (Through buckets, Solid roller bucket, Slotted roller bucket, Ski jump bucket), Correlation between Jump Height and Tail Water Depth, Classification of energy dissipation devices, Energy dissipation in stilling basin, Stilling basin components, Indian Standard stilling basins.

Spillway gates: Classification – Based on function, Based on mechanism of gates. Requirements inspection and maintenance of spillway gates

Unit IV – Earth Dams

Classification of earth dam, Classification based on---materials, method of construction, height; Selection of type of earth dam, Limitations of earth dam, Components of an earth dam, Requirements for safe design of earth dam, Hydraulic (Seepage) Analysis,

Plotting of seepage line and determination of seepage discharge for Homogeneous earth dam with horizontal drainage blanket, Composite earth dam with casing and hearting,

Properties of phreatic line, Determination of seepage discharge through earth dam using flow-net, Stability analysis of homogeneous and zoned earth dam, using Swedish slip circle method, Fellenius Method of Locating Centre of Critical Slip circle, Failure of earth dam, Types of failure of earth dams: Hydraulic, Seepage failure, Structural failure, Other failures. Causes of seepage and seepage control, Construction of earth dam.

Unit V– Diversion Headworks and C.D. Works

Diversion headworks: Functions, Selection of site, typical layout, and components.

Analysis of weir on permeable foundation using, Khosla's theory. Exit gradient and design criteria of weirs on permeable foundations.

Cross-Drainage Works: Necessity, Selection of site, Data required for design, Classification (Drain over canal – Siphon, Super passage, Canal over drain – Aqueduct, Siphon aqueduct, Drain and Canal at the same level – Level crossing, Inlet and Outlet).Suitable type of C. D. Work. Design considerations for C. D. Work.

Unit VI – Canals, Canal Structures, and river training works

Classification of canals: Based on alignment, based on soil, Based on source of supply, Based on discharge, Based on lining, and Based on excavation. Components of canal, Data required for canal design, Selection of canal alignment, Design of stable canal in alluvial beds. Kennedy's theory and its

limitations. Design of canal based on Kennedy's theory, Lacey's regime theory, Design of canal based on Lacey's theory, Canal lining: Need, requirements of lining material, Classification, advantages and limitations of canal lining, Design of lined canal

Overview of canal structures – Canal Regulator, Canal Falls, Canal Outlets, and Canal Escape: Necessity, typical layout, types/ classification with suitability, pros and cons. Introduction to river training works: Necessity, Types and Suitability

Term Work

Term Work consists of parts A, B, C and D.

Part (A): Analysis /Design Assignments (Any three): *Each exercise is to be completed in the allotted Lab. Hence requires two practical sessions each.*

1) Stability analysis of gravity dam
2) Design of Ogee of spillway and energy dissipation device below the spillway
3) Stability analysis of earthen dam
4) Analysis of weirs on permeable foundations
5) Design of lined and unlined canal

Part (B): Any two site visits (Out of the following and individual reports with photographs)

1) Gravity dam
2) Earthen dam
3) C.D. Work
4) Canal structure

Note: *Visit report should clearly mention Name of project, date of visit, need and practical significance of project, its salient features, technical details, description and figures of different components, special features, and photographs at the site wherever allowed.*

Textbooks:

1. Irrigation, Water Resources and Waterpower Engineering- Modi, P.N. - Standard Book House, New Delhi, 7th e, 2008.
2. Irrigation Engineering and Hydraulic Structures- S. K. Garg - Khanna Publishers N.D. 29th e, 2014.
3. Irrigation Engineering and Hydraulic Structures- S. R. Sahasrabudhe- S. K. Kararia & Sons (Katson Books), 3rd e, 2011.

Reference books:

1. Irrigation Engineering- R. K. Sharma –S. Chand, 2007.
2. Irrigation Engineering- N.N. Basak–Tata McGraw Hill, 1999.
3. Irrigation and Water Resources Engineering- G. L. Asawa - New Age International (P) Ltd. Publishers, 1st e, 2005.

Professional Elective – II
Advanced Surveying (CVUA32181B)

Teaching Scheme	**Examination Scheme**						
Credits: 4 Lecture (L): 3 hrs./week Tutorial (T): 0 hr./week Practical (P): 2 hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	25	-	125

Course Objectives:

1. To understand principles of geodetic surveying, trigonometric levelling and theory of errors and adjustments
2. To understand the basic concepts of SBPS, remote sensing and GIS
3. To Understand photogrammetry concepts and fundamentals of Air photo Interpretation

Course Outcomes: Upon completion of the course, students will be able to:

1. **Explain** triangulation method for geodetic survey and **determine** intervisibility and elevation difference between triangulation stations using trigonometric levelling
2. **Explain** fundamentals of geodesy and segments, positioning methods, and errors in Space Based Positioning System
3. **Describe** concepts, physical fundamentals and components of Remote Sensing
4. **Describe** objectives, components, limitations and applications of Geographical Information System
5. **Compute** most probable values of angles in triangulation, considering plane and spherical angles **Describe** classification, applications, flight planning in aerial photogrammetry and **determine** scale & relief displacement in vertical photograph

Unit I – Geodetic Survey & Trigonometric Levelling

a) Geodetic Survey - Objects, Methods of Geodetic Surveying, Introduction to Triangulation, classification of Triangulation Systems, Triangulation figures, Concept of well-conditioned Triangle,selection of stations, intervisibility and height of stations.
b) Trigonometric Levelling - Terrestrial refraction, Angular corrections for curvature and refraction, Axis Signal correction, Determination of Difference in Elevation by single observation and reciprocal observations.

Unit II– Geodesy & Satellite Based Positioning System

a) Geodesy - Definitions and fundamentals, Geoid and Ellipsoid of rotation, Reference surface, Geodetic systems, Indian Geodetic System, Coordinate systems and transformation.
b)Introduction to Satellite based positioning systems (SBPS), SBPS systems - GPS, Glonoss, Galileo, Navic, Compass, etc. and their features, Segments of SBPS (Space, Control and User), their importance and role in SBPS, Positioning with SBPS - Absolute & Differential Methods, Use of SBPS in Surveying, SBPS Co-ordinates & heights, Factors governing accuracy in SBPS positioning, Different types of errors in SBPS Positioning.

Unit III – Remote Sensing

Introduction and definition, development of remote sensing technology and advantages, different platforms of remote sensing, EM spectrum, solar reflection and thermal emission remote sensing, interaction of EM radiation with atmosphere including atmospheric scattering, absorption and emission; interaction mechanisms of EM radiation with ground, spectral response curves, principles of imageinterpretation, multi-spectral scanners and imaging devices, salient characteristics of LANDSAT, IRS, Cartosat, ResourceSat etc. sensors, image characteristics and different resolutions in Remote Sensing; manual and digital image interpretation techniques; Remote Sensing integration with GIS and GPS, Georeferencing Technique, spatial filtering techniques; Remote sensing for underground utility mapping; Image classification techniques, Hyperspectral Remote Sensing, applications of RS, Limitations of
Remote Sensing Technique.

Unit IV – Geographical Information System

Introduction & definition, different components, types of vector data, Raster data models and their types, TIN data model; Advantages and disadvantages associated with vector, raster and TIN, Non-spatial data (attributes) and their type, Raster data compression techniques, Different raster data file formats, Spatial database systems and their types; Pre-processing of spatial datasets, Different map projections, Spatial interpolation techniques, Different types of resolutions, Digital Elevation Model (DEM); GIS analysis and applications, Errors in GIS, Key elements of maps

Unit V– Theory of Errors & Triangulation Adjustment

Kinds of errors, Laws of weights, Determination of most probable values (MPV) of conditioned and independent quantities, Method of Least Squares, Indirect observations, Probable error and its determination, Distribution of error to the field measurements, Normal equation, Method of correlates. Station and figure adjustment of Geodetic Quadrilateral without central station. Spherical triangle, Calculations of spherical excess and sides of spherical triangle.

Unit VI – Aerial Photogrammetry

Objects, Classification- qualitative & quantitative photogrammetry Applications, comparison of map and aerial photograph, Vertical, Tilted and Oblique photographs, Scale of & Relief displacement in vertical photograph, Stereoscopic parallax & its measurement by parallax bar. Mirror stereoscope, Differential height from differential parallax. Ground control points (GCPs), Flight planning.

Term Work

Geodetic Surveying and Trigonometrical levelling (any three)

1. Measurement of horizontal and vertical angles with 1" theodolite.
2. Determination of elevation of inaccessible objects by trigonometrical levelling.
3. Practical based on various special functions available in a total station such as remote elevationmeasurements, remote distance measurements and co-ordinate stakeout.
4. Establishing control station using single or dual frequency GPS receiver

Aerial Photogrammetry (any two)

1. Study of aerial photograph and finding out the scale of the photograph.
2. Determination of air base distance using mirror stereoscope.
3. Determination of difference in elevation by parallax bar.

Remote Sensing

1. Study and applications of different RS data products available with National Remote SensingCentre (NRSC)
2. Use of RS images and visual interpretation

GIS

1. Use of interface and tools in GIS software such as GRAM++ or QGIS or equivalent software.

Project: (any one)

1. Adjustment of geodetic quadrilateral without central station by method of correlates.

Field survey (500 sq.m.) using GPS (Control as well as mapping).

Textbooks:

1. Surveying & Levelling, 2/E—Subramanian - Oxford University Press
2. Surveying: Vol. II. and III by Dr. B. C. Punmia : Laxmi Publication - New Delhi.
3. Surveying and Levelling Vol. II by T. P. Kanetkar and S. V. Kulkarni Pune Vidyarthi Publication.
4. GPS Satellite Surveying—Alfred Leick—Wiley
5. Remote sensing and Geographical Information System, By A. M. Chandra and S. K. Ghosh, Narosa Publishing House.
   Remote Sensing & GIS,2/E—Bhatta-- Oxford University Press

Reference books:

1. Principles of Geographical Information System—Burrough-- Oxford University Press
2. Surveying—M.D.Saikia—PHI Learning Pvt .Ltd.Delhi
3. Advanced Surveying -Total Station, GIS and Remote Sensing by SatheeshGopi, R.Sathikumar and N. Madhu , Pearson publication
4. Surveying Vol. 2 by S. K. Duggal, McGraw Hill Publication
   Remote sensing & image interpretation, Lillesand& Kiefer, John wiley Pub.

Suggested Reading

Bureau Gravimetrique International (BGI)
International GPS Service for Geodynamics (IGS)
International Association of Geodesy (IAG)
International Federation of Surveyors (FIG)
Permanent Service for Mean Sea Level (PSMSL)
Commission X Global and Regional Geodetic Networks
www.nrsa.gov.in
www.iirs-nrsa.gov.in
www.surveyofindia.gov.in

Professional Elective – II
Advanced Concrete Technology (CVUA32181C)

Teaching Scheme	**Examination Scheme**						
Credits: 4 Lecture (L): 3 hrs./week Tutorial (T): 0 hr./week Practical (P): 2 hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	25	-	125

Course Objectives:

1. To develop the ability to understand the science and technology of concrete, design of special types of concrete mixes. The course will help the students to understand use of various non-destructive techniques to assess the condition of reinforced concrete structures, fundamental understanding of the behavior of concrete and the mechanism governing concrete performance as well as maintenance of reinforced concrete infrastructure.

Course Outcomes: Upon completion of the course, students will be able to:

1. Explain the microstructure and properties of the concrete, properties of mineral admixtures and demonstrate the effect of admixtures on properties of concrete
2. Understand a suitable type of special concrete for appropriate application/s
3. Describe and justify properties and applications of Fibre Reinforced Concrete
4. Analyze characteristics of mix constituents and design a concrete mix for field applications using mix proportioning principles
5. Explain the use of non-destructive techniques as a tool to assess the condition of reinforced concrete structures
6. Understand behavior of concrete under stress and choose a suitable strengthening / repair technique for maintenance of reinforced concrete infrastructures
7. Evaluate the behavior of concrete and communicate the same through a report

Unit I – Mineral Admixtures and Composition of Concrete

Review of types mineral admixtures, origins and manufacture of mineral admixtures; chemical composition; physical characteristics; effects of mineral admixtures on properties of concretes, methods of test, applications, mixer blends and blended cements, modern methods of analysis – SEM,XRD, TEM etc.

Properties of concrete, w/b ratio, gel space ratio, aggregate cement bond strength, microstructure of the aggregate phase, microstructure of the hydrated cement phase, interfacial transition zone inconcrete, maturity concept of concrete.

Unit II– Special Concretes and Concreting Techniques

Structural Light weight concrete, ultra-light weight concrete, High Density concrete, vacuum concrete, mass concrete, waste material based concrete, Sulphur concrete and Sulphur infiltrated concrete, Jet cement concrete (ultra- rapid hardening), gap graded concrete, high strength concrete, high performance concrete, Self-compacting concrete, Self-curing concrete, Pervious concrete, Geo polymer concrete, Green concrete, Roller compacted concrete, Ferrocement: Properties & specifications of ferrocement materials and techniques, Under water concreting, Hot & Cold Weather
concreting, Shotcreting and Guniting.

Unit III – Fibre Reinforced Concrete

Historical development of fibre reinforced concrete (FRC), properties of metallic fibre, polymeric fibres, carbon fibres, glass fibres, Basalt fibres and naturally occurring fibres. Interaction between fibres and matrix (uncracked and cracked matrix), basic concepts and mechanical properties: tension and bending. Properties of hardened FRC, behavior under compression, tension, and flexure of steel fibres and polymeric fibres, GFRC, SFRC, SIFCON - development, constituent materials, casting, quality control tests and physical properties.

Unit IV – Concrete Mix Design

Guidelines for Quality control & Quality assurance of concrete, Design of concrete using mineral admixtures, Design of pumpable concrete mixes, Design of high strength concrete mixes, Design of self-compacting concrete, Design of Mass concrete.

Unit V– Advanced Non-destructive Techniques

Concept of Structural Health monitoring, Advanced non-destructive testing methods - Probe penetration, breakoff, Stress wave propagation methods – Ultra sonic Pulse, Acoustic Emission, Impact methods, Electromagnetic methods – Covermeter, Ground Penetration Radar, Infrared Thermography. Corrosion of reinforced concrete and introduction to electrochemistry of reinforced concrete, Electrical methods – Concrete Resistivity, Electrochemical methods – Half cell potential, Polarizationresistance.

Unit VI – Durability and Maintenance of concrete structures

Durability of concrete, Behaviour of concrete under various stress states – uniaxial compression, uniaxial tension, shear, bond, biaxial and multiaxial stresses, Failure modes in concrete, Introduction to concrete fracture mechanics, fracture process zone.
Maintenance of concrete structures, Structural Strengthening of RC structures – Structuralstrengthening of Beams, Slabs, Columns, Walls, Joints, and connections, Waterproofing of concrete structures, surface treatments for reinforced concrete infrastructures.

Term Work

The Term work / Lab work will be based on completion of assignments / practical / reports of site visits, confined to the course in that semester.

1. Write a review on any recent research article from standard peer-reviewed journal based on any topic from the syllabus.
2. Concrete mix design and production in lab of any one – Self compacting concrete, Fiber reinforced concrete, high strength or ultra-high strength concrete. Comparison with traditional concrete mix along-with cost analysis is to be clearly stated in the report.
3. Perform Fresh (workability tests according to type of concrete, Visual Stability Index) and Hardened (Compressive, tensile, flexural) concrete properties tests as per serial no. 2 mentioned above.
4. Experiment on the topics – (1) NDTs, (2) Microscopic examination of concrete.
5. Case study report on any one topic - Structural strengthening of beams / slabs / columns / walls, water proofing of concrete structures, surface treatments for reinforced concrete infrastructures
6. Visit reports on site visit exploring the field and practical aspects of concrete technology.
7. Seminar presentations on Special Concretes and Concreting Techniques.

Note: Term Work should include a detailed analysis of practical interpretation, significance and application of test results including above contents and site visit report in form of journal.

Textbooks:

1. Concrete Technology --M.S. Shetty, S. Chand Publications.
2. Concrete Technology – A. R. Santhakumar, Oxford University Press.
3. Concrete technology -- M. L. Gambhir, Tata McGraw Hill Publications.
4. Fiber Reinforced Cement Composite- P. N. Balguru & P. N. Shah.
5. Concrete: Microstructure, Properties and Materials-- P. Kumar Mehta and P. S. M. Monteiro—
   Tata Mc-Graw Hill Education Pvt. Ltd.

Reference books:

1. Handbook on Advanced concrete Technology Edited by N. V. Nayak, A.K. Jain, Narosa Publishing House.
2. Design of concrete mixes by Raju N Krishna, CBS Publisher.
3. Properties of concrete by A. M. Neville, Longman Publishers.
4. Concrete Technology by R.S. Varshney, Oxford and IBH.
5. Concrete technology by A M. Neville, J.J. Brooks, Pearson.
6. Ferrocement Construction Mannual-Dr. D.B.Divekar-1030, Shivaji Nagar,Model Colony, Pune.
7. Concrete Mix Design-A. P. Remideos--Himalaya Publishing House (ISBN-978-81-8318-996-5
8. Concrete, by P. Kumar Metha, Gujrat Ambuja.
9. Learning from failures ---- R. N. Raikar.
10. Structural Diagnosis-----R. N. Raikar.
    Concrete Mix Design --Prof. Gajanan Sabnis.

E-Resources:

NPTEL course videos - (1) https://nptel.ac.in/courses/105/106/105106202/
(2) https://nptel.ac.in/courses/105/106/105106176/
(3) https://nptel.ac.in/courses/105/104/105104030/

Professional Elective – III
Irrigation and Drainage (CVUA32182A)

Teaching Scheme	**Examination Scheme**						
Credits: 4 Lecture (L): 3 hrs./week Tutorial (T): 0 hr./week Practical (P): 2 hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	25	125

Course Objectives:

1. To impart the knowledge of Soil Water and Crop Relationship
2. To introduce students to various aspects of Irrigation and methods.
3. To equip the students to design the lift and drip irrigation schemes.
4. To expose the students to design the Sprinkler irrigation scheme
5. To impart the knowledge of effects of water logging, salinity, and its remedial measures.
6. To equip the students to design the drainage system the irrigated land

Course Outcomes: Upon completion of the course, students will be able to:

1. Understand Soil Water and Crop Relationship
2. Understand the Irrigation techniques in general and canal irrigation in particular
3. Design the lift and drip irrigation schemes
4. Design the Sprinkler irrigation scheme
5. Understand effects of water logging, salinity, and its remedial measures
6. Understand the drainage system the irrigated land

Unit I – Soil Water-Crop Relationship

Crop water Relationship – Crop period, base period, Duty and Delta of a crop, relation between Duty and Delta, factors affecting Duty and delta, Importance of Duty Delta, Cash crops. Optimum utilization of irrigation water, irrigation efficiency, Uniformity coefficient, Consumptive use of water, factors governing consumptive use of water, estimation of consumptive use and assessment water charges, conjunctive use of surface and groundwater. Soil classification, soil moisture Determination of soil moisture, Field capacity, readily available moisture, estimating depth and frequency of irrigation

Unit II– Irrigation Practices

Irrigation: Definition, Necessity of irrigation, advantages, disadvantages, and ill effects of irrigation. Types of irrigation systems (Surface and Subsurface irrigation), free flooding, border flooding, check flooding and basin flooding. Factors affecting the choice of irrigation methods, quality of irrigation water.

Canal irrigation system: alignment of canals, watershed canal, contour canal, side slope canal, distribution system for canal irrigation, main canal, branch and distributaries, minors, gross command area, culturable command area , Intensity of irrigation , area to be irrigated, time factor, capacity factor, full supply coefficient , nominal duty , determination of required channel capacity, channel losses (Evaporation and seepage), Empirical formulas for channel losses.

Unit III – Lift and Drip irrigation

Lift Irrigation: General concepts, advantages, disadvantages, elements of lift Irrigation schemes, design considerations of Lift irrigation system, distribution systems, concept of cost economics.
Drip Irrigation: Definition and functions, types of drip Irrigation systems, components of Drip Irrigation systems. Design and installation of drip Irrigation systems, advantages, and disadvantages of Drip Irrigation systems.

Unit IV – Sprinkler Irrigation

Sprinkler Irrigation: Definition and introduction of Sprinkler Irrigation,, advantages and disadvantages of Sprinkler Irrigation, components of sprinkler Irrigation systems (Pumping set, desilting basin and debris screen, main and lateral pipe lines , sprinkler heads, perforated pipes, take off valves and flow control valves, fertilizer applicators), types of sprinklers, basic design of sprinkler irrigation system.

Unit V– Salt Affected Land and Their Reclamation

Salt accumulation in soil water, classification of salts affecting the soils and their characteristics, reclamation of saline and alkaline soils, leaching and salinity control. Water and wind erosion, design of various types of soil conservation measures.

Unit VI – Drainage of Irrigated Land

Need and purpose of drainage water logging of agricultural lands and its reclamation, steady state and transient designs of surface and sub-surface drainage systems, drainage by wells. Soil Erosion and conservation.

Term Work

Term work will include following assignments /exercises (including numerical wherever required):

1. Affecting Duty and delta
2. Conjunctive use of surface and groundwater.
3. Types of irrigation systems,
4. Canal irrigation system
5. Lift Irrigation
6. Drip Irrigation
7. Sprinkler Irrigation
8. Reclamation of salt affected lands
9. Soil erosion and conservation measures
10. Water logging

Textbooks:

1. Irrigation Engineering and hydraulic structures – S.R.Sahasrabudhe- Catson books, Delhi, 2014-3ed.
2. Irrigation Engineering - S. K. Garg.
   Irrigation, Water Resources, and waterpower engineering- Dr. P. N. ModiPubl Standard book house.

Reference books:

1. Irrigation, Michael, B.A.M., Vikas Publishing House Pvt. Ltd. New Delhi, 1990
2. Theory & design of irrigation structures Vol.I, II, III Varshney Gupta and Gupta Nemchand and brother's publication
   Water Management – Jasapal Singh, M.S.Achrya, Arun Sharma – Himanshu Publication Press

Professional Elective – III
Infrastructure Engineering (CVUA32182B)

Teaching Scheme	**Examination Scheme**						
Credits: 4 Lecture (L): 3 hrs./week Tutorial (T): 0 hr./week Practical (P): 2 hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	25	125

Course Objectives:

1. To aware the students about different infrastructure projects
2. To know about the basics and design of various components of railway engineering
3. To get knowledge about tunnel types and different method of tunnel
4. To study about the types and components of docks and harbors
5. To learn about the aircraft characteristics, planning and components of airport.
6. To study about components of bridge and its types

Course Outcomes: Upon completion of the course, students will be able to:

1. Explain Infrastructure projects and its necessity
2. Understand components and geometric parameters of railways
3. Explain types of tunnel and Describe methods of tunneling
4. Understand elements of dock and harbors
5. Understand airport planning with layout, use of wind rose diagram and determine the runway length
6. Understand bridge engineering, bridge types, bridge components and Determine the discharge, economical span, afflux

Unit I – Infrastructure Engineering

Scope of infrastructure engineering in national and global development, Forthcoming infrastructure projects at national and global level, Necessity, advantages, and disadvantages of PPP (Public Private Partnership), Salient features of smart city, Bus rapid transit system. Provisions made for various infrastructure sectors like Roads & Highways, Railways, Airports, Ports, Housing, Energy & Power sector with reference to latest five-year plan.

Unit II– Railways

Permanent way, Track structure of BG, Functions of rail, Standard rail, tilting of rail, Coning of wheels, Types of sleepers, Fastenings, Ballast, Modern development in railways- metro rails, mono rails, bullet train. Rail joints, types, evil effects, remedial measures, Welding of rails, Short and long welded rails, Types of gradients, Curves, Grade compensation on curves, Alignment, Super elevation, Equilibrium cant, Equilibrium speed, Maximum permissible limits for cant, Cant deficiency, Cant excess, Speed on curves, Safe speed on curves using Indian railways formula only for fully transition curves, Concept of negative cant, Points, crossings and turnouts- functions, Components, elements of points, Types of crossings and turnouts, Track maintenance: Regular and Periodic.

Unit III – Tunnel Engineering
Tunneling, functions & types of tunnel, Criteria for selection of size & shape of tunnels. Pilot tunnel, shaft, addit and portal, Needle beam, NATM, TBM & earth pressure balance method of tunneling in soft soil, Drilling & blasting method of tunneling including various operations like mucking, Drainage in tunneling-Pre drainage and permanent drainage, Ventilation in tunneling-temporary and permanent, Micro tunneling and trenchless tunneling.
Unit IV – Docks and harbors
Introduction, Requirements of harbors and ports, Classification of harbors with examples, Selection of site for harbor, Various components of ports, Break waters- types, comparison, design criteria , methods of construction, Tetra pod, Tri bar, Hexapod, Quay wall, Wet & dry dock, Floating dock, Wharves, Jetties, Types of fenders, Dolphins, Marin railway. Harbor docks, Wet docks, Repair docks, Lift docks, Floating docks, Slipways
Unit V– Airport Engineering
Introduction: Advantages and limitations of air transportation. Airplane component parts and important technical terms. **Airport planning and Airport layout:** Aircraft characteristics, which influence judicious and scientific planning of airports, Selection of sites, survey, and drawings to be prepared for airport planning. Characteristics of good layout, runway configuration, airport obstruction, location of terminal buildings, aprons, and hangers. Zoning requirements regarding permissible heights of constructions and landing within the airport boundary. Runways and taxiways: Runway orientation, wind coverage, use of wind rose diagram, basic runway length, corrections for elevation, temperature, and gradient as per ICAO and FAA recommendation. Airport classification by ICAO.
Unit VI – Bridge engineering
Introduction: Classification of bridges, components of bridges, preliminary data to be collected during investigation of site for bridges, determination of discharge – empirical formula, direct methods, economical span, afflux, HFL, scour depth and clearance, locations of piers and abutments, factors influencing the choice of bridge super structure, approach roads. **Loads on bridges and substructure:** Brief specifications of different loads, forces, stresses coming on bridges, IRC load specification, requirements of traffic in the design of highway bridges, Abutment, Piers, and wing walls with their types based on requirement and suitability. **Types of bridges:** Culvert, Temporary bridges: timber, floating and pontoon bridges, Movable Bridges: Bascule, cut boat, flying, swing, lift, transporter and transverse bridges, their requirement and suitability, Fixed span bridges: Simple, continuous, cantilever, arch, suspension, bowstring girder type and rigid frame and cable stayed bridges, materials for super structure. **Bearing:** Definition, purpose, and importance. Types of bearings with their suitability. **Erection of bridge super structure and maintenance:** Introduction to different techniques of erection of bridge super structure and maintenance of bridges
Term Work
Term work shall consist of: 1. Study basic requirements of a good alignment and different types of surveys conducted before

fixing railway alignment and different components of railway track.
2. Assignment on methods of tunneling in soft soil and hard rock. Explain any two in each of them with sketches
3. Assignment on significance of water transportation compare to other modes of transportation. Explanation in detail of the factors to be considered while selecting site for a harbor, Draw a typical layout plan of a harbors showing various components
4. Assignment on study and use of Windrose Type 1 and 2 diagrams
5. Assignment on Runway Design for length and related corrections
6. Assignment on conditional assessment of existing Bridges
7. Seminar on one topic as syllabus
8. Report on Guest lecture on any one of projects
9. Report on site visit
   a. Site visit to Railway/Tunnel/Dock and Harbor
   b. Site visit to Bridge site / Airport site

Textbooks:

1. Saxena Subhash C and Satyapal Arora, "A Course in Railway Engineering", Dhanpat Rai and Sons, Delhi.
2. S.C. Saxena, "Tunnel Engineering", Dhanpat Rai Publications
3. Bindra S P, "A Course in Docks and Harbour Engineering", Dhanpat Rai and Sons, New Delhi.
4. S.K. Sharma, "Docks and Harbour", McGraw Hill.
5. Airport Engineering - Rangawala, Charotar publishing House, Anand 388001 (Gujrat)
6. Airport planning and design – S.K. Khanna, M.G. Arora, S.S. Jain, Nem Chand and Brothers, Roorkee
7. Bridge engineering – S. Ponnuswamy, Tata Mc Graw – Hill publishing co. Ltd. New Delhi.
8. Essentials of Bridge Engineering – D. Johnson and Victor, Oxford and IBH publishing Co. Pvt. Ltd. , New Delhi.
9. Bridge engineering – Rangawala, Charotar Publishing House, Anand –388 001.
10. Railway Engineering – Rangawala, Charotar Publishing House, Anand –388 001.
11. Harbor Engineering – Rangawala, Charotar Publishing House, Anand –388 001.
12. Principles and practice of Bridge Engineering – S.P. Bindra, Dhanpatrai and Sons, Delhi.

Reference books:

1. Satish Chandra and Agarwal M.M, "Railway Engineering", 2nd Edition, Oxford University Press, New Delhi
2. Mundrey J.S. "A course in Railway Track Engineering". Tata McGraw Hill
3. Harbour, Dock & Tunnel Engineering: R. Srinivasan
4. Dock & Harbour Engineering: Hasmukh P. Oza & Gautam H.Oza-Charoter Book Stall
5. Vicksburg, "Coastal Engineering Manuals Volume I and II", US Army Corps of Engineers.
6. The Art of Tunnelling by Szechy, K, Akademiai Kiado
7. C.J.Khisty and Lall B.K, "Transportation Engineering: An Introduction", 3rd Edition,Pearson publication.
8. J.S. Mundrey, "Railway Track Engineering", Tata McGraw Hill, New Delhi
   Alonzo Def. Quinn, Design and Construction of Ports and Marine Structure, McGraw -Hill Book Company, New York

Handbooks:

Handbook of Road Technology- Lay M.G., Gorden Breach Science Pub. New York Civil Engineering Handbook-Khanna S.K.

Codes:

1. Specifications for Road and Bridge works (MORTH)-IRC, New Delhi. **2.** ICAO manual of Airport
e – Resources: 1. www.nptel.iitm.ac.in/courses/iitkanpur 2. www.cdeep.iitb.ac.in/nptel 3. www.fhwa.dot 4. https://www.isrm.net 5. www.nirm.in 6. http://umich.edu/~gs265/tunnel.htm

Professional Elective – III
Structural Dynamics and Earthquake Engineering (CVUA32182C)

Teaching Scheme	**Examination Scheme**						
Credits: 4 Lecture (L): 3 hrs./week Tutorial (T): 0 hr./week Practical (P): 2 hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	25	125

Course Objectives:
To prepare the students to apply the knowledge of Structural Dynamics in Earthquake Engineering

Course Outcomes: Upon completion of the course, students will be able to:

1. Determine the response of Single Degree of Freedom System under undamped- free and forced vibrations
2. Determine the response of Single Degree of Freedom System under damped- free and forced vibrations
3. Determine the response of Multi Degree of Freedom System under free undamped vibrations.
4. Comprehend the basics of seismology and seismic resistant structural systems.
5. Compute the base shear and lateral loads acting on regular RC buildings.
6. Draw the detailing of members of RC building for seismic resistance.

Unit I – Un-damped SDOF Systems

Introduction to structural Dynamics, Basic Concepts of Vibration, Dynamic Loading, Comparison of Static Loading and Dynamic Loading, Types of Vibration, Response of the System, Degrees of Freedom, Simple Harmonic Motion.
Introduction to SDOF systems- Undamped Vibration of SDOF system, Natural Frequency, Period of Vibration, Damping in the structure, Newton's Laws of Motion, D-Alembert's Principle, Solution of Differential Equation of Motion, Amplitude of motion. Forced Vibration under Harmonic Excitation.

Unit II– Damped SDOF Systems

Viscous Damping, Equation of Motion, Critically damped, Over-damped and Under-damped Systems, Solution of Differential Equation of Motion, Logarithmic Decrement.

Unit III – Multi Degree of Freedom System

Concept of Shear Building, mathematical Model, Equation of Motion, Free Vibration Analysis for Undamped System, Natural Frequency, Mode Shapes, Orthogonality Property of Normal Modes. (Maximum up to 3 Degrees of Freedom)

Unit IV- Introduction to Earthquake Engineering

Causes of Earthquake, Types of Earthquakes, Strong Ground Motion- Characteristics of the Strong Ground Motion, Factors affecting the Ground Motion, Seismic Zoning map of India, Earthquake Design Philosophy, Importance of Ductility in Earthquake Resistant Design, Structural Systems for Seismic Resistance- Moment Resisting Frames, Shear Wall Frame System and Tube System

Unit V– Computation of Seismic Forces on the Structures
Codal Provisions for Seismic Analysis as per IS 1893, General Principles, Load Combinations, Equivalent Static Method- Zone Factor, Importance factor, Response Reduction Factor, Approximate Period of Vibration, Design Response Spectrum, Estimation of Base Shear, Lateral Loads at Floor Level, Numerical Examples on Regular RC buildings.
Unit VI - Design and Detailing of RC Building Structure for Seismic Resistant
Ductility Criteria for earthquake Resistant Structure, General Design and Detailing Principles toensure Ductility, Ductile Detailing of Flexural Members as per IS 13920- Longitudinal Reinforcement, Shear Reinforcement, Anchorage of Reinforcement and Concept of the Development Length, Lap Splices, Structural behavior of Shear Wall. Numerical Examples on Design of Beam and Column of RC portal Frame for given Loads and Load Combinations.
Term Work
The Term Work will be based on the completion of assignments as shown below. 1. At least one assignment on each unit. 2. Analysis of R.C. Building (G+3) for Seismic Loads using any Software.
Textbooks: 1. Pankaj Agarwal and Manish Shrikhande, 'Earthquake Resistant Design of Structures', PHI, 2008 2. S. R. Damodarasamy and S. Kavitha- 'Basics of Structural Dynamics and Aseismic Design, PHI, 2009. 3. Mario Paz and William Leigh, 'Structural Dynamics-Theory of Computation', Kluwer Academic Publishers
Reference books: **1.** A.K. Chopra, Dynamics of Structures - Theory and Application to Earthquake Engineering, Prentice Hall **2.** Clough R.W. and Penzien J., 'Dynamics of Structures', McGraw-Hill, 2nd edition, 1992

Environmental Engineering (CVUA32183)

Teaching Scheme	**Examination Scheme**						
Credits: 4 Lecture (L): 3 hrs./week Tutorial (T): 0 hr./week Practical (P): 2 hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	25	-	125

Prerequisite course(s):

Course Objectives:

1. To increase the awareness among the students regarding ambient air & noise pollution and its control.
2. To know Solid and Hazardous Waste Management and its disposal.
3. To prepare students with an ability to understand Water transportation, distribution, and leakage detection system.
4. To prepare students with an ability to understand different water treatment processes and designing of water treatment system for various water demands.
5. To increase the awareness amongst the students regarding Importance of Filtration and Disinfection process of water treatment.
6. To prepare students with an ability to explore Advanced Water Treatments.

Course Outcomes: Upon completion of the course, students will be able to:

1. Understand the system for control of particulate matter, gaseous pollution and Explain the measurement of ambient Air Pollution, Noise level & control system
2. Understand solid waste management system with hazardous waste
3. Explain functioning of water distribution system with its components
4. Explain ruler, town, metro city water treatment processes, Physical, Chemical, Bacteriological Characteristics of water, theory of coagulation and Design of aeration, sedimentation
5. Understand rapid sand filter, slow sand filter, pressure filter, multimedia filter, dual media filter with materials, Disinfection processes and Design of Rapid Sand Filter, Chlorine Demand and Dose
6. Explain the advances in water treatment process for methods of water softening, Demineralization, removing of colour and odour, De-fluoridation & fluoridation and Describe SCADA system for Smart City

Unit I – Air Pollution & Noise Pollution Control

Ambient air pollution measurement technique, stack sampling. Control of Particulate Matter by ESP, Bag House, Cyclone Separator, and gravity settling chamber. Control of gaseous pollution by Absorption, adsorption, catalytic converter, and incineration. Measurement of ambient noise level and control technique.

Unit II– Solid Waste & Hazardous waste management

Basic concept in solid waste, population forecasting for city, generation of waste, collection, transfer of solid waste, transportation of solid waste. Characteristics of solid waste.
Disposal of solid waste: Disposal technique such as aerobic, anaerobic, incineration, pyrolysis, power generation etc.
Hazardous waste: Characteristics of hazardous waste, effect on environment. Method of disposal of hazardous waste.

Unit III – Water transportation, distribution, and leakage detection system

Water transportation appurtenances such as pipe and its material, pumps design, joints, valve etc. Water distribution system, types of water supply scheme, continuous & intermittent system, their component. Types of ESR structure and design of ESR. Leak detection & maintenance of distribution system.

Unit IV – Water treatment process and its design

Water treatment flow diagram, theory of treatment process for ruler, town, and metro city. Water characteristics, Design of aeration, sedimentation & flocculator with all the design criteria. Theory of coagulation and its various types.

Unit V– Filtration process & Disinfection

Filtration theory and mechanism, filter material, types of filter (rapid sand filter, slow sand filter, pressure filter, multimedia filter & dual media filter), under drainage system, working and cleaning of filter, Design of rapid sand filter. Methods of disinfection in water, chicks' law, calculation of chlorine demand and chlorine dose.

Unit VI – Advanced Water treatment process

Methods water softening methods: lime-soda, Ion exchange & zeolite process. Demineralization of Water: By using methods like R.O. & Electro dialysis. De-fluoridation & fluoridation. Methods for removal of Odour and colour from water. Smart water supply for smart city and SCADA system.

Term Work

List of Experiments- (Any 8)
1. Determination of pH and alkalinity from water.
2. Determination of Hardness from water.
3. Determination of chlorides from water.
4. Determination of optimum dose of alum.
5. Determination of chlorine dose and chlorine demand.
6. Determination of Iron or Manganese from water.
7. Determination of ambient PM10 and Noise level.
8. Determination of fluoride from water.
9. Design of 1MLD WTP in spread sheet or any software.
10. Site Visit on WTP describing Unit Operations in Water Treatment.

List of Assignments:
1. Study of Plumbing fixture and accessories.
2. SWM Rule 2016 technical note.
3. Types of intake structure.
4. Automation in water supply system.

Textbooks:
1. Water Supply Engg. Vol. -1 By S.K. Garg
2. Environmental Engg. Vol. 2 By S.K. Grag

Water Supply Engg. Vol. 1 By B.C.Punmia
Reference books: 1. Water Supply & Sanitary Engg. By G.S. Birdi-Laxmi publications (p) Ltd. New Delhi 2. Water & Waste Water Technology by Mark J.Hammer Prentice – Hall of India, New Delhi 3. Environmental Engineering – H.S. Paeavy& D.R. Rowe Mc Graw Hill Book Co. New Delhi Water & Wastewater Technology G.M. Fair & J.C. Geyer.

Professional Practice, Law and Ethics (ES32184CV)

Teaching Scheme	Examination Scheme						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): 0 hr./week Practical (P): 0 hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Course Objectives:

1. To make the students aware of types of roles they would play in the society as professionals/ practitioners of the Civil Engineering profession.
2. To introduce some legal and practical aspects of Civil Engineering profession

Course Outcomes: Upon completion of the course, students will be able to:

1. Explain the terms related to civil engineering profession and various professional bodies including their roles and responsibilities
2. Summarize necessity and all aspects related to professional ethics
3. Identify all details of Civil Engineering contracts and tenders
4. Use Arbitration for disputes in Civil Engineering projects
5. Explain the legal provisions with reference to labor in construction works
6. Understand concepts of Copyright, Trademark, Intellectual Property Right , Patents

Unit I – Introduction to Professional Practice

Concepts of Profession, Professionalism, and Professional Responsibility. Roles of various stakeholders: Government (Statutory/ regulatory bodies and organizations), Standardization Bodies such as BIS, IRC (formulating standards of practice); Professional bodies such as Institution of Engineers (India), Local Bodies/ Planning Authorities (certifying professionals); Clients/ owners (role governed by contracts); Developers (role governed by regulations such as RERA); Consultants (role governed by bodies such as CEAI); Contractors (role governed by contracts and regulatory Acts and Standards); Manufacturers/ Vendors/ Service agencies (role governed by contracts and regulatory Acts and Standards)

Unit II– Introduction to Professional Ethics

Definition/ meaning of Ethics and its necessity/ importance. Types of ethics – Personal, Engineering, Professional, Business, and Corporate. Code of Ethics as defined by Institution of Engineers (India). Conflict of Interests, Gift Vs Bribery, Environmental breaches, Negligence, Deficiencies in state-of-the-art; Vigil Mechanism, Whistleblowing, protected disclosures.

Unit III – Legal Aspects Part-I

General Principles of Contracts & Management: Indian Contract Act 1972 and amendments covering general principles of contracting, Contract Formation & Law, Privacy of contract. Various types of contract and their features. Valid & Voidable Contracts. Prime and sub-contracts. Joint Ventures & Consortium. Tenders, its types & tender Notice, Bids & Proposals. Bid Evaluation. Contract Conditions & Specifications. Variations & Changes in Contracts, Differing site conditions, Cost escalation, Delays, Suspensions & Termination. Liquidated damages & Penalties.

Unit IV – Legal Aspects Part-II

Definition/ meaning of Arbitration & Arbitrator, necessity, scope, and types. Conciliation and ADR (Alternative Dispute Resolution) system. Extent of judicial intervention; International commercial arbitration. Award including Form and content, Grounds for setting aside an award, Enforcement, Appeal and Revision. Enforcement of foreign awards – New York and Geneva Convention Awards. Distinction between conciliation, negotiation, mediation, and arbitration.

Unit V– Legal Aspects Part-III

Labour & other construction-related Acts/ Laws. Role of Labour in Civil Engineering. Methods of engaging labour: on-roll (Muster), labour sub-contract, piece rate work. Industrial Disputes Act, 1947. Industrial Employment (Standing Orders) Act, 1946; Workmen's Compensation Act, 1923; Building & Other Construction Workers (regulation of employment and conditions of service) Act (1996) and Rules (1998); RERA Act 2017, NBC 2017.

Unit VI – Introduction to Copyright, IPR and related aspects.

Law relating to Intellectual Property*:* Introduction – meaning of Intellectual Property and IPR, main forms of IP, Copyright, Trademarks, Patents and Designs, Secrets; Meaning of copyright – computer programs, etc. Ownership of copyrights and assignment. Piracy & Remedies. Meaning and process for Patents. Law relating to Patents under Patents Act, 1970.

Textbooks:

1. B.S. Patil, Legal Aspects of Building and Engineering Contracts, 1974.
2. The National Building Code, BIS, 2017
3. RERA Act, 2017
4. Meena Rao (2006), Fundamental concepts in Law of Contract, 3rd Edn. Professional Offset
5. Avtarsingh (2002), Law of Contract, Eastern Book Co.
6. Dutt (1994), Indian Contract Act, Eastern Law House
7. Kwatra G.K. (2005), The Arbitration & Conciliation of Law in India with case law on UNCITRAL Model Law on Arbitration, Indian Council of Arbitration
8. T. Ramappa (2010), Intellectual Property Rights Law in India, Asia Law House
9. O.P. Malhotra, Law of Industrial Disputes, N.M. Tripathi Publishers
10. Rustamji R.F., Introduction to the Law of Industrial Disputes, Asia Publishing House
11. ASCE Code of Ethics (2011) – Principles Study and Application
12. www.ieindia.org

Open Elective – I
Information and Cyber Security (IOEUA32185A)

Teaching Scheme	**Examination Scheme**						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): 0 hr./week Practical (P): 0 hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Course Objectives:

1. To know the need and basic of security
2. To learn various types of Cryptographic algorithm algorithm
3. To learn various authentication techniques
4. To acquire knowledge of protocols employed to provide Confidentiality and integrity
5. To understand various threats
6. To acquaint with current security scenario

Course Outcomes: Upon completion of the course, students will be able to:

1. Identify the basics and need of security
2. Make use of various Cryptographic algorithm
3. Examine various authentication techniques
4. Differentiate protocols for confidentiality and integrity
5. Select techniques for securing a network
6. Summarize Top OWASP top 10 vulnerabilities

Unit I – Security Basics and Introduction to cryptography

Introduction, Elements of Information Security, Understanding concepts: threat, exploit, privacy, vulnerability and policy, Types of Attacks, Operational Model of Network Security, Cryptography, Substitution Ciphers, Transposition Ciphers, Stenography applications and limitations

Unit II– Symmetric Key Cryptography

Introduction, Encryption Methods: Symmetric, Asymmetric, Block Ciphers and methods of Operations, Data Encryption Standard (DES), Advance Encryption Standard (AES).

Unit III – Asymmetric Key Cryptography

Public Key Cryptography, RSA Algorithm: Working, Key length, Security, Key Distribution, Deffie-Hellman Key Exchange, Authentication methods, Message Digest, Kerberos, X.509 Authentication service. Digital Signatures: Implementation, Algorithms, Standards (DSS), Authentication Protocol

Unit IV – Network Layer Security

IP Security: IPSec protocols, and Operations, AH Protocol, ESP Protocol, ISAKMP Protocol, Oakkey determination Protocol, VPN.
WEB Security: Introduction, Secure Socket Layer (SSL), SSL Session and Connection, SSL Record Protocol, Change Cipher Spec Protocol, Alert Protocol, Handshake Protocol.
Electronic Mail Security: Introduction, Pretty Good Privacy, MIME, S/MIME, Comparison. Secure Electronic Transaction (SET)

Unit V– Firewall and Intrusion

Introduction, Computer Intrusions. Firewall Introduction, Characteristics and types, Benefits, and limitations. Firewall architecture, Trusted Systems, Access Control. Intrusion detection, IDS: Need, Methods, Types of IDS, Password Management, Limitations and Challenges.
Unit VI – Introduction to OWASP
Introduction, Top 10 Vulnerabilities, understanding Top 10 Vulnerabilities.
Textbooks: 1. Atul Kahate, "Cryptography and Network Security", Mc Graw Hill Publication, 2nd Edition, 2008, ISBN: 978-0-07-064823-4 2. Dr. V.K.Pachgare, "Cryptography and Network Security", PHI, 2nd Edition, 2015
Reference books: 1. William Stallings, "Cryptography and network security principles and practices", Pearson, 6th Edition, ISBN: 978-93-325-1877-3 2. Forouzan, "Cryptography and Network Security (SIE)", Mc Graw Hill, ISBN, 007070208X, 9780070702080
Web Resource: www.owasp.org

Open Elective – I
Automotive Electronics (IOEUA32185B)

Teaching Scheme	**Examination Scheme**						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): 0 hr./week Practical (P): 0 hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Prerequisite course(s):

Course Objectives:

1. To make familiar about automotive system operations.
2. To illustrate need for automation in automotive operations and appropriate electronics for the same.
3. To discuss suitability of electronics hardware and software platform for control, compute and communication systems in automotive.
4. To discuss control algorithms used in automotive.
5. To introduce various communication standards used for intra and inter-cluster communication in automotive electronic system.
6. To make awareness of fault diagnosis system in automotive.

Course Outcomes: Upon completion of the course, students will be able to:

1. Understand powertrain and transmission mechanism of SI and DI engine.
2. Identify need of automation in automotive operations and appropriate electronics for the same.
3. Select suitable electronics hardware and software platform for design and development of various control, compute and communicate oriented automotive systems.
4. Understand control theory for automotive systems
5. Understand communication and fault diagnostic protocols used in automotive
6. Able to use the techniques, skills, and modern engineering tools necessary for automotive engineering practice

Unit I - Power Train Engineering and fundamentals of Automotive.

Fundamentals of Petrol, diesel and gas engines and electric motors. Basic Automotive System. Alternators and charging, battery technology, Ignition systems. Basic of Hybrid designs (solar power, electric/gasoline, LPG, fuel cells). Basic Transmission systems.

Unit II– Sensors and actuators in Automotive

In-vehicle sensors: Working principles, Characteristics, limitations and use within the automotive context of the following: Temperature sensing e.g. coolant. Position sensing e.g. crankshaft, throttle plate. Pressure sensing e.g. exhaust differential, tyre pressure measurement system. Distance sensing e.g. anti-collision, Velocity sensing e.g. speedometer, anti-skid, Torque sensing e.g. automatic transmission, Vibration sensing e.g. Airbags, Flow sensing and measurement e.g. Fuel injection.
Use of Actuators: Types, working principle, Characteristics, limitations and use within the automotive context of each type.

Unit III – Electronics processing System in automotive

Interfacing electronics: Operational amplifier circuits, Instrumentation amplifiers, Comparators. Level shifting, Wave-shaping, Filters. Noise mechanisms and reduction.
Electronics control unit: Automotive processors and OS, typical design consideration of ECU.

Unit IV – Automotive Control Systems

Control system approach in Automotive: Analog and Digital control methods. Cruise control, traction control, actuator limiting, wind-up, gain scheduling, adaptive control.
Special Control Schemes: Vehicle braking fundamentals, Antilock systems, Variable assist steering and steering control, Controls for Lighting, Wipers, Air-conditions/Heating, Remote keyless Entry and Anti-theft System. Spark Ignition and Compression Ignition Engines and their electronic controls.
Engine management testing: Engine management system strategies and implementation, Simulation, and implementation methods.

Unit V– Automotive Communication Systems

Communication interface with ECUs: Interfacing techniques and interfacing with infotainment gadgets. Automotive Buses: Use of various buses such as CAN, LIN, Flexural, Recent trends in automotive buses (Such as OBDII, MOST, IE, IELLI, D2B, and DSI: Only Comparative study).
Application of Telematics in Automotive: Global Positioning Systems (GPS) and General Packet Radio Service (GPRS), for use in an automotive environment.

Unit VI – Diagnostics and Safety in Automotive

Fundamentals of Diagnostics: Basic wiring system and Multiplex wiring system. Preliminary checks and adjustments. Self-Diagnostic system. Fault finding and corrective measures. Electronictransmission checks and Diagnosis. Diagnostic procedures and sequence. On board and off board diagnostics in Automotive.
Safety in Automotive: Safety norms and standards. Passenger comfort and security systems. Electromagnetic environment and Automotive EMC Standards. SAE and IEEE Standards.

Textbooks:

1. Williams. B. Ribbens, "Understanding Automotive Electronics", 6th Edition, 2003, Elsevier Science, Newness Publication.
2. Robert Bosch, "Automotive Electronics Handbook", John Wiley and Sons, 2004.
3. K.P. Ramchandran, G.K. Vijayraghavan, M.S. Balsundaram, "Mechatronics: Integrated Mechanical and Electronic System", Wiley India, 2010.

Reference books:

1. Ronald K Jurgen, "Automotive Electronics Handbook", 2nd Edition, McGraw-Hill, 1999.
2. James D Halderman, "Automotive Electricity and Electronics", PHI Publication 2005.

Open Elective – I
Industrial Engineering (IOEUA32185C)

Teaching Scheme	**Examination Scheme**						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): 0 hr./week Practical (P): 0 hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Course Objectives:

1. To introduce the concepts, principles, and framework of contents of Industrial Engineering.
2. To acquaint the students with various productivity enhancement techniques.
3. To acquaint the students with different aspects of Production Planning and Control and Facility Design.
4. To introduce the concepts of various cost accounting and financial management practices as applied in industries
5. To acquaint the students with different aspects of Human Resource activities and Industrial Safety rules.
6. To acquaint students with different aspect of simulation modeling for various industrial engineering\applications.

Course Outcomes: Upon completion of the course, students will be able to:

1. Apply the Industrial Engineering concepts to solve industrial problems.
2. Understand, analyze, and implement different concepts in method study so as to reduce the cost.
3. Design and Develop different aspects of work system and facilities to improve effectiveness of production processes.
4. Apply Industrial safety standards and financial management practices to take financial decision.
5. Undertake project work based on modeling & simulation area.
6. Understand project planning and its control

Unit I – Introduction to Industrial Engineering and Productivity

Definition and Role of Industrial Engineering, Types of production systems and organization structure, Functions of management. Measurement of productivity: Factors affecting the productivity, Productivity Models and Index (Numerical), Productivity improvement techniques.

Unit II– Methods Study

Work Study: Definition, objective and scope of work-study, Human factors in work-study.

Method Study: Definition, objective and scope of method study, work content, activity recording and exam aids.

Charts to record movements: Operation process charts, flow process charts, travel chart, two-handed chart and multiple activity charts.

Principles of Motion Economy: Classification of movements, SIMO chart, and micro motion study. Definition and installation of the improved method, brief concept about synthetic motion studies. Introduction to Value Engineering and Value Analysis.

Unit III – Work System Design

Work Measurements: Definition, objectives and uses, Work measurement techniques.
Work Sampling: Need, confidence levels, sample size determinations, random observation, conducting study with the simple problems.
Time Study: Definition, time study equipment, selection of job, steps in time study. Breaking jobs into elements, recording information, Rating and standard rating, standard performance, scales of rating, factors affecting rate of working, allowances, and standard time determination.
Introduction to PMTS, MTMand MOST.

Unit IV – Production Planning and Control

Introduction: Types of production systems, Need and functions of PPC, Aggregate production planning. Capacity Planning, ERP: Modules, Master Production Schedule, MRP and MRP-II.
Forecasting Techniques: Causal and time series models, moving average, exponential smoothing, trend and seasonality (Numerical), Demand Control strategies (MTO, MTA, MTS).
Introduction to Supply Chain Management: Basic terminologies.

Unit V– Facility Design

Plant Location: Need and factors influencing plant location, Plant Layout: Objectives, principles, types of plant layouts.
Introduction to Assembly Line Balancing and Layout parameters to evaluate.
Material Handling systems: Objectives, relation with plant layout, principles. Types and purpose of different material handling equipment, Selection of material handling equipment.
Inventory control and Management: Types of inventories, Need of inventories, terminology, costs, Inventory Models: Basic production models, (with and without shortage and discount), ABC, VED Analysis.

Unit VI – Engineering Economy, Human Resource and Industrial Safety

Introduction to Costing: Elements of Cost, Break-Even Analysis (Numerical). Introduction to Debit and Credit Note, Financial Statements (Profit and loss account and Balance Sheet), Techniques for Evaluation of capital investments.
Human Resource Development: Functions: Manpower Planning, Recruitment, Selection, Training. Concept of KRA (Key Result Areas), Performance Appraisal (Self, Superior, Peer, 360º). Industrial Safety: Safety Organization, Safety Program

Textbooks:

1. M Mahajan, Industrial Engineering and Production Management, Dhanpat Rai and Co.
2. O. P. Khanna, Industrial engineering, and management, Dhanpat Rai publication
3. Martend Telsang, Industrial Engineering, S. Chand Publication.
4. Banga and Sharma, Industrial Organization& Engineering Economics, Khanna publication

Reference books:

1. Introduction to Work Study by ILO, ISBN 978-81-204-1718-2, Oxford & IBHPublishing Company, New Delhi, Second Indian Adaptation, 2008.
2. H. B. Maynard, K Jell, Maynard 's Industrial Engineering Handbook, McGraw Hill Education.
3. Askin, Design and Analysis of Lean Production System, Wiley, India
4. Zandin K.B., Most Work Measurement Systems, ISBN 0824709535, CRCPress,2002

Open Elective – I
Artificial Neural Network in Engineering (IOEUA32185D)

Teaching Scheme	**Examination Scheme**						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): 0 hr./week Practical (P): 0 hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Course Objectives:

1. To make students aware of various soft computing techniques in general and Artificial Neural Networks in particular, giving details about its working and analogy with Biological Neural networks.
2. To give students ideas about designing and training an Artificial Neural network using different algorithms to solve univariate and multivariate time series problems.

Course Outcomes: Upon completion of the course, students will be able to:

1. Understand ANN as AI, soft computing and data driven model and describe its types
2. Compute the Net information given components of neuron
3. Describe various network training algorithms
4. Determine various design related aspects of ANN namely architecture, stopping criteria, performance function, overfitting
5. Describe working of Recurrent networks, Radial basis function networks, Generalized regression neural networks, Self-organizing maps using case studies
6. Design, train, and test 2 or 3 layered Feed forward back propagation neural network for time series and cause effect models

Unit I – Introduction to Artificial Neural Networks

Biological Neural Network, Introduction to Artificial Intelligence, soft computing techniques, Data driven modeling, ANN as AI, Soft computing and data driven technique, Artificial Neuron, ANN-history and general properties, ANN types according to architecture and Neuro-Dynamics, ANN Vs empirical, statistical, physical, physics based models

Unit II– Artificial Neuron

Components of artificial neuron, methods of computing net information, Activation functions (linear, sigmoidal, hyperbolic tangent, hard limiter, soft-lin), perceptron, Multi-layered perceptron (MLP)

Unit III – Network training

Pre-training procedures- data normalization, network initialization, Types of training-Supervised and un-supervised, Network training using supervised training algorithms – Standard back propagation algorithm or gradient descent algorithm (mathematical treatment), introduction to Network training using conjugate gradient, resilient back propagation, Broydan-Fletcher-Goldfarb-Shanno algorithm, One step secant algorithm, Levernberg-Marquardt algorithm

Unit IV – Important Aspects of ANN design

Network architecture- inputs, outputs, number of hidden layers, number of hidden neurons, stopping criteria, overfitting, validation, testing, De-normalization, Evaluating model performance, data division, performance function

Unit V– Types of ANN
Recurrent networks, Radial basis function networks, Generalized regression neural networks, Self-organizing maps (discuss using case studies of each referring to published papers and literature).
Unit VI – Applications of Feed Forward Back Propagation Neural Networks
Time series (univariate and multivariate) models, cause-effect models, Applications in Civil engineering, Electronics and Telecommunications, Mechanical Engineering, Computer Engineering, design, train and test simple 2 or 3 layered feed forward back propagation ANN for time series and cause effect models. Image Classifications using ANN
Continuous Internal Evaluation
1. Calculation of network output for any given ANN with sigmoidal, hyperbolic tangent and linear activation functions 2. Implementing standard backpropagation algorithm manually, Using WEKA or any other software 3. Designing, training, and testing 2-3 layered FFBP ANN using standard backpropagation algorithm for any time series problem (univariate) 4. Evaluating the performance of ANN developed in Experiment 3 by varying number of hidden neurons, activation functions, normalization ranges 5. Designing, training, and testing 2-3 layered FFBP ANN using standard backpropagation algorithm for any time series problem (multi-variate) 6. Evaluating the performance of ANN developed in Experiment 5 by varying number of hidden neurons, activation functions, normalization ranges 7. Designing, training, and testing 2-3 layered FFBP ANN using standard backpropagation algorithm for any cause effect problem 8. Evaluating the performance of ANN developed in Experiment 7 by varying number of hidden neurons, activation functions, normalization ranges 9. Demonstration of MNIST digit classification using ANN.
Textbooks: 1. Wasserman, P.D., (1993), " Advanced methods in neural computing", Van Nostrand Reinhold, New York 2. Kosko, B., (1992), "Neural Networks and Fuzzy systems", Prentice Hall, Englewood Cliffs, NJ Bose, N. K., Liang, P. (1998), "Neural Network Fundamentals with Graphs, Algorithms and Applications", Tata McGraw-Hill Publication.

Open Elective – I
Social Media Analytics (IOEUA32185E)

Teaching Scheme	**Examination Scheme**						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): 0 hr./week Practical (P): 0 hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Course Objectives:

1. To understand foundations of Social Media Analytics.
2. To Visualize and understand the data mining aspects in social networks.
3. To solve mining problems by different algorithms.
4. To understand network measures for social data.
5. To understand behavioral part of web applications for Analysis.
6. To analyze the data available on any social media applications

Course Outcomes: Upon completion of the course, students will be able to:

1. Understand the basics of Social Media Analytics.
2. Understand the visualization of social networks and the significance of Data mining in Social media.
3. Demonstrate the algorithms used for text mining.
4. Evaluate the performance of centrality measures on social graph.
5. Explain Behavior Analytics techniques used for social media data.
6. Apply social media analytics for Facebook, LinkedIn and Twitter kind of applications.

Unit I – Introduction to Social Media Analytics (SMA) and Types of Analytics Tools

Social media landscape, Need for SMA; SMA in Small organizations; SMA in large organizations; Application of SMA in different areas, The foundation for analytics, Social media data sources, Defining social media data, data sources in social media channels, Estimated Data sources and Factual Data Sources, Public and Private data, data gathering in social media analytics.

Unit II– The Social Networks Perspective and its Visualization

The social networks perspective - nodes, ties and influencers, Social network and web data and methods. Graphs and Matrices- Basic measures for individuals and networks.
A Taxonomy of Visualization, The convergence of Visualization, Interaction and Analytics. Data mining in Social Media: Introduction, Motivations for Data mining in Social Media, Data mining methods for Social Media.

Unit III – Text Mining in Social Networks

Introduction, Keyword search, Classification Algorithms, Clustering Algorithms-Greedy Clustering, Hierarchical clustering, k-means clustering, Transfer Learning in heterogeneous Networks, Sampling of online social networks, Comparison of different algorithms used for mining, tools for text mining.

Unit IV – Network Measures

Centrality: Degree Centrality, Eigenvector Centrality, Katz Centrality, PageRank, Betweenness Centrality, Closeness Centrality, Group Centrality, Transitivity and Reciprocity, Balance and Status, Similarity: Structural Equivalence, Regular Equivalence

Unit V– Behavior Analytics

Individual Behavior: Individual Behavior Analysis, Individual Behavior Modeling, Individual Behavior Prediction Collective Behavior: Collective Behavior Analysis, Collective Behavior Modeling, Collective Behavior Prediction

Unit VI – Case Study

Mining Twitter: Overview, Exploring Twitter's API, Analyzing 140 Characters
Mining Facebook: Overview, Exploring Facebook's Social Graph API's, Analyzing Social Graph Connections.
Mining Linked In: Overview, Exploring Linked In API

Textbooks:

1. Reza Zafarani Mohammad Ali Abbasi Huan Liu, Social Media Mining, Cambridge University Press, ISBN: 10: 1107018854.
2. Charu C. Aggarwal, Social Network Data Analytics, Springer, ISBN: 978-1-4419-8461
3. Matthew Ganis, Avinash Kohirkar Social Media Analytics: Techniques and Insights for Extracting Business Value Out of Social Media,Pearson publications,2016

Reference books:

1. Marshall Sponder, Social Media Analytics: Effective Tools for Building, Interpreting, and Using Metrics, McGraw Hill Education, 978-0-07-176829-0. 2.
2. Matthew A. Russell, Mining the Social Web, O'Reilly, 2nd Edition, ISBN:10: 1449367615.
3. Jiawei Han University of Illinois at Urbana-Champaign Micheline Kamber, Data Mining: Concepts and Techniques, Morgan Kaufmann, 2nd Edition, ISBN: 13: 978-1-55860-901-3 ISBN: 10: 1-55860-901-6
4. Bing Liu, Web Data Mining: Exploring Hyperlinks, Contents and Usage Data, Springer, 2nd Edition, ISBN: 978-3-642-19459-7

Structural Design and Drawing - II (CVUA32186)

Teaching Scheme	**Examination Scheme**						
Credits: 3 Lecture (L): 2 hrs./week Tutorial (T): 0 hr./week Practical (P): 2 hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	-	-	50	-	-	25	75

Course Objectives:
To develop the ability to understand the effect of various loads on components of steel structure, the actual behavior of members & connections in steel structures subjected to combination of various loads, basic concepts in design of various steel structural components based on provisions of Indian Standard code.

Course Outcomes: Upon completion of the course, students will be able to:

1. Apply the principles of plastic theory for classification of sections and Design bolted and welded connections for components of steel structure subjected to axial force, moment and shear force by Limit State Method using the guidelines given in Indian Standard code
2. Design the structural elements subjected to axial tensile and compressive force along with stable connections using the guidelines given in Indian Standard code
3. Design laterally supported and unsupported beams for limit state of strength and serviceability using the guidelines given in Indian Standard code
4. Design column footings along with stable connections using the guidelines given in Indian Standard code
5. Demonstrate the ability to create structural drawings using modern engineering tools individually and / or through a teamwork

Unit I – Plastic Theory and Design of Connections

Introduction to Steel Structures & their types, Role of the designer, Advantages of structural steel, Types/grades of structural steel, Mechanical properties of steel, various rolled steel sections (Angle, Channel, I – s/n,) relevant IS specifications such as IS:800-2007, IS:808-1989, IS:875 part I to III, SP: 6(1), SP: 6(6), IS:4000-1992. Philosophy of limit state design for strength and serviceability, partial safety factor for load and resistance. Introduction to plastic theory: Plastic hinge concept, plastic collapse load, plastic moment, shape factor, plastic section modulus. Classification of cross section such as plastic, compact, semi-compact and slender.
Bolted Connections: Types/grades of bolts, Behavior of bolted joints, Strength of joint/connection, efficiency of joint, Design of bolted connections subjected to tension, compression, and moment.
Welded Connections: Types & properties of welds, Types of welds, codes for welded connections, Design of welded connections subjected to tension, compression, and moment.

Unit II - Design of Tension and Compression members

Tension members: Behavior, Modes of failures, various cross sections such as solid threaded rod, cable and angle sections. Limit strength due to yielding, rupture and block shear. Design of tension member: using single and double angle sections, connections of member with gusset plate by bolts and welds.
Compression members: Behavior, Modes of failures, buckling classification as per geometry of cross section, buckling curves, design of struts in trusses using single and double angle section, connections of members with gusset plate by bolts and welds. Design of columns subjected to axial load using rolled steel section. Concept of built-up columns.

Unit III – Design of Beams
Design of Beams - laterally supported, simply supported beams using single rolled steel section without flange plate, strength in flexure, low and high shear, check for web buckling, web crippling and deflection, Concept of plate girder. Design of Beams - laterally unsupported, simply supported beams using single rolled steel section without flange plate, strength in flexure, low and high shear, check for web buckling, web crippling and deflection, Concept of gantry girder.
Unit IV – Design of Column Footings
Design of column bases: Design of slab base, gusseted base and moment resistant base (axial load and uni-axial bending).
Term Work
During practical sessions students will complete the following assignments 1) Numerical examples based on section classification 2) Assignment on assessment of dead load, live load, and wind load for roof truss as per IS 875 (part – I, II & III) considering various design load combinations and analysis of truss 3) Assignment on design of tension member of a truss with stable connections 4) Assignment on design of compression member of a truss with stable connections 5) Assignment on design of column 6) Assignment on design of purlin 7) Assignment on design of footings 8) Assignment on structural drawing related to industrial building (maximum two full imperial sheets using suitable software) Note: Maximum number of students in a group, if any, should not be more than three to five for the term work design assignments.
Textbooks: 1. Limit state design in Structural Steel by M.R. Shiyekar, PHI, Delhi 2. Limit state design of steel structures by S K Duggal, Tata McGraw Hill Education, New Delhi. 3. Fundamentals of structural steel design M L Gambhir, Tata McGraw Hill Education Private limited, New Delhi.
Reference books: 1. Design of Steel Structure by N Subramanian, Oxford University Press, New Delhi. 2. Structural Design in Steel—Sarwar Alam Raz—New Age International Publishers 3. Analysis and Design: Practice of Steel Structures—Karuna Ghosh-- PHI Learning Pvt. Ltd. Delhi 4. Design of Steel Structures by K S Sai Ram, Pearson, New Delhi. 5. Design of steel structure by Limit State Method as per IS: 800- 2007 by Bhavikatti S. S. I K International Publishing House, New Delhi