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 2020)

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 needfor 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.

T.Y. B. TECH (CIVIL ENGINEERING), SEMESTER V (PATTERN 2020)

Course Code	Course Title	Course Type	Teaching Scheme			Examination Scheme					Total	Credits
			L	T	P	CIE	ISE	SCE	ESE	PR/OR/TW		
CVUA31201	Irrigation Engineering-II	TH	3	-	2	20	30	20	30	25*	125	4
CVUA31202	Structural Design & Drawing - I	TH	3	-	2	20	30	20	30	25*	125	4
CVUA31203	Transportation Engineering	TH	3	-	2	20	30	20	30	25	125	4
CVUA31204	Foundation Engineering	TH	3	-	-	20	30	20	30	-	100	3
CVUA31205	Professional Elective - I	TH	3	-	2	20	30	20	30	25	125	4
CVUA31206	Design Project - I	CE	1	-	2	-	-	-	-	25	25	2
M2	Mandatory Course	AU	-	-	-	-	-	-	-	-	-	-
	Total		16	0	10	100	150	100	150	125	625	21

*Course has Oral Examination

Professional Elective I

1. CVUA31205A: Construction Management
2. CVUA31205B: Advanced Surveying
3. CVUA31205C: Advanced Structural Analysis

Mandatory Course:

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

BoS Chairman | Dean Academics | Director

Department of Civil Engineering

T.Y. B. TECH (CIVIL ENGINEERING), SEMESTER VI (PATTERN 2020)

Course Code	Course Title	Course Type	Teaching Scheme			Examination Scheme					Total	Credits
			L	T	P	CIE	ISE	SCE	ESE	PR/ OR/ TW		
CVUA32201	Structural Design & Drawing - II	TH	3	-	2	20	30	20	30	25*	125	4
CVUA32202	Environmental Engineering-II	TH	3	-	2	20	30	20	30	25*	125	4
CVUA32203	Quantity Survey, Contacts & Tenders	TH	3	-	2	20	30	20	30	25	125	4
CVUA32204	Professional Elective-II	TH	3	-	2	20	30	20	30	25	125	4
IOEUA32205	Open Elective -I	TH	3	-	-	20	30	20	30	-	100	3
CVUA32206	Design Project - II	CE	1	-	2	-	-	-	-	25	25	2
M2	Mandatory Course	AU	-	-	-	-	-	-	-	-	-	-
	Total	-	16	0	10	100	150	100	150	125	625	21

*Course has Oral Examination

Professional Elective II
1. CVUA32204A: Irrigation & Drainage
2. CVUA32204B: Advanced Concrete Technology
3. CVUA32204C: Systems Approach in Civil Engineering

Open Elective-I
IOEUA32205A: Professional Practice, Law and Ethics

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

Irrigation Engineering - II (CVUA31201)

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

Prerequisite course(s): Fluid Mechanics, Hydraulic Engineering, Irrigation Engineering-I

Course Objective(s):

1. To facilitate the students about knowledge of reservoir planning, stability check of gravity dam & Earthen dam, design of spillway energy dissipater and canals.
2. To facilitate the students to analyze weirs on permeable foundations and introductory knowledge about cross drainage works and river training works.

Course Outcomes:

Upon completion of the course, students will be able to

1. Determine reservoir capacity using annual inflow and outflow, elevation capacity curve and dependable yield.
2. Execute stability analysis of gravity dam.
3. Design of ogee spillway and energy dissipation device below the spillway
4. Perform stability analysis of earthen dam.
5. Execute analysis of weirs on permeable foundations and design of lined canal
6. Understand functioning of cross drainage works and river training works.

Unit I: Introduction to dams and Reservoir Planning

Introduction, Different terms related to dams, Selection of site for dam, Factors governing selection of type of dam, Classification of dams, Dams and earthquakes, Dams and social issues, large dams verses small dams, Displacement and rehabilitation, Dams and climate change

Reservoir Planning: Introduction, Term related to reservoir planning (Yield, Reservoir planning and operation curves, Reservoir storage, Reservoir clearance), Investigation for reservoir planning, Significance of mass curve and demand curves, Applications of mass curve and demand curves, Fixation of reservoir capacity from annual inflow and outflow, Fixation of reservoir capacity using elevation capacity curve and dependable yield, Reservoir regulation,

Unit II: Gravity Dams and Arch Dams

Gravity Dams

Introduction, Components of gravity dam, Conditions favoring gravity dams, Forces acting on gravity dam, Combinations of loading for design, Seismic analysis of dam, Terms related to seismic analysis, Determination of Seismic forces, Effect of horizontal earthquake acceleration, Effect of vertical earthquake acceleration, Stress analysis in gravity dam, Vertical or normal stress , Principal stresses, Shear stress, Middle third rule, Modes of failure of gravity dam, Elementary profile of gravity dam, Design of low and high gravity dams, Design methods of gravity dam (Introduction only)--Gravity method or 2 D method

Arch Dam and Other Dams (Introduction only)

Introduction, Concept of Arch Dam, Conditions favoring an arch dam, Classification of an arch dam, Constant angle arch dam, Constant radius arch dam, Variable radius arch dam, Arch gravity dam, Double curvature arch dam, Buttress dams, Advantages of Buttress dams, Limitations of Buttress dams, Types of buttress dams.

Unit III: Spillway and Gates

Introduction, Location of Spillway, Different key levels and heads in spillway, Spillway Capacity, Components of spillway, Classification of spillway, Introduction to straight drop spillway(Free overflow spillway),Saddle spillway, Side channel spillway, Overflow or 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 or overflow spillway, Shape of crest, Equations for spillway profile, Energy dissipation below spillway, Classification of energy dissipation devices, Energy dissipation in stilling basin, Stilling basin, Components of stilling basin, Types of stilling basins, Indian standard stilling basins, Energy dissipation through buckets, Solid roller bucket, Slotted roller bucket, Ski jump bucket, Correlation between jump height and tail water depth, Correlation 1-2-3-4-5 of TWD Vs Jump depth.

Spillway gates, Classification of spillway crest gates, Requirements of spillway gates, Maintenance of gates, Inspection of gates

Unit IV: Earthen Dam

Introduction, Conditions favoring an earth dam, Limitations of earth dam, Classification of earth dam, Components of an earth dam, Requirements for safe design of earth dam, Hydraulic (Seepage) Analysis, Plotting of seepage line,

Case 1: Homogeneous earth dam with horizontal drainage blanket, Determination of seepage discharge using phreatic line.

Case II: Composite earth dam with casing and hearting, Properties of phreatic line, Determination of seepage discharge through earth dam using flownet, Structural stability analysis, Forces acting on earth dam, Method of stability analysis of an earth dam, Procedure of analysis by Swedish slip circle method, Fellenius Method of Locating Centre of Critical Slip circle, Stability Analysis for Foundation, Failure of earth dam, Classification of failure of earth dams, Seepage control in earth dams, causes of seepage, Seepage control measures

Unit V: Diversion head works and Canals

Introduction, Function of diversion head works, Selection of site for diversion head works, Layout of diversion head works, Components of diversion head works, Design of weir on permeable foundation, Criteria for safe design of weir floor, Khosla's theory based on potential theory approach, Khosla's theory of independent variables, Design criteria of weirs on permeable foundations

Canals

Introduction, Classification of canals, Selection of canal alignment, Design of stable canal in alluvial beds, Kennedy's theory, Design of canal by Kennedy's theory, Limitations of Kennedy's theory, Lacey's regime theory, Design of canal by Lacey's theory, Canal lining, Need of canal lining, Requirements of lining material, Classification of canal lining

Unit VI: Cross Drainage Works and River Training Works

C. D. Works (Introductory treatment only)

Introduction, Necessity of cross drainage works, Selection of site for Cross Drainage work, Classification of Cross Drainage works, Selection of suitable type of C. D. works

River Training Structures (Introductory treatment only)

Introduction, Classification of rivers, Behavior of rivers, River training, Objectives of river training, Classification of river training, purpose, orientation, River training structures, Embankment or Levee, Guide banks, Groynes or spurs, Artificial cut off, Pitched Island, submerged sill or dykes, Closing dykes.

Term Work:
(Oral Examination will be based on this term work)

Following are the assignments to be completed by students

1. Determination of reservoir capacity
2. Stability analysis of gravity dam
3. Design of profile of spillway and energy dissipation device below the spillway
4. Stability analysis of earthen dam
5. Analysis of weirs on permeable foundations.
6. Design of lined canal

Textbooks:

1. Modi, P.N, (2008) "Irrigation, Water Resources and Water Power Engineering", Standard Book House, New Delhi, 7the.
2. S.K. Garg, (2014), "Irrigation Engineering and Hydraulic Structures", Khanna Publishers N.D.
3.Dr. B. C. Punmia, Dr. Pande Brij Basi Lal, Ashok Kumar Jain, Arun Kumar Jain, (2009), "Irrigation and Waterpower Engineering", Laxmi Publications Pvt Limited

Reference Books:

1. R. K. Sharma, (2007) "Irrigation Engineering", S. Chand. Publications
2. N.N. Basak, (1999) "Irrigation Engineering", Tata McGraw Hill.
3. G.L. Asawa, (2006), "Irrigation and Water Resources Engineering", New Age International (P) Ltd. Publishers
4. S.R. Sahasrabudhe, (2011), "Irrigation Engineering and Hydraulic Structures", S.K. Kararia & Sons, Katson Books, 3rdedition.

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.

New Delhi.
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.
11. I.S. 7365-1985, Criteria for hydraulic design of bucket type energy dissipaters, first revision, B.I.S. New Delhi.

Structural Design and Drawing I (CVUA31202)

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

Course Objectives:

- To develop the ability to understand the behaviour 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

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

1. Understand the composite action of reinforced concrete, concept of transformed section, singly and doubly reinforced concrete section, design philosophies and analyze under reinforced singly, doubly and flanged reinforced concrete section subjected to flexure using Limit State Method.
2. Understand concepts of limit state of serviceability and stability of a structure and designreinforced concrete section subjected to flexure using Limit State Method (LSM)
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. Design reinforced concrete isolated column footing subjected to gravity loads using Limit State Method as per guidelines given in Indian Standard Code

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. Concept of transformed section, singly and doubly R. C. sections.
Classification of limit states. Characteristic strengths and loads. Partial safety factors. 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). Design parameters for rectangular R.C. section, Moment of resistance of rectangular under reinforced singly, doubly, and flanged R. C. section.

Unit II– Design for flexure using LSM

Loads and load combinations. Stability of a structure and code provisions (Actions on a structure, failure behavior and safety). Limit state of serviceability: IS code recommendation for limit state of deflection, cracking and fire.
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 short column

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

Unit VI – Design of column footing

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.

Term Work

Any seven assignments from the list below (Assignments 1, 6 and 9 mandatory) and the detailing of the section to be shown using any drafting software

1. Report on one site visit
2. Design of Singly Reinforced Simply Supported Tee beam for flexure and shear with all necessary checks (deflection, development length) and curtailment of main reinforcement
3. Design of Doubly Reinforced Simply Supported rectangular beam for flexure and shear with all necessary checks (deflection, development length) and curtailment of main reinforcement
4. Design of Three Span Continuous Beams for Flexure and Shear with all necessary checks (deflection, development length) and curtailment of main reinforcement
5. Drawing structural plan for G+1 building and designing of a typical floor of a building having one way and two-way slabs with different boundary conditions with all necessary checks (at least 1 one-way slab and 2 two-way slabs)
6. Design of Dog Legged stair Case
7. Design of short column subjected to axial load and uni-axial bending using interaction curves
   Design of short column subjected to axial load and bi-axial bending using interaction curves
8. Design of rectangular isolated column footing
9. Any one of the above exercises using any software/ spreadsheets

Note:

a. Reinforcement details should be developed as per SP - 34.
b. Reinforcement details should be drawn using any drafting software (e.g. AutoCAD).

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.

Reference books:

1. Illustrated Design of Reinforced Concrete Buildings (G+3), Dr. V. L. Shah and Dr. S.R. Karve, Structures Publications, Pune.
2. Illustrated Reinforced Concrete Design, Dr. V. L. Shah and Dr. S.R. Karve, Structures Publications, Pune.

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.

Department of Civil Engineering
Transportation Engineering - I (CVUA31203)

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

Prerequisite course(s): Basic civil Engineering, Engineering Materials, Concrete Technology

Course Objective(s):

1. To provide broad awareness to the students to deal with traffic planning & Geometric design
2. To provide broad awareness to the students to deal with traffic issues and pavement materials
3. To provide basic knowledge about bridge component its function, classification and types and erection techniques.
4. To provide basic knowledge about aviation system and its functions with plan and design basic airport facilities such as runways, taxiways, etc.
5. To know about the basics and design of various components of railway engineering.
6. To get knowledge about tunnel types & different method of tunnel and to study about the types and components of docks and harbors.

Course Outcomes:

Upon completion of the course, students will be able to

1. Explain the fundamentals of highway planning, development and Determine highway geometric parameter.
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 about bridge engineering, bridge types, bridge components, Bearings, Erection techniques and Maintenance.
4. Understand about airport planning with layout, use of wind rose diagram and determine the runway length.
5. Understand the components and geometric parameters of railways.
6. Explain types of tunnels and Describe methods of tunnelling, and understand the basics of dock and harbors.

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; Provisions made for various infrastructure sectors like Roads & Highways, Railways, Airports, Ports, Housing, Energy & Power sector with reference to latest five-year plan. Highway alignment 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: Bridge Engineering

Introduction: Components of bridges, Classification and all types of bridges, preliminary data to be collected during investigation of site for bridges, 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.
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.

Unit IV: Airport Engineering

Introduction: Advantages and limitations of air transportation. Aeroplane 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 V: 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 VI: Tunnel Engineering and Dock & Harbor

Tunnels - functions & types, criteria for selection of size & shape. Pilot tunnel, shaft, portal, Methods of tunneling in hard and soft ground (Needle beam, NATM, TBM & earth pressure balance method, drilling & blasting). Various operations in tunneling like mucking, drainage in tunneling- Pre drainage and permanent drainage, Ventilation in tunneling (temporary and permanent), Micro tunneling and trenchless tunneling.

Dock & Harbour -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, Dolphin. Dredging techniques.

Term work shall consist of the following:

Practicals:

A 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

B. 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

C. Technical visits to 1) Bridge site/Airport/Railway/Tunnel and 2) Hot mix Plant with detailed report

Textbooks:

1. F. L. Mannering, Scott S (2011), "Washburn Principles of Highway Engineering and Traffic Analysis", Wiley India
2. S.K. Khanna and C.E.G. Justo (2011), "Highway Engineering" Nem Chand and Brothers, Roorkee
3. L.R. Kadiyali (2019), "Principles and Practices of Highway Engineering" Khanna Publishing
4. S. Ponnuswamy (2017), "Bridge Engineering", Tata Mc Graw Hill publishing Co. Ltd. New Delhi.
5. S.K. Khanna, M.G. Arora, S.S. Jain (1999), "Airport Planning and Design", Nem Chand and Brothers, Roorkee.
6. Rangwala (1905), "Airport Engineering" Charotar publishing House, Anand 388001 (Gujrat)
7. Satish Chandra, M.M. Agarwal (2013), "Railway Engineering", Oxford University Press
8. R. Srinivasan (2016), "Harbor, Dock & Tunnel Engineering", Charotar publishing House, Anand 388001 (Gujrat)
9. Rangwala (2015) "Highway Engineering", Charotar publishing House, Anand 388001 (Gujrat)
10. Rangwala, (2015) "Bridge Engineering" Charotar Publishing House, Anand 388 001.

Reference Books:

1. S.P. Bindra (2008), "A Course in Highway Engineering", Dhanpat Rai and Sons, Delhi.
2. G.V. Rao (2000), "Principles of Transportation Engineering" Tata Mac Graw Hill Publication
3. Partha Chakraborty, Animesh Das (2017), "Principles of Transportation Engineering" Prentice Hall of India Pvt. Ltd., New Delhi.
4. B.L. Gupta, Amit Gupta (2020), "Highway and Bridge Engineering" Standard publishers Dstributors, Delhi.
5. S.P. Bindra, (2012) "Principles and Practice of Bridge Engineering", Dhanpatrai and Sons, Delhi.
6. J.S. Mundrey (2009), "Railway Track Engineering", Tata McGraw Hill
7. P.Oza & Gautam H.Oza (2017), "Dock & Harbor Engineering", Hasmukh -Charoter Book Stall
8. D. Johnson and Victor (2019), "Essentials of Bridge Engineering", Oxford and IBH publishing

Co. Pvt. Ltd., New Delhi.

Handbooks:

1. Gordon and Breach (1990), "Handbook of Road Technology", Science Pub. New York
2. S.K.-Khanna (2017)," Civil Engineering Handbook", UBS Publishers Pvt Ltd

Codes:

1. I.S. 1201 TO 1220 - 1978 (Reaffirmed 2004), Methods of Testing Tar and Bituminous Material, B.I.S. New Delhi
2. IS 73 – 1950 (Reaffirmed 2013), Paving Bitumen, B.I.S. New Delhi
3.IS 2386 PART I to IX – 1963, Methods of Test for Aggregates for Concrete, B.I.S. New Delhi
4. I.R.C. 58 - 2015, Guidelines for the Design of Plain Jointed Rigid Pavements for Highways
5.IRC 37 – 2018, Guidelines for The Design of Flexible Pavements, IRC New Delhi
6.IRC 44 – 2017, Guidelines for Cement Concrete Mix Design for Pavements, IRC New Delhi
7. MORTH – 2005, Specifications for Road and Bridge works (MORTH), IRC, New Delhi.
8. ICAO Manual of Airport Engineering

e Resources:

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

Department of Civil Engineering

Foundation Engineering (CVUA31204)

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

Prerequisite course(s): None

Course Objective(s):
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. **Explain** field investigation and understand field tests to investigate properties of soil
2. **Determine** bearing capacity of the soil and explain effect of water table on bearing capacity
3. **Understand** consolidation process and **calculate** settlement of soil due to external pressure
4. **Understand** the deep foundation and **calculate** load carrying capacity of single and group of pile by using soil properties
5. **Explain** construction process of foundation over soft clayey soil and problems associated with black cotton soil during design of the foundation
6. **Explain** the mechanism of soil reinforcement and **understand** effect of earthquake 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

Professional Elective – I

Construction Management CVUA31205A)

Teaching Scheme	**Examination Scheme**						
Credits: 3 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 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 andcontract 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. Understand project planning and scheduling techniques
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 – I – Project Planning & Scheduling.

Work Breakdown Structure (WBS), Gantt /Bar chart, Network Analysis, C. P. M.- . Activity on Arrow (A.O.A.), Critical path and type of floats, Precedence network analysis (A.O.N.), Network Crashing – Time- Cost – Resource optimization, P. E. R.T.

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 performancerating. 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, projectcash flow projections and statements, project balance sheet, profit loss account statements.
Introduction, principles, types, origin, risk control, use of mathematical models: sensitivity analysis, breakever 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 withothe functional areas, vendor networking, buyer-seller relationships, E material codification and classification concept of logistics and supply chain management. Inventory models- EQQ models withvariations.
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 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. Prasanna Chandra, "Projects – Planning, Analysis, Selection, Implementation and Review", Tata McGraw Hill Publications.
2. P. K. Joy,"Total Project Management – The Indian Context", –MacMillian Publications
3. Gopal Krishnan & Sunderasan, "Materials Management", Prentice Hall Publications.
4. Bhat , "Management –Principal, process, and practices", Oxford University Press.
5. Shrivastava, " Financial management", Oxford University Press
6. Gordon B. Davis, Margrethe H. Olson, " Management Information Systems", Tata McGraw Hill Publ. Co.
7. S.C Sharma, "Construction Equipment's & its Management", Khanna Publication
8. Dr. V. K. Raina, "Construction Management practice and contract management practice",2nd Edition,SPD publications, New Delhi.

Reference books:

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

List of Practicals

1. Site Visit to a Construction project to study following documents and preparing a report – (2)
   a. Project Cash Flow Analysis.
   b. Project Balance Sheet.
   c. Materials Flow System in the Project.
2. Assignment on CPM (2)
3. Assignment on PERT (2)
4. Study of various contracts related to construction Industry (2)
5. Assignment on sensitivity analysis, break even analysis, simulation analysis, decision tree analysis (2)
6. Assignment on Work Study and work measurement on any two Construction Trades. (2)
7. Assignment on EOQ Model and its variation. (2)
8. Assignment on Equipment Management. (2)
9. Assignment on MIS in construction industry. (2)
10. Seminar on any one topic from syllabus (2)

Professional Elective – I
Advanced Surveying (CVUA31205B)

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

Prerequisite course(s): Surveying

Course Objective(s):

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

7. **Explain** triangulation method for geodetic survey and **determine** intervisibility and elevation difference between triangulation stations using trigonometric levelling
8. **Compute** most probable values of angles in triangulation, considering plane and spherical angles
9. **Explain** fundamentals of geodesy and segments, positioning methods, and errors in Space Based Positioning System
10. **Describe** concepts, physical fundamentals and components of Remote Sensing
11. **Describe** objectives, components, limitations and applications of Geographical Information System
12. **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: 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 III: 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 IV: 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 image interpretation, 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 V: 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 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 elevation measurements, remote distance measurements and co-ordinate stakeout.
4. Establishing control station using single or dual frequency GPS receiver

Remote Sensing

1. Study and applications of different RS data products available with National Remote Sensing Centre (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.

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.

Project: (Any one)

1. Adjustment of geodetic quadrilateral without central station by method of correlates.
2. Field survey (500 sq.m.) using GPS (Control as well as mapping).

Textbooks:

1. R. Subramanian, (2012) "Surveying & Levelling", Oxford University Press
2. Dr. B. C. Punmia, (2005) "Surveying: Vol. II", Laxmi Publication - New Delhi.
3. T. P. Kanetkar and S. V. Kulkarni, (2010) "Surveying and Levelling Vol. II", Vidyarthi Griha Prakashan.
4. Alfred Leick, (2015) "GPS Satellite Surveying, 4th Edition" Wiley
5. A. M. Chandra, S. K. Ghosh (2006) "Remote sensing and Geographical Information System" Alpha Science.
6. Basudeb Bhatta (2011) "Remote Sensing & GIS", Oxford University Press

Reference Books:

1. Peter A. Burrough, Christopher D. Lloyd, Rachel A. Mcdonnell (2015) "Principles of Geographical Information System"' Oxford University Press
2. Satheesh Gopi, R. Sathikumar, N. Madhu (2014) "Advanced Surveying -Total Station, GIS and Remote Sensing", Pearson Publication
3. S. K. Duggal (2004) "Surveying Vol. 2"' McGraw Hill Publication
4. Thomas Lillesand, Ralph W. Kiefer, Jonathan Chipman (2004) "Remote Sensing & Image Interpretation", Wiley Publication.

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

Department of Civil Engineering
Professional Elective – I

Advanced Structural Analysis (CVUA31205C)

Teaching Scheme	Examination Scheme						
Credits: 4 Lecture (L): 3 hrs./week Tutorial (T): NA 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 analyze indeterminate beams, trusses and frames having degree of indeterminacy up to two

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

1. **Apply** influence line diagram concept for determining maximum shear force and bending moment in a beam subjected to uniformly distributed load, two concentrated loads and series of concentrated loads
2. **Analyse** the two hinged arch to determine the support reactions, radial shear and normal thrust at any section
3. **Use** the central difference operator for finding out the deflection of simply supported beam subjected to concentrated loads and uniformly distributed load
4. **Understand** the basic concepts of Theory of Elasticity and Finite Element Method
5. **Develop** the generalized stiffness matrix for the analysis of bar and beam element
6. **Develop** the generalized stiffness matrix for the analysis of plane truss

Unit I –Rolling Loads

Maximum shear force and bending moment in a beam supporting uniformly distributed load, Maximum shear force and bending moment in a beam supporting two concentrated loads, Maximum shear force and bending moment in a beam supporting a series of concentrated loads

Unit II–Two Hinged Arches

Introduction, support reactions and radial shear and normal thrust for two hinged parabolic arch at the same level and different level, support reactions and radial shear and normal thrust for two hinged circular arch at the same level

Unit III – Finite Difference Method

Finite Difference Method – Introduction, application to deflection problems of determinate beams by central difference method

Unit IV: Introduction to Finite Element Method

Theory of elasticity: Strain-displacement relations, compatibility conditions in terms of strain, plane stress and plane strain problems, differential equations of equilibrium, compatibility condition in terms of stresses, stress-strain relations in 2D and 3D problems. General steps of the finite element method, Applications and advantages of FEM, concept of finite element for continuum problems, discretization of continuum, use of polynomial displacement function, Pascal's triangle, convergence criteria.

Unit V: Stiffness Matrix and Boundary Conditions for bar and beam
Bar element: stiffness matrix, load vector, assembly of element matrices implementing boundary conditions, stress calculations , support reactions Beam element : Introduction, Derivation of Element Stiffness Matrix, Generalized Stiffness Matrix of a Beam Member, stress calculations ,support reactions
Unit VI: Stiffness Matrix and Boundary Conditions for Truss
Introduction, Element Stiffness of a Truss Member, Member Stiffness with Varying Cross Section, Generalized Stiffness Matrix of a Plane Truss Member, Analysis of Truss.
Term Work
At least two assignments on each unit
Textbooks: 4. S.B. Junnerkar and H.J. Shah, (2015), "Mechanics of Structures-Vol II", Charotar Publishing House 5. B.C.Punmia, Ashok kumar Jain and Arun Kumar Jain, (2017), "Theory of Structures", Laxmi Publications (P) Ltd. 6. S.Ramamrutham and R. Narayan , (2017), "Theory of Structures", Dhanpat Rai Publishing Company 7. S.S.Bhavikatti (2018), "Structural Analysis-II", Vikas Publishing House Pvt. Ltd. 8. S.S. Bhavikatti (2015), "Finite Element Analysis", New Age International Publishers, Delhi
Reference books: 1. Devdas Menon (2009), "Advanced Structural Analysis" Narosa Publishing House, Mumbai 2. R.C.Hibbler, (2017) , "Structural Analysis" , Pearson Publications 3. Dr. A.S.Meghre and S.K.Deshmukh, (2016), "Matrix Methods of Structural Analysis", Charotar Publishing House

Department of Civil Engineering

Design Project - I (CVUA31206)

Teaching Scheme	**Examination Scheme**						
Credits: 2 Lecture (L): 1 hrs./week Tutorial (T): NA Practical (P): 2 hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	-	-	-	-	-	25	25

Prerequisite course(s): Basic Mathematics

Course Objective(s):

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 technique and describe its types and various network training algorithms as well as compute the Net information for given components of neuron
2. Determine various design related aspects of ANN namely architecture, stopping criteria, performance function, overfitting and design, train, test 2 or 3 layered Feed forward back propagation neural network for time series and cause effect models.

Unit I – Artificial Neural Networks

Introduction to Artificial Intelligence, soft computing techniques, Data driven modeling, ANN as AI, Soft computing and data driven technique, ANN- history and general properties, ANN types according to architecture and Neuro-Dynamics, ANN Vs empirical, statistical, physical, physics based models, Biological Neural Network, 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), Network training, Pre-training procedures- data normalization, network initialization, Types of training-Supervised and un-supervised, Network training using Standard back propagation algorithm or gradient descent algorithm, introduction to Network training using conjugate gradient, resilient back propagation, Broydan-Fletcher-Goldfarb-Shanno algorithm, One step secant algorithm, Levernberg-Marquardt algorithm, Network architecture, stopping criteria, overfitting, validation, testing, data division, performance function, Evaluating model performance, Recurrent networks, Radial basis function networks.

Unit II: Applications of ANN in Civil Engineering and Design of ANN

Time series (univariate and multivariate) models, cause-effect models, Applications in Civil engineering Designing a FFBP ANN using the given data set.

Term Work:

Students should work on a small project work wherein they need to design a FFBP ANN Model based on time series (univariate or multivariate) / cause-effect data provided to them.

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 3. Bose, N. K., Liang, P. (1998), "Neural Network Fundamentals with Graphs, Algorithms and Applications", Tata McGraw-Hill Publication.
Reference Books:
Research papers which include applications of ANN in variety of engineering problems (specifically to civil engineering domain)

Semester – II

Structural Design and Drawing II (CVUA32201)

Teaching Scheme	**Examination Scheme**						
Credits: 4 Lecture (L): 3 hrs./week Tutorial (T): NA Practical (P): 2 hr./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	25	50	125

Prerequisite course(s): Engineering Mechanics, Mechanics of Solids -I, Mechanics of Solids -II

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. The practical sessions will help the students to develop the detailed drawing skills and to acquire practical knowledge of design and drafting of various structural components with the oral and written communication skills.

Course Outcomes:

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

1. Explain Limit state design philosophy for design of steel structures, types of steel structures, steel code provisions and design bolted and welded connections using the guidelines given in Indian Standard code.
2. Design the structural elements subjected to axial tensile and compressive forces along with stable connections using the guidelines given in Indian Standard code.
3. Design rolled and built-up columns and column bases along with stable connections using the guidelines given in Indian Standard code.
4. Design laterally restrained and unrestrained beams for limit state of strength and serviceability using the guidelines given in Indian Standard code
5. Analyze and design the truss and gantry girder using the guidelines given in Indian Standard code.
6. Explain the concept of welded plate girder and design the cross section for welded plate girder including stiffeners and its connections using the guidelines given in Indian Standard code.

Unit I – Design philosophy 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, 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, design load combinations, 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.
Unit III – Design of Columns and column bases
Design of columns subjected to axial load using rolled steel section. Design of built-up column, lacing and battening and its connections. Concept of eccentrically loaded column. Design of column bases: Design of slab base, gusseted base and moment resistant base (axial load and uni-axial bending).
Unit IV – Design of Beams
Design of Beams - laterally restrained, simply supported beams using single rolled steel section with and without flange plate, curtailment of flange plates, strength in flexure, low and high shear, check for web buckling, web crippling and deflection. Design of Beams - laterally unrestrained, simply supported beams using single rolled steel section with and without flange plate, curtailment of flange plates, strength in flexure, low and high shear, check for web buckling, web crippling and deflection.
Unit V – Design of Truss and Gantry girders
Roof truss: Types of loads acting on industrial structures, Introduction to IS Codes & specifications: IS 875 (part –I, II & III) , assessment of dead load, live load and wind load for roof truss as per IS 875 (part –I, II & III), design of purlin, design of members of a truss, detailing of typical joints and supports. Design of gantry girder: selection and design of cross section, check for moment capacity, buckling resistance, bi-axial bending, serviceability and fatigue strength.
Unit VI – Design of Welded Plate Girder
Concept of plate girder, components of welded plate girder, intermittent weld, design of cross section, curtailment of flange plates, end bearing, load bearing, and intermediate stiffeners, design of connection between flange & web plate and web plate & stiffeners, check for shear buckling of web, shear capacity of end panel and serviceability condition.
Term Work
A) Four full imperial size drawing sheet showing structural detailing of 16 sketches based on syllabus. (Hand drawn) B) Design of industrial building including roof truss, purlin, gantry girder, column, column base and connections. Use of suitable software for analysis of truss. Three full imperial size hand drawn drawing sheets presenting design details. C) Design of welded plate girder: design of cross section, curtailment of flange plates, stiffeners and connections. One full imperial size drawing sheet presenting design details using any suitable software. D) At least one site visit based on industrial steel structure or welded plate girder. Report should contain structural details with sketches.

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IS Codes & Handbooks:

1. IS:800-2007 – General construction in Steel – Code of practice.
2. IS 808-1989: Dimensions for hot rolled steel beam, column, channel and angle sections, Bureau of Indian Standards, New Delhi
3. IS:875 Part I -1987 - Code of practice for design loads (other than earthquake) for buildings and structures, Part 1- Dead loads — unit weights of building materials and stored materials.
4. IS:875 Part II-1987 - Code of practice for design loads (other than earthquake) for buildings and structures, Part 2- Imposed loads.
5. IS:875 Part III-2015 - Design loads (other than earthquake) for buildings and structures — code of practice, Part 3 - Wind loads.
6. IS 4000-1992: Code of practice for high strength bolts in steel structures, Bureau of Indian Standards, New Delhi.
7. SP-6(1) and 6(6): ISI handbook for Structural Engineers, Bureau of Indian Standards, New Delhi.
8. SP-38: Handbook for typified design for structures with steel roof trusses, Bureau of Indian Standards, New Delhi.

Textbooks:

1. Shiyekar M.R., (2013), "Limit state design in Structural Steel", PHI Learning Pvt. Ltd., New Delhi.
2. Duggal S. K., (2019), "Limit state design of steel structures", Tata McGraw Hill Education, New Delhi, 3 rd Edition .
3. Gambhir M. L. (2013), "Fundamentals of structural steel design", Tata McGraw Hill Education Private limited, New Delhi.

Reference Books:

1. Subramanian N., (2018), "Design of Steel Structure", Oxford University Press, New Delhi.
2. Sarwar Alam Raz, (2013), "Structural Design in Steel", New Age International Publishers.
3. Ghosh Karuna, (2013), "Analysis and Design: Practice of Steel Structures" PHI Learning Pvt. Ltd. Delhi
4. Sai Ram K. S., (2010), "Design of Steel Structures", Pearson, New Delhi.
5. Bhavikatti S. S., (2010), "Design of steel structure by Limit State Method as per IS: 800- 2007" I K International Publishing House, New Delhi

Department of Civil Engineering

Environmental Engineering II (CVUA32202)

Teaching Scheme	Examination Scheme						
Credits: 4 Lecture (L): 3 hrs./week Tutorial (T): NA Practical (P): 2 hr./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	25	50	125

Course Objectives:

- Study of process used in waste water treatment
- To prepare students with an ability to understand designing of Waste water treatment system and apply same in future.
- To increase the awareness amongst the students for Importance of waste water & their management.

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

1. Explain the process used in waste water treatment
2. Analyze the Characteristics of sewage
3. Design preliminary and primary treatment units for sewage treatment
4. Design of Secondary Biological treatment unit
5. Develop an ability to design STP plants.
6. Develop Low cost treatment & advance treatment methods of waste water

Unit I - Waste Water and Treatment Concept

Fundamentals of waste water, types of waste water , unit operation and process, treatment system such as preliminary, primary, secondary and tertiary, functions of treatment plant.
flow rate concept of mass flow rate, types of reaction and reactors.
Concept for HRT, SLR, WLR, OLR, F/M ratio, horizontal and settling velocity, generation rate of waste water, method of sampling.

Unit II – Characteristics of sewage, stream sanitation

Characteristics of sewage: physical, chemical and biological, effluent standards as per CPCB/MPCB norms.,
Stream sanitation: Self-purification of natural streams, Oxygen Sag Curve, Streeter -Phelps equation and terminology (without derivation and numerical).

Unit III – Design of preliminary and primary treatment units for sewage treatment

Analysis of flow measurement, equalization basin, screen chamber, grit chamber, oil and grease trap. Design of circular sanitary sewers pipe system. Design of primary and secondary sedimentation tank.

Unit IV– Biological treatment of waste water

Secondary Biological treatment unit: Suspended growth process, consideration of HRT, MCRT,F/M ratio, OLR, Qty. of oxygen required, Power required, sludge production, sludge flow rate, recycling ratio
Secondary Biological treatment unit: Attach growth process.

Tricking (NRC equation), introduction to bio- towers

Unit V– Anaerobic biological treatment of waste water and sludge treatment

Anaerobic treatment process, anaerobic reactor types. Principle of anaerobic digestion, stages of digestion, factors governing anaerobic digestion, Dewatering of sludge by gravity thickener, sludge drying bed, decanters. Methods of sludge treatment and disposal, advantages & disadvantages. Up-flow Anaerobic Sludge Blanket (UASB) Reactor–Principle, advantages & disadvantages.

Unit VI– Low cost treatment & advance treatment methods of waste water

Oxidation pond: Bacteria –algae symbiosis, oxidation pond as per the manual of CPHEEO, advantages & disadvantages of oxidation ponds.
Aerated lagoons: Principle, aeration method, advantages & disadvantages of aerated Lagoons, Removal of nutrient process such as phosphate, nitrate from waste water.

List of practical – (Any Six of the following)

1. Determination of dissolved oxygen
2. Determination of biological oxygen demand
3. Determination of chemical oxygen demand
4. Determination of sludge volume index.
5. Determination of phosphate or nitrate
6. Determination of solids such as suspended, total, fixed
7. Determination of total dissolved solids by conductivity method
8. Visit to sewage treatment plant (STP)
9. Design of 1 MLD STP by using any software or excel sheet.

Text books:

1. Environmental studies by Rajgopalan -Oxford University Press.
2. Waste Water Treatment & Disposal –Metcalf & Eddy -TMH publication.
3. Environmental Engg. -Peavy, Rowe-McGraw Hill Publication.
4. Waste Water Treatment -Rao & Dutta.

Reference books:

1. Waste Water Engg. –B.C. Punmia& Ashok Jain -Arihant Publications.
2. Water Supply & Waste Water Engg.-B.S.N. Raju –TMH publication.
3. Sewage Disposal & Air Pollution Engg. –S. K. Garg–Khanna Publication.
4. Environmental Engg. –Davis -McGraw Hill Publication
5. Manual on sewerage and sewage treatment –Public Health Dept., Govt. of India.
6. Standard Methods by APHA.

Department of Civil Engineering

Quantity Survey, Contacts & Tenders (CVUA32203)

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

Prerequisite course(s): Material Science & Computer Aided Drawing

Course Objective(s):

4. To make the students aware of types of estimates, its rates and valuation of a project.
5. 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. Liquidateddamages, 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

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., InternationalFederation 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 Engineering 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

Department of Civil Engineering

Professional Elective II
Irrigation & Drainage (CVUA32204A)

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

Prerequisite course(s): Fluid Mechanics, Hydraulic Engineering, Irrigation Engineering -I

Course Objective(s):

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): (Any 8)

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:

7. K. Subramanyam, (2013) "Engineering Hydrology", Tata McGraw Hill.
8. P. N. Modi, (2008), "Irrigation, Water Resources, and Water Power engineering", Standard Book House.
9. S. K. Garg, (2009), "Irrigation Engineering and Hydraulic Structures", Khanna Publishers
10. Dr. B. C. Punmia, Dr. Pande Brij Basi Lal, Ashok Kumar Jain, Arun Kumar Jain, (2009), "Irrigation and Waterpower Engineering", Laxmi Publications Pvt Limited

Reference Books:

5. G.L. Asawa, (2006), "Irrigation and Water Resources Engineering", New Age International (P) Ltd. Publishers
6. David Keith Todd, (2006), "Groundwater Hydrology", Wiley-India
7. M.J. Deodhar, (2008), "Elementary Engineering Hydrology", Pearson Education
8. C. Shekhar P. Ojha, Ojha, R. Berndtsson, P. Bhunya, (2008), "Engineering Hydrology", Oxford University Press

Department of Civil Engineering

Professional Elective II
Advanced Concrete Technology (CVUA32204B)

Teaching Scheme	**Examination Scheme**						
Credits: 4 Lecture (L): 3 hrs./week Tutorial (T): NA Practical (P): 2 hr./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	25	50	125

Prerequisite course(s): Concrete Technology

Course Objectives:

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 behaviour of concrete and the mechanism governing concrete performance as well as maintenance of reinforced concrete infrastructure.

Course Outcomes:

Upon the 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. Analyse 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 behaviour of concrete under stress and choose a suitable strengthening / repair technique for maintenance of reinforced concrete infrastructures.
7. Evaluate the behaviour 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 in concrete, 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, Greenconcrete, 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, Polarization resistance.

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 – Structural strengthening 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. M.S. Shetty (2006), "Concrete Technology", S. Chand Publications.
2. A. R. Santhakumar (2018), "Concrete Technology", Oxford University Press.
3. M. L. Gambhir (2017), "Concrete Technology", Tata McGraw Hill Publications.
4. P. N. Balguru & P. N. Shah (1992), "Fiber Reinforced Cement Composite", McGraw Hill Publications
5. P. Kumar Mehta and P. S. M. Monteiro Concrete (2017), "Microstructure, Properties and Materials", Tata Mc-Graw Hill Education Pvt. Ltd.

Reference Books:

1. N. V. Nayak, A.K. Jain (2012), "Handbook on Advanced concrete Technology", Narosa Publishing House.
2. Raju N Krishna (2017), "Design of Concrete mixes", CBS Publisher and Distributors Pvt Ltd
3. A. M. Neville (2012), "Properties of Concrete", Pearson Publishers.
4. R.S. Varshney (1982), "Concrete Technology", Oxford and IBH Publishing, New Delhi.
5. A M. Neville and J.J. Brooks (2019), "Concrete Technology", Pearson Publishers
6. Dr. D. B. Divekar (2012), "ferrocement Technology", A construction Manual", 1030, Shivaji Nagar, Model Colony, Pune.
7. A. P. Remedios (2015), "Concrete Mix Design", Himalaya Publishing House
8. R. N. Raikar (2002) "Learning from failures", R & D Centre, Structwel Designers & Consultants Pvt Ltd
9. R. N. Raikar (1994), "Structural Diagnosis", R & D Centre, Structwel Designers & Consultants
10. Gajanan Sabnis (2001), "Concrete Mix Design", Vipul Publications

IS Codes:

IS 4031 All parts, IS 2386 All parts IS 456, IS 383, IS 9103, IS 10262:2019 Latest revised editions for all codes as mentioned.

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 II
Systems Approach in Civil Engineering (CVUA32204C)

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

Prerequisite course(s): Basic Mathematics

Course Objective(s):

1. To introduce 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.
Term Work
Term work will include following assignments /exercises (including numerical wherever required): 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. S. S. Rao,(2013), "Engineering Optimization: Theory And Practice" ,New Age International Publications 2. Hamdy A. Taha, (2015), "Operations Research: An Introduction", 9th edition, Pearson. 3. N.D. Vohra, (2010) "Quantitative Techniques in Management", McGraw Hill. 4. Premkumar Gupta and D.S. Hira, (2014) "Operations Research" , S. Chand Publications .
Reference Books:
1. Robert E. Markland, (2010) "Topics in Management Science", Wiley Publication 2. Paul J. Ossen bruggen, (2007) "An Approach to Teaching Civil Engineering System" 3. Thomas K. Jewell, (2012) "A System Approach to Civil Engineering Planning & Design", Harper Row Publishers.

Department of Civil Engineering

Open Elective-I

Professional Practice, Law and Ethics (IOEUA32205A)

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,
Whistle blowing 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);
Real Estate Regulatory Authority(RERA) Act 2017,
National Building Code **(**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. National Building Code, Latest
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

Department of Civil Engineering
Design Project - II (CVUA32206)

Teaching Scheme	Examination Scheme						
Credits: 2 Lecture (L): 1 hrs./week Tutorial (T): NA Practical (P): 2 hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	-	-	-	-	-	25	25

Prerequisite course(s): Pavement Design and its Construction

Course Objective(s):

To provide broad awareness to the students for pavement design and its construction process

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

1. Design the Flexible and Rigid Pavement
2. Explain the Pavement Construction and Discuss the Modern Trends

Unit I – 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 37-2018; rigid pavements- components and functions; factors affecting design; stresses in rigid pavements (ESWL); design guidelines for concrete pavements as per IRC 58-2015; joints in CC pavements, problems.

Unit II: Pavement Construction and Modern Trends

A. 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).
B. 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:

Students should work on a small project work wherein they need to
1.Project on Pavement based on IRC Code and suggest its Construction method with Cost.
2.Design of earth retaining structures (Gravity wall/Gabion wall/Reinforced earth wall) For Highway work
3.Prepare map using interface and tools in GIS software such as GRAM++ or QGIS or equivalent software (e.g., Road Network, Road Quality, Drainage Maps, traffic hotspots, etc.) for Highways.
4.Project Estimation of 10 km Road of Rigid and Flexible pavement

Textbooks:

1. F. L. Mannering, Scott S (2011), "Washburn Principles of Highway Engineering and Traffic Analysis", Wiley India
2. S.K. Khanna and C.E.G. Justo (2011), "Highway Engineering" Nem Chand and Brothers, Roorkee
3. L.R. Kadiyali (2019), "Principles and Practices of Highway Engineering" Khanna Publishing

4. Rangwala (2015), "Highway Engineering", Charotar publishing House, Anand 388001 (Gujrat)
5. A. M. Chandra and S. K. Ghosh, "Remote sensing and Geographical Information System", Narosa Publishing House
6. B.M. DAS, "Principles of Geotechnical Engineering", Cengage Learning

Reference Books:

1. S.P. Bindra (2008), "A Course in Highway Engineering", Dhanpat Rai and Sons, Delhi.
2. G.V. Rao (2000), "Principles of Transportation Engineering" Tata Mac Graw Hill Publication
3. Partha Chakraborty, Animesh Das (2017), "Principles of Transportation Engineering" Prentice Hall of India Pvt. Ltd., New Delhi.
4. B.L. Gupta, Amit Gupta (2020), "Highway and Bridge Engineering" Standard publishers Distributors, Delhi.
5. Burrough, "Principles of Geographical Information System", Oxford University Press
6. Pillai and Menon, "Reinforced Concrete Design" Tata Mc-Graw Hill

Codes:

1. I.R.C. 58 - 2015, Guidelines for the Design of Plain Jointed Rigid Pavements for Highways, IRC New Delhi
2.IRC 37 – 2018, Guidelines for The Design of Flexible Pavements, IRC New Delhi
3.IRC 44 – 2017, Guidelines for Cement Concrete Mix Design for Pavements, IRC New Delhi
4. MORTH – 2005, Specifications for Road and Bridge works (MORTH), IRC, New Delhi.
5. IRC: SP:116-2018 Guidelines for design and installation of gabion structures, IRC, New Delhi.

e Resources:

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

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