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:

To be a Leading Centre of Education in Civil Engineering through Holistic Development

Mission:

Develop competent Civil Engineers by imparting practical skills imbibed with ethics and societal values. Provide holistic education empowering students to address real-world challenges in Civil Engineering. Equip graduates with necessary knowledge and skills to pursue research, higher studies, entrepreneurship.

PROGRAM EDUCATIONAL OBJECTIVES

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

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

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

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSO):

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

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

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

Course Code	Course Title	Course Type	Teaching Scheme			Assessment Scheme (100 mark scale)									Total	Credits
						ISA						ESA				
			T	T	P	HA	TW	SCE	PPT	GD	CIE	ESE	Practical exam	OR		
CVUA31201	Irrigation Engineering-II	TH	3	-	2	10	20	20	-	-	-	40	-	10	100	4
CVUA31202	Structural Design and Drawing - I	TH	3	-	2	10	20	20	-	-	-	40	-	10	100	4
CVUA31203	TransportationEngineering	TH	3	-	2	10	20	20	-	-	10	40	-	-	100	4
CVUA31204	Foundation Engineering	TH	3	-	-	10	20	20	-	-	-	40	-	10	100	3
CVUA31205	Professional Elective - I	TH	3	-	2	10	20	20	-	-	10	40	-	-	100	4
CVUA31206	Project - I	CE	0	-	4	-	-	-	-	-	-	-	-	25	25	2
CVUA31207	Research Methodology and IPR	CE	2	-	-	-	-	50	-	-	-	-	-	-	50	2
	Total		17	0	12	50	100	150			20	200		55	575	23

Professional Elective I

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

BOS CHAIRMAN

DEAN ACADEMICS

DIRECTOR

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Department of Civil Engineering

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

Course Code	Course Title	Course Type	Teaching Scheme			Assessment Scheme (100 mark scale)									Total	Credits
						ISA						ESA				
			L	T	P	HA	TW	SCE	PPT	GD	CIE	ESE	Practical exam	OR		
CVUA32201	Structural Design and Drawing - II	TH	3	-	2	10	20	20				40		10	125	4
CVUA32202	EnvironmentalEngineering-II	TH	3	-	2	10	20	20				40		10	125	4
CVUA32203	Quantity Surveying, Contracts and Tenders	TH	3	-	2	10	20	20				40		10	125	4
CVUA32204	Professional Elective-II	TH	3	-	2	10	20	20				40		10	125	4
IOEUA32205	Open Elective -I	TH	3	-	-	10	20	20				40		10	100	3
CVUA32206	Project - II	CE	-	-	4	-	-	-				-		25	25	2
M3	Mandatory Course	AU	-	-	-	-	-	-				-		-	-	-
	Total	-	15	0	12	100	150	100				200		125	625	21

*Course has Oral Examination

Professional Elective II

1. CVUA32204A: Irrigation and Drainage.
2. CVUA32204B: Advanced Concrete Technology
3. CVUA32204C: Systems Approach in Civil Engineering
4. CVUA32204D: Repair and Rehabilitation of Reinforced Concrete Structures

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Open Elective-I

IOEUA32205A: Social Science & Engineering Economics (IT)IOEUA32205B: Engineering Economics and FinTech (Comp)
IOEUA32205C: Explainable Artificial Intelligence (XAI) for Engineering Applications (AI&DS)
IOEUA32205D: Management Information System (E&TC)
IOEUA32205E: Professional Practice, Law and Ethics (Civil)
IOEUA32205F: Industrial Engineering (Mech)
IOEUA32205G: Robotic Process Automation (Industry)
IOEUA32205H: Green Software Development for Sustainable IT (Comp)
IOEUA32205I : Industrial Automation (ETC)
IOEUA32205J : Robotics and Application (ETC)
IOEUA32205K: Generative AI (AIDS)
IOEUA32205L: Web 3.0 (Comp)

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

BoS Chairman

Dean Academics

Director

Semester – I

Vishwakarma Institute of Information Technology, Pune-48
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Irrigation Engineering - II (CVUA31201)

	Assessment Scheme (100 mark scale)									
Teaching Scheme	**ISA**						**ESA**			
Credits: 4 Lecture (L): 3 hrs./week Tutorial (T): NA Practical (P): 2 hrs./week	**HA**	**TW**	**SCE**	**PPT**	**GD**	**CIE**	**ESE**	**Practical exam**	**OR**	Total
	10	20	20	-	-	-	40	-	10	100

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 and 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 and 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.

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Structural Design and Drawing - I (CVUA31202)

	Assessment Scheme (100 mark scale)								
Teaching Scheme	**ISA**						**ESA**		
Credits: 4 Lecture (L): 3 hrs./week Tutorial (T): NA Practical (P): 2 hrs./week	**HA**	**TW**	**SCE**	**PPT**	**GD**	**CIE**	**ESE**	**Practical exam**	**OR**
	10	20	20	-	-	-	40	-	10

Course Objectives:

- To develop the ability to understand the behavior and basic concepts in design of various members of reinforced concrete structures subjected to combination of different loads based on provisions of Indian Standard code

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 design reinforced 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.

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Transportation Engineering (CVUA31203)

Teaching Scheme	Assessment Scheme (100 mark scale)								
	ISA						ESA		
Credits: 4 Lecture (L): 3 hrs./week Tutorial (T): NA Practical (P): 2 hrs./week	HA	TW	SCE	PPT	GD	CIE	ESE	Practical exam	OR
	10	20	20	-	-	10	40	-	-

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 and 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 and 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 and Planning

History, Development Plans, Classification of roads, Road Patterns, road development in India -Vision 2021 and Rural Road Development Vision 2025, Current Road projects in India; Provisions made for various infrastructure sectors like Roads and Highways, Railways, Airports, Ports, Housing, Energy and Power sector with reference to latest five-year plan. Highway alignment and highway project report preparation (Planning surveys and Master Plans based on saturation system).

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: 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 IV: Airport Engineering

Introduction: Advantages and limitations of air transportation. Aeroplan 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: 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 VI: Tunnel Engineering and, Dock and Harbor

Tunnels - functions and types, criteria for selection of size and shape. Pilot tunnel, shaft, portal, Methods of tunneling in hard and soft ground (Needle beam, NATM, TBM and earth pressure balance method, drilling and 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 and 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 and 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 and 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 and 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 and Gautam H.Oza (2017), "Dock and 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

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Department of Civil Engineering

Foundation Engineering (CVUA31204)

Teaching Scheme	**Assessment Scheme (100 mark scale)**								
	ISA						**ESA**		
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): NA Practical (P): NA	**HA**	**TW**	**SCE**	**PPT**	**GD**	**CIE**	**ESE**	**Practical exam**	**OR**
	10	20	20	-	-	-	40	-	10

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 and 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 and 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

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Professional Elective – I

Construction Management CVUA31205A)

Teaching Scheme	**Assessment Scheme (100 mark scale)**								
	ISA						**ESA**		
Credits: 4 Lecture (L):3 hrs./week Tutorial (T):NA Practical (P):2hrs./week	**HA**	**TW**	**SCE**	**PPT**	**GD**	**CIE**	**ESE**	**Practical exam**	**OR**
	10	20	20	-	-	10	40	-	-

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 – Project Planning and 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 performance rating. Activity sampling, time-lapse photography technique, Analytical production studies. Meaning of value, value analysis, value engineering and value management, energy resources, consumption patterns, energy cost escalation and its impact.

Unit III – Financial aspects and Risk Management of construction projects

Capital investments: importance and difficulties, means of finance, working capital requirements, projectcash flow projections and statements, project balance sheet, profit loss account statements.
Introduction, principles, types, origin, risk control, use of mathematical models: sensitivity analysis, breakeven 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 withother 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 and 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 and 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 and 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)

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Professional Elective – I
Advanced Surveying (CVUA31205B)

Teaching Scheme	**Assessment Scheme (100 mark scale)**								
	ISA					**ESA**			
Credits: 4 Lecture (L): 3 hrs./week Tutorial (T): NA Practical (P): 2 hrs./week	**HA**	**TW**	**SCE**	**PPT**	**GD**	**CIE**	**ESE**	**Practical exam**	**OR**
	10	20	20	-	-	10	40	-	-

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 and relief displacement in vertical photograph

Unit I: Geodetic Survey and 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 and 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 and 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 and Differential Methods, Use of SBPS in Surveying, SBPS Co-ordinates and 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, Resource Sat 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 and 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 and quantitative photogrammetry Applications, comparison of map and aerial photograph, Vertical, Tilted and Oblique photographs, Scale of and Relief displacement in vertical photograph, Stereoscopic parallax and 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 and 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 and 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 and 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

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Professional Elective – I

Advanced Structural Analysis (CVUA31205C)

Teaching Scheme	Assessment Scheme (100 mark scale)								
	ISA					ESA			
Credits: 4 Lecture (L): 3 hrs./week Tutorial (T): NA Practical (P): 2 hrs./week	HA	TW	SCE	PPT	GD	CIE	ESE	Practical exam	OR
	10	20	20	-	-	10	40	-	-

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

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Project - I (CVUA31206)

Teaching Scheme	Assessment Scheme (mark scale 25)								
	ISA						ESA		
Credits: 2 Lecture (L): NA Tutorial (T): NA Practical (P): 4 hrs./week	HA	TW	SCE	PPT	GD	CIE	ESE	Practical exam	OR
	-	25	-	-	-	-	-	-	-

Prerequisite course(s): Fundamentals of Civil Engineering

Course Objective(s):

1. Identify latest technical/practical problems in the field of Civil Engineering
2. Inculcate the ability to describe, interpret and analyze technical content.
3. Develop competence in preparing report which will enhance critical thinking and develop the skill of technical writing along with presentation

Course Outcomes:

Upon completion of the course, students will be able to

1. Appraise the current Civil Engineering research/techniques/developments/interdisciplinary areas.
2. Review and organize literature survey utilizing technical resources, journals etc.
3. Evaluate and draw conclusions related to technical content studied.
4. Demonstrate the ability to perform critical writing by preparing a technical report.
5. Develop technical writing and presentation skills.

The Project Stage I report should contain the following. Internal guides may prepare a continuous evaluation sheet of each individual and refer as continuous assessment for term work marks. Project group must comprise of minimum two and maximum five students.

1. Introduction of the topic, its relevance to civil engineering, need for the study, aims and objective, limitations.
2. Literature review from reference books, journals, conference proceedings, published reports/articles/documents with conclusion. The literature review should be from published literature in the last five years.
3. Problem statement and methodology
4. Theoretical contents related to the chosen topic or case studies if applicable.
5. Concluding remarks or summary.

Term Work

Oral Examination: The students must prepare presentation on Project I and present in presence of pair of examiners through a viva-voce examination.

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Research Methodology and IPR - CVUA31207

Teaching Scheme	Assessment Scheme (50 mark scale)								
	ISA						ESA		
Credits: 2 Lecture (L):2 hrs./weekTutorial (T): NA Practical (P): NA	HA	TW	SCE	PPT	GD	CIE	ESE	Practical exam	OR
	-	-	50	-	-	-	-	-	-

Course Objectives: The course will help students

- Explain the formulation of Research Problem
- Explain the importance of ideas, concept and creativity.
- Transfer the knowledge about the IPR required for Engineer's.
- Describe the how IPR creates National wealth.
- Teach National and International IP System

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Formulate the research problem with appropriate objectives
2. Understand the right of ownership, scope of protection as well as the ways to create and to extractvalue from IP.
3. Identify different types of Intellectual Properties (IPs)
4. Discover how IPR are regarded as a source of national wealth and mark of an economic leadership incontext of global market scenario.
5. Analyze national & International IP system.

Unit I: (8Hrs) : Introduction to Research problem

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations, Effective literature studies approaches, analysis Plagiarism, Research ethics

Unit II: (6Hrs) Introduction to Intellectual Property

Introduction to the concepts Property and Intellectual Property, Nature and Importance of Intellectual Property Rights Understanding the types of Intellectual Property Rights: - Patents, Designs, Trademarks (Registered and unregistered trademarks), Copyright, Traditional Knowledge, Geographical Indications, Trade Secrets, Idea Patenting, (Case Studies)

Unit III: (6Hrs) Introduction to Patents

New Developments in IPR, Process of Patenting and Development: technological research, innovation, patenting, development, International Scenario: WIPO, TRIPs, Indian Patent Office and its Administration.

Unit IV: (6Hrs) Patent Acts and Licensing

Administration of Patent System – Patenting under Indian Patent Act, Patenting under PCT ,Patent Rights and its Scope, Licensing and transfer of technology, Patent information and database. Provisional and Non Provisional Patent Application and Specification

Textbooks:

1. Ranjit Kumar, 2 nd Edition , "Research Methodology: A Step by Step Guide for beginners"
2. Resisting Intellectual Property by Halbert, Taylor& Francis Ltd ,2007.
3. Industrial Design by Mayall, Mc Graw Hill.
4. Intellectual Property in New Technological Age by Robert P. Merges, Peter S. Menell, Mark A. Lemley

Reference Books:

1. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
2. Intellectual Property Rights under WTO by T. Ramappa, S. Chand
3. Introduction to Design by Asimov, Prentice Hall

Semester – II

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Structural Design and Drawing - II (CVUA32201)

Teaching Scheme	**Assessment Scheme (100 mark scale)**								
	ISA						**ESA**		
Credits: 4 Lecture (L): 3 hrs./week Tutorial (T): NA Practical (P): 2 hr./week	**HA**	**TW**	**SCE**	**PPT**	**GD**	**CIE**	**ESE**	**Practical exam**	**OR**
	10	20	20	-	-	-	40	-	10

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 and 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 and 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 and 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 and specifications: IS 875 (part –I, II and III) , assessment of dead load, live load and wind load for roof truss as per IS 875 (part –I, II and 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 and web plate and web plate and 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.

IS Codes and 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

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Department of Civil Engineering

Environmental Engineering - II (CVUA32202)

Teaching Scheme	**Assessment Scheme (100 mark scale)**								
	ISA						**ESA**		
Credits: 4 Lecture (L): 3 hrs./week Tutorial (T): NA Practical (P): 2 hr./week	**HA**	**TW**	**SCE**	**PPT**	**GD**	**CIE**	**ESE**	**Practical exam**	**OR**
	10	20	20	-	-	-	40	-	10

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 and 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 and 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 and disadvantages. Up-flow Anaerobic Sludge Blanket (UASB) Reactor–Principle, advantages and disadvantages.

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

Oxidation pond: Bacteria –algae symbiosis, oxidation pond as per the manual of CPHEEO, advantages and disadvantages of oxidation ponds.
Aerated lagoons: Principle, aeration method, advantages and 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 and Disposal –Metcalf and Eddy -TMH publication.
3. Environmental Engg. -Peavy, Rowe-McGraw Hill Publication.
4. Waste Water Treatment -Rao and Dutta.

Reference books:

1. Waste Water Engg. –B.C. Punmia and Ashok Jain -Arihant Publications.
2. Water Supply and Waste Water Engg.-B.S.N. Raju –TMH publication.
3. Sewage Disposal and 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.

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Quantity Surveying, Contracts and Tenders (CVUA32203)

Teaching Scheme	Assessment Scheme (100 mark scale)								
	ISA						ESA		
Credits: 4 Lecture (L): 3 hrs./week Tutorial (T): NA Practical (P): 2 hrs./week	HA	TW	SCE	PPT	GD	CIE	ESE	Practical exam	OR
	10	20	20	-	-	-	40	-	10

Prerequisite course(s): Material Science and 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 and 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 and 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 and 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 and prime cost items, contingencies, work chargeestablishment, centage charges. Introduction to D. S. R.

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

Unit II– Taking out quantities and 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 andCentre Line Method).

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

Unit III – Specifications and Rate Analysis

Specifications: Meaning and 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 and plant, overheads and 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 and obsolescence, Sinking Fund, Years Purchase.

Methods of Valuation of Building: Rental Basis, Land and 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 andGlobal Tendering, E-tendering. (A mockup exercise of preparation, submission, opening of tender documents is suggested).

Unit VI – Contracts

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

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

Term Work

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

1. Report on contents, use of current DSR and 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 and B and Conditions of Contract regarding

Textbooks:

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

e – Resources: nptel.iitm.ac.in

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Department of Civil Engineering

Professional Elective - II
Irrigation and Drainage (CVUA32204A)

Teaching Scheme	Assessment Scheme (100 mark scale)								
	ISA						ESA		
Credits: 4 Lecture (L): 3 hrs./week Tutorial (T): NA Practical (P): 2hrs./week	HA	TW	SCE	PPT	GD	CIE	ESE	Practical exam	OR
	10	20	20	-	-	-	40	-	10

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. 1 Establish relationship between soil water and crop
2. Design an irrigation water conveyance in the form of a channel or pipe and understand water application methods
3. Understand concepts of lift irrigation system
4. Design drip irrigation system
5. Design sprinkler irrigation system
6. Understand parameters of drainage system and its components
7. Design surface and subsurface drainage system

Unit I: Soil Water-Crop Relationship

Introduction, water resources in India, irrigation potential, irrigation definition, benefits, disadvantages, types of irrigation projects, surface irrigation systems, pressure irrigations systems, reasons for low irrigation efficiency, irrigation terminology, basic soil water relationships, water in soil, soil water availability to the plant, soil water potential, Field water balance, infiltration, Evapotranspiration, consumptive use, Crop water requirement, irrigation water requirement, total irrigation water requirement, Irrigation scheduling, indicators of irrigation needs, irrigation scheduling methods, scheduling strategies,

Unit II: Irrigation water Conveyance

Canal system, lining of irrigation canals, water conveyance structures, diversion structures, structure for pipeline, Irrigation channel design, pipe flow of irrigation water.
Water Application Methods classification, surface irrigation methods: borders, basins, furrows, Sprinkler irrigation, drip irrigation, other forms

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 system design
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– Agricultural drainage:
Introduction, what is drainage, benefits, problems of drainage, sources of excess water (introduction to water logging and salinity causes, effects and remedial measures), drainage requirements, Drainage system components: field drainage system, surface drainage system, sub surface drainage system, combined drainage system
Unit VI – Drainage system Design
Sub-surface drainage system design: Drainage coefficient, drain spacing, Hooghoudt formula, equivalent depth Surface drainage system design, hydrologic design (rational, Cook's and SCS-CN), hydraulic design, design of open ditch
Term Work
Experiments for Lab (All experiments) 1. Assignment on Soil-water-crop relationship 2. Measurement of infiltration 3. Design of Irrigation channels 4. Assignment on Lift Irrigation scheme 5. Design of sprinkler irrigation system 6. Design of drip irrigation system 7. Design of sub-surface land drainage system 8. Design of surface land drainage System
Textbooks:
1. Irrigation Theory and Practices: A.M.Michael, S Chand Publications 2. Open Channel flow K. Subramanyam, (2013) Tata McGraw Hill. 3. Irrigation Engineering and Hydraulic Structures, S. K. Garg, (2009), Khanna Publishers
Reference Books:
1. Land Drainage: Principles, methods and Applications, A.K.Bhattacharya and A.M.Michael, Vikas Publication 2. Land and Water Management Engineering V.V.N. Murthy, Madan Jha, Kalyani Publishers 2015 3. Irrigation and Water Resources G.L. Asawa, (2006), New Age International (P) Ltd. 4. Publishers

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Department of Civil Engineering

Professional Elective - II

Advanced Concrete Technology (CVUA32204B)

Teaching Scheme	Assessment Scheme (100 mark scale)								
	ISA						ESA		
Credits: 4 Lecture (L): 3 hrs./week Tutorial (T): NA Practical (P): 2 hr./week	**HA**	**TW**	**SCE**	**PPT**	**GD**	**CIE**	**ESE**	**Practical exam**	**OR**
	10	20	20	-	-	-	40	-	10

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, Green concrete, Roller compacted concrete, Ferrocement: Properties and specifications of ferrocement materials and techniques, Under water concreting, Hot and 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 and 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 and 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 and D Centre, Structwel Designers and Consultants Pvt Ltd
9. R. N. Raikar (1994), "Structural Diagnosis", R and D Centre, Structwel Designers and 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/

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Department of Civil Engineering

Professional Elective - II
Systems Approach in Civil Engineering (CVUA32204C)

Teaching Scheme	Assessment Scheme (100 mark scale)								
	ISA						ESA		
Credits: 4 Lecture (L): 3 hrs./week Tutorial (T): NA Practical (P): 2 hrs./week	**HA**	**TW**	**SCE**	**PPT**	**GD**	**CIE**	**ESE**	**Practical exam**	**OR**
	10	20	20	-	-	-	40	-	10

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 and 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 and Design", Harper Row Publishers.

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Department of Civil Engineering

Professional Elective II

Repair and Rehabilitation of Reinforced Concrete Structures (CVUA32204D)

Teaching Scheme	**Assessment Scheme (100 mark scale)**								
	ISA						**ESA**		
Credits: 4 Lecture (L): 3 hrs./week Tutorial (T): NA Practical (P): 2 hr./week	**HA**	**TW**	**SCE**	**PPT**	**GD**	**CIE**	**ESE**	**Practical exam**	**OR**
	10	20	20	-	-	-	40	-	10

Prerequisite course(s): Concrete Technology

Course Objectives:
The major objective of this course is to give an in-depth understanding of the various methods of repair, retrofitting and rehabilitation techniques for reinforced concrete and masonry structures. This course will help students learn how to identify various deterioration/damage mechanisms in concrete structures. The causes and types of deterioration, use of various non-destructive, partially-destructive tools to assess the condition of the structure, the materials for repair and retrofitting, the maintenance and strengthening techniques as well as importance for preventive maintenance practices are covered in detail in this course. The course will discuss both the scientific aspects and its use while practicing repair works at site. Thus, at the end of the course students will be able to suggest evaluation and repair/retrofitting methods for extending the service life of concrete structures.

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

1. Understand and explain the physical and chemical mechanism of concrete degradation.
2. Understand the corrosion mechanism and methods to control the corrosion in reinforced concrete.
3. Explain the use of non-destructive techniques as a tool to assess the condition of reinforced concrete structures.
4. Understand and explain behaviour of various concrete repair chemicals and their applicability.
5. Understand and explain various methods used for concrete surface preparation, surface treatment and their practical applicability.
6. Explain and select a suitable strengthening technique for maintenance and rehabilitation of reinforced concrete and masonry infrastructures.

Unit I –Concrete Degradation

Physical mechanisms of concrete degradation–Cracking of concrete due to shrinkage, thermal cracking – freeze-thaw attack, Chemical mechanisms of concrete degradation – sulphate attack, acid attack, alkali-aggregate reaction. Importance and necessity of building maintenance.

Unit II – Corrosion of steel reinforcement

Corrosion mechanism in reinforced concrete, chemistry of galvanic corrosion, modes of corrosion – chloride induced and carbonation induced corrosion, steps to control the corrosion of embedded metal, use of inhibitors for corrosion control,Cathodic control and cathodic protection, Control of anodic areas.

Unit III – Condition assessment using Non-Destructive Tests

Concept of Structural Health monitoring, Condition assessment through laboratory tests – chemical analysis, advanced non-destructive techniques - Stress wave propagation methods – Ultra sonic Pulse, Acoustic Emission, Impact methods, Electromagnetic methods – Covermeter, Ground Penetration Radar, Infrared Thermography. Electrical methods – Concrete Resistivity, Electrochemical methods – Half cell potential, Polarization resistance.

Unit IV – Concrete repair chemicals

Commonly used concrete repair chemicals - Epoxy (Epoxy Resin along with Hardener), Polymers and Latex, Acrylic Polymer, Polyester Resins, Others, Applications of repair chemicals - Bonding coats, Steel corrosion inhibitor paint for steel in reinforced concrete construction, Water Base Rust remover, Use of Poly Ironic Ceramic Cementitious (PICC), Polymer Modified Mortar (PMM) and Polymer Modified Concrete (PMC) for Repairs, Protection against ingress, UV Resistance, Moisture control, Concrete restoration, Preserving or restoring passivity, Increasing resistivity,

Unit V – Methods for concrete surface repair and treatment

Surface repair – Condition assessment, Analysis, strategy, and design, Surface repair – Material requirement, surface preparation, placement of repair material, Poly Ironic Ceramic Cementitious (PICC) technology, Surface treatment using PICC - case studies, Waterproofing of concrete structures - case studies.

Unit VI – Strengthening of RC structures

Structural Strengthening of RC structures – Structural strengthening of Beams, Slabs, Columns, Walls, Joints, and connections, case studies thereon, case studies on rehabilitation of old RC structures, hydraulic structures as well as masonry structures.

Term Work

The Term work / Lab work will be based on completion of technical reports / practical / site visit reports on following:

1. Practical performance to understand the concept of surface preparation – using bio-wash, corrosion remover, oil remover - technical report writing thereon.
2. Practical performance to understand the concept of application of coating on surfaces – bond coat using water miscible epoxy, water proofing, pipe line coating – MS & concrete, coating for steel structures for corrosion protection - technical report writing thereon.
3. Structural rehabilitation using PICC Technology – understanding detailed methodology and writing technical report thereon.
4. Experiment on condition assessment of structural element using any one non-destructive technique.
5. Visit report on site visit exploring the field and practical aspects of repair and rehabilitation of structures – at Dhom Balewade Dam near Wai.
6. Visit report on site visit exploring the field and practical aspects of repair and rehabilitation of structures – at TATA Dam near Kamshet.
7. Technical training to understand various aspects of repair and rehabilitation methods at Dimple Chmicals factory, Ghotawade - technical report writing thereon.

Textbooks:

6. Concrete Technology, M.S. Shetty, S. Chand Publications.
7. Concrete: Microstructure, Properties and Materials, P. Kumar Mehta and P. S. M. Monteiro, Tata Mc-Graw Hill Education Pvt. Ltd.
8. Properties of concrete, A. M. Neville, Longman Publishers.

Reference Books:

11. Maintenance Repair & Rehabilitation & Minor Works of Buildings, P.C. Varghese, PHI Learning Pvt. Ltd., New Delhi
12. Concrete Structures – Protection, Repair and Rehabilitation, R. Dodge Woodson, Butterworth-Heinemann – Elsevier, UK
13. Concrete Durability, by Thomas Dyer, CRC Press, Taylor & Francis Group
14. Handbook on Non destructive Testing of Concrete; Edited by Malhotra, V. M. and Carino, N. J., CRC Press

15. Dam Engineering Volume XXV Issue 1- International paper of technical excellence. (Chapter:- Repairs to the damages in the Baffle blocks of salauli dam using PICC material).
16. Manual for Rehabilitating Large Dams – Doc. No. CDSO_MAN-DS-02_v1.0 January 2018 (Chapter 11:- Krishna Raj Sagar Dam, Karnataka).

E-Resources:

NPTEL course material –

(1)https://onlinecourses.nptel.ac.in/noc23-ce06

(2) https://onlinecourses.nptel.ac.in/noc23_ce36

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Department of Civil Engineering

Project - II (CVUA32206)

Teaching Scheme	Assessment Scheme (25 mark scale)								
	ISA						ESA		
Credits: 2 Lecture (L): NA Tutorial (T): NA Practical (P): 4 hrs./week	HA	TW	SCE	PPT	GD	CIE	ESE	Practical exam	OR
	-	25	-	-	-	-	-	-	-

Prerequisite course(s): Fundamentals of Civil Engineering

Course Objective(s):

1. Identify latest technical/practical problems in the field of Civil Engineering.
2. Inculcate the ability to describe, interpret and analyze technical content.
3. Develop competence in preparing report which will enhance critical thinking and develop the skill of technical writing along with presentation.

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

1. Appraise the current Civil Engineering research/techniques/developments/interdisciplinary areas.
2. Review and organize literature survey utilizing technical resources, journals etc.
3. Evaluate and draw conclusions related to technical content studied.
4. Demonstrate the ability to perform critical writing by preparing a technical report.
5. Develop technical writing and presentation skills.

Term Work

The Project Stage II report should contain the following. Internal guides may prepare a continuous evaluation sheet for each student and refer as continuous assessment for term work marks.

1. Introduction including aim and objective
2. Review of literature
3. Problem statement and methodology
4. Concepts associated with the project topic
5. Results and discussion
6. Validation of results
7. Conclusions and future scope of work
8. References

Students publication/achievements

In Project II, the student shall complete the project and prepare the final report of project work in standard format duly certified for satisfactory completion of the project work by the concerned guide and Head of the Department/Institute. The final project report shall be submitted in hard bound copy as well as a soft copy. The term work of project stage II shall be assessed jointly by the pair of internal and external examiners, along with oral examination of the same. It is recommended that at least one publication on the project topic to be presented in a conference or published in a referred journal.
Oral Examination: The students must prepare presentation on Project II and present in presence of pair of examiners through a viva-voce examination.

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

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Department of Civil Engineering

Social Science & Engineering Economics (IT Engg.)
(IOEUA32205A)

Teaching Scheme	Examination Scheme						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): NA Practical (P): NA	CIE	ISE	SCE	ESE	PR/ OR	TW	TOTAL
	20	20	20	40	--	--	100

Prerequisites: NIL

Course Objectives:

- Human and social development.
- Contemporary national and international affairs.
- Emergence of Indian society and Economics.
- Sectoral development and Economic development and related issues (such as international economics, WTO,RBI, etc).

Course Outcomes:

After completion of the course, student will be able to

1. Understand various issues concerning human and society.
2. Realize social, cultural, economic and human issues, involved in social changes
3. Understand the nature of the individual and the relationship between the self and the community
4. Express their opinion about national health and education policies.
5. Understand major ideas, values, beliefs, and experiences that have shaped human history and cultures.
6. Understand the fundamental concepts in engineering economics

Unit I - Indian Society

Structure of Indian Society, Indian Social Demography– Social and Cultural, Differentiations: caste, class, gender and tribe; Institutions of marriage, family and kinship- Secularization –Social Movements and Regionalism- Panchayatraj Institutions; Affirmative Action Programme of the Government-various reservations and
commissions.

Unit II - Social Development

Scientific approach to the study of human beings. Evolution of human kind, social change and evolution. Industrial revolution. National policy on education, health and health care and human development.

Unit III – Sectorial Development

Agriculture: Technology changes, Green revolutions, Employment Rural and Urban, Government Schemes. Industrial Development: Strategies, Public and Private Sectors, Categories, infrastructure, transport and communication, Consumer Awareness.

Unit IV - Economic Development

Need for planned economic development – Law of demand and supply. Planning objective,five years plan, priorities and problems. Population and development.
Indian Economics – basic features, natural resources population size and composition, national income concepts, micro economics of India, inflation, GDP.

Unit V - Banking and Trades	
Financial Analysis, Ratios, Cost Analysis, financial Institutions, Finance Commissions, Budget Analysis. IndianBanking, Role of Reserve bank of India International Economy, WTO, International aid for economic growth.	
Unit VI - Understanding Cash Flow and Taxes	
Accounting for Depreciation and Income Taxes, Project Cash-Flow Analysis, Understanding Financial Statements, Case Studies - cash flow analysis done in start-up companies.	
Textbooks:	1. Krugman, International Economics, Pearson Education. 2. Prakash, The Indian Economy, Pearson Education. 3. Thursen Gerald, Engineering Economics, Prentice Hall. 4. C.S. Rao, Environmental Pollution Control Engineering, New Age International Pvt. Ltd.
Reference Books:	1. Rangarajan, Environmental Issues in India, Pearson Education. 2. University of Delhi, The Individual & Society, Pearson Education. 3. Wikipedia.org / wiki /social studies. 4. M. N. Srinivas, Social change in modern India, 1991, Orient Longman. 5. David Mandelbaum, Society in India, 1990, Popular

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Teaching Scheme	Examination Scheme						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): NA Practical (P): NA	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	20	20	40	-	-	100

Prerequisites :

- NA

Course Objectives :

Economic development and related issues

- To explain the Indian banking structure and terms like GDP, inflation
- To introduce Cash Flow analysis and Taxes
- To introduce FinTech and it's sub sectors
- To explain the classification of various models of FinTech.
- To describe the innovation in FinTech

Course Outcomes :

After completion of the course, student will be able to

1. Understand the fundamental concepts in engineering economics
2. Illustrate the terms like GDP, inflation, and Indian banking structure
3. Analyze and Calculate cash flow analysis.
4. Understand what FinTech is and the sub sectors that comprise it.
5. Classify various models of the Fintech
6. Illustrate various innovations done using latest technology trends in FinTech

Unit I: Introduction to Economics

Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics – Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost.

Unit II: Banking and Trades

Indian Economics – basic features, natural resources, population size and composition, national income concepts, microeconomics of India, Indian Banking, Role of Reserve bank of India, International Economy, inflation, GDP, Financial Analysis, Ratios, financial Institutions, Finance Commissions.

Unit-III: Understanding Cash Flow analysis

Budget Analysis, Break-even analysis, Elementary economic Analysis – Material selection for product,Accounting for Depreciation, Project Cash-Flow Analysis, Understanding Financial Statements.

Unit-IV:Introduction to FinTech

Introduction, Financial Services and Fintech: Introduction, Changing Environment, Customer Centricity,Digital Transformation, Definition of Fintech, History of Fintech, Fintech stages, An Overview of Fintech Initiatives Around the World, Ecosystems, Downsides of Disruptive Fintech Initiatives.

Unit-V: Model and Classifications

Introduction, Classification, Five Ws and one H : 1. Why a fintech initiative was born? 2. For whom was it born? 3. Which are the services it aims to provide? 4. Where does it aim to perform its business? 5. When does it aim to operate, within the framework of the financial cycle? 6. How is fintech working? The organization and its elements, The V4 business model framework, A Business Model, A Business Model for Fintech. Business Model Canvas (BMC) for FinTech.

Unit VI: FinTech Innovation

Innovation and Fintech, Digital Transformation and Fintech, A model for an integrated innovation strategy, Types of Innovation: Product (or services), Process, Organization, Examples of Innovation, Process Innovation : Big Data Analytics, Value Creation from Big Data Analytics, Kreditech's self-learning algorithm, Internet of Things, Blockchain Technology, Organizational Innovation: Social Networks.

Text Books :

1 B. Nicoletti, The Future of FinTech, 1st ed. Palgrave Macmillan, 20172
Krugman, International Economics, Pearson Education.
3 Thursen Gerald, Engineering Economics, Prentice Hall.

Reference Books

1 Accenture. (2015). The future of Fintech and banking: Digitally disrupted or reimagined? Accenture Research, 1–12

2 Dietz M., Khanna S., Olanrewaju T., and Rajgopal K. (2015). Cutting through the fintech noise:Markers of success, imperatives for banks. Practice, G. B. (Ed.), 1–18. McKinsey and Company. Retrieved from http://www.mckinsey.com/ industries/financial-services/our-insights/cutting- through-the-noise round financial -technology.

3 "What is FinTech and why does it matter to all entrepreneurs?". Hot Topics. July 2014.retrieved December 9, 2014

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Department of Civil Engineering

Explainable Artificial Intelligence (XAI) for Engineering Applications (AI&DS) (IOEUA32205C)

Teaching Scheme	Examination Scheme						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): NA Practical (P): NA	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	20	20	40	-	-	100

Prerequisite course(s): • Fundamentals of Probability & statistics • Machine Learning and Deep Learning basics • Python for Data Science

Course Objective(s):

1. Making students familiarize with the need of XAI for engineering applications and its central concepts
2. Making students understand with the mathematical concepts like ensemble models and non- linear models to analyse the problems
3. Providing tools and techniques of XAI for design and building solutions

Course Outcomes:

Upon completion of the course, students will be able to

1. Learn the fundamental concepts of XAI and its use to build various use cases in engineering domain
2. Compare merits and demerits of linear and non-linear model in problem analysis
3. Provide knowledge about using ensemble learning and contrastive explanations and LRP for machine learning
4. Performs parametric evaluation of AI-based and XAI-based solutions
5. Apply the knowledge for drafting clear requirements to build end-to-end XAI solution
6. Learn and apply knowledge of XAI and tools for application and protocol development in engineering applications

Unit I: Introduction to Explainable Artificial Intelligence

Artificial Intelligence, Need for XAI, Explainabillty vs. Interpretability, Explainability Types: Intrinsic explanation, Post-hoc explanation, Model specific, Model agnostic, Local interpretation, Global interpretation, Sublocal interpretation, Textual explanations, Visual explanations. Tools for Model Explainability: SHAP, LIME, ELI5, Skater, Skope_rules. Evolution of XAI, Biasness, and Reliability, Challenges to achieve explainable AI and design issues Case Studies: Fraud Detection, Online Recommendations, Credit and Loan Decision Making.

Unit II: Explainability for Linear Models

Linear Models, Linear Regression VIF and the Problems It Can Generate: Final Model, Model Explainability Trust in ML Model: SHAP - Local Explanation and Individual Predictions in a ML Model, Global Explanation and Overall Predictions in ML Model, LIME Explanation and ML Model, Skater Explanation and ML Model, ELI5 Explanation and ML Model, Logistic Regression: Interpretation, LIME Inference. Case Studies: Linear Regression

Unit III: Explainability for Non Linear Models

Non-Linear Models Decision Tree Explanation, Data Preparation for the Decision Tree Model Creating the Model , Decision Tree — SHAP, Partial Dependency Plot, PDP Using Scikit-Learn, Non- Linear Model Explanation — LIME, Non-Linear Explanation — Skope-Rules, Case Studies: Comparison of Husky Dog and Wolf

Unit IV: Explainability for Ensemble Models
Ensemble Models: Types of Ensemble Models Why Ensemble Models?, Using SHAP for Ensemble Models, Using the Interpret Explaining, Boosting Model, Ensemble Classification Model: SHAP, Using SHAP to Explain Categorical Boosting Models, Using SHAP Multiclass Categorical Boosting Model, Using SHAP for Light GBM Model Explanation Case Studies: Model Interpretability
Unit V: Counterfactual Explanations for XA I Models
AI Model Fairness Using a What-If Scenario: What Is the WIT (Google Tool)?, Evaluation Metric. Counterfactual Explanations for XAI Models: What Are CFEs?, Implementation of CFEs, CFEs Using Alibi, Counterfactual for Regression Tasks. Case Studies: Causability Algorithms and Applications
Unit VI: Contrastive Explanations and LRP for Machine Learning
What Is CE for ML?, CEM Using Alibi, Comparison of an Original Image vs. an Autoencoder Generated Image, CEM for Tabular Data Explanations. Layer wise relevance propagation (LRP): Introduction, Working Principle, Mathematical Modeling. Case Studies: Pertinent Negatives, Explanation based on missing
Textbooks:
1. Practical Explainable AI Using Python: Artificial Intelligence Model Explanations Using Python-based Libraries, Extensions, and Frameworks Pradeepta Mishra
Reference Books:
1. Hands-On Explainable AI (XAI) with Python: Interpret, visualize, explain, and integrate reliable AI for fair, secure, and trustworthy AI apps by Denis Rothman

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Department of Civil Engineering

Management Information System (E & TC)
(IOEUA32205D)

Teaching Scheme	Examination Scheme						
Credits: 3	CIE	ISE	SCE	ESE	PR/OR	TW	Total
Lecture(L):3hrs./week Tutorial(T):- NA Practical(P): NA	20	20	20	40	-	-	100

Prerequisite: Readers/students are expected to know the following concepts:
Basics terminology of Information Technology/Internet/MS Excel,

Course Objectives:

1. To understand types of MIS applications in organizations
2. To understand information system and its components, its association in big picture
3. To analyses the requirement of users and draft specifications of system
4. To study data bases and its importance in system and business process
5. To develop broad understanding of ethics and code of conduct
6. To study process of decision making and its phases

Course Outcomes:
After completion of this course student should be able to
1. Appreciate what a supply chain is and what it does
2. Understand the role of IT in Engineering and business process
3. Describe a business process and link it to information system
4. Apply MIS concepts to reach to decision in the task she/she undertake
5. Apply ethical practices in day-to-day life

Unit-I: Information Technology and its Impact
Information Technology-Definition, Data, Information, Knowledge , Dataflow,system,Apps.ITCapabilitiesandtheirimpactonIndustrial,Educational,Businessand Profession. Telecommunication and Networks – Need, Basics of networking and internet, Concept of cloud and data centers, Video Conferencing and virtual meetings IT enabled services such as Call Centres, Geographical Information Systems, E Commerce, etc.

Unit-II: Information System Analysis and Design
User requirement analysis, Feasibility study, Software Development/Product development lifecycle, system study and systems design, Resource utilization, implementation, audit, operation, maintenance and modification.

Unit–III: Database Management System
Introduction, Types, Advantages using data base models, Basics of data models, Queries, generating are port, Excel as a data base for end analysis.

Unit IV Functional MIS: MIS within functional areas such as Human Resources, Marketing & Sales, Production, Accounting& Finance, Customer Relationships Management(CRM),Product Supply Chain Management systems, Logistic Management, Learning Management System

Unit V: Decision Support System and strategic management:
Decision support systems, expert systems, office automation systems and knowledge-based systems, Structured decision making, unstructured decision making and semi structured decision making, Setting Up Strategy for the organization/situation

Unit VI: **Ethical and Social Issues in Information Systems:**
Moral dimensions of Information Age, Concept of responsibility, accountability and liability, Professional code of conduct, Information rights: Privacy and freedom, Ethical Dilemma

Text Books:

1. Kenneth C. Laudon& Jane P. Laudon, essentials of Management Information Systems, 16thEdition, PearsonPrentice-Hall,2012.ISBN978-0132668552
2. Analysis and Design of Information Systems, Rajaraman, Prentice Hall

Reference Books:

1. Management Information Systems, Laud on and Laudon,7th Edition, Pearson Education
2. Management Information Systems, Davis and Olson, Tata McGraw Hill
3. Decision Support Systems and Intelligent Systems, Turban and Aronson, Pearson Education Asia

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Department of Civil Engineering

Open Elective II
Professional Practice, Law and Ethics (Civil) (IOEUA32205E)

Teaching Scheme	Examination Scheme						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): NA Practical (P):NA	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	20	20	40	-		100

Course Objective(s):

1. To make the students aware of types of roles they would play in the society as professionals/ practitioners of the Engineering profession

2. To introduce some legal and practical aspects of Civil Engineering profession

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Course Outcomes:

Upon completion of the course, students will be able to

1. Explain the terms related to 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 Engineering contracts and tenders
4. Use Arbitration for disputes in Engineering projects
5. Explain the legal provisions with reference to labor in construction/ Industry 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 1872 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. The National Building Code, BIS, 2017
3. RERA Act, 2017
4. Meena Rao (2006), Fundamental concepts in Law of Contract, 3rd Edn. Professional Offset
5. Avtar Singh (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

Vishwakarma Institute of Information Technology, Pune-48
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Department of Civil Engineering

Industrial Engineering (Mechanical Engg.)
(IOEUA32205F)

Teaching scheme	Examination Scheme						
Credits: 3 Lectures (L): 3 Hrs./week Tutorial (T): NA Practical (P): NA	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	20	20	40	-	-	100

Prerequisite(s): Manufacturing Processes, Engineering Mathematics, Computer Fundamentals

Course Objectives:

- To introduce the concepts, principles and framework of contents of Industrial Engineering.
- To acquaint the students with various productivity enhancement techniques.
- To acquaint the students with different aspects of Production Planning and Control and Facility Design.
- To introduce the concepts of various cost accounting practices as applied in industries
- To acquaint students with different aspect of simulation modeling for various industrial engineering applications.

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

1. Compute the partial productivity and total productivity indexes considering different influencing factors
2. Analyze each operation with a view to eliminate unnecessary operations, avoidable delays and other forms of waste.
3. Compute the standard time for a qualified worker to carry out a specified job at a defined level of performance.
4. Design a physical arrangement of facilities most economically at optimum plant location.
5. Design the production system considering an estimate of future event through past data.
6. Calculate optimum inventory level by establishing the relationship among the factors affecting profit.

Unit I: Introduction to Industrial Engineering and Productivity

Definition, Industrial engineering approach, Objectives of Industrial Engineering Role of Industrial Engineer, Techniques of industrial Engineering, Industrial engineering in service sector, Measurement of productivity: Factors affecting the productivity, Productivity Models and Index, Productivity improvement techniques. Some case studies on applications of industrial engineering to different service sectors

Unit II: Method Study

Work Study: Definition, Objectives, Procedure, Concept of work content, Method Study: Definition, Objectives, Scope and Steps involved in method study, Recording techniques, Micro- motion study, Cycle graph and chronocycle graph, Critical examination, Principles of motion economy, Concepts of value engineering and value analysis. Some case studies on method study referring to research papers.

Unit III: Work Measurements
Work Measurements: Definition, Objectives and techniques of work measurement, Steps in makingtime study, Types of elements, Time study equipment's, Performance rating, Allowances, Computation of standard time, Comparison of various techniques, Introduction to PMTS, MTM and MOST. Some case studies on work measurements referring to research papers.
Unit IV: Plant Location and Plant Layout
Need for selecting a suitable plant location, Factors influencing plant location, Comparison between urban and rural locations, Quantitative method for evaluation of plant location, Plant Layout: Objectives, Principles, Types, Factors affecting plant layout, Types of manufacturing systems, Tools and techniques of plant layout, Computer packages for layout analysis. Some case studies on plant layout based on actual industry visit and referring to research papers.
Unit V: Production Planning and Control – I (PPC - I)
Production Planning and Control (PPC): Need, Objectives, Functions, Production procedure, Measures of capacity, Capacity planning, Factors influencing effective capacity, Aggregate planning: Methods, advantages and limitations, Demand forecasting: Need and classification (Least square method, moving average, weighted moving average, exponential smoothing method and Casual forecasting method. Some case studies on production planning and control referring to research papers and visit to industry.
Unit VI: Production Planning and Control – II (PPC - II)
Inventory types, Inventory control: Objectives and benefits, Inventory cost relationships, Inventory models: Basic inventory models, (with and without shortage and discount), Selective control of inventory: ABC and VED analysis, Production cost concepts and break-even analysis, Cost-volume-profit analysis. Some case studies on production planning and control referring to research papers and visit to industry.
Textbooks:
1. M Mahajan, Industrial Engineering and Production Management, Dhanpat Rai and Co. 2. O. P. Khanna, Industrial engineering and management, Dhanpat Rai publication 3. MartendTelsang, Industrial Engineering, S. Chand Publication. 4. Banga and Sharma, Industrial Organization& Engineering Economics, Khanna publication
Reference Books:
1. Askin, Design and Analysis of Lean Production System, Wiley, India 2. Barnes, Motion and time Study design and Measurement of Work, Wiley India 3. Introduction to Work Study by ILO, ISBN 978-81-204-1718-2, Oxford & IBH Publishing Company, New Delhi, Second Indian Adaptation, 2008. 4. H. B. Maynard, K Jell, Maynard _s Industrial Engineering Hand Book, McGraw Hill Education