

	(V	Savit TE Vith e	ribai (Civil effect	Phule l Engi from	Pun neeri Acad	e Un ng) 2 lemi	iversi 2019 c Yea	ity, P Patte 1r 202	une rn 21-22)							
	X			SEM	IEST	ER:	V			,							
Course Code	Course Name	T S (Ho	eachi Schen urs/W	ng 1e /eek)	Exa Mai	min rks	ation	Sche	eme a	and	Credit						
		Theory	Practical	Tutorial	IN-Sem	End-Sem	ML	PR	OR	Total	ΗT	ΤW	PR	OR	TUT	Total	
301001	Hydrology and Water Resources Engineering	03			30	70				100	03					03	
301002	Water Supply Engineering	03			30	70				100	03					03	
301003	Design of Steel Structures	03			30	70				100	03					03	
301004	Engineering Economics and Financial Management	03			30	70				100	03					03	
301005	Elective I	03			30	70				100	03					03	
301006	Seminar			01		-	50			50					01	01	
301007	Hydrology and Water Resources Engineering Lab		02				25			25		01				01	
301008	Water Supply Engineering Lab		02					50		50			01			01	
301009	Design of Steel Structures Lab		04						50	50				02		02	
301010	Elective I Lab		02				25			25		01				01	
301011	Audit Course I: Professional Ethics and Etiquettes/ Sustainable Energy Systems			01		GR				GR							
	Total	15	10	02	150	350	100	50	50	700	15	02	01	02	01	21	
Abbrevia	ations: TH : Theory, TW: Terr	n Wo	rk, P	R : Pi	actio	al, ()R: (Dral,	TUT	: Tute	orial,	GR	Gra	de			

Elective I: 301005

S N	Course Code	Course Name
01	301005 a	Advanced Fluid Mechanics and Hydraulic Machines
02	301005 b	Research Methodology and IPR
03	301005 c	Construction Management
04	301005 d	Advanced Concrete Technology
05	301005 e	Matrix Methods of Structural Analysis
06	301005 f	Advanced Mechanics of Structures

	SEMESTER-VI															
Course Code	Course Name	Te S (Hou	eachii chem irs/W	ng e (eek)	Examination Scheme and Marks						Credit					
		Theory	Practical	Tutorial	IN-Sem	End-Sem	WT	PR	OR	Total	ΗT	ΤW	PR	OR	TUT	Total
301012	Waste Water Engineering	03			30	70				100	03					03
301013	Design of RC Structures	03			30	70				100	03					03
301014	Remote Sensing and GIS	03			30	70				100	03					03
301015	Elective II	03			30	70				100	03					03
301016	Internship						100			100		04				04
301017	Waste Water Engineering Lab		02						50	50				01		01
301018	Design of RC Structures Lab		04						50	50				02		02
301019	Remote Sensing and GIS Lab		02				50			50		01				01
301020	Elective II Lab		02				50			50		01				01
301021	Audit Course II: Leadership and Personality Development/ Industrial Safety			01		GR				GR						
	Total	12	10	01	120	280	200		100	700	12	06		03		21
Abbrevi	ations: TH : Theory, TW: Te	rm W	ork,	PR :	Pract	ical, (OR: (Oral	and	ГUТ :	Tutor	rial, (GR:	Grad	le	

Elective II: 301015

S N	Course Code	Course Name
01	301015 a	Advanced Engineering Geology with Rock Mechanics
02	301015 b	Soft Computing Techniques
03	301015 c	Advanced Surveying
04	301015 d	Advanced Geotechnical Engineering
05	301015 e	Architecture and Town Planning
06	301015 f	Solid Waste Management

Savitribai Phule Pune University, Pune TE Civil (2019 Pattern) w. e. f. June 2021 301005 c: Elective I: Construction Management

Teaching schemeCreditExamination schemeLectures: 03 Hours/week03In semester exam: 30 marksEnd semester exam: 70 marks

Prerequisite

Fundamental of Project Management

Course Objectives

- 01 To understand various construction activities and evaluating construction projects.
- 02 To handle all situations with knowledge of various labour laws and financial aspects of construction projects.
- 03 To know about risk management and value engineering
- 04 To utilize material and human resources efficiently with managerial skills interpersonal and intrapersonal skills.
- 05 To apply knowledge of artificial intelligence on construction project

Course Outcomes

On successful completion of this course, the learner will be able to:

- 01 Understand the overview of construction sector.
- 02 Illustrate construction scheduling, work study and work measurement.
- 03 Acquaint various labor laws and financial aspects of construction projects.
- 04 Explain elements of risk management and value engineering.
- 05 State material and human resource management techniques in construction.
- 06 Understand basics of artificial intelligence techniques in civil engineering.

Course Contents

Unit I: Overview of Construction Sector

Role of construction industry in infrastructure development, components of infrastructure sector, construction industry nature, characteristics, size, structure, role in economic development, construction management: necessity, applications, project management consultants: role, types, selection and appointment process, project overruns and means to combat them, project monitoring and reporting systems, managerial correspondence and communications, generation and identification of project investment opportunities.

Unit II: Construction Scheduling, Work Study and BIM

Construction project scheduling: definition, objectives factors affecting scheduling, work breakdown structure, project work break down levels, line of balance technique, project monitoring controlling, and introduction to building information modeling (BIM) based on software. Work study (time and motion study): definition, objectives, process of method study, symbols, multiple activity charts, two handed process chart, string diagram.

(06 Hours)

(06 Hours)

22

Unit III: Labour Laws and Financial Aspects of Construction Project (06 Hours)

Need and importance of labour laws, study of some important labour laws associated with construction sector, workman's compensation act 1923, building and other construction workers act 1996, child labour act, interstate migrant workers act, the minimum wages act 1948. Capital investments: importance and difficulties, means of finance, working capital requirements, project cash flow projections and statements, project balance sheet, profit loss account statements.

Unit IV: Risk Management and Value Engineering:

Risk Management: introduction, principles, steps in risk management, risk in construction, origin, use of mathematical models: sensitivity analysis, break even analysis, simulation analysis (examples), decision tree analysis, risk identification, mitigation of project risks, role of insurance in risk management and case study on risk management. Value Engineering: meaning of value, types of value, value analysis, value engineering and its application, energy cost escalation and its impact on infrastructure project.

Unit V: Material Management

Material: introduction, need, objectives and functions and scope of material management, integrated concept of material management, material management organization, various phases of material flow system, application of each phase, role of material manager, role of material management in construction management and its linkage with other functional areas, inventory control methods, EOQ Model, stores management and control, break even analysis, concept of logistics and supply chain management, role of ERP in material management and material resource information systems.

Unit VI: Human Resource Management

Human resource: introduction, nature and scope of human resource management, human resource in construction sector, staffing policy and patterns, human resource management process, human resource development process, recruitment & selection, performance evaluation and appraisal, training & development, succession planning, compensation and benefits, career planning, human resources information systems, HR data and analytics, role of ERP in human resource management and human resource information system. Introduction to artificial intelligence technique, basic terminologies and applications in civil engineering: artificial neural network, fuzzy logic and genetic algorithm.

Text Books

- 01 Construction Management and Planning, B. Sengupta and H. Guha, Tata McGraw Hill Publications.
- 02 Total Project Management The Indian Context, P. K. Joy, Mac Millian Publications.
- 03 Projects: Planning, Analysis, Selection, Implementation and Review, Prasanna Chandra, Tata Mc Graw Hill Publications.

(06 Hours)

(06 Hours)

(06 Hours)

Reference Books

- 01 Civil Engineering Project Management, C. Alan Twort and J. Gordon Rees, Elsevier Publications
- 02 Principles of Construction Management, Roy Pilcher (Mc Graw Hill)
- 03 Human Resource Management, Biswajeet Pattanayak, Prentice Hall Publishers.
- 04 Materials Management, Gopalkrishnan & Sunderasan, Prentice Hall Publications.
- 05 Labour and Industrial Laws, S. N. Mishra, Central Law Publications.
- 06 Artificial Neural Network, Veganarayanan, Prentice Hall.

Savitribai Phule Pune University, Pune TE Civil (2019 Pattern) w. e. f. June 2021 301015 e: Elective II: Architecture and Town Planning

Teaching scheme	Credit	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 Marks
		End semester exam: 70 Marks

Pre-requisites

Fundamentals of Building Technology and Architectural Planning

Course objectives

- 01 To use principles of architectural planning and understand futuristic need of users.
- 02 To discuss and demonstrate the concepts of landscaping, urban renewal and sustainable architecture
- 03 To distinguish and relate planning levels and understand use of act and to develop neighborhood plan
- 04 To interpret need of civic surveys for DP proposal and value planning agencies and ITS
- 05 To understand and demonstrate planning strategy with reference to different acts, guidelines, norms.
- 06 To appraise multifaceted zones like SEZ, CRZ and Special township, understand applications of modern Tools like GIS / GPS / RS in town planning and need of Rural Planning

Course outcomes

On successful completion of this course, the learner will be able to:

- 01 Apply the principles of architectural planning and landscaping for improving quality of life
- 02 Understand the confronting issues of the area and apply the acts.
- 03 Evaluate and defend the proposals.
- 04 Appraise the existing condition and to develop the area for betterment.

Course Contents

Unit I: Architect and Urban Planning

Principles and elements of architectural composition and its expected outcome, qualities of architecture: user friendly, contextual, eco-friendly, utility of spaces, future growth etc. with case study. Role of urban planner and an architect in planning and designing in relation with spatial organization, utility, demand of the area and supply etc considering situations like disasters / pandemic conditions.

Unit II: Landscaping

Landscaping: objectives, principles, elements, material (soft and hard), styles of landscaping, green roofs and vertical gardens: need, means, outcome, urban renewal process and its impact

(06 Hours)

(06 Hours)

on quality of life and livability, importance of sustainable architecture, urban conservation with case study.

Unit 3: Town Planning

Scope, purpose and benefits of town planning, components of town planning, planning levels: regional plan, development plan, town planning scheme, neighborhood planning, new towns and satellite towns, legislative mechanism for preparation of DP: MRTP Act 1966

Unit 4: Civic Survey

Civic surveys and its utility for DP proposal: like demographic, housing, land use, water supply and sanitation. Planning agencies for various levels of planning and the organizational details with purpose (CIDCO, MHADA, MIDC, MMRDA/PMRDA, SRA and HUDCO), Traffic transportation systems: hierarchy of roads, traffic management, intelligent transport systems

Unit 5: Acts

Land acquisition rehabilitation and resettlement Act, 2013, real estate (regulation and development) act 2016 and MAHA-RERA, URDPFI Guidelines (for land use, infrastructure etc.), AMRUT Guidelines (water/sewerage, transport etc.)

Unit 6: Special Township

Special townships: SEZ and CRZ, application of GIS, GPS, remote sensing in Town planning, rural planning: need, strategies, government initiatives

Text Books

- 01 Town Planning, G. K. Hiraskar, Dhanpat Rai Publications
- 02 Town Planning, S. C. Rangwala, Charotar Publishing House Pvt. Ltd.

Reference Books

- 01 MRTP Act 1966 : The director, government printing, stationary and publications, Maharashtra state, Mumbai
- 02 URDPFI & AMRUT Guidelines: Ministry of housing and urban affairs, Government of India
- 03 LARR Act 2013: Ministry of law and justice, Government of India
- 04 Climate Responsive Architecture, Arvind Krishnan, Nick Baker, Simos Yannas and Steve Szokolay, McGraw Hill Education
- 05 An Introduction to Landscape Architecture, Michael Laurie, American Elsevier Publishing Company

(06 Hours)

(06 Hours)

(06 Hours)

(06 Hours)

SAVITRIBAI PHULE PUNE UNIVERSITY



Board of Studies in Civil Engineering

Structure and Syllabus for B.E. Civil 2015 Course (w. e. f. June, 2018)



SAVITRIBAI PHULE PUNE UNIVERSITY Board of Studies in Civil Engineering Structure for B.E. Civil 2015 Course (w. e. f. June 2018)

	Semester-I												
Subject code	Subject	Teaching Scheme Hrs/Week		In-Semester Assessment	TW	Pract /Or	End- Semester	Total	Cro	edit			
		Lect	Tu	Pr				Exam		Th	Lab		
401 001	Environmental Engineering II	3		2	30		50	70	150	3	1		
401002	Transportation Engineering	3		2	30	50		70	150	3	1		
401 003	Structural Design and Drawing III	4		2	30		50	70	150	4	1		
401 004	Elective I	3		2	30	50		70	150	3	1		
401 005	Elective II	3			30			70	100	3			
401 006	Project (Phase-I)		2				50		50		2		
	Total :	16	2	8	150	100	150	350	750	16	6		
										22 Ci	redits		

					Sem	ester-II					
Subject code	Subject	Teaching Scheme Hrs/Week		In-Semester Assessment	TW	Or	End- Semester	Total	Cro	edit	
		Lect	Tu	Pr				Exam		Th	Pr
401 007	Dams and Hydraulic Structures	3		2	30		50	70	150	3	1
401008	Quantity Surveying, Contracts and tenders	3		2	30		50	70	150	3	1
401 009	Elective III	3		2	30	50		70	150	3	1
401 010	Elective IV	3		2	30	50		70	150	3	1
401 006	Project		6			50	100		150		6
	Total :	12	6	8	120	150	200	280	750	12	10
										22 Ci	redits

Semester I

Elective-I 401 004	Elective-II 401 005
1. Structural Design of Bridges	1. Matrix Methods of Structural Analysis
2. Systems Approach in Civil Engineering	2. Integrated Water Resources Planning and Management
3. Advanced Concrete Technology	3. TQM & MIS in Civil Engineering
4. Architecture and Town Planning	4. Earthquake Engineering
5. Advanced Engineering Geology with Rock	5. Advanced Geotechnical Engineering
Mechanics	

Semester-II

Elective-III 401 009	Elective-IV 401 010
1. Advanced Structural Design	1. Construction Management
2. Statistical Analysis and Computational	2. Advanced Transportation Engineering
Methods in Civil Engineering	3. Advanced foundation Engineering.
3. Hydropower Engineering	4. Coastal Engineering
4. Air Pollution and control	5. Open Elective
5. Finite Element Method in Civil Engineering	a) Plumbing Engineering
6. Airport and Bridge Engineering	b) Green Building Technology
	c) Ferrocement Technology
	d) Sub sea Engineering
	e) Geoinformatics

Elective I: (1) Structural Design of Bridges 401 004

Teaching Scheme: Lecture: 3 Hrs/week. **Practical:- 2 Hrs/week**

Unit 1 (6 Hrs.) Introduction to RC highway bridges and steel railway bridges: Types of bridges, classification, IRC codal provisions for RC highway bridges, IRS codal provisions for railway steel bridges, loading standards.

RC highway bridges: Slab culvert and T-beam deck slab bridges - Design of slab culvert, Deck slab: Structural configuration, Piegaud's method, analysis and design of deck slab.

RC highway bridges: T-beam deck slab bridges – Post tensioned girders: Load distribution on longitudinal and cross girders, methods of analysis, analysis and design of longitudinal and cross girders.

Railway steel bridges - Truss bridges: Structural configurations, loads and load combinations, analysis and design of truss elements, longitudinal and cross-girders, bracing systems.

Unit 5

Unit 4

Unit 2

Unit 3

Bearings: Function of bearings, types of bearings, design of steel bearings and elastomeric bearings.

Unit 6

Sub-structure: Function, loads, analysis and design of RC abutments and piers, design of well foundation.

Note: The designs should conform to the latest codal provisions.

Examination Scheme: In-sem. Exam.: 30 Marks (1 Hr.) End Sem. Exam.: 70 Marks (2.5 Hrs.) Term work: 50 Marks.

(6 Hrs.)

(6 Hrs.)

(6 Hrs.)

(6 Hrs.)

(6 Hrs.)

Term Work:

a) One project on RC highway bridges which shall include - the design of deck slab, longitudinal girder, cross-girder, bearings and abutment and pier.

The detailing shall be shown in at least three full imperial sheets.

 b) One project on railway steel bridges which shall include – the design of truss elements, longitudinal girder, cross-girder, and bearings.

The detailing shall be shown in at least two full imperial sheets.

- c) The term work can be prepared in a group of not more than four students in a group.
- d) Report of at least two site visits covering the contents of the syllabus.
- e) The projects can be done using any drafting software.

Reference Books:

- Design of Bridges, N. Krishna Raju, Oxford and IBH Publishing Company Pvt. Ltd.
- Design of Bridge Structures, M.A. Jayaram Prentice-Hall Of India Pvt. Limited. Prestressed Concrete, N. Krishna Raju, Tata-McGraw Hill.
- 3. Design of Steel Structures, Ramachandra, Standard Publications New-Delhi.

401 004 Elective I (2) - Systems Approach in Civil Engineering

Teaching scheme: Lectures: 3 Hrs/week Practical: 2 Hrs/week Examination scheme: In semester exam: 30 marks---1 Hr. End semester exam: 70 marks—2.5 Hrs. Term Work: 50 marks.

Unit 1: Introduction of systems approach

- (A) Introduction to System approach, Operations Research and Optimization Techniques, Applications of systems approach in Civil Engineering.
- (B) Introduction to Linear and Non linear programming methods (with reference to objective function, constraints), Graphical solutions to LP problems.
- (C) Local & Global optima, unimodal function, convex and concave function.

Unit 2: Stochastic Programming

- (A) Sequencing– n jobs through 2, 3 and M machines.
- (B) Queuing Theory : elements of Queuing system and it's 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/ /).
- (C) Simulation : Monte Carlo Simulation.

Unit3: Linear programming (A)

- (A) The Transportation Model and its variants.
- (B) Assignment Model, and its variants.

Unit 4: Linear programming (B)

- (A) Formulation of Linear optimization models for Civil engineering applications. The simplex method.
- (B) Method of Big M, Two phase method, duality.

Unit 5: Nonlinear programming

(A) Single variable unconstrained optimization: Sequential Search Techniques-Dichotomous, Fibonacci, Golden section.

(6 Hrs)

(6 Hrs)

(6 Hrs)

(6 Hrs)

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(6 Hrs)

- (B) Multivariable optimization without constraints-The gradient vector and Hessian Matrix, Gradient techniques, steepest ascent/decent technique, Newton's Method.
- (C) Multivariable optimization with equality constraints Lagrange Multiplier Technique.

Unit 6: Dynamic programming, Games Theory & Replacement Model (6 Hrs)

- (A) Multi stage decision processes, Principle of optimality, recursive equation, Applications of D. P.
- (B) Games Theory 2 persons games theory, various definitions, application of games theory to construction Management.
- (C) Replacement of items whose maintenance and repair cost increase with time, ignoring time value of money.

Term Work :

- 1. One exercise/assignment on each unit. Out of these any one exercise/assignment to be solved using Computer.
- 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).

Text Books :

- 1. Operations Research by Premkumar Gupta and D.S.Hira, S. Chand Publications (2014).
- Engineering Optimization: Methods and Application-- A. Ravindran, K. M. Ragsdell— Wiley India.
- 3. Engineering Optimization by S. S. Rao.
- 4. Operations Research by Hamdy A. Taha.
- 5. Quantitative Techniques in Management by N.D. Vohra (Mc Graw Hill).
- 6. Operations Research by Pannerselvam, PHI publications.

Reference Books :

- 1. Topics in Management Science by Robert E. Markland(Wiley Publication).
- 2. An Approach to Teaching Civil Engineering System by Paul J. Ossenbruggen.
- 3. A System Approach to Civil Engineering Planning & Design by Thomas K. Jewell (Harper Row Publishers).

e - Resources

- 1. Mathematical Model for Optimization (MMO Software).
- 2. nptel.iitm.ac.in/courses/webcourse-contents/IISc-Bang/OPTIMISATION METHODS/Newindex1.html.

401004 Elective I (3) - Advanced Concrete Technology

Teaching scheme Lectures: 3 Hrs/week Practical: 2 Hrs/week Examination scheme In semester exam: 30 Marks-1 Hr. End semester exam: 70 Marks—2.5 Hrs. Term Work: 50 Marks

Unit I

(6 Hrs.)

Cement and its types: general, hydration of cement, alkali aggregate reaction. Grading curves of aggregates, Manufactured sand as fine aggregate, copper slag as fine aggregate.

Concrete: properties of concrete, w/b ratio, gel space ratio, Problems on maturity concept, aggregate cement bond strength, Green concrete, Guidelines for Quality control & Quality assurance of concrete, Effect of admixtures.

Unit II

Structural Light weight concrete, ultra light weight 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 curing concrete, Pervious concrete, Geo polymer concrete .

Unit III

Design of high strength concrete mixes, design of light weight aggregate concrete mixes, design of fly ash cement concrete mixes, design of high density concrete mixes, Design of pump able concrete mixes, Design of self-compacting concrete.

Advanced non-destructive testing methods: ground penetration radar, probe penetration, break off maturity method, stress wave propagation method, electrical/magnetic methods, nuclear methods and infrared thermographs.

Unit IV

Historical development of fibre reinforced concrete, 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.

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(6 Hrs.)

(6 Hrs.)

(6 Hrs.)

Unit V

Properties of hardened frc, behavior under compression, tension and flexure of steel fibres and polymeric fibres, GFRC, SFRC, SIFCON,SIMCON -development, constituent materials, casting, quality control tests and physical properties.

Unit VI

(6 Hrs.)

Ferrocement: Properties & specifications of ferrocement materials ,analysis and design of prefabricated concrete structural elements,manufacturing process of industrial concrete elements, precast construction, erection and assembly techniques.

Termwork / Labwork :

The Termwork / Labwork will be based on completion of assignments / practicals / 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.
- 2. Report on at least one patent (national/international)- on any topic related to concrete technology.
- 3. Concrete mix design and production in lab of any one Self compacting concrete, Fiber reinforced concrete, light-weight concrete, high strength or ultra-high strength concrete . Comparison with traditional concrete mix is to be clearly stated in the report. 4. Cost analysis (material, labour, equipment, others) of any type of concrete for lab, in-situ and RMC production.
- Perform any two Fresh (workability tests Slump Flow Test, T-50, J-Ring, Visual Stability Index, Column Segregation, L-Box, U-box) and Hardened (Compressive, tensile, flexural) properties tests on any high performance concrete.
- 5. Any one experiment on any one of the topics NDTs; Microscopic examination of cement/concrete; Performance study of any one admixture (Mineral/Chemical) in concrete.
- 6. Visit reports on minimum two site visits exploring the field and practical aspects of concrete technology.

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.

(6 Hrs.)

Text books:

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

Reference Books:

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

General Reading suggested:

- 1) Codes : i) IS 456 ii) IS 383 iii) IS 10262-2009 iv) IS 9103.
- 2) Ambuja cement booklets on concrete Vol .1 to 158.
- 3) ACC booklets on concrete.

401 004 Elective I (4)- Architecture and Town Planning

Teaching scheme: Lectures: 3 Hours/week Practical: 2 Hrs/week Examination scheme: In semester exam: 30 marks-1 Hr. End semester exam: 70 marks-2.5 Hrs. Term Work: 50 marks

Unit I

• Principles and elements of Architectural Composition.

• Qualities of Architecture: user friendly, contextual, ecofriendly, utility of spaces, future growth etc.

• Role of "Urban Planner and Architect" in planning and designing in relation with spatial organization, utility, demand of the area and supply.

Unit II:

• Landscaping: importance, objectives, principles, elements, material (soft and hard).

- Urban renewal for quality of life and livability.
- Importance of sustainable architecture with case study.

Unit III:

- Goals and Objectives of planning; components of planning; benefits of planning.
- Levels of planning: Regional plan, Development Plan, Town Planning Scheme.
- Neighborhood plan; Types of Development plans: Master Plan, City Development Plan, Structure Plan.

Unit IV:

- Various types of civic surveys for DP: demographic, housing, land use, Water Supply & sanitation, etc.
- Planning agencies for various levels of planning. Their organization and purpose (CIDCO-MHADA-MIDC, MMRDA/ PMRDA etc).
- Traffic transportation systems: urban road, hierarchy, traffic management, Intelligent Transport Systems.

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(6 Hrs.)

(6 Hrs.)

(6 Hrs.)

(6 Hrs.)

Unit V:

- Legislative mechanism for preparation of DP: MRTP Act 1966.
- UDPFI guidelines (for land use, infrastructure etc.), SEZ, CRZ, Smart City Guidelines.

Unit VI :

(6 Hrs.)

- Special townships, Land Acquisition Rehabilitation and Resettlement Act 2013.
- Application of GIS, GPS, remote sensing in planning.

Term Work: - 50 Marks

Sr. no. 1 and 2 are compulsory and any four from remaining.

- 1. Study and analysis of Development Plan with respect to land use, services, infrastructure, street furniture, housing etc. (group work).
- 2. Neighborhood- planning (group work).
- 3. Report on contribution of Engineers, Planners and Architects in post-independence India (individual work).
- Report on any existing new towns and planned towns like new Mumbai, Gandhinagar, PCNTDA etc.(infrastructure, disaster management etc), (individual work).
- 5. Study of salient features of urban renewal schemes (group work).
- 6. Study of any existing town planning scheme (group work).
- 7. Smart City approaches (individual work).
- 8. Study of Special Townships: (site visit) (group work).
- 9. Study of urban housing and housing change (group work).

Text Books:

- 1. Town Planning By G K Hiraskar -- Town Planning by S Rangwala.
- Building Drawing and Built Environment- 5th Edition Shah, Kale, Patki--Planning Legislation by Koperdekar and Diwan.
- 3. G. K. Bandopadhyaya, "Text Book of Town Planning".
- 4. Climate Responsive Architecture Arvind Krishnan.
- 5. Introduction to Landscape Architecture by Michael Laurie.

Reference Books:

- MRTP Act 1966.
- Manual Of Tropical Housing And Building By Koenigsbeger.

- Sustainable Building Design Manual.
- UDPFI Guidelines.
- "The Urban Pattern: City planning and design" by Gallion and Eisner.
- Design of cities by Edmond bacon.
- LARR Act 2013.
- MoUD By GoI.
- Web sites of NRSA, CIDCO, MHADA, MIDC, MMRDA, PMRDA.

401004 Elective-I (5) Advanced Engineering Geology with Rock Mechanics

Teaching Scheme: Lecture: 3 Hrs/week Practical: 2 Hrs/week Exam. Scheme: In Sem: 30 Marks (1 Hr.) End Sem: 70 Marks (2.5 Hrs.) Termwork: 50 Marks

Unit I:

(6 Hrs.)

Indian Geology, Seismic Zones and Geological Studies in Engineering Projects.

Geological Map of India with special reference to Maharashtra. Distribution and Geological characters of Major rock formations of India. Engineering characters of major rock formations of India. Engineering characters of major rock formations of India. Engineering characters of major rock formations of India.

The study of Plate Tectonics and highlights of Seismic Zones of India. Importance of geological studies in engineering investigations.

Unit II (6 Hrs.) Geohydrological characters of rock formations and Geological process of Soil formations *Geohydrological characters of major rock formations of India:*

Geohydrological characters and factors controlling various characters of rocks. Introduction to morphometric analysis. Various water conservation techniques, effect of over exploitation of tube wells, bore wells and dug wells. Artificial recharge, rainwater harvesting, watershed development and necessity of geological studies. Relevant case studies highlighting success and failure of these techniques.

Geological Process of Soil formations:

Effect of climate on formation of soil. Soil profile of different states in India.

Rock weathering conditions favorable for decomposition, disintegration, residual and transported soils.

UNIT III

(5 Hrs.)

Resource Engineering, Role of Geology in planning and development.

Resource Engineering:

Utility of various rock formations as construction material. Illustrative case studies. Geological Hazards and mitigation.

Role of Geology in planning and development:

Influence of geological factors upon urban development & planning. Reclamation of abandoned grounds and mining regions, illustrative examples.

UNIT IV:

Rock Mechanics and Geophysical techniques.

Rock Mechanics:

General principles of rock mechanics. Dependence of physical and mechanical properties of rocks on geological characters.

Analyzing and evaluating of core recovery, R.Q.D. and Joint Frequency Index.

Various Methods of Geomechanical classifications of rocks such as Terzahagi, U.S.B.M, R.M.R., R.S.R., Q- system, Deer and Miller, Bieniawaski's geomechanical classification etc. *Geophysical techniques :*

Electrical Resistivity method and Seismic method of exploration. Evaluation and analyzing the data produced through electrical resistivity for the determination of thickness of overburden, locating ground water potential zones which leads for strengthening the major civil projects.

UNIT V

Subsurface Geological Explorations for various projects; Foundation Treatments, Tail Channel Erosion.

Subsurface Explorations for Dams, Reservoir, Percolation Tanks:

The strength and water tightness of rocks found at the dam, reservoir and percolation tank site. Case studies illustrating the success and failure of major projects owing to negligence of geological studies. Earthquakes occurring in the areas of some dams and RIS theories.

Geological Foundation Treatments for various Civil Engineering Projects:

Foundation investigation during construction of projects for assessing various geological defects in rocks and suggesting appropriate remedial measures by various methods of grouting.

Erosion of Tail Channels:

Geological reasons for selection of site for spillway, causes of erosion of tail channel. Relevant Case studies.

(7 Hrs.)

Unit VI:

Geological exploration for Tunnels and Bridges

Geological exploration for Tunnels:

Variations in methodology of investigation for different types of tunnels for different purposes, location, spacing, angles & depths of drill holes suitable for different types of tunnels.

Difficulties introduced in various geological formation and their unfavorable field characters. Standup time of rock masses and limitations of it.

Dependence of protective measures such as guniting, rock bolting, shotcreting, steel fiber shotcreting, permanent steel supports, lagging concreting & grouting above permanent steel supports on geological conditions. Illustrative case studies.

Bridges Investigation for bridge foundation, difference in objectives of investigation of bridge foundation. Bridge foundation based on nature & structure of rock. Foundation settlements. Case studies.

Practical Work / Term Work

i.	Study of Geological map and seismic zone map of India	(2 Practicals)
ii.	Study of Morphometric Analysis of river, (topsheet will be made available	by the college)
		(1 Practical)
iii.	Study of Soil Profile, weathering index and clay geology.	(1 Practical)
iv.	Use of electrical resistivity method for determining depth of bedrock.	(1 Practical)
v.	Engineering Classification of rocks and Computation of RQD & Joint F	requency Index

(1 Practical)

- vi. Interpretation of drill hole data. Logging of drill cover, preparation of Litho logs & interpretation of drill data. Preparing geological cross sections from drill hole data & using them for designing of civil engineering structures representing following case studies.
 - 1. Dipping sedimentary formation.
 - 2. Faulted region.
 - 3. Folded region.
 - 4. Locating spillway.
 - 5. Tunnels in Tectonic areas.
 - 6. Tunnels and open cuts in non-tectonic areas.

(6 Practicals)

vii. A compulsory guided tour to study geological aspects of an engineering projects & writing a report based on studies carried out during visits to civil engineering projects.

Note:

Field visits will be made to different places around study area and one study tour to important geological places.

The practical journal will be examined as term work.

REFERENCE BOOKS AND TEXT BOOKS:

- Jaeger J. C., Cook N. & Zimmerman R. Fundamentals of Rock Mechanics, Blackwell Scientific Publications.
- 2. Goodman R. E. Introduction to Rock Mechanics, John Wiley & Sons.
- 3. Bieniawski Z. T. Engineering Classification of jointed Rock Masses.
- 4. M. B. Dobbrin Introduction to Geophysical Prospecting, McGraw Hill Inc., USA.
- 5. B. P. Verma Introduction to Rock Mechanics, Khanna Pub New Delhi.
- 6. Keller E A Environmental Geology, Prentice Hall Publication.
- 7. Subinoy Gangopadhyay Engineering Geology, Oxford University Press.
- 8. Vasudev Kanithi Engineering Geology, Universities Press.
- 9. Dr. J. B. Auden Commemorative Volume Indian Soc. Of Engineering Geology, Culcutta.
- Seminar on Engineering and Geological Problems in Tunneling (Part 1 & 2) Indian Society of Engineering Geology, New Delhi.

Handbooks:

- a. Gupte R. B. (1980) P. W. D. Handbook Chapter –6, Part-II 'Engineering Geology Government of Maharashtra.
- b. Tunneling India '94, "Central Board of Irrigation and Power", New Delhi.
- c. Manual on Rock Mechanics, Central Board of Irrigation and Power, New Delhi, 1988.
- d. Handbook of Geology in Civil engineering, Robert Fergussion, Legget, Mc- Graw hill.

I. S. Codes

- a. IRC code of practice for Road Tunnels. IRC-78-2000; IS-12070; IS-1336 Part I and II.
- b. I. S. 4453-1967 Code of practice for Exploration, pits, trenches, drifts & shaft.
- c. I. S. 6926-1973 Code of practice for diamond drilling for site investigation river valley project.
- d. I. S. 4078-1967 Code of practice for Logging and Storage of Drilling Core.
- e. I. S. 5313-1969 Guide for core drilling observation.

e- Resources:

- 1. www.ebd.co.in/undergraduate/eng
- 2. www.library.iisc.ernet.in
- 3. www.iitb.ac.in
- 4. www.nptel.iitm.ac.in
- 5. Free online course-swayam-https//swayam.gov.in
- 6. Open source course management https//moodle.org

401 005 **Elective-II** (1) Matrix Methods of Structural Analysis

Teaching scheme: Lectures: 3 Hrs/week **Examination scheme:** In semester exam: 30 marks (1 Hr.) End semester exam: 70 marks (2.5 Hrs.)

Unit I: Computational Techniques

Review of matrix algebra, computer oriented numerical methods-Gauss elimination, Gauss Jordon and Gauss Seidel. Computer algorithm and flowcharts of above methods.

Unit II: Flexibility matrix method for beams and frame (6 Hrs)

Degree of static indeterminacy, flexibility, selection of redundant, flexibility matrix, analysis of indeterminate continuous beams and simple portal frames involving not more than three unknowns.

Unit III: Stiffness matrix method for bars and trusses

- a) Degree of kinematic indeterminacy (degrees of freedom), local and global coordinate systems, stiffness matrices of a axially loaded bar members, global stiffness matrix, analysis of determinate/indeterminate bars involving not more than three unknowns using member approach.
- b) Stiffness matrices of a truss member with four DOF, transformation matrix, global stiffness matrix, analysis of determinate/indeterminate trusses involving not more than three unknowns using member approach.

Unit IV: Stiffness matrix method for beams

- a) Structure approach: Degree of kinematic indeterminacy, problems involving not more than three unknowns.
- b) Member approach: Derivation of stiffness matrix for beam member, Global stiffness matrix, problems involving not more than three unknowns.

Unit V: Stiffness matrix method for frames

- a) Structure approach: Degree of kinematic indeterminacy, problems involving not more than three unknowns.
- b) Member approach: Derivation of stiffness matrix for plane and space frame member, transformation matrix, global stiffness matrix, problems involving not more than three unknowns.

(6 Hrs)

(6 Hrs)

(6 Hrs)

(6 Hrs)

Unit VI: Stiffness matrix method for grid structures

- a) Structure approach: Degree of kinematic indeterminacy, problems involving not more than three unknowns.
- b) Member approach: Derivation of stiffness matrix for grid member, transformation matrix, global stiffness matrix, problems involving not more than three unknowns.

Reference Books:

- [1] Matrix Methods of Structural Analysis- Wang, C. K., International Textbook Co., 1970.
- [2] Matrix Analysis of Framed Structures Gere & Weaver- CBS Publications, Delhi.
- [3] Matrix & Finite Element analysis of structures A.H. Shaikh and Madhujit Mukhopadhyay.
- [4] Numerical Methods for Engineering S.C. Chapra& R.P. Canale Tata McGraw Hill Publication.
- [5] Structural Analysis A Matrix Approach Pandit & Gupta Tata McGraw Hill Publication.
- [6] Matrix Methods of Structural Analysis Meghre & Deshmukh- Charotar Publishing House, Anand.

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401005 Elective-II (2) Integrated Water Resources Planning & Management

Teaching Scheme: Lectures: 3 Hrs / week

Examination Scheme: Paper In-sem. 30 Marks (1 hr), Paper End-sem : 70 Marks (2.5 hr)

Unit1:

a) **Introduction** :World water resources, water resources in India, water as finite resource, variability of water in time & space, history of water resources development, water infrastructure-problems and perspectives, present institutional framework for water management.

b) Water laws: Constitutional provisions, National Water Policy, riparian rights / ground water owner ship, prior appropriation, permit systems, acquisition and use of rights, scope for privatization. EPA 1986, MWRRA act.

Unit2: Economics & Paradigm shift in water management (6 Hrs)

a) Economics of water :Water as economic good, intrinsic value, principles of water pricing & water allocation, capital cost, opportunity cost, internal rate of return, benefit cost analysis, principles of planning and financing of water resources project : Discussion on any two case studies.

b) Paradigm shift in water management:

Global and national perspectives of water crisis, water scarcity, water availability and requirements for human and nature, concepts of 'blue water', 'Green water', and 'virtual water', and their roles in water management. Sustainability principles for water management, framework for planning a sustainable water future.

Unit 3: Basin scale flogy

a) Estimation of surface water, estimation of ground water draft/recharge import/export of water (inter basin water transfer, interlinking of national river), recycling and reuse and storage, control of water logging, salinity, & siltation of storages.

b) Flood & Drought management: causes of floods, structural and non-structural measures, mitigation plan, flood damage assessment, use of geoinformatics for flood management. Types of droughts, severity index, drought forecasting, damage assessment, mitigation plan, use of geoinformatics for drought management.

(6 Hrs)

(6 Hrs)

Unit 4: Water demand and supply based management

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- a) Consumptive & non consumptive demands, irrigation demand estimation, water utilization, irrigation efficiency, water management in irrigation sector.
- **b**) Demand estimation in hydro/thermal/nuclear power sector, estimation & forecasting of water demands of domestic & industrial sector, navigation and recreational water demands.

Unit 5: Environmental and social aspects

a) Environmental management: protection of vital ecosystem, water requirements for environmental management, aquaculture, minimum flows, environmental flow, water quality management for various uses.

b) Social impact of water resources development: direct/ indirect benefits, employment generation, industrial growth, agro-industry, enhanced living standards, education & health, co-operative movement, management of rehabilitation & resettlement, interstate dispute of water sharing and tribunals, sectorial conflicts.

Unit6: Basin planning & Watershed management

a) Perspective plan for basin development & management, Decision support system for Integrated Water Resources Management (IWRM), use of data driven techniques like Artificial Neural Networks, Genetic programming, Model Tree in water resources planning, development & management.

b) Watershed Management:

Watershed definition, classification of watersheds, integrated approach for watershed management, role of RS & GIS in watershed management, soil and water conservation-necessity- soil erosion-causes- effects-remedial measures, contour bunding-strip cropping-bench terracing-check dams, farm ponds, percolation tank.

Text Books:

- 1) Water Resources Systems Engg, D. P. Loucks, Prentice Hall
- 2) Water Resources Systems Planning and Management, Chaturvedi, M.C. Tata McGraw Hill
- 3) Economics of Water Resources Planning, James L.D and Lee R.R, McGraw Hill
- 4) Water resources hand book; Larry W. Mays, McGraw International Edition
- 5) Design of Water Resources Systems, Arthur Mass, MacMillan 1962
- 6) Water resource system, Pramod .R. Bhave Narosa Publication

(6 Hrs)

(6 Hrs)

Reference Books:

- 1. Economics of Water Recourses Planning, L. D. James & R.R.Leo, McGraw Hills, NY 1971.
- 2. Water Resources Systems Engineering, W. A. Hill & J. A. Dracup.
- 3. Water shed Management B.M. Tideman
- 4. Watershed management –J. V. S. MURTY, new Age International Publisher.
- Integrated Watershed Management Perspectives and Problems Beheim, E., Rajwar, G.S., Haigh, M., Krecek, J. (Eds.), Springer Publication.
- 6. Managing Water in River Basins: Hydrology, Economics and Institutions -- M. Dinesh
- 7. Kumar, Publisher: Oxford Universit Press
- 8. Water Resources Design Planning Engg. and Economic; Edward Kuiper, Butterworth & Co.
- 9. ANN in Hydrology; Govinda Raju & Ramachandra Rao; PHI
- 10. Integrated Water Resources Management in Practice: Better Water Management for
 Development R. L. Lenton, Mike Muller, Publisher Earthscan.
- Sustainability of Integrated Water Resources Management Editors: Setegn, Shimelis Gebriye, Donoso, Maria Concepcion (Eds.) Publisher Springer International Publishing .
- Integrated Water Resources Management in the 21st Century: Revisiting the paradigm -Pedro Martinez-Santos, Maite M. Aldaya, M. Ramón Llamas, Publisher CRC Press, Taylor & Francis Group.
- 13. Key Concepts in Water Resource Management: A Review and Critical Evaluation Jonathan Lautze, publisher Routledge.
- 14. Water Management Jasapal Singh, M.S.Achrya, Arun Sharma Himanshu Publication.

e – Resources:

1. nptel.iitm.ac.in/courses /webcourse-contents / IISc-Bang/water resource management.

401 005 Elective II (3) TQM and MIS in Civil Engineering

Examination scheme:

In semester exam: 30 marks---1 Hr.

Teaching scheme: Lectures: 3 Hrs/week

Unit I: Quality in Construction

- a) Quality Various definitions and interpretation. Importance of quality on a project in the context of global challenges, Factors affecting quality of construction, Reasons for poor quality & measures to overcome, Contribution of various Quality Gurus(Juran, Deming, Crossby, Ishikawa).
- b) Evolution of TQM- QC, TQC, QA, QMS, TQM.

Unit II: TQM & Six Sigma

- a) TQM Necessity, advantages, 7QC tools, Quality Function Deployment(QFD).
- b) Six sigma Importance, levels.
- c) Defects & it's classification in construction. Measures to prevent and rectify defects.

Unit III: ISO & Quality Manual

- a) Study of ISO 9001 principles.
- b) Quality manual Importance, contents, documentation. Importance of check-lists in achieving quality. Typical checklist for concreting activity, formwork activity, steel reinforcement activity.
- c) Corrective and Preventive actions, Conformity and NC reports.

Unit IV: Management Control & Certifications

- a) Benchmarking in TQM, Kaizen in TQM.
- b) Quality Circle.
- c) Categories of cost of Quality.
- d) CONQAS, CIDC-CQRA certifications.

Unit V: Techniques in TQM Implementation and awards

- a) 5 'S' techniques.
- b) Kaizen.
- c) Failure Mode Effect Analysis (FMEA).

End semester exam: 70 marks—2.5 Hrs.

(6 Hrs)

(6 Hrs)

(6 Hrs)

(6 Hrs)

(6 Hrs)

- d) Zero Defects.
- e) National & International quality awards- Rajeev Gandhi Award, Jamuna lal Bajaj Award, Golden Peacock Award, Deming Prize, Malcolm Baldrize award.

Unit VI: MIS

(6 Hrs)

- a) Introduction to Management Information systems (MIS) Overview, Definition.
- b) MIS and decision support systems, Information resources, Management subsystems of MIS, MIS based on management activity whether for operational control, management control, strategic control.
- c) Study of an MIS for a construction organization associated with building works.

Text Books:

- 1. Total Quality Management-- Dr. Gunmala Suri and Dr. Puja Chhabra Sharma-Biztantra.
- Quality Control and Total Quality Management by P.L.Jain- Tata McGraw Hill Publ. Company.
- 3. Total Quality Management Dr. S.Rajaram and Dr. M. Sivakumar—Biztantra.
- 4. Total Engineering Quality Management Sunil Sharma Macmillan India Ltd.

Reference Books:

- 1. Juran's Quality Handbook Juran Publication. Importance of quality on a project in the context of global challenges. Importance of quality on a project in the context of global challenges.
- 2. Management Principal, process and practices by Bhat Oxford University Press.
- 3. Financial management by Shrivastava- Oxford University Press.
- Management Information Systems Gordon B. Davis, Margrethe H. Olson Tata McGraw Hill Publ. Co.
- 5. Total Project Management The Indian Context P.K.Joy Macmillan India Ltd.

E- Sources:

 $www.nptel.ac. in\ ,\ www.mobile.enterprise appstoday.com$

401 005 Elective II (4) Earthquake Engineering

Teaching scheme: Lectures: 3 Hrs/week Examination scheme: In semester exam: 30 marks---1 Hr. End semester exam: 70 marks—2.5 Hrs.

Unit I

Introduction to earthquakes:

Geology of earth, configuration of tectonic plates in a globe, influence of Geology on earthquake, behavior of plates, their motion and effects, causes of earthquake and their Characteristics, Earthquake parameters, magnitudes, intensity, scales, classification of earthquake seismic zoning of India, seismic coefficients for different zones, .Lessons from past earthquake: - Study of damages caused due to past, earthquakes in/ outside India and remedial measures.

Unit II

Theory of vibrations:

Vibrations - definition, causes, classifications. Single Degree of Freedom systems (SDOF) -Free, forced, damped, un-damped vibrations with basic examples. Introduction to Multidegrees of Freedom systems (MDOF) - derivations of related equations and solutions to two degree and three degree of freedom systems.

Unit III

Static analysis of earthquake forces:

Introduction to IS1893 (Part-I): Seismic design Philosophy, provision, Seismic coefficient method.

Unit IV

Dynamic analysis of earthquake forces:

Response Spectra, estimation of story shear, effect of unsymmetrical geometry and masses, mass center and stiffness center, estimation of story shear for symmetrical and torsion for unsymmetrical buildings. Effect of infill masonry and shear walls.

(6 Hrs.)

(6 Hrs.)

(6 Hrs.)

(6 Hrs.)

Unit V

Earthquake force calculation and analysis and design of frames

Estimation of combined effect of lateral forces and vertical loading on multi storeyed frames. Design any intermediate continuous beam of the frames for combined effect of loadings, Concept of ductile detailing, IS 13920 provisions for RC frame.

Unit VI

(6 Hrs.)

Introduction of different control systems: Passive control: base isolation and active control: bracing system. Strengthening and Retrofitting techniques, methodology of retrofitting for walls, slabs roofs columns, foundations etc. for buildings in stones, bricks, RCC. Introduction to Disaster Management: Types of Disaster, Phases of disaster management, Disaster rescue, psychology and plan of rescue operations.

Notes:

Every design should confirm to latest versions of IS 1893, 4326, 13920, 13827, 13828, 13935

Text Books:

- 1. Earthquake resistance design of structure by Duggal- Oxford University Press.
- 2. Earthquake Resistant Design of Building Structures-Dr. Vinod Hosur-- Wiley India.
- 3. Earthquake Tips NICEE, IIT, Kanpur.
- 4. Elements of Earthquake Engineering by Jaikrishna and Chandarsekaran.
- 5. Earthquake resistant design of structures- Agarwal, Shrikhande, PHI learning.

Reference Books:

- Dynamics of structure by Clough R.W. and Penzin J. McGraw Hill Civil Engineering Series.
- 2. Dynamics of structure by Anil Chopra, Prentice Hall India Publication.
- 3. Dynamics of structure by Mario Paz, CBSPD Publication.
- 4. Geo-technical Earthquake Engineering by Kramer S. L. Prentice Hall India Publication.
- 5. Introduction to Structural Dynamics by John M. Biggs.
- 6. Mechanical Vibrations by V. P. Singh.
- 7. Relevant Latest Revisions of IS codes.
401 005 Elective II (5)- Advanced Geotechnical Engineering

Teaching scheme: Lectures: 3 hours/week Examination scheme: In semester exam: 30 marks---1 hour End semester exam: 70 marks—2.5 hours

(a) Soil classification Identification and classification, criteria for classifying soil - classification on the basis of grain size, plasticity, symbolic & graphic presentation. Classified soils and engineering properties. (b) Soil structure & clay minerals Clay minerals, clay water relations, clay particle interaction, soil structure & fabric, granular soil fabric.

Unit II

Unit I

(a) Earth pressure theory Earth pressure theories for calculation of active and passive pressure, Rankines and coulombs earth pressure theories, analytical and graphical methods. (b) Design of earth retaining structures Design of gravity and cantilever retaining walls, design - cantilever sheet pile walls, anchored sheet pile walls, timbering and bracing for open cuts.

Unit III

(a) Geosynthetics Geosynthetics- types, functions, properties and functional requirements. Application of geosynthetics in geoenviroment. (b) Reinforced soil Mechanism, reinforcement soil – interaction. Applications – reinforcement soil structures with vertical faces, reinforced soil embankments. Reinforcement soil beneath unpaved roads, reinforcement of soil beneath foundations. Open excavation and slope stabilization using soil nails.

Unit IV

- (a) Soil behavior under dynamic loads Soil behavior under static and dynamic loads. Acceptable levels of strain under static and dynamic loading. Soil properties relevant for dynamic loading and its determination.
- (b)Machine foundations: Types of machine foundations, design criteria, methods of analysis elastic half space method, linear elastic weightless spring method. Evaluation of soil parameters. Design procedure for a block foundation for cyclic loading and impact loading.

(6 Hrs.)

(6 Hrs.)

(6 Hrs.)

Unit V

Ground Improvement In-situ ground improvement by compaction piles, dynamic loads, sand drains, grouting, deep mixing, inserting reinforcement elements, freezing soil, and vibroflotation.

Unit VI

(6 Hrs.)

Rheology Rheological elements, basic and composite rheological models. Examples of compound models used to explain different soil phenomena; such as secondary consolidation, creep etc.

Reference Books:

- 1. Physical and Geotechnical properties of soils- Joseph E. Bowels, Tata Mac-Grawhill.
- 2. Advance Soil Mechanics Braja Mohan Das- Tata Mc- Grawhill.
- 3. Geotechnical Engineering by Shashi K. Gulati & Manoj Datta Tata Mc-Grawhill.
- 4. Basic and Applied Soil Mechanics- Gopal Ranjan & A.S. Rao- New Age Publication.

Codes:

- I.S. Codes 1. IS: 1892-1979 "Code of Practice for Subsurface Investigation for Foundation".
- 2. 2. IS: 2131-1981 (Reaffirmed 1997), "Method for Standard penetration Test for Soils".

Handbooks:

- 1. Bolt, Bruce A.(1999),"Earthquakes", W. H. Freeman.
- 2. Baghi, A., (1994)" Design, Construction and Monitoring of Landfills." John Wiley & Sons.
- 3. Day. R.W.(2002),"Geotechnical Earthquake Engineering Handbook", McGraw Hill.

e -Resources:

1. Website www.nptel.iitm.ac.in

Elective III (1) Advanced Structural Design 401 009

Teaching Scheme Lectures: 3 hours/week Practical: 2 hours/week **Examination Scheme** Theory Examination: In-sem : 30 marks (1 Hour) End-sem:70 marks (2.5.Hours) Term work: 50 Mark

Unit 1

Unit 2

Cold-formed light gauge steel structural members: Design of axially loaded compression members, tension members and beams (not more than two spans).

Frames: Uniqueness theorem, lower bound and upper bound theorems, mechanisms, analysis and design of frames (single story), design of connections.

Unit 3

Composite deck slab: Design of composite deck slab with cold form light gauge profile and shear connectors.

Unit 4

Yield line analysis and design of slabs: Yield line theory, yield lines, ultimate moment along a yield line, principle of virtual work, analysis and design of slabs of different geometry, support conditions and loading conditions.

Unit 5

Elevated water tanks: Analysis and design for gravity and earthquake loads (static analysis) for square, rectangular and circular water tanks (excluding Intze tank) supported on staging, design of staging and foundation system.

Unit 6

Shear walls: Function, types, analysis and design of cantilever type shear walls.

Note: The designs should conform to the latest codal provisions.

(6 Hrs.)

(6 Hrs.)

(6 Hrs.)

(6 Hrs.)

(6 Hrs.)

Term Work:

- a) At least three plates showing the details of cold-formed light gauge steel sections used in compression, tension and flexural members
- b) At least three plates showing the details based on yield line analysis and design of slabs
- c) Sheet 1: Detailing of any one design problem from Unit 2 or Unit 3
- d) Sheet 2: Detailing of any one design problem from Unit 5 or Unit 6
- e) Report of two site visits covering the contents of the syllabus mentioned above.

References:

- 1). Design of Steel Structures, Ramachandra, Standard Publications New-Delhi
- 2). Structural and Stress Analysis, T.H.G. Megson, Butterworth-Heinemann
- 3). Design of Concrete Structures, J. N. Bandyopadhyay, PHI
- 4). Punmia, Reinforced Concrete Structures Vol. 1 and 2, Standard Book House NewDelhi.
- 5). Sinha and Roy., RCC Analysis and Design . S. Chand and Co. New-Delhi
- 6). Ramachandra, Design of Steel Structures Vol.-II Standard Publications New-Delhi.
- Punmia,B. C. and Jain and Jain, Comprehensive Design of Steel Structures, Standard Book House
- 8) INSDAG publications

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401009 Elective=III (2) Statistical Analysis and Computational Methods in **Civil Engineering**

Examination Scheme Teaching Scheme Lectures : 3 hours/week In-sem : 30 marks (1 Hour) **Practical: 2 hours/week** End-sem:70 marks (2.5.Hours) Term work: 50 Mark

Unit I:

Numerical methods: Bisection method, False Position method, Newton Raphson, Secant method.

Unit II:

Numerical Integration Need and scope, trapezoidal rule, Simpsons 1/3rd rule, Simpsons 3/8th rule, Gauss Quadrature method.

Unit III:

Optimization techniques: Introduction to optimization techniques-concepts and applications, direct solution of linear equations-Gauss elimination and Gauss Jordon method. Iterative solution of linear equations- Gauss Seidel method.

Unit IV:

Statistical methods: Introduction, collection, classification and representation of data, measures of central value (mean, median, mode), measures of dispersion, sampling.

Unit V:

Probability and Probability distributions including Binomial, Poisson, Normal, test of hypothesis, chi-square test.

Unit VI:

Correlation analysis, regression analysis. Coefficient of correlation, probable error, single and multiple regression, curve fitting, Interpolation and extrapolation.

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(6 Hrs.)

(6 Hrs.)

(6 Hrs.)

(6 Hrs.)

(6 Hrs.)

Term Work:

1. One exercise on each unit.

2. Any two problems to be solved using c, c++, excel or using softwares like SPSS, minitab, etc.

3. One exercise on formulation and solution of an optimization problem applicable to any field of Civil Engineering.

Reference Books:

- 1. Statistical methods S.P.Gupta.
- Probability and Statistics for Engineers Richard A Johnson 3. Probability and Statistics for Science and Engineering – G Shankar Rao.
- 4. Numerical Methods E Balagurusamy.
- 5. Numerical methods for Engineers S. Chapra, R.P.Canale.
- 6. Higher Engg. Mathematics B.S. Grewa.

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401009 Elective III (3): Hydro Power Engineering

Teaching Scheme Lectures: 3 hours/week Practical: 2 hours/week Examination Scheme Theory Examination In-sem: 30 marks (1 Hour) End-sem:70 marks (2.5.Hours) Term work: 50 Marks

Unit I

Energy Resources – Planning and Potential:

Power resources – Conventional and Nonconventional, Need and advantages, Overview of World Energy Scenario, energy and development linkage, Environmental Impacts of energy use, Green House Effect, Trends in energy use patterns in India, Hydropower development in India, Hydropower potential basin wise and region wise, investigation in hydropower plants.

Unit II

Hydropower Plants:

Hydrological Analysis, Classification of hydropower plants based on hydraulic characteristics -Run of river plants, Storage or Valley dam plants, Pumped storage plants, Classification based on head, Classification based on operating function, Classification based on plant capacity, Classification based on nature of topography, Introduction to micro hydro, advantages and disadvantages, Principle Components of hydropower plants.

Unit III

Load Assessment:

Estimation of electrical load on turbines. Load factor, Plant factor, peak demand and utilization factor, installed capacity, diversity factor, firm power, secondary power, load curve, load duration curve, Prediction of load and significance, Tariffs, Hydro-Thermal Mix, Combined Efficiency of Hydro-Thermal-Nuclear Power Plants.

Unit IV

Water Conductor System and Powerhouse:

Water Conductor System – Alignment, Intake Structures- Location and Types, Trash Rack. Headrace tunnel/ Canal, Penstock and pressure shaft, Types of Powerhouses, Typical layout of powerhouse, Components, Power plant equipments, Instrumentation and control.

(6 Hrs.)

(6 Hrs.)

(6 Hrs.)

Unit V

Turbines:

Classification, Principles and design of impulse and reaction turbines, Selection of Turbine, Specific Speed, Governing of turbines, Water hammer, Hydraulic Transients and Surge tanks, Draft tubes, Cavitation.

Unit VI

Economics of Hydroelectric Power:

Hydropower - Economic Value and Cost and Total Annual Cost. Economic considerations – pricing of electricity, laws and regulatory aspects, Policies, Electricity act – 2003, Investment in the power sector, Carbon credits, Participation of private sector.

Term Work:

Minimum eight assignments as per the list given below. Assignments 1 and 10 are compulsory.

- 1. Calculating the electricity bill of upper middle class family that uses various electrical appliances.
- 2. Determination of power output for a run of river plant with and without pondage.
- 3. Justification of economics of Pumped storage plants.
- 4. Design of Kaplan / Francis / Pelton turbine.
- 5. Determination of diameter of penstock using different methods.
- 6. Design of surge tank.
- 7. Design of straight conical draft tube.
- 8. Use of any software to calculate water hammer pressure.
- 9. Case study of any hydropower project.
- 10. Report based on visit to any micro/small/mega hydropower project

Reference Books:

- Water Power Engineering M. M. Dandekar and K. N. Sharma, Vikas Publishing House.
- 2. Water Power Engineering R. K. Sharma and T. K. Sharma, S. Chand and Co. Ltd.
- 3. Handbook of Hydroelectric Engineering P.S. Nigam
- 4. Modern Power System Planning Wang.
- 5. Hydropower Resources in India CBIP.

- 6. Hydro Power Structures R. S. Varshney.
- 7. Water Power Development E. Mosonvi, Vol. I & II.
- 8. Hydro-electric Engineering Practice G. Brown, Vol. I, II & III.
- 9. Hydro Electric Hand Book Creager and Justin.
- 10. Water Power Engineering P. K. Bhattacharya, Khanna Pub., Delhi.
- 11. Water Power Engineering M. M. Deshmukh, Dhanpat Rai Pub.
- 12. Manual of "Energy Group" of 'PRAYAS', an NGO.

401009 Elective-III: (4) Air Pollution and Control

Teaching Scheme: Lectures: 3 Hrs/week Practical: 2 Hrs/week Examination Scheme: Paper In-sem. 30 Marks (1 hr), Paper End-sem : 70 Marks (2.5 hrs) TW : 50 Marks

Unit I

Meteorological aspects: Zones of atmosphere, Scales of meteorology, Meteorological parameters, Temperature lapse rate, Plume behaviour. Gaussion diffusion model for finding ground level concentration, Plume rise, Types & quality of fuels, Formulae for effective stack height and determination of minimum stack height as per CPCB norms.

Unit II

Ambient Air sampling and analysis: Air pollution survey, basis and statistical considerations of sampling sites, devices and methods used for sampling of gases and particulates. Stack emission monitoring for particulate and gaseous matter, isokinetic sampling. Analysis of air samples chemical and instrumental methods. Emission inventory and source apportionment studies. Ambient air quality monitoring as per the procedure laid down by CPCB. National Ambient Air Quality Standards (NAAQS) 2009.

Unit III

Indoor air pollution: Causes of air pollution, sources and effects of indoor air pollutants, factors affecting exposure to indoor air pollution, sick building syndrome. Investigation of indoor air quality problems, changes in indoor air quality, control of indoor air pollutants and air cleaning systems. Use of various plants to control indoor air pollution. Radon and its decay products in indoor air.

Odour pollution: Theory, sources, measurement and methods of control of odour pollution.

Unit IV

Control of air pollution: By process modification, change of raw materials, fuels, process equipment and process operation. Control of particulate matters. Working principle and design of control equipment as Settling chamber, Cyclone, Fabric filter and Electro Static Precipitator. Control of gaseous pollutants. Combustion chemistry & control of air pollution from automobiles.

(6 hrs)

(6 hrs)

(6 hrs)

(6 hrs)

Unit V

Land use planning: As a method of control. Economics of air pollution control: Cost/benefit ratio and optimization. Legislation and regulation: Air (Prevention and Control) Pollution Act, 1981. The Environment (Protection) Act 1986. Emission standards for stationary and mobile sources.

Unit VI

(6 hrs)

Environmental impact assessment and management: Methodology for preparing environmental impact assessment (Identifying the sources of air pollution, calculating the incremental values, prediction of impacts and mitigation measures). Role of regulatory agencies and control boards in obtaining environmental clearance for project. Public hearing. Environmental impacts of thermal power plants, sugar and cement industry. Environmental management plan. The environmental rules 1999 (sitting of industries).

Term Work:

Term work shall consist of

- A. One assignment on each unit.
- B. Detailed industrial visit report on Sugar/Cement/Steel//Thermal/Rubber/Dairy industry with reference to air pollution Control device(s).

Reference Books:

- 1. Air Pollution H. V. N. Rao and M. N. Rao, TMH, Pub.
- 2. Air pollution KVSG Murali krishna.
- 3. Air Pollution Perkins.
- 4. Environmental Engineering Davis, McGraw Hill- Pub.
- 5. Environmental Engineering Peavy H.S and Rowe D.R, McGraw Hill- Pub.
- 6. Air Pollution Stern.
- 7. Air Pollution Control Martin Crawford.
- 8. Air Pollution Control: its origin and control, K. Wark, C.F. Warner & W.T.Davis .
- 9. Fundamentals of Air Pollution-Richard W. and Donald L. Academic Press.

I.S. Codes:

- 1. I.S. 5182 (all parts), and
- 2. I.S. 15442 (2004)

e – Resources:

- 1. http://nptel.iitm.ac.in/courses-contents/IIT Kanpur and IIT Madras.
- 2. http://cpcb.nic .in
- 3. http://moef.nic .in

401009 Elective III (5): Finite Element Method in Civil Engineering

Teaching Scheme: Lectures: 3 hours/week **Practical: 2 hours/week** **Examination Scheme: Theory Examination:** In-sem: 30 marks (1 Hour) End-sem:70 marks (2.5.Hours) Term work: 50 Mark

Unit I

Theory of elasticity: Strain-displacement relations, compatibility conditions in terms of strain, plane stress, plane strain and axisymmetric problems, differential equations of equilibrium, compatibility condition in terms of stresses, stress-strain relations in 2D and 3D problems.

Unit II

General steps of the finite element method, Applications and advantages of FEM, concept of finite element for continuum problems, discretisation of continuum, use of polynomial displacement function, Pascal's triangle, convergence criteria.

Principle of minimum potential energy, formulation of stiffness matrix for truss element using variational principles.

Unit III

Displacement function for 2D triangular (CST and LST) and rectangular elements, Use of shape functions, Area co-ordinates for CST element, Shape functions in cartesian and natural coordinate systems, shape functions for one dimensional element such as truss and beam, shape functions of 2D Lagrange and serendipity elements.

Unit IV

Introduction to 3D elements such as tetrahedron and hexahedron. Iso-parametric elements in 1D, 2D and 3D analysis, Jacobian matrix, Formulation of stiffness matrix for 1D and 2D Isoparametric elements in plane elasticity problem.

Unit V

Formulation of stiffness matrix, analysis of spring assemblage, member approach for truss and beam element, node numbering, assembly of element equations, formation of overall banded matrix equation, boundary conditions and solution for primary unknowns, applications to truss and beam not involving unknowns more than three.

(6 Hrs.)

(6 Hrs.)

(6 Hrs.)

(6 Hrs.)

Unit VI

Formulation of stiffness matrix using member approach for portal frame and grid elements, transformation matrix, applications to frame and grid not involving unknowns more than three.

Termwork:

The Termwork shall be based on completion of assignments as given below.

- 1. At least one assignment on each unit.
- 2. One assignment based on FEM by using coding tools for
 - a) Formulation of stiffness matrix for any 1-D element
 - b) Formulation of stiffness matrix for any 2-D element
- 3. Finite Element Method -Software applications of any one of following cases using any standard available software.
 - a) Truss/ grid problem
 - b) Plane stress / plane strain problem

Reference Books

- 1. A first course in the finite element method-Daryl L. Logon, Thomson Publication.
- 2. Nonlinear finite element analysis by Reddy- Oxford University Press.
- Introduction to the Finite Element Method Desai & Abel, CBS Publishers & Distributors, Delhi
- Introduction to Finite Elements in Engineering T.R. Chandrupatla & A.D. Belegundu Prentice Hall of India Pvt. Ltd.
- Matrix, Finite Element, Computer & Structural Analysis M. Mukhopadhyay, Oxford IBH Publishing Co. Pvt. Ltd.
- Finite Element Analysis Theory & Programming C.S. Krishnmoorthy, TATA McGraw Hill Publishing Co. Ltd.
- An Introduction to the Finite Element Method J.N. Reddy, TATA Mc Graw Hil Publishing Co. Ltd.
- Theory & Problems Finite Element Analysis Gorge R. Buchanan, Schaum's Outline series. TATA Mc Graw Hill Publishing Co. Ltd.
- The Finite Element Method O.C. Zien kiewicz, TATA Mc Graw Hill Publishing Co. Ltd.
- 10. Finite Element Analysis S.S. Bhavikatti, New Age International (P) Ltd.

401 0010 Elective III (6): Airport & Bridge Engineering

Teaching scheme Lectures: 3 hours/week Practical: 2 hrs Examination Scheme In-Sem Exam: 30 marks 1 hour End-Sem Exam: 70 marks 2.5 hrs Termwork: 50 marks

Unit 1:

Introduction:

Advantages and limitations of air transportation. Aeroplane component parts and important technical terms, Organizations related to Air Transportation (ICAO, FAA, AAI) Roles and Responsibilities.

Airport planning:

Aircraft characteristics, which influence judicious and scientific planning of airports, Selection of sites, survey and drawings to be prepared for airport planning, Air Travel Demand forecasting, Airport classification by ICAO.

Unit 2:

Airport layout:

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, Airport landslide planning, Navigation and landing aids – ILS, Air Traffic Control (ATC).

Design of 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, Taxiways – Concept, types, design criteria.

Unit 3:

Structural Design of Runways and taxiways:

Runway pavement design criteria, aircraft loading, Design methods for flexible and rigid runways, Airport drainage.

(6 hrs.)

(6 hrs)

(6 hrs.)

Unit 4:

Heliports

Helicoptor characteristics, planning of heliports - site selection, size of landing area, orientation of landing area, Heliport marking and lighting, Vertical Takeoff and Landing (VTOL).

Unit 5:

Bridge engineering:

Introduction:

Classification of bridges, components of bridges, preliminary data to be collected during investigation of site for bridges, determination of discharge – empirical formula, direct methods, economical span, afflux, HFL, scour depth and clearance, locations of piers and abutments, factors influencing the choice of bridge super structure, approach roads.

Loads on bridges:

Brief specifications of different loads, forces, stresses coming on bridges, IRC load specification, requirements of traffic in the design of highway bridges.

Substructure:

Abutment, Piers, and wing walls with their types based on requirement and suitability.

Unit 6: Types of bridges Various types of bridges:

Culvert: Definition, waterway of culvert and types.

Temporary bridges: Definition, materials used brief general ideas about timber, floating and pantoon bridges.

Movable Bridges: Bascule, cut boat, flying, swing, lift, transporter and transverse bridges, their requirement and suitability.

Fixed span bridges: Simple, continuous, cantilever, arch, suspension, bowstring girder type and rigid frame and cable stayed bridges, materials for super structure.

Bearing: Definition, purpose and importance. Types of bearings with their suitability.

(6 hrs)

Erection of bridge super structure and maintenance:

Introduction to different techniques of erection of bridge super structure and maintenance of bridges.

Term work:

Term work shall consist of: (Any eight)

- 1. Recent Trends in Airport planning and design (report expected)
- 2. Assignment on study and use of Windrose Type 1 and 2 diagram
- 3. Assignment on Runway Design for length and related corrections
- 4. Structural Design of Flexible or Rigid Runway
- 5. Selection of Bridge site, alignment and collection of design data
- 6. Assignment on conditional assessment of existing Bridges
- 7. Seminar on one topic each in Airport Engineering or Bridge Engineering
- 8. Report on Guest lecture in Airport Engineering or Bridge Engineering
- 9. Site visit to Bridge site or Airport site

Text Books:

- 1. Bridge engineering S. Ponnuswamy, Tata Mc Graw Hill publishing co. Ltd. New Delhi.
- 2. Airport planning and design S.K. Khanna , M.G. Arora , S.S. Jain, Nem Chand and Brothers, Roorkee.
- 3. Airport Engineering Rangawala, Charotar publishing House, Anand 388001 (Gujrat)
- Essentials of Bridge Engineering D. Johnson and Victor, Oxford and IBH publishing Co. Pvt. Ltd., New Delhi.
- 5. Bridge engineering Rangawala, Charotar Publishing House, Anand –388 001.
- 6. Principles and practice of Bridge Engineering S.P. Bindra, Dhanpatrai and Sons, Delhi.

401 010 Elective IV (1): Construction Management

Teaching Scheme: Lectures: 3 hours/week Practical: 2 hours/week Examination Scheme: Theory Examination: In-sem : 30 marks (1 Hour) End-sem:70 marks (2.5.Hours) Term work: 50 Mark

Unit – I

Overview of construction sector:

Role of construction industry in infrastructure development, components of infrastructure sector, construction industry nature, characteristics, size, structure, role in economic development, construction management – necessity, applications, project management consultants – role, types, selection and appointment process, project overruns and means to combat them, project monitoring and reporting systems, managerial correspondence and communications, generation and identification of project investment opportunities. (*At least 2 expert lectures by experts from field are to be conducted on above topics).

Unit – II

Construction scheduling, work study and work measurement Construction scheduling. Construction project scheduling – purpose, factors affecting scheduling, time as a control tool, work breakdown structure, project work breakdown levels, line of balance technique, repetitive project management Work study and work measurement.

Definition, objectives, basic procedure of work study, symbols, activity charts, string diagrams, time and motion studies.

Unit – III

Labour laws and financial aspects of construction projects Labour laws. Need and importance of labour laws, study of some important labour laws associated with construction sectorworkmans compensation act 1923, Building and other construction workers act 1996, child labour act, interstate migrant workers act Financial aspects of construction projects. Capital investments: importance and difficulties, means of finance, working capital requirements, project cash flow projections and statements, project balance sheet, profit loss account statements.

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(6 Hrs.)

(6 Hrs.)

Unit – IV

Elements of risk management and value engineering. Risk management. Introduction, principles, types, origin, risk control, use of mathematical models: sensitivity analysis, break even analysis, simulation analysis, decision tree analysis, risk identification, analysis and mitigation of project risks, role of insurance in risk management. Value engineering Meaning of value, value analysis, value engineering and value management, energy resources, consumption patterns, energy cost escalation and its impact.

Unit – V

Materials management and human resource management . Materials management Materials flow system, role of materials management in construction management and its linkage with other functional areas, vendor networking, buyer-seller relationships, eoq model and its variations, material codification and classification, concept of logistics and supply chain management, role of ERP in materials management – material resource information systems Human resource management. Human Resource in Construction Sector, Staffing policy and patterns, Human Resource Management Process, Human Resource Development Process, Performance Appraisal and Job Evaluation, Training and Career planning, Role of ERP in Human Resource Information System (HRIS).

Unit – VI

Introduction to artificial intelligence technique. Basic terminologies and applications in civil engineering (a) Artificial neural network (b) Fuzzi logic (c) Genetic algorithm.

Term Work:

- 1. Site Visit to a Construction project to study following documents and preparing a report -
- a. Project Cash Flow Analysis.
- b. Project Balance Sheet.
- c. Work Break Down Structure.
- d. Materials Flow System in the Project.
- 2. Scheduling of a Construction Project using Line of Balance Technique.
- 3. Assignment on Work Study on any two Construction Trades.
- 4. Assignment on EOQ Model and its variation.
- 5. Assignment on application of AI techniques in Civil Engineering.
- 6. Seminar on any one topic from above syllabus.

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(6 Hrs.)

(6 Hrs.)

Reference Books:

- Projects Planning, Analysis, Selection, Implementation and Review, Prasanna Chandra, Tata McGraw Hill Publications.
- Construction Management and Planning B. Sengupta and H. Guha, Tata McGraw Hill Publications.
- Civil Engineering Project Management C. Alan Twort and J. Gordon Rees, Elsevier Publications.
- 4. Total Project Management The Indian Context P. K. Joy, MacMillian Publications.
- 5. Materials Management–Gopalkrishnan & Sunderasan, Prentice Hall Publications.
- 6. Human Resource Management Biswajeet Pattanayak, Prentice Hall Publishers.
- Laws for Engineers : Dr. Vandana Bhat and PriyankaVyas –Published by PROCARE,5/B,/Sagarika Society,Juhu Tara Road,Juhu,Santacruz(W),Mumbai-400049 (procure@technolegal.org).
- 8. Labour and Industrial Laws S. N. Mishra, Central Law Publications.
- 9. Artificial Neural Network Veganarayanan Prentice Hall.
- 10. Genetic Algorithm David & Goldberg.
- 11. Fuzzi Logic & Engg Applications Ross.
- 12. Principles of Construction Management by Roy Pilcher (McGraw Hill)

e-Resourses:

- 1. ERP Software-Builders Management Software.
- 2. Project mates Construction Software.

401 0010 Elective IV (2): Advanced Transportation Engineering

Teaching scheme Lectures: 3 hours/week Practical: 2 hrs Examination Scheme In-Sem Exam: 30 marks 1 hour End-Sem Exam: 70 marks 2.5 hrs Termwork: 50 marks

Unit I

(6 hrs.)

Transport System Planning: Transportation planning process and types of surveys. Travel demand forecasting - trip generation, modal spilt analysis, trip distribution and route assignment analysis, Transportation System Management (TSM), application in Comprehensive Mobility Plan (CMP) and DPR.

Unit II

Urban Transport Technology: Classification- light, medium, mass and rapid transit system, Introduction to Intelligent Transportation System (ITS) and its components, Public Transport Policy. Introduction to BRT, Mono rail, Metro rail, Bullet train and Hyperloop. Concept of Integrated Inter Model Transit System and freight transportation.

Unit III

A. Transport Economics & Financing: Road user cost - Vehicle operations cost, running cost, value of travel time, road damage cost, accident cost. Economic evaluation – Benefit cost method, Net present value method, First year rate of return method, Internal rate of return method & comparison of various methods.

B. Environmental Impact Assessment: EIA requirement of highway projects, procedure and guidelines, pollution cost and concept of congestion pricing.

Unit IV

Traffic Engineering: Traffic studies, basic traffic theory, traffic analysis process, level of service, intersection studies- turning movements, grade separated intersection, signal design-IRC method and Webster's method, parking study and analysis, bicycle and pedestrian facility design, instrumentation of traffic monitoring.

(6 hrs.)

(6 hrs.)

(6 hrs.)

Unit V

Study of flexible pavement: Philosophy of design and design criteria, design of flexible pavement using IRC 37-2012, Distresses in flexible pavement, evaluation of pavement – Benkelmen beam, Falling Weight Deflectometer (FWD), Pavement Management Systems (PMS).

Unit VI

(6 hrs.)

a) **Study of rigid pavement:** Philosophy of rigid pavement, comparison of rigid pavement over flexible pavement, types of rigid pavements, design of rigid pavement using IRC 58-2015 including design of joints, distresses in rigid pavement.

b) **Overlay types and their design as per IRC:** Types of overlays, design of overlay using IRC 81-1997.

Term work:

- 1. Traffic counts using Manual Methods.
- 2. Design of a flexible pavement using IRC: 37-2012 using IITPAVE.
- 3. Design of rigid pavement using IRC: 58-2015.
- 4. Road deflections measurement using Benkelmen Beam method.
- 5. Design of an overlay using IRC: 81-1997.
- 6. Conduct of distress surveys on a flexible pavement or a rigid pavement and determining its condition index (PCI).
- 7. Study of any two softwares related to transportation engineering.
- 8. Study of format of household survey and recording sample measurements.
- 9. Parking survey and analysis.

Reference Books:

- 1. Highway Engineering Laurence I Hewes & Clarkson H Oglesby
- 2. Traffic Engineering and Transport Planning L R Kadiyali, Khanna Publishers.
- 3. The Design and Performance of Road Pavements David Croney, Paul Croney.
- 4. Understanding Traffic System -Michel A Taylor, William Young, PeterW Bonsall.
- 5. Principles of Urban Transport Systems Planning B. G.Hutchinson.
- 6. Introduction to transport planning M. J. Bruton.

(6 hrs.)

- Transportation Engineering An Introduction C. Jotin Khisty, B. Kent Lall, Pearson Publication.
- Transportation Engineering & Planning C. S. Papacostas, P. D. Prevedouros, Pearson Publication.
- 9. Principles of Pavement Design E.F. Yoder (John Wiley & Sons, Inc USA).
- 10. Fundamentals of Transportation Engineering C. S. Papacostas.
- 11. Pavement analysis and Design Huang Y H, Prentice Hall, Englewood Cliff, New Jersey.
- 12. Introduction to Transportation Engg. and Planning Morlok E K, McGraw-Hill company.
- 13. Fundamentals of Traffic flow Theory Drew, McGraw-Hill book Co.
- 14. A course in Traffic Planning and design-Saxena Subhash, Dhanpat Rai & sons, Delhi
- 15. Traffic analysis (New technologies new solutions)-Taylor M P ,Hargreen Pub.Co. New Delhi.

Codes:

- 1. IRC 37-2012
- 2. IRC 58-2015
- 3. IRC 81-1997
- 4. IRC 82-2015
- 5. IRC 115-2014

Hand Books:

Handbook of Road Technology _Lay M. G.Gorden Breach Science Pub.Newyork.

e-Resources:

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

Teaching Scheme Lectures: 3 Hours/week **Practical: 2 Hours/week**

Unit I (6 Hrs.) IS code provision in respect of subsoil exploration for dams, canals, tunnels, off shore structure, air ports and bridges. IRC, provisions for exploration in respect of roads. Case studies of failures of foundation.

Unit II

Design of pile based on cyclic load test. Study of provision made in different IS codes related to deep foundation, various types of pile. Design of Racer piles & piles subjected to lateral load. Testing and Design of piles subjected to tensile loads.

Unit III

Design of under reamed pile foundation subjected to tensile loads. Design of sand drains and stone columns.

Unit IV

Design of shallow foundations subjected to inclined loads. Design of Raft foundation on different types of soil. Design of combined and isolated footing based on field test including calculation of settlement. Introduction to software available for geotechnical foundation design.

Unit V

Study of various provisions made as per IRC and as per IS in respect of design of well foundation. Case studies of failure of well foundation. Design of Rock fill coffer Dams.

Unit VI

Stress distribution in the shaft, tunnels, underground conduits, classification, load on ditch conduits, positive and negative projecting conduits, and Imperfect ditch conduits.

(6 Hrs.)

(6 Hrs.)

(6 Hrs.)

(6 Hrs.)

(6 Hrs.)

Examination Scheme

Theory Examination:

Term work: 50 Mark

In-sem : 30 marks (1 Hr.) End-sem:70 marks (2.5Hrs.)

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Term Work:

Term work will consist of

A) Any Four of following 6 assignments.

- 1) Comparative study of provisions made for the extent of exploration in IS, IRC codes adapted by Indian railways, and PWD.
- 2) Detailed study of any two Geophysical methods of exploration.
- 3) Computations of Bearing capacity and Settlement of a Shallow Foundation involving inclined loads.
- 4) Design of Pile foundations subjected to inclined load and tensile load.
- 5) Design of Sand Drains.
- 6) Comparative study of provisions for well Foundation as per IS, IRC and code adapted by Indian railways.

B) Computer Modeling:

Design of any one type of Deep foundation using computer software.

C) Site visit and Case study:

- 1) One site visit to any important deep foundation and submission of report on the same giving details of design and construction.
- 2) Any one case study of failure of foundation from the published literature.

Reference Books:

- 1. Foundation Analysis and Design- Joseph E. Bowels, TATA Mc-Graw hill.
- 2. Design Aids in Soil Mechanics and Foundation Engineerimg-Shenbage R Kaniraj, TATA Mc-Grawhill.
- 3. Foundation Design & Construction (4th Ed.)- M.J.Tamlinson, ELBS publication.
- 4. G. A. Leonards, Foundation Engineering, McGraw-Hill, 1962.
- 5. R.B. Peck, W.E. Hanson and T.H. Thornburn, Foundation Engineering, 2nd Edition, John Wiley and Sons, 1974.
- 6. "Principles of Foundation Engineering" by B.M. Das.
- 7. Theory and Practice of Pile Foundations Wei Dong Guo CRC Press.

I.S .Codes:

IS: 1892-1979 – "Code of Practice for Subsurface Investigation for Foundation".

IS: 2131-1981 (Reaffiemed 1997), "Method for Standard penetration Test for Soils".

IS: 6403-1981 - "Code of Practice for Determination of B.C. of Shallow Foundation".

IS: 8009 (Part-1) 1976, "Code of Practice for Calculation of settlements of foundations".

IS: 1904-1986, "Code of Practice for Design and Construction of Foundations in Soils, general Requirements".

IS: 2911-1979, "Code of Practice for Design and Construction of Pile Foundation".

Handbooks:

- 1. Fang, H.Y.,(1991)," Foundation Engineering Handbook", Chapman & Hall, NY.
- 2. Teng .W.C.(1962), Foundation Design , Prentice Hall International.
- 3. Foundation Design Manual by Narayan V. Nayak, Dhanpat Rai & Sons.

401 0010 Elective IV (4): Coastal Engineering

Teaching Scheme Lectures: 3 Hours/week **Practical: 2 Hours/week**

Unit I

Basics of Ocean Waves:

Generation ,classification, Basic understanding of wave mechanics including wave propagation, wave theories, wave diffraction, wave refection, wave breaking. Waves of unusal character-currents, giant waves, tsunami etc.

Unit II

Tides:

Tide producing forces- earth moon and earth sun system, dynamic theory of tides-; types of tides- tides and tidal current in shallow sea, storm surges, tides in rivers and estuaries ,tidal power.

Unit III

Coastal Processes:

Coastal process- Erosion/accretion due to waves, bed forms, long shore transport (Littoral drift) estimate of wave induced sediment, budget. Tides, effect of Tides, stability of inlets. Effect of construction of coastal structures on stability of shoreline / beaches.

Unit IV

Design of Marine Structures:

Design of Marine Structures: Seawalls, Revetments, Breakwater rubble mound, composite, floating and pneumatic types, and jetties. Offshore structures, Oil Production platform, sub marine pipelines. Model studies.

Unit V

Design Technology:

Dredging Technology: Types of dredgers, design of disposal methods of dredged materials Environmental aspect of dredging, studies for feasibility of dumping ground for dredged material.

Unit-VI

Coastal Management:

Pollution in Coastal zone, disposal of waste/dredged spoils, design criteria of coastal outfall inlets and system. Oil spills and contaminants, coastal zone management: activities in coastal zone, CRZ, Issues related to Integrated coastal zone management. Coastal regulation zone.

Reference Books:

- 1. Brunn Per , B. U. Naik, "Shore Protection Manual", NIO Goa.
- 2. Quinn A. D., "Port Planning", Mc Grow Hill Book Co. New York.
- 3. Richard Silvester, "Coastal Engineering", Vol-I-II, University of Western Australia.
- 4. Shore Protection Manual-U.S.Waterways Experiment Station Corps of Engineer.
- 5. Costal Engineering Research Center, Vickburg and U.S.A. 1984. Coastal Protection Manual 2002.
- 6. Harbour and Coastal Engineering", Vol. I&II, Ocean and Coastal Engineering Publication, NIOT. Chennai.

Term work-

One assignment on each unit.

Examination Scheme Theory Examination: In-sem: 30 marks (1 Hour) End-sem: 70 marks (2.5.Hours) **Termwork : 50 marks**

(6 Hrs.)

(6 Hrs.)

(6 Hrs.)

(6 Hrs.)

(6 Hrs.)

Teaching Scheme: Lectures: 3 hours/week Practical: 2 hours/week Theory Examination Scheme: In-sem : 30 marks (1 Hour) End-sem :70 marks (2.5 Hours) Term work: 50 Marks

Unit I

(6Hrs.)

Introduction to plumbing engineering Definition- plumbing engineering/public health engineering, Indian plumbing industry, Roles of plumbing contractor, plumber, plumbing consultant, plumbing terminology, Principles of plumbing,

a) Introduction to codes and standards:

Introduction to UPC-I and ITM, Green plumbing code supplement-India (GPCS-I) and other codes applicable in plumbing, Approvals of authority having jurisdiction, General regulations, Testing and labeling, Alternative materials, workmanship and minimum standards, Prohibited fittings and practices, Local laws related to plumbing.

b) Architectural and structural coordination, plumbing shafts, Sunken toilet floors, Ledge walls.

Unit II

Water Supply, fixtures and fittings.

- a) Water Supply: Types of water supply pipes Fittings and joints, Galvanized iron, Copper, Stainless steel, HDPE, MDPE, Rigid PVC, CPVC, PPR, Composite pipes, (PE-AL-PE), PEX, Joints, Jointing methods and materials, Tools etc. Water hammering, Pipe protection, Velocity, pressure, temperature limitations, Water Supply Fixture Unit (WSFU), Sizing, testing, Valves and regulators, Backflow prevention, Commissioning, Water tanks.
- b) Plumbing fixtures, Water conserving fixtures, Rating system for water efficient products, (WEP-I), Water closets, Bidets, Urinals, Flushing devices, Lavatory and bath units, Kitchen sinks, Water coolers, Purifiers, Drinking water fountain, Cloth washers, Mop sinks, Dish washers, Receptors Overflows, Strainers, Standard heights. Prohibited fixtures, Floor slopes, Minimum spacing.

Unit III

Sanitary system and Storm water Drainage:

a) Sanitary system: Fixtures, Appliances and appurtenance, Classification of fixtures, Soil and waste and grey water, Soil fixtures, Bathroom fixtures, Accessories, Indirect waste connections, Food handling establishments, Fixtures below invert level.

b) Building Drains:

Introduction, Four systems of plumbing, One pipe and two pipe system, Air admittance valves and solvents, Comparison of systems, Vent pipe, Symphonic action, Antisyphon and vent pipes, Loop, Circuits, Types of building drainage pipes, Fittings and jointing methods, Clean outs, Drainage fixture units (DFU), Sizing, Testing, Case study

Unit IV Traps and Interceptors

Traps-Purpose, Fixture traps and floor traps, Prohibited traps, Trap arm, Developed length, Trap seal, Trap seal protection, Venting of traps, Trap primers, Building traps, Clarifiers, Grease interceptors, Sizing, oil and sand interceptors.

b) Vents:

Vent requirement, Parts of vent system. Parts of vent system, Materials, Sizing, Vent connections, Flood rim level, Island sink venting, Venting of interceptors, Water curtain and hydraulic jump, Termination of vent stacks, Stack venting, Yoke vent, Wet venting.

Unit V

a) Building Sewers:

DFU, Change in direction of flow, Hydraulic jump,Sudsing stack, Cleanouts, Pipe grading, pipes and fittings suitable for building sewers, RCC, PVC, Nu-Drain, Stoneware., Sizing, testing, Types of traps, Gully, Chambers and manholes, Materials, Venting, Sizing, Testing, Sumps, Pumps, Sewage disposal, Septic tanks.

b) Plumbing in high rise buildings:

Definition of high rise building, Multiple storage tanks, Plumbing shafts, Break pressure tanks, Water supply, Hydro pneumatic system, Pressure reducing valves, Building drainage system, Rain water system, Sizing, Testing, Case study, Introduction to centralized hot water supply, Principles of design.

(6Hrs.)

Unit VI

Design Parameters & Case Study

Introduction, Plumbing Drawings & Layouts, Water Supply Design Consideration, Sewer Network design consideration, Storm water design consideration as per CPHEEO manuals, Case study on each.

Term work

Term work will consist of 8 assignments with necessary plans /sketches.

- 1. Introduction of available codes in plumbing
- 2. Introduction of associations in plumbing in India and outside India
- 3. Detailed hydraulic design for High rise structure OR G+1 Bungalow by using software.
- 4. Compilation of rules and regulations of local governing bodies.
- 5. Roles of plumbing contractor and plumbing consultants.
- 6. Report on Plumbing fixtures and fittings and explain any ten.
- 7. Report on materials for water supply and drainage.
- 8. Report on necessity of traps, intercepts and vents

Books:

- 1. "Plumbing Engineering" by Deolalikar.
- "Plumbing, Sanitation and Domestic Engineering" Volume 1to 4 by G. S. Williams, Mc Graw Hill.
- "Plumbing, Sanitation and Domestic Engineering, Data Sheets & Wall Charts" by G. S. Williams, Mc Graw Hill
- 4. "Plumbing Engineering, Theory and Practice" by Subhsh Patil. SEEMA Publishers Mumbai
- 5. "National Plumbing Codes Handbook", by R. Dodge Woodson.
- 6. "Central Public Health and Environmental Engineering Organisation Manual (CPHEEO)".

Codes:

- 1. Uniform Plumbing Code- India (UPC-I), 2008
- 2. Illustrated Training Manual (ITM), 2008.

401 010 Elective IV: Open Elective: 5 (b): Green Building Technology

Teaching Scheme: Lectures: 3 Hours/week Practical: 2 Hours/week Examination Scheme: Theory Examination: In-sem : 30 Marks (1 Hour) End-sem:70 Marks (2.5 Hours) Term work: 50 Marks

Unit I:

Materials and Its Applicability, Indoor Environmental Quality, Reuse and Recycle of Construction Waste.

- A) Eco Friendly/ Green Building Materials: To understand Environmental impact of building materials. Eco Friendly building materials, their composition, availability, production, physical properties etc. Application of the Eco Friendly/ Green Building materials for different components of the buildings at different level, both internally and externally.
- B) Indoor environmental quality, Low VOC materials: Adhesives Sealants, Paints- Coatings etc.
- C) Construction Waste as a Resource- Resource Economics, Disposable Materials, Recovery, Recycling, Collection, Processing, Governmental Role in Waste Management, Potential for Reuse.

Unit II

Site / Building Planning

- A) Sustainable Site planning: wind / sun path, water management , material use, landscape, topography.
- B) Climate Responsive Architecture: orientation, solar- wind, Building envelope.
- C) Thermal comfort indices. Heat flow through building materials. Thermal properties of common building materials available in India. Thermal performance of building envelope. Air movement and buildings. Ventilation and buildings. Wind an Stack effect. Mechanical ventilation. HVAC System, Day lighting. Passive and sustainable architecture. Passive and active systems.

Unit III

(6 Hrs.)

Embodied Energy, Life Cycle Assessment, Environmental Impact Assessment, Energy Audit and Energy Management.

(6 Hrs.)

- A) Embodied energy of various construction materials. Introduction to the Concept: "Life Cycle assessment of materials".
- B) EIA : Introduction to EIA., Process of EIA and its application through a case study., EIA as a strategic tool for sustainable development.
- C) Energy Management.

Unit IV

Appropriate Technologies / Approaches for:

- A) Water conservation / efficiency.
- B) Sanitation (Grey water, black water management, SWM)
- C) Treatments.
- D) Biogas.
- E) Composting.
- F) Solar energy and its applicability through panels, photovoltaic cells etc.
- G) Use of "LED, CFL, Fresnel Lens" etc.
- H) Wind energy and its use.
- I) Orientation aspects in site planning to achieve maximum daylight and natural ventilation.

UNIT V:

- A) Clean Development Mechanism.
- B) Kyoto Protocol.
- C) Energy Conservation Building Code.

UNIT VI

Rating Systems: - Leadership in Energy and Environmental Design (LEED), Green Globes, National Association for Home Builders (NAHB) – For Homes, Building Research Establishment Environmental Assessment Method (BREEAM), Green Star by Green Building Council Australia (GBCA), LEED India, Comprehensive Assessment System for Built Environment Efficiency (CASBEE), Estimada -Abu Dhabi Urban Planning Council (UPC) etc.

Term Work:

Any Eight of the following:

- A) To study: Innovative Materials Developed by CBRI, SERC.
- B) To study: Environmental Audit of any existing building and prepare a report.
- C) To study, analyze present scenario of organic waste collection and management of any of the premise; preferably hotels.

(6 Hrs.)

(6 Hrs.)

- D) To compare the benefits under different rating systems.
- E) To prepare detailed plan for a hypothetical site indicating utility of solar path, wind direction, rainfall intensity etc. to make it sustainable.
- F) To prepare a report on carbon credit.
- G) To prepare a report on energy efficient buildings in India.
- H) To study sustainable planning aspects for urban housing.
- I) Study of Design of On Site Sanitation Systems for Indian conditions developed by Appasaheb Patwardhan Safai V Paryavaran Tantraniketan, Dehugaon.
- J) To study the benefits given by Municipal Corporations to Green Buildings.

Reference Books and Additional Reading material:

- 1. Manual of Tropical housing and climate by Koenisberger.
- 2. Climate responsive architecture by Arvind Krishnan.
- 3. Manual of solar passive architecture by Nayak J.K. R. Hazra J. Prajapati.
- 4. Energy Efficient Buildings in India by Milli Mujumdar.
- 5. Green Building Materials by Ross Spiegel and Dru Meadows.
- 6. Publications from CBRI Roorkee, IDC Mumbai, NID Ahmedabad.
- 7. Solar Energy in Architecture and Urban Planning by Herzog Thomas.
- 8. Solar Heating, Design Process by Kreider Jan F.
- 9. Energy Manual for college teachers (CEE publications).
- 10. Renewable Energy & Environment A policy analysis for India (CEE publications).
- 11. Sustainable Building Design Manual-Volume I and II TERI Publication.
- 12. Mechanical and Electrical Systems in Construction and Architecture-by Frank R Dagostino.

Principles of Air conditioning-By V. Paul Lang:

- 1. Heating, Cooling and lighting design methods for architecture. By Lechor Worbert.
- 2. LEED Manual.
- 3. Green Globes Manual.
- 4. Florida Green Building Coalition Manual.
- 5. The green building process.
- 6. Green building codes and standards.
- 7. International Green Construction Code.
- 8. ASHRAE 189P.
- 9. ANSI/GG 01, TERI, BREEAM etc.

401 010 Elective IV: Open Elective: 5 (c): Ferrocement Technology

Teaching Scheme: Lectures: 3 hours/week **Practical: 2 hours/week** **Examination Scheme: Theory Examination:** In-sem : 30 marks (1 Hour) End-sem:70 marks (2.5 Hours) Term work: 50 Mark

Unit 1

What is Ferrocement?

a) Definition, Basic concept like bond increase. Comparison with concretes like RCC, Prestressed, Asbestos cement, Fiber reinforced, Polymer concretes. Composition of ferrocement. Special types of ferrocement. Ferrocement as substitute for conventional building materials. Typical characteristics and their applications.

b) Raw materials, skills, tools and plants. Ferrocement as material of construction. Forming a ferrocement structure. Properties and specifications of raw materials. Proportioning of cement mortar. Job requirements of required skills. Tools and plants.

Unit 2

Mechanical properties and construction methods:

- a) Mechanical properties and typical features affecting design. Properties under static and dynamic loading. Shrinkage and creep. Testing of ferrocement.
- b) Methods of constructing ferrocement structures. Standardizing method of construction. Planning the work. Fabricating skeleton, tying meshes and mortaring. Curing. Maintenance. Protective surface treatments. Damage to ferrocement structures.

Unit 3

Strength through shape and design:

a) Strength through shape. Design of structure based on form and shape. Forms in nature, various structural forma and their behavior. Typical strengths of different materials. Comparative study of various forms.

b) Design of ferrocement structures. Design, analysis and optimization. Special design considerations for ferrocement. Typical features of ferrocement affecting design. Conventional design methods like working stress, load factor, applied to ferrocement. Design based on equivalent area method for compression, tension and flexural members. Specific surface method and crack control method, Design of structures subjected to membrane stresses. Design of

(6 Hrs.)

(6 Hrs.)

shaped structures in ferrocement like stiffened plates, arch faced walls, stiffened cavity walls and hollow floors and beams, Design of forms like 'T' 'U' 'T' '+' 'L'

Unit 4

Cost analysis and ferrocement in Building construction.

a) Cost analysis : Factors governing cost analysis. Special considerations for ferrocement structures. Cost comparison with conventional construction. Specifications for ferrocement structures. Quantity analysis of material and labour for ferrocement items. Cost and value of ferrocement construction.

b) Ferrocement in building construction. Ferrocement in foundations, walls, floors roofs. Ferrocement single wall construction. Design and construction of houses with cavity walls, hollow floors and hollow beams. Staircases and other building accessories. Earthquake resisting structures. Special characteristics of ferrocement to resist shock loading design and construction of quake proof structures.

Unit 5

Hydraulic and soil retaining structures in ferrocement :

a) Hydraulic structures. Why ferrocement? Water retaining structures, Storage tanks of various types. Structures across streams. Ferrocement in layered form used for lining, water proofing and surface coating.

b) Soil retaining structures. Types of retaining walls and their comparison with ferrocement arch faced wall. Design and method of fabrication and casting. Ferrocement counterfort retaining wall. Ferrocement containers for storing granular materials.

Unit 6

Space structures and precast products:

a) Ferrocement large size special purpose structures. Space structures like shells, pyramids, domes corrugated catenaries.

b) Precast ferrocement products : Why ferrocement for precasting? Methods of precasting. Design of precast elements. Ferrocement precast walling and flooring panels. Joints in precast ferrocement elements.

Term Work :

Minimum 02 site visits with detailed reports and one assignment based on each unit (Journal consisting of total 6 assignments + 2 visit reports).

(6 Hrs.)

(6 Hrs.)

Books Recommended:

- 1) Ferrocrete Technology- A Construction Manual. -- Dr. B. N. Divekar Published by the Author.
- 2) Ferrocement --- : B. R. Paul and R. P. Pama.Published by International Ferrocement Information Centre. A.I.T. Bangkok, Thailand.
- 3) Ferrocement and laminated cementitious composites --: A.E. Naaman. Publisher : Technopress, Ann Arbor, Michigan, USA.
- 4) Ferrocement Materials and applications; Publication SP 61, A C I Detroit. USA
- 5) State of the art report and guide for design, Construction and repairs of Ferrocement; ACI Committee Report. No. ACI 549R-88 and ACI 549.1R.88. Published by American Concrete Institute, Detroit, USA.
- 6) Chapter 1 titled 'Ferrocement' by S. P. Shah and P. N. Balaguru in book 'Concrete Technology and Design Vol. II, Editor; R. N. Swamy.
- Proceedings of International Symposiums on 'Ferrocement and thin reinforced composites Ferro 1 to Ferro 10. Available with International Ferrocement Information Centre, A I T Bangkok, Thailand.
- Ferrocement Conference Proceedings of Ferrocement Society, India--FS 2011, F.S.2013, F. S. 2015.
Board of Studies (Civil Engineering) Syllabus for B. E. Civil 2015 Course (w.e.f. 2018

401 010 Elective IV: Open Elective: 5 (d): Sub Sea Engineering

Teaching Scheme Lectures: 3 hours/week Practical 2 hours/week Examination Scheme Theory Examination In-sem: 30 marks (1 Hour) End-sem: 70 marks (2.5.Hours) Termwork: 50 Marks.

Unit1

(6 Hrs.)

Introduction to oil and gas industry: general view of oil and gas industry, technological challenges and future developments. Overview of deep water developments: introduction, deep water areas and potential, challenges, route for development Metaocean and environmental conditions: Overview of the determination of Metaocean conditions (meteorological and oceanographic) and the influence of wave, wind, tide and current on marine operations. Introduction to marine ecology and its impact on marine operations.

Unit 2

Introduction to subsea infrastructure development: Summarize the current state of the art and highlights the design challenges. Outlines the way in which water depth influences the architecture and technology of Oil and Gas infrastructure.

Flow assurance: overview of flow assurance and the fundamentals of flow management for subsea production systems, Introduction to flow assurance issues like paraffin deposition; hydrate formation and blockage; Asphaltene precipitation; emulsions; experimental methods, flow assurance assessment methods; prevention, mitigation and remediation tools for flow assurance issues; thermal management and insulation materials.

Unit 3

Subsea installation and intervention: Overview of the installation of subsea plant, risers and pipelines and the main intervention methods including AUVs, ROVs and divers.

Subsea operations and control: An overview of the principle methods of subsea control including electrical, acoustic and hydraulic systems.

Subsea processing and artificial lift: introduction the analytical and numerical models used to design subsea processing systems for sustained recovery of hydrocarbons.

Unit 4

Reliability and integrity management: Introduction to Risk Assessment, FMECA and HAZOPS, Monitoring, Intervention and Inspection Methods, Data Management Construction management of oil field, future challenges.

Unit 5

Subsea field equipment, structures and architectures: scale of operations, environmental factors, A description of each of the pieces of the subsea infrastructure, their use and interconnection including subsea trees, flow lines, umbilicals, risers, moorings and pipelines Materials and corrosion. Types of corrosion found in the oilfield with emphasis on the effects of acid gases (CO_2 and H_2S).

Unit 6

Pipelines and design: Introduction to pipeline engineering, the main pipeline design challenge in deep water. Analysis and design methods of pipelines that address stress analysis, buckling and collapse of deep water pipelines. Limit state based strength design methods. Geotechnical aspects of pipeline design and its installation.

Deepwater risers: different design options available for deep water risers, and defines the key design drivers for each. General principles of stress analysis: An introduction to the principles of stress analysis and the principles of reliability based design, finite element analysis.

Termwork:--Shall consist of one assignment per unit.

References:

- 1. A Primer of Offshore Operations by Petex
- 2. Subsea Engineering Handbook Hardcover by Yong Bai (Editor), Qiang Bai (Editor)
- C. Norsok standard Common requirements Subsea structures and piping system U-cr-001 Rev. 1, January 1995.
- D. Norsok codes, DNV codes : Design specifications for subsea system.

(6 Hrs.)

401 010 Elective IV : Open Elective : 5 (e): (Geoinformatics)

Teaching Scheme: Lectures: 3 Hrs/week

Unit I

Introduction to Remote Sensing GIS and SBPS:

Electro-magnetic radiations (EMR) - atmospheric scattering, Raleigh scattering, Mie scattering, non-selective scattering - atmospheric absorption - atmospheric windows, refraction - interaction of EMR earth's surface - reflection - transmission - spectral signature - Reflectance characteristics of Earth's cover type: Vegetation, water, soil

Introduction to GIS - Basic spatial concepts - Coordinate Systems - GIS and Information Systems – Definitions – History of GIS - Components of a GIS – Hardware, Software, Data, People, Methods – Proprietary and open source Software - Types of data – Spatial, Attribute data- types of attributes – scales/ levels of measurements. Introduction to SBPS, Segments and errors in GPS.

Unit II

THERMAL REMOTE SENSING: Thermal radiation principles – Thermal interaction sensors and characters – thermal image characters – image degradation sources & correction – interpretation of thermal images – Application and Case studies.

MICROWAVE REMOTE SENSING: Introduction-Plane waves-Interference, Radar remote sensing - Radar basics- Antenna Systems -Real aperture radar - Radar frequency bands - SLAR Imaging Geometry, Resolution Concepts - Geometric Distortions, SAR – Concepts - Doppler principle & Processing. RADAR Interaction with earth surface- RADAR equation.

Unit III Unit II

DIGITAL IMAGE PROCESSING :

Fundamentals of Image Processing, sensors model and pre processing, image enhancement, image classification, object recognition.

Examination Scheme: Paper In-sem. 30 Marks (1 Hrs), Paper End-sem : 70 Marks (2.5 Hrs.)

(6 Hrs.)

(6 Hrs.)

Unit IV

OPEN SOURCE GIS:

DESKTOP GIS WITH OPEN SOURCE GIS : View Graphics – Data exchanges- portability and interoperability – Raster handling and Image analysis – vector data management –Rater and vector analysis - 2D/3D vectors with topology, 3D Voxel, 2D Raster.

OPEN SOFTWARE AND WEB MAPPING : Open Source Software : GRASS, QGIS, OSSIM, PostopesSQL and (R) Environment – WEB Mapping Architecture and components – WEB mapping servers- Thin clients in WEB mapping - WMS,WFS, WCS,WPS and other web services- Open Server standards.

Unit V

MAP PROJECTION:

Concepts of sphere, ellipsoid and geoid - latitudes, longitudes and graticules –map projections– shape, distance, area and direction properties - role of aspect, development surface, secant and light source / view points – perspective and mathematical projections – Indian maps and projections – Map co-ordinate systems – UTM and UPS references – common projections and selections– projections for hemispheres and the world maps , Map projection for cadastral maps.

Unit VI

FUNDAMENTALS and GEOMETRIC GEODESY:

Definitions- Classifications, Problem of Geodesy and purpose of Geodesy Historical development and Organization of Geodesy. Reference Surfaces and their relationship. Applications, Engineering, Lunar, Planetary and interferometric Synthetic aperture radar Geodesy – Local and International Spheroid.

Geomentry of ellipsoid, fundamental mathematical relationship of ellipsoid, Geodetic, Geocentric and Reduced latitudes and their relationship. Ellipsoidal Co-ordinates in terms of Reduced, Geodetic and geocentric latitude. Radius of curvature in the meridian & prime vertical and their relationship. Mean Radius of curvature in any azimuth, Length of the meridian arcs and arcs of parallel and Area of trapezium on the ellipsoid. Curves on the ellipsoid, properties of Geodesic.

(6 Hrs.)

Reference Books:

- 1. Wolfgang Torge, Geodesy, Walter De Gruyter Inc., Berlin, 2001
- Lillesand, T.M. and Kiefer R.W. Remote Sensing and Image interpretation, John Wiley and Sons, Inc, New York, 2002.
- Neteler M, Helena M (2008) _Open source GIS: A GRASS GIS approach', 3rd edn, Springer, New York
- 4. Kang-Tsung Chang, Introduction to Geographic Information Systems, Mc-Graw Hill Publishing, 2nd Edition, 2011.
- John, R. Jensen, Introductory Digital Image Processing, Prentice Hall, New Jersey, 2005 3rd edition
- 6. R.W. Anson and F.J. Ormeling, Basic Cartography for students and Technicians. Vol.I, II and III, Elsevier Applied Science Publishers, 3rd Edition, 2004.