Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institute of Information Technology, Pune-48

(An Autonomous Institute affiliated to Savitribai Phule Pune University)

Syllabus for

S.Y.B. Tech.

Civil Engineering (Pattern 2017)

Department of Civil Engineering

Vision:

Excellence in Civil Engineering Education

Mission:

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

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

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

PROGRAM EDUCATIONAL OBJECTIVES

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

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

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

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

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

PROGRAM SPECIFIC OUTCOMES (PSO):

PSO1: Engineering graduates will be able to plan and execute various activities on construction projects.

PSO2: Engineering graduates will be able to analyze and design a system, component or process to meet desired needs, using fundamental knowledge of mathematics, science and engineering.

Department of Civil Engineering

Second Year B. Tech. Civil Engineering (SYBT) - Semester I (Pattern 2017)

Course Code	Course	Course Type	Teaching Scheme			Examination Scheme					Total	Credits
						Formative Assessment			Summative Assessment			
			L	T	P	ISE T1	ISE T2	CE	ESE	PR/ OR		
CVUA21171	Engineering Mathematics – III	TH	4	-	-	15	15	20	50	-	100	4
CVUA21172	Mathematics Practice – III	CE	-	1	-	-	-	50	-	-	50	1
CVUA21173	Infrastructure Engineering	TH	3	1	-	15	15	20	50	-	100	4
CVUA21174	Strength of Materials*	TH	3	-	-	15	15	20	50	-	100	3
CVUA21175	Concrete Technology*	TH	3	-	-	15	15	20	50	-	100	3
CVUA21176	Building Materials and Construction*	TH	3	-	-	15	15	20	50	-	100	3
CVUA21177	Lab Practice – I	CE-PR/OR	-	-	6	-	-	50	-	50	100	3
CVUA21178	Skill Development (Civil Engineering Skills and Practices - I)	CE	-	-	2	-	-	50	-	-	50	1
CVUA21179	Environmental Studies	CE	1	-	2	-	-	50	-	-	50	2
A2	Audit Course	-	-	-	-	-	-	-	-	-	-	-
	Total	**-**	**17**	**2**	**10**	**75**	**75**	**300**	**250**	**50**	**750**	**24**

*Courses have lab practice component of 2 hrs./week each under Lab Practice head.
Theory, Tutorial : 1hr. : 1 Credit, Practical: 2 hrs. : 1 Credit, Audit Course: No Credits

Audit Courses: Professional Ethics; Cyber Security; Value Engineering and Human Rights; Legislative Procedures; Technical Writing/Documentation; Sports/Yoga; Performing Art such as music, dance, and drama etc.; Languages; Online certification course (minimum two weeks); Participation in intercollegiate co-curricular and extra-curricular activities.

BOS Chairman Dean Academics Director

Second Year B. Tech. Civil Engineering (SYBT) - Semester II (Pattern 2017)

Department of Civil Engineering

Course Code	Course	Course Type	Teaching Scheme			Examination Scheme					Total	Credits
						Formative Assessment			Summative Assessment			
			L	T	P	ISE T1	ISE T2	CE	ESE	PR/ OR		
CVUA22171	Theory of Structures	TH	4	-	-	15	15	20	50	-	100	4
CVUA22172	Theory of Structures Practice	CE	-	1	-	-	-	50	-	-	50	1
CVUA22173	Fluid Mechanics-I*	TH	3	-	-	15	15	20	50	-	100	3
CVUA22174	Surveying*	TH	3	-	-	15	15	20	50	-	100	3
CVUA22175	Geotechnical Engineering*	TH	3	-	-	15	15	20	50	-	100	3
CVUA22176	Psychology	TH	3	-	-	15	15	20	50	-	100	3
CVUA22177	Lab Practice –II	CE-PR/OR	-	-	6	-	-	50	-	50	100	3
CVUA22178	Skill Development (Civil Engineering Skills and Practices II)	CE	-	-	2	-	-	50	-	-	50	1
CVUA22179	Project Management	CE	2	-	-	-	-	50	-	-	50	2
A2	Audit Course	-	-	-	-	-	-	-	-	-	-	-
	Total	**-**	**18**	**1**	**8**	**75**	**75**	**300**	**250**	**50**	**750**	**23**

*Courses have lab practice component of 2 hrs./week each under Lab Practice head.
Theory: 1hr. : 1 Credit, Practical: 2 hrs. : 1 Credit, #1 hr. : 1 Credit, Audit Course: No Credits

Audit Courses: Professional Ethics; Cyber Security; Value Engineering and Human Rights; Legislative Procedures; Technical Writing/Documentation; Sports/Yoga; Performing Art such as music, dance, and drama etc.; Languages; Online certification course (minimum two weeks); Participation in intercollegiate co-curricular and extra-curricular activities.

BOS Chairman Dean Academics Director

Semester – I

Engineering Mathematics – III (CVUA21171)

Teaching Scheme
Credits: 4
Lectures: 4 hrs./ week
Practical: NA
Tutorial : NA

Examination Scheme
Formative Assessment: 50 Marks
Summative Assessment: 50 Marks

Course Objectives:
To develop the ability, to know the concepts of Engineering Mathematics and to apply these to solve engineering problems in various fields. The Tutorial sessions and assignments will help the students to practice more problems on all the topics mentioned in the course contents.

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

1. Solve higher order linear differential equations comprising of problems on bending of beams, whirling of shaft and mass spring system.
2. Apply Fourier Transform and Numerical technique, to analyse the data.
3. Demonstrate Statistical technique to analyse the data.
4. Apply vector differentiation for Conservative and irrotational vector fields.
5. Solve Line Integral, surface integral, volume integrals.
6. Solve boundary value problems (Wave, Heat, & Laplace equations)

Unit I - Linear Differential Equations

Linear Differential Equations (LDE) Solution of nth order LDE with Constant Coefficients, Method of Variation of Parameters, Cauchy's & Legendre's DE, Solution of Simultaneous & Symmetric Simultaneous DE, Modeling of problems on bending of beams, whirling of shaft and mass spring system.

Unit II - Numerical methods and Fourier Transform

Numerical solution of 1) System of Linear Equations by Gauss Elimination. Gauss Seidel method 2) Ordinary Differential equations by Runge kutta 4^{th} order method.
Fourier Transform, Fourier cosine and sine Transforms, Inverse Fourier Transform.

Unit III – Statistics and Probability

Measures of Central Tendency, Standard Deviation, Coefficient of Variation, Moments, Skewness and Kurtosis, Correlation and Regression, Reliability of Regression Estimates ,Theorems and Properties of Probability, Probability Density Function, Probability Distributions: Binomial, Poisson, Normal and Hypergometric; Test of Hypothesis: Chi-Square test.

Unit IV - Vector differential Calculus

Vector Differential Calculus: Physical Interpretation of Vector Differentiation, Vector Differential Operator, Gradient, Divergence and Curl, Directional Derivative, Solenoidal, Irrotational and Conservative Fields, Scalar Potential, Vector Identities.

Unit V - Vector Integral Calculus
Vector integration, Line integral, Greens Theorem, Gauss divergence Theorem. Stokes theorem and application to problems in Electromagnetic fields.
Unit VI - Applications of Partial Differential Equations.
Basic concepts, modeling of vibrating string ,wave equations, one and two dimensional heat flow equations, method of separation of variables, use of Fourier series. Applications of PDE to problems of civil Engineering and allied Engineering.
Text books: 1. Higher Engineering Mathematics Dr. B. S. Grewal, Khanna Publications 2. Applied Engineering Mathematics by P. N. Wartikar and J. N. Wartikar, Pune Vidyarthi Griha Prakashan
Reference books: 1. Advanced Engineering Mathematics By Erwin Kreyszig, Wiley Publications. 2. Advanced Engineering Mathematics By O'Neil, Cengage India.

Mathematics Practice III- (CVUA21172)

Teaching Scheme
Credits : 1
Theory: NA
Practical: NA
Tutorial : 1 hr./ week

Examination Scheme
Formative Assessment : 50 Marks
Summative Assessment: NA

Course Objectives :
To develop the ability, to know the concepts of Engineering Mathematics and to apply these to solve engineering problems in various fields. The Tutorial sessions and assignments will help the students to practice more problems on all the topics mentioned in the course contents.

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

1. Solve higher order linear differential equations comprising of problems on bending of beams, whirling of shaft and mass spring system.
2. Apply Fourier Transform and Numerical technique, to analyse the data.
3. Demonstrate Statistical technique to analyse the data.
4. Apply vector differentiation for Conservative and irrotational vector fields.
5. Solve Line Integral, surface integral, volume integrals.
6. Solve boundary value problems (Wave, Heat, & Laplace equations)

Tutorial No.1 Linear Differential Equations
Problems on Differential Equations
Tutorial No.2 Fourier Transform
Problems on Fourier Transform
Tutorial No.3 Numerical methods
Problems on Numerical Methods
Tutorial No.4 Statistics and Probability
Problems on Statics and Probability
Tutorial No.5 Vector differential Calculus
Problems on Vector Differentiation
Tutorial No.6 Vector Integral Calculus
Problems on Vector Integration
Tutorial No.7 Applications of Partial Differential Equations.
Problems on Wave, Heat Equation
Tutorial No.8 Applications of Partial Differential Equations
Problems on Laplace equations

Tutorial No.9 Group Presentations
Groups presentations on Applications of Linear Differential Equations
Tutorial No.10 Group Presentations
Text Books: 1. Higher Engineering Mathematics Dr. B. S. Grewal, Khanna Publications Applied Engineering Mathematics by P. N. Wartikar and J. N. Wartikar, Pune Vidyarthi Griha Prakashan
Reference Books: 1. Advanced Engineering Mathematics By Erwin Kreyszig, Wiley Publications. Advanced Engineering Mathematics By O'Neil, Cengage India.

Infrastructure Engineering (CVUA21173)

Teaching Scheme
Credits : 4
Lectures : 3 Hrs./week
Practical: NA
Tutorial: 1 Hr./Week

Examination Scheme
Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Course objectives:

- To provide basic understanding of various transportation systems (rail, road, air, and water) and construction techniques used for them.
- To give an outline of fundamentals of design, construction and maintenance aspect with reference to transportation modes.
- To introduce various structures needed for transportation modes, their locational and safety, aspects.

Course Outcomes:

Upon completion of this course, student will be able to:

1. **Explain** scope of infrastructure development in national as well as global context and **compare** various transportation systems.
2. **Identify** and **describe** components of a permanent way and modern developments in railways.
3. **Illustrate** geometric design fundamentals of railways and **discuss** details of railway track as well as its maintenance.
4. **List** various types of transportation structures and construction techniques for them.
5. **Identity** requirements of docks, harbors and **classify** the harbors.
6. **Explain** airport planning, layout and zoning requirements.

Unit I – Introduction to Infrastructure Engineering

Scope of infrastructure engineering in national and global development. Necessity, advantages and disadvantages of PPP (Public Private Partnership).
Introduction to various Transportation Systems including rail transport, road transport, air transport, and waterways. Comparison of various modes of transportation. Salient features of smart city, Bus Rapid Transit system.

Unit II - Railway Engineering – Permanent Way and Modernization

Permanent way, Track structure of BG, Functions of rail, Standard rail, Tilting of rail, Coning of wheels, Types of sleepers, Fastenings, Ballast, Rail joints, types, ill effects, remedial measures, Welding of rails, Short and long welded rails.
Modern development in railways- metro rails, mono rails, bullet train.

Unit III – Railway Engineering – Geometric Design and Track Maintenance

Types of gradients, Curves, Grade compensation on curves, Alignment, Super elevation, Equilibrium cant, Equilibrium speed, Maximum permissible limits for cant, Cant deficiency, Cant excess, Speed on curves, Safe speed on curves using Indian railways formula only for fully transition curves, Concept of negative cant.

Points, crossings and turnouts- functions, Components, elements of points, Types of crossings and turnouts, Track maintenance: Regular and Periodic.

Unit IV – Transportation Structures

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

Bridges - Types – Culverts, Bridge, fly-overs, components, classification, requirements, site selection, alignment, bridge sub structure, Bridge Super Structure - Super structure elements, bridge flooring, slab bridges & girder bridges, bridge bearings, joints in bridges, piers, abutments, wing walls and approaches, loads and stresses. Erection of bridge super structure and maintenance.

Unit V – Docks and Harbors

Introduction, Requirements of harbors and ports, Classification of harbors with examples, Selection of site for harbor.

Various components of ports, Break waters- types, comparison, design criteria , methods of construction, Tetra pod, Tri bar, Hexapod, Quay wall, Wet & dry dock, Floating dock, Wharves, Jetties, Types of fenders, Dolphin. Dredging techniques.

Unit VI – Air Transport

Advantages and limitations of air transportation. Airport planning: scientific planning of airports, selection of sites, survey and drawings to be prepared for airport planning. 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. Runways and taxiways: Runway orientation, wind coverage, use of wind rose diagram, basic runway length, corrections for elevation, temperature and gradient as per ICAO and FAA recommendation. Airport classification by ICAO.

Text books:

1.Construction Planning Methods & Equipment: Puerifoy –Tata MC Graw Hill
2. Railway Engineering, 2nd Edition by Chandra—Oxford University Press
3. Bridge engineering – S. Ponnuswamy, Tata Mc Graw – Hill publishing co. Ltd.
4. Airport planning and design – S.K. Khanna , M.G. Arora , S.S. Jain, Nem Chand and Brothers
5. Harbor, Dock & Tunnel Engineering: R. Srinivasan

Reference books:

1.Construction Equipments & its Management: S.C Sharma,Khanna Publication
2. Railway Track Engineering: J.S.Mundrey,Tata McGraw Hill
3. Dock & Harbor Engineering: Hasmukh P.Oza & Gautam H.Oza-Charoter Book Stall
4. Essentials of Bridge Engineering – D. Johnson and Victor, Oxford and IBH publishing.

5.Airport Engineering - Rangawala, Charotar publishing House
Tutorials
1. Presentation by students of a Case Study of PPP (Unit-I). 2. Presentation by students of a Case Study of Smart City (Unit-I). 3. Presentation by students of a Case Study of BRT (Unit-I). 4. Presentation by students on case studies of metro rail, mono rail and bullet train (Unit-II). 5. Group Discussion on functioning/ operations of Railways in India, details of permanent track and geometric design aspects such as gradient, curves, etc. (Unit-III) 6. Presentation by students on case studies of tunnels (tunneling) under different types of terrains and geological (sub-soil) conditions (Unit-IV). 7. Presentation by students on case studies of road and railway bridges for different types of terrains and geological (sub-soil) conditions (Unit-IV). 8. Presentation by students on case studies of docks and harbours (Unit-V). 9. Presentation by students on fundamentals of airport with reference to a new/ proposed airport (Unit-VI). 10. Presentation by students on fundamentals of airport design (Unit-VI). 11. Presentation by students on case studies of an Airport (Unit-VI).

Strength of Materials (CVUA21174)

Teaching Scheme
Credits : 3
Lectures : 3 Hrs./week
Practical: NA
Tutorial: NA

Examination Scheme
Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Course Objectives:
The course will help

- To prepare students to compute axial, bending, torsion, shearing and combined stresses in beams.
- To prepare students to draw Axial Force Diagram, Shear Force Diagram, Bending Moment Diagram and Torsion Moment Diagram
- To prepare students to compute Principal Stresses and Strains using analytical and graphical methods.
- To prepare students to compute deflections of beams

Course Outcomes:
At the end of the course the students will have an ability to:

1. **Apply** equilibrium equations to calculate the internal forces like shear force and bending moments for various beam configurations
2. **Demonstrate** knowledge of various types of stresses and strains
3. **Apply** flexural formula and shear formula to study bending stress and shear stress distribution
4. **Determine** critical load on columns and investigate direct and bending stresses for columns, chimneys and dams
5. **Identify** principal planes and compute principal stresses due to combination of axial forces, bending moments and shear.
6. **Determine** slope and deflection of various types of beams and apply torsion formula to circular shafts

Unit I – Shear Force Diagram and Bending Moment Diagram

Types of supports and beams, Shear force, bending moment, relation between loads, shear force and bending moment, S.F.D. and B.M.D. for Cantilevers, Simple supported beams.
Beams with overhangs, beams subjected to couples. Maximum bending moment for a beam, point of contra flexure, properties of shear force and bending moment diagrams.

Unit II – Simple Stresses and Strains

Resistance of axially loaded bar, concept of stress, Normal Stresses, simple stress, shear stress, bearing stress, simple strain, shearing strain, working stress, ultimate stress, factor of safety, stress-strain diagram, Hooks Law, lateral strain.
Bars of varying section, bars of uniform tapering section, bars of composite sections, stresses due to changes of temperature, Axial force diagrams.

Concrete Technology (CVUA21175)
Unit III – Stresses in Beams
Definition, Theory of simple bending, Neutral axis, bending stress, bending stress distribution, Moment of resistance, Bending equation, Moment of Inertia, Section modulus, section moduli for rectangular, triangular, circular, I and T sections. Equivalent or transformed section, Beams of uniform strength. Shear stress, shear stress distribution for rectangular, triangular, circular I and T sections. Shear Centre.
Unit IV– Direct and Bending Stresses
Axially loaded compression members, crushing load, crippling or critical load, Euler's theory of long columns and Rankine's formula. Combined direct and bending stresses, eccentric load on short columns, kern of a section, eccentricity of load about both axes of section. Chimney subjected to wind pressure and simple problems on dams.
Unit V– Principal Stresses and Strains
Normal and tangential stresses, Principal stress, Principal planes, normal and shear stresses on oblique plane, Ellipse of stress, Mohr's circle of stress. Determination of principal plane and principal stresses, analytical and graphical methods
Unit VI –Deflection of Determinate Beams and Torsion of Circular Shaft
Beam differential equation, Macaulay's method, Castigliano's first theorem, unit load method, Concept of moment area method and conjugate beam method. Torsion of circular shafts: Theory of pure torsion, Torsion formula, Torsion moment of resistance,solid and hollow circular determinate shafts, Torsion Moment Diagram, transmission of power through circular shafts.
Text books: 1. Strength of Materials- S.Ramamrutham- Dhanapat Rai Publishing Company 2. Strength of Materials- S.S.Rattan- Tata Mc Graw Hill Education Pvt. Ltd. New Delhi 3. Strength of Materials- Dr. R.K.Bansal-Laxmi Publications (P) Ltd.
Reference books: 1. Structural Analysis- R.C.Hibbler , Pearson. 2. Mechanics of Materials- Beer Ferdinand P, Johnston E Russell, DeWolf John T, Tata McGraw-Hill 3. Mechanics of Materials-Gere James M, PWS Publishing Company

Teaching Scheme:

Credits : 3
Lectures: 3 hrs. / week
Practical: NA
Tutorial: NA

Examination Scheme:

Formative Assessment: 50 Marks
Summative Assessment: 50 Marks

Course Objectives: To prepare the students to;

- Understand and gain fundamental knowledge of various ingredients of concrete including their properties.
- Review and apply the QAQC norms as per standards in constriction practices.
- Acquire the knowhow of special concretes and NDT methods for concrete.
- Be cognizant of various technologies in concreting.
- Be able to design concretes mixes using standards.
- Acquire the knowledge of durability requirements of concrete and its maintenance**..**

Course Outcomes:

At the end of the course the students will have an ability to:

1. Identify the materials used to make concrete; including their sources, production and properties.
2. Appraise and practice standard tests relevant to the use and QAQC norms of fresh concrete and hardened concrete.
3. Evaluate the different types of special concretes based on their properties and applications.
4. Identify and select the various concreting technologies to place the concrete on site.
5. Design concrete mixtures with and without admixtures per standard codes.
6. Examine the durability requirements of concrete and Choose suitable maintenance measures.

Unit I – Introduction to Concrete as a Construction Material

Cement – manufacture of Portland cement, basic chemistry of cement, hydration of cement, classification of cement, types of cement, tests on cement-field tests & laboratory tests Fly Ash: Classification of fly ash , properties of fly ash, tests on fly ash.
Aggregate and water – Different classifications, Fine aggregate, coarse aggregate , mechanical properties, physical properties, deleterious materials, soundness, alkali-aggregate reaction, sieve analysis: fineness tests on aggregates, artificial and recycled aggregate, mixing water, curing water, tests on water. Admixtures – functions, classification, types: mineral and chemical, IS: specifications (9103 and 456), compatibility of admixtures.

Unit II – Properties, Production and Placement of Concrete

Fresh concrete: workability – factors affecting workability, cohesion and segregation, Bleeding, Laitance, workability tests, mixing- handling, placing and compaction of concrete, Hardened concrete: Strength of concrete, factors affecting strength, compression test on cube and cylinder, Flexural test, indirect tensile strength, micro-cracking and stress-strain relationship, other strength properties, relation between tensile and compression strength, impact strength, abrasion resistance, elasticity and creep, shrinkage and swelling, maturity rule.

Unit III – Non Destructive testing of Concrete &Special Concretes

Nondestructive testing: Rebound hammer, Ultrasonic pulse velocity, Pullout test and Impact echo test, Core test, Rebar locator.
Special concretes: light weight concrete, Cellular light weight concrete-Form concrete and autoclave C.L.C,

polymer concrete, types of fibers, fiber reinforced Concrete, high density concrete, self-compacting concrete and applications.

Unit IV – Special Concreting Technology

Introduction to concrete related equipments: batching plants, hauling, pumps, Types of concrete mixers – Tilting, Non tilting and Reversible drum mixer, Types of vibrators
Special concreting techniques: pumping of concrete, under water concreting, ready mix concrete, roller compacted concrete Cold weather concreting, hot weather concreting, shotcrete. Ferrocement: Introduction, Definition, Basic concepts in forming ferrocement composites, Methods of construction, Applications in construction industry.

Unit V – Concrete Mix Design

Concepts of Mix Design, Factors for proportioning of concrete. Factors to be considered, Statistical quality control, Laboratory trial mixes and guidelines to improve mix
Methods of Mix Design- IS (10262-2017, 456) and DOE. Demonstration and application of concrete mix design software

Unit VI – Durability and Maintenance of concrete

Durability: permeability, chemical attack and sulphate attack by seawater, acid attack, chloride attack, carbonation of concrete and its determination, corrosion of reinforcement,
Maintenance: Corrosion monitoring techniques & preventive measures, Symptoms and diagnosis of distress, evaluation of cracks, selection of repair procedure, choice of repair material, repair of defects, common types of repairs, Introduction of retrofitting by using FRP, Steel Jacketing.

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

Reference books:

1. Properties of concrete by A. M. Neville, Longman Publishers.
2. Concrete Technology by R.S. Varshney, Oxford and IBH.
3. Concrete technology by A M. Neville, J.J. Brooks, Pearson
4 Ferrocement Construction Mannual-Dr. D.B.Divekar-1030,Shivaji Nagar,Model Colony, Pune
5 Concrete Mix Design-A.P.Remideos--Himalaya Publishing House (ISBN-978-81-8318-996-5)
6. Concrete, by P. Kumar Metha, GujratAmbuja.

General Reading suggested:

1) Codes : 1)IS 456 2)IS 383 3)IS 10262-2017 4)IS 9103 and other related codes.
2) Ambuja cement booklets on concrete
3) ACC booklets on concrete

Building Materials and Construction (CVUA21176)

Teaching Scheme
Credits: 3
Lectures: 3 hrs. / week
Practical: NA
Tutorial: NA

Examination Scheme
Formative Assessment. : 50 Marks
Summative Assessment : 50 Marks

Course Objectives:

- To prepare students with an ability to understand different building components,
- To prepare students for choosing different building materials and construction practices,
- To increase the awareness amongst the students for various safety measures during construction.

Course Outcomes: At the end of the course the students will have an ability to,

1. **Compare** and **choose** different types of buildings, building elements and apply the same in given situations and masonry.
2. **Understand** block masonry, plaster and formwork.
3. **Interpret** function of various building components,
4. Plan and **Design** different types of staircases,
5. **Determine** various types of Doors, Windows, Arches and Lintels
6. **Demonstrate** various safety measures on Construction Site.

Unit I - Introduction to Building Construction and Masonry

Introduction to building construction- definition, types of building as per national building code. Substructure Types of shallow and deep foundation and their suitability, Causes of Failures in foundations. Damp proof course, plinth filling and soling.

Masonry- Stone masonry- Principal terms, types of stone masonry. Brick masonry- characteristics of good building bricks, IS specification and tests, classification of bricks (silica, refractory, fire and fly ash bricks). Brick work, types of bonds- English, Flemish, Header, Stretcher, construction procedure, supervision, underpinning, Scaffolding- Purpose, types, suitability.

Unit II - Block Masonry and Form work

Block masonry: Cellular Lightweight Concrete blocks, Hollow blocks, solid blocks, cavity wall construction. Reinforced brick masonry: applications, advantages, materials required and construction procedure. Composite masonry- types, advantages, applications, materials required and construction procedure.

Form work and casting procedure for reinforced concrete columns, R.C.C. beams and girders, R.C.C. slabs, curing methods, precast concrete construction and joints in concrete work. Slip Form work- Component parts.

Unit III - Flooring and Roofing Materials
Flooring and flooring materials -Functional requirement of flooring, varieties of floor finishes and their suitability, construction details for concrete, tiles and stone flooring. Types of flooring: (timber flooring, cement concrete flooring, tiled flooring, rubber flooring, cork flooring, epoxy asphalt flooring or mosaic asphalt flooring) Roofing materials: GI, AC fiber sheets. Roof construction: types and their suitability, method of construction, types of trusses.
Unit IV - Doors, Windows, Arches and Lintels.
Doors and windows: definition of technical terms, installation of doors and window frames and their size specifications, fixtures and fastenings. Types of doors (glazed or sash doors, plastic doors, flush doors, louvered doors, collapsible doors, revolving doors, rolling steel doors, sliding doors, swing doors, folding doors.) Types of windows: (casement window, double hung window, pivoted window, sliding windows, louvered or Venetian window, metal window, sash or glazed window, bay window, corner window, dormer window, gable window, skylight window, circular window, mosquito proof window, curtain wall window.) Ventilators: purpose and types. Arches and lintels: principle of arch action, types of arches, method of arch construction, Lintels: necessity and types, chajja or weather shade necessity and types.
Unit V - Vertical Circulation and Protective Coatings
Vertical circulation: design considerations, Types of Staircase and ramps. lifts, and escalator. Materials, fire resisting materials, Protective coatings: plastering types and application, plastering methods, modern materials for plaster. pointing- purpose & types, mortar- Preparation and types, painting and varnishing, white washing, distempering, oil paints. Wall cladding: materials, method, wall papering and glazing work.
Unit VI- Miscellaneous Materials and Safety in Construction
Miscellaneous materials: Properties, types and uses of following materials, lime, polymers, plastic, gypsum, clay tiles and glazed wares, aluminum panel cladding, Steel. Structural 3-D printing, Glass: uses, types and properties, Glass claddings, Eco-friendly materials. Safety in construction: safety on site, storage of materials, construction safety, prevention of accidents, Repairs and maintenance: addition, and alteration, Plumbing: Drainage fixtures units , pipe capacity, ,Fixtures, types of pipes
Text books: 1. Building Construction --- B.C. Punmia, Laxmi Publications 2. Building Materials— S.V.Deodhar , Khanna Publication 3. Building Construction -- Bindra and Arora (Dhanpat Rai Publications) 4. Building Construction -- S.C. RangwalaCharotar Publishing House
Reference books: 1. Building Materials---S.K. Duggal—New Age International Publishers 2. Materials of construction --- Ghosh, Tata McGraw Hill. 3. National Building Code of India 2005 (BIS) IS Code 962:1989

Department of Civil Engineering

Lab Practice-I (CVUA21177)

Teaching Scheme
Credits : 3
Theory: NA
Practical: 6 hrs. / week;
Tutorial: NA

Examination Scheme
Formative Assessment: 50 Marks
Summative Assessment : 50Marks

Course Objectives:

- To impart the knowledge of tests to study various mechanical properties of metals
- To impart the knowledge of various tests on cement, fine aggregates and coarse aggregates
- To impart the knowledge of building components and various tests on bricks and tiles

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

1. Conduct tension test, shear test, torsion test and impact test on metals
2. Conduct compression test, bending test on timber
3. Conduct Fineness test, Standard consistency test, setting time and Soundness test, workability and compressive strength of cement
4. Conduct Fineness modulus test, Moisture content test, silt content test, density and Specific gravity of fine aggregate test, Flakiness and Elongation test of coarse aggregate, Impact Value and crushing Value test of fine/coarse aggregate
5. Draw plan of existing building and sketches of paneled door, window, staircase and masonry, shallow foundations, deep foundations and arches using CAD
6. Conduct test on flooring tiles and bricks

Strength of Materials

The term work shall consist of a journal giving details of the following,

1. Tension test on mild and TMT steel.
2. Tension test on M.S. Flat section.
3. Shear test on mild and TMT steel.
4. Torsion test on mild steel and Aluminium.
5. Izod and Charpy impact test on mild steel, aluminum, brass and copper
6. Compression Test on Timber
7. Bending Test on Timber
8. Minimum 3 experiments using VIRTUAL Laboratory.
9. Flexural Strength on Flooring Tiles.
10. Abrasion Test on Flooring Tiles.
11. Comparative study of behavior of Mild Steel and TMT steel under axial tension.

The term work shall consist of a journal giving details of the following,

I) Cement & fly ash

1. Fineness of cement and fly ash (by dry method)
2. Standard consistency of cement
3. Initial and Final setting time and Soundness of Cement
4. Workability Test on Cement Mortar
5. Compressive strength of Cement.

II) Fine and Coarse Aggregates

6. Fineness modulus and grading of fine aggregate and coarse aggregate
7. Moisture content, silt content, density and Specific gravity of fine aggregate
8. Moisture content , water absorption, density and Specific gravity of coarse aggregate
9. Flakiness and Elongation of coarse aggregate
10. Impact Value and crushing Value of aggregate.
11. Site Visit: At least two site visits related to term work and technical report of it.

Building Materials & Construction

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

1) Measurement Drawing of an existing building I (Detailed plan, Elevation, Section to be drawn)
2) Measurement Drawing of an existing building II (Detailed plan, Elevation, Section to be drawn)
3) Measurement Drawing of an existing building III (Detailed plan, Elevation, Section to be drawn)
4) Measurement Drawing of an existing building IV (Detailed plan, Elevation, Section to be drawn)
5) Full imperial drawing of paneled door and window
6) Full imperial drawing of staircase and masonry
7) Auto CAD drawing – Shallow foundations
8) Auto CAD drawing – Deep Foundations
9) Auto CAD drawing – Arches
10) Site visit and technical report of the same

Text books:

Strength of Materials- S.S.Rattan- Tata Mc Graw Hill Education Pvt. Ltd. New Delhi

Concrete Technology --M.S. Shetty, S. Chand Publications.

Building Construction --- B.C. Punmia, Laxmi Publications

Reference books:

Structural Analysis- R.C.Hibbler , Pearson.

Properties of concrete by A. M. Neville, Longman Publishers.

Building Materials---S.K. Duggal—New Age International Publishers

Civil Engineering Practices and Skills- I (CVUA21178)

Teaching Scheme
Credits : 1
Lectures : NA
Practical : 2 hrs./week
Tutorial : NA

Examination Scheme
Formative Assessment : 50 Marks
Summative Assessment : NA

Course Objectives:

- To introduce to the students various skills, which are necessary for a Civil Engineer to be a successful professional.
- To emphasize the necessity of optimization of resources, team-work, coordination, interpersonal skills, etc. to the students for better productivity and efficiency.
- To make the students aware of legal aspects related to Civil Engineering.

Course Outcomes:

Upon completion of the course, students will have an ability to:

1. Apply rules of simple geometry, mathematical formulas and statistical parameters at appropriate places.
2. Demonstrate hands on skills on computers for Civil Engineering related works.
3. Create as well as interpret Building drawings.

List of Exercises (Any 12)

1. Determination of area by Trapezoidal Rule and Simpson's Rule
2. Determination of volume of ground profile
3. Statistical analysis of data by calculation
4. Data interpretation and analysis using Microsoft Excel-I
5. Data interpretation and analysis using Microsoft Excel-II
6. Data interpretation and analysis using Microsoft Excel-III
7. Application of M.S. Excel formulae for Civil Engineering Computation
8. AutoCAD- Creation of Building Layout
9. AutoCAD- Modification of Building Layout - I
10. AutoCAD- Modification of Building Layout - II
11. Market Survey of Civil Engineering Machinery or Equipment
12. Study of specifications of Machinery or Equipment
13. Study of provisions in the BOCW Act
14. Pros cons of the concept 'smart city'
15. Study of QGIS software

Continuous Evaluation shall be based on: **(i)** the level of participation of the student during the practical sessions, **(ii)** level of understanding (exhibited / applied/ demonstrated) during the practical sessions, and **(iii)** exercises/ home assignments, etc.

Text books: **(1)**Surveying and Leveling by Kanetkar, Kulkarni, Pune Vidyarthi Publication.
Reference books: **(1)** User Manual for MsExcel, AutoCAD, Q-GIS **(2)** IS 962: 1989 **(3)** http://clc.gov.in/Acts/shtm/bocw.php
e-Resourses: http://nptel.iitm.ac.in/courses.php

Department of Civil Engineering

Environmental Studies (CVUA21179)

Teaching Scheme
Credits: 2
Lectures: 1 hr. / week;
Practical: 2 hrs./week
Tutorial: NA

Examination Scheme
Formative Assessment : 50 Marks
Summative Assessment : NA

Course Objectives:

- Student will be able to identity impact of civil engineering activities on environment and its remedial measure.

Course Outcomes: At the end of the course the students will have an ability to,

1. To understand characterizes of water and waste water.
2. To understand solid waste management system
3. To understand noise pollution and control technique.

Unit I :- Introduction to water & Waste water pollution and treatment.

Types of water & waste water pollutant, characteristics of water such as physical, chemical water characteristics with respect to total dissolved solids, chlorides, pH and alkanity etc. and biological water qualities with respect to most probable number, E-coli and B-Coli etc.
Flow diagram of water treatment plant (WTP) & Sewage treatment plant and working of its units.

Unit II :- Introduction to municipal solid waste management.

Characteristics of municipal solid waste as per solid waste management rule 2000.

a. Generation, collection, segregation and transportation of solid waste.
b. Method of treatment of municipal solid waste Sanitary Land filling, vermin composting.

Unit III :- Introduction noise pollution and control

Ambient noise measurement, sound, pressure, intensity, sound pressure level, decibel scale, numerical on decibel scale, addition and subtraction of noise level.
Noise pollution control and source, path, receiver. Noise level standards.

Term Work:

1) Drawing flow diagram of WTP and STP in Auto CAD
2) Assignment I : Write characteristics of water and waste water in detailed.
3) Assignment II : Study of Municipal SWM Rule 2000 and prepare technical note.
3) Assignment III : Field survey for municipal solid waste generation for small community.
4) Assignment IV : Field survey for measurement of ambient noise level.
5)Assignment V : Control technics of noise pollution.
6) Assignment VI : Write case study on each unit.
7) Assignment VII :Preparing posters/mini projects.

Text books:

1. Air pollution and control by M N Rao , Tata McGrawhill Publication.

2. Water supply engineering by B C Punmia, Laxmi Publication.
3. Waste water engineering by B C Punmia, Laxmi Publication.
4. Water supply engineering by S K Garg, Khanna Publication.
5. Solid waste management manual by MHRD.

Reference books:

1. Environmental engineering by H.S. Pavey Rowe , Tata McGrawhill Publication.
2. Introduction to environmental engineering by Mackenzie L Davis. Tata McGrawhill Publication

Semester - II

Theory of Structures (CVUA22171)

Teaching Scheme
Credits : 4
Lectures: 4 hrs. / week
Practical: NA
Tutorial: NA

Examination Scheme
Formative Assessment: 50 Marks
Summative Assessment : 50 Marks

Course Objectives:

- To prepare students to analyze the structures using approximate methods
- To prepare students to analyze three hinged arches.
- To prepare students to analyze indeterminate beams, frames and trusses using Three Moments Theorem, Strain energy method, , slope deflection method, flexibility method.

Course Outcomes:

At the end of the course the students will have an ability to

1. **Analyze** indeterminate beams and frames using Three Moment Theorem and Castigliano's II Theorem.
2. **Analyze** indeterminate beams, frames and trusses using Slope Deflection Method and Moment Distribution Method.
3. **Analyze** indeterminate beams, frames and trusses using Flexibility method.
4. **Analyze** indeterminate beams, frames and trusses using Stiffness method.
5. **Demonstrate** applications of Influence Line Diagram and **Analyze** three hinged arches.
6. **Analyze** indeterminate structures for vertical and lateral load using approximate methods.

Unit I Statically indeterminate Beams and Frames

Determinateness of structures, stability and indeterminacy, External and Internal Redundancy Methods of Analysis-Force Method and Displacement Method. Clapeyron's Theorem of Three Moments, Application of theorem for -General Loading, Fixed Beams, Sinking of supports. (involving not more than 3 unknowns)
Castigliano's Second Theorem, Application of theorem for -General Loading, Fixed Beams, Sinking of supports and frames. (involving not more than 3 unknowns)

Unit II–Analysis of Indeterminate Structures

Slope Deflection Method, sign conventions, development of slope deflection equations, modification for simple ends, Application to beams and sway and non-sway Frames. (involving not more than 3 unknowns)
Moment Distribution Method, Carry over moment, distribution factors, fixed end moments, modification of stiffness for simple ends, Application to beams and sway and non-sway frames. (involving not more than 3 unknowns)

Unit III– Flexibility Method
Fundamental concepts, formulation of flexibility matrix, application to beams and sway and non-sway frames. (involving not more than 3 unknowns) Application to pin jointed plane trusses.(involving not more than 3 unknowns)
Unit IV–Stiffness Method
Fundamental concepts, formulation of stiffness matrix, application to beams using member approach. (involving not more than 3 unknowns) Application to sway and non-sway frames. (involving not more than 3 unknowns)
Unit V–Three Hinged Arches and Influence Line Diagram
Influence Line Diagram: Basic concepts, influence line diagram for reactions, shear and bending moment for simply supported and overhanging beams. Three Hinged Arches: Concept, analysis of parabolic and semicircular arch with supports at same and different levels. Horizontal thrust, radial shear and normal thrust for parabolic and semicircular arch.
Unit VI – Approximate Methods of Analysis
Approximate methods of analysis of multistoried multi-bay 2-D rigid jointed frames by substitute frame method. Approximate methods of analysis of multistoried multi-bay 2-D rigid jointed frames by portal method and cantilever method.
Text books: 1. Mechanics of Structures Vol. II - S.B. Junnerkar and H.J. Shaha, Charotar Publishing House 2. Theory of Structures- B.C.Punmia, Ashok kumar Jain and Arun Kumar Jain, Laxmi Publications (P) Ltd. 3. Structural Analysis- Madan Mohan Das, Bhargab Mohan Das and Mimi Das Saikia, PHI Learning Private Ltd. 4. Structural Analysis- S.S.Bhavikatti, Vikas Publishing House Pvt. Ltd.
Reference books: 1. Intermediate Structural Analysis- C.K.Wang, Tata Mc Graw Hill Education Pvt. Ltd. New Delhi 2. Structural Analysis- R.C.Hibbler , Pearson 3. Matrix Methods of Structural Analysis- Dr. A.S.Meghre and S.K.Deshmukh, Charotar Publishing House

Theory of Structures Practice (CVUA22172)

Teaching Scheme

Credits : 1
Lecture: NA
Practical: NA
Tutorial: 1 hr./week

Examination Scheme

Formative Assessment : 50 Marks
Summative Assessment: NA

Course Objectives:

- To prepare students to analyze the structures using approximate methods
- To prepare students to analyze three hinged arches.
- To prepare students to analyze indeterminate beams, frames and trusses using Three Moments Theorem, Strain energy method, , slope deflection method, flexibility method

Course Outcomes:

At the end of the course the students will have an ability to

1) **Analyze** indeterminate beams and frames using Three Moment Theorem and Castigliano's II Theorem.
2) **Analyze** indeterminate beams, frames and trusses using Slope Deflection Method and Moment Distribution Method.
3) **Analyze** indeterminate beams, frames and trusses using Flexibility method
4) **Analyze** indeterminate beams, frames and trusses using Stiffness method.
5) **Demonstrate** applications of Influence Line Diagram and **Analyze** three hinged arches
6) **Analyze** indeterminate structures for vertical and lateral load using approximate methods.

Assignment 1 and 2 Statically indeterminate Beams and Frames

Practice problems on Determination of degree of indeterminacy, Clapeyron's Theorem of Three Moments and Castigliano's Second Theorem for General Loading (involving not more than 3 unknowns)

Assignment 2 Analysis of Indeterminate Structures

Practice problems on Slope Deflection Method and Moment Distribution Method applied to beams and sway and non-sway Frames. (involving not more than 3 unknowns)

Assignment 3 Flexibility Method

Practice problems on Flexibility Method applied to beams, pin jointed trusses and sway and non-sway frames. (involving not more than 3 unknowns)

Assignment 4 Stiffness Method

Practice problems on Stiffness Method applied to beam and sway and non-sway frames. (involving not more than 3 unknowns)

Assignment 5 Three Hinged Arches and Influence Line Diagram

Practice problems on Influence Line Diagram for reactions, shear and bending moment for simply supported and overhanging beams.
Practice problems on Three Hinged Parabolic and Semicircular Arches to determine Horizontal thrust, radial shear and normal thrust

Assignment 6 Approximate Methods of Analysis

Practice problems on Approximate methods of analysis of multistoried multi-bay 2-D rigid jointed frames by substitute frame method, portal method and cantilever method..

Text books:

1. Mechanics of Structures Vol. II- S.B. Junnerkar and H.J. Shaha, Charotar Publishing House
2. Theory of Structures- B.C.Punmia, Ashok kumar Jain and Arun Kumar Jain, Laxmi Publications (P) Ltd.
3. Structural Analysis- Madan Mohan Das, Bhargab Mohan Das and Mimi Das Saikia, PHI Learning Private Ltd.
4. Structural Analysis- S.S.Bhavikatti, Vikas Publishing House Pvt. Ltd.

Reference books:

1. Intermediate Structural Analysis- C.K.Wang, Tata Mc Graw Hill Education Pvt. Ltd. New Delhi
2. Structural Analysis- R.C.Hibbler , Pearson.
3. Matrix Methods of Structural Analysis- Dr. A.S.Meghre and S.K.Deshmukh, Charotar, Publishing House

Fluid Mechanics-I (CVUA22173)

Teaching Scheme
Credits: 3
Lectures: 3hrs./ week
Practical: NA
Tutorial: NA

Examination Scheme
Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Course Objectives:

- To impart knowledge of fluid properties and dimensional analysis**.**
- To introduce students the concept of pressure and its use to solve fluid statics problems.
- To inculcate an ability to apply the theories of fluid statics and fluid dynamics to solve problems related to fluid mechanics.
- To introduce students the concept of laminar flow and principles of fluid mechanics to solve laminar flow problems.
- To introduce students the concept of boundary layer theory and its use to calculate drag force.
- To expose the students to the turbulent flow and flow through pipes.

Course Outcomes:

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

1. **Understand** and **use** different fluid properties.
2. **Establish** relation between various fluid, flow and geometrical parameters using dimensional analysis
3. **Calculate** total pressure, center of pressure, metacentric height using principles of statics.
4. **Use** principals of kinematics and dynamics to solve fluid flow problems.
5. **Solve** problems related to laminar flow accompanied by boundary layer theory.
6. **Analyze** turbulent flow through pipes**.**

Unit I - Properties of Fluids & Dimensional Analysis

Definition of fluid and fluid mechanics: physical properties of fluids: density, specific weight, specific volume, relative density. Newton's law of viscosity, classification of fluids, rheological diagram, Dynamic and kinematic viscosity, compressibility, cohesion, adhesion, surface tension, capillarity, vapor pressure.
Dimensions of physical quantities, dimensional homogeneity, dimensional analysis using Buckingham's π theorem method, geometric kinematic and dynamic similarity, important dimensionless parameters, Reynolds' model law, Froude model law.

Unit II - Fluid Statics

The basic equation of hydrostatics, concept of pressure head, measurement of pressure, study of pressure measuring devices like simple manometers, differential manometers and precision manometers, pressure transducers. Centre of pressure, total pressure on plane and curved surfaces.
Principle of floatation and buoyancy, equilibrium of floating bodies, stability of floating bodies. Metacentre and metacentric height and its determination (experimental &analytical).

Unit III – Fluid Kinematics

Methods of describing the motion of fluid, velocity and acceleration, and their components in Cartesian co-ordinates, concept of stream line, stream tube, path line, and streak line, control volume. Classification of flow, steady and unsteady, uniform and non-uniform, laminar and turbulent. One, two, and three-dimensional flows.
Equation of continuity for three dimensional flow in Cartesian co-ordinates, equation of continuity for one-dimensional flow along a streamline, types of motion, rotational and irrotational motion, velocity potential, stream function and flow net, methods of drawing flow net, uses and limitations of flow net.

Unit IV - Fluid dynamics

Forces acting on fluid mass in motion, Euler's equation of motion along a streamline and its integration, Bernoulli's equation, kinetic energy correction factor. Hydraulic grade line and total energy line. Linear momentum equation and momentum correction factor.
Application of Bernoulli's equation for understanding working of orifice, venturimeter, pitot tube.

Unit V - Boundary layer theory and Laminar flow

Development of boundary layer on a flat plate, nominal, displacement, momentum, energy thicknesses, laminar, transitional and turbulent boundary layer, laminar sub layer, Local and mean drag coefficients, hydrodynamically smooth and rough boundaries. Boundary Layer separation and its control.
Reynolds experiment, laminar flow through a circular pipe, flow between two parallel plates-both stationary and one plate moving, Stokes' law, methods of measurement of viscosity, Transition from laminar to turbulent flow.

Unit VI - Turbulent flow and Flow through Pipes

Definition of turbulent flow, Characteristics of turbulent flow, Prandtl's mixing length theory
Flow through pipes: energy losses in pipe flow (major losses and minor losses), Darcy Weisbach Equation, variation of friction factor for laminar flow and for turbulent flow, Nikuradse's experiments on artificially roughened pipes, resistance to flow in smooth and rough pipes, friction factor for commercial pipes, Moody's diagram, flow through pipes such as simple, compound, series parallel, Dupit's equations, branched pipes,(Three reservoir and pipe network analysis- only theory).

Text books

1. Hydraulics & Fluid Mechanics by Modi and Seth, Standard Book House
2. Theory and Applications of Fluid Mechanics—K.Subramanya- Tata McGraw

Reference books

1. Fluid Mechanics-Yunus Cengel, JhonCimbala- Tata Macgraw Hill,New Delhi
2. Fluid Mechanics by .R.J.Garde, A.J Mirajgaonkar, SCITECH Publication
3. Fluid Mechanics by Streeter & Wylie, Tata McGraw Hill.
4. Fluid Mechanics by White, McGraw Hill.

Surveying (CVUA22174)

Teaching Scheme
Credits: 3
Lectures: 3hrs./ week;
Practical: NA
Tutorial: NA

Examination Scheme

Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Course Objectives:

- To understand principles traversing plane tabling
- To understand the effects of curvature, refraction and contouring
- To Understand uses and applications of theodolite and permanent adjustment
- To understand the setting out different works and engineering curves
- To know different electronic surveying techniques

Course Outcomes:

At the end of the course the students will have an ability to,

1. **Use** techniques and skills of angular measurements to correct bearings of line also use methods of plane tabling for locating the object.
2. **Apply** knowledge of levelling to plot contour map of area.
3. **Apply** corrections to plot the traverse using Theodolite.
4. **Analyze and design** of curves .
5. **Determine** reduce levels and distances using indirect method of Tacheometry and setting out works using various surveying instruments .
6. **Use** of modern surveying techniques for measurements and **Demonstrate** the concepts of Hydrographic survey

Unit I –Compass & Plane Table Surveying

Concept of bearing, meridian and their types, construction and use of prismatic compass, local attraction and correction for local attraction, dip, declination and calculation of true bearings.
Equipment required for plane table surveying and their uses, advantages and disadvantages, methods of plane table survey: Radiation and intersection method.

Unit II–Levelling and Contouring

Introduction to levelling, Types of levelling, Construction and use of auto level, laser level in construction industry, reciprocal levelling, curvature and refraction corrections, distance to the visible horizon, trigonometric leveling (Plane Survey)
Contouring: direct and indirect methods of contouring, uses of contour maps, study and use of topo-sheets, profile levelling and cross-sectioning and their applications.

Unit III–Theodolite Surveying

Study of Vernier transit 20" theodolite, uses of theodolite for measurement of horizontal angles by repetition and reiteration, vertical angles and magnetic bearing, prolonging a line, lining in and setting out an angle with a theodolite.
Theodolite traversing: computation of consecutive and independent co-ordinates, adjustment of closed traverse by transit rule and Bowditch's rule, Gales traverse table, omitted measurements, area calculation by independent co-ordinates, open traverse and its uses, measurement of deflection angles using transit

theodolite, open traverse survey, checks in open traverse.

Unit IV–Curves

Introduction to horizontal and vertical curves (no numerical and derivations to be asked on vertical curves and reverse curves), different types and their applications, simple circular curves, elements and setting out by linear methods such as radial and perpendicular offsets, offsets from long chord, successive bisection of chord. Angular methods: Rankine's method of deflection angles (one and two theodolite methods). (Numerical on simple circular curves to be asked), Transition curves: necessity and types

Unit V–Tachometry and Setting Out Works

Tachometry: application and limitations, principle of stadia tachometry, fixed hair method with vertical staff to determine horizontal distances and elevations of points.
Setting Out Works - buildings, maintaining verticality of tall buildings, drainage lines, canals, bridge (determination of the length of the central line and the location of piers) and tunnel (surface setting out and transferring the alignment underground)

Unit VI–Electronic Measurement Techniques and Hydrographic Survey

Surveying using total station – Construction, types, principle features, field equipment, method of use, introduction to various special functions available in a total station such as remote elevation measurements, remote distance measurements and co-ordinate stake out. Levelling using digital level
Hydrographic survey - Objects, applications, Establishing controls, Shore line survey, Sounding, Sounding Equipment, Methods of locating soundings – conventional and using GPS , Nautical Sextant and its use, Three point problem and its use, solution of three point problem analytical method, determination of MSL.

Text books:

1. Surveying and Levelling by Vol. I and Vol. II – T.P.Kanetkar and S.V.Kulkarni
2. Surveying and Levelling by Subramanian, Oxford University Press.
3. Surveying, Vol. I & II by Dr.B.C.Punmia, Ashok K. Jain, ArunK.Jain
4. Surveying for Engieers-John Uren & Bill Price—Palgrave Macmillan

Reference books:

1. Plane Surveying----A.M.Chandra---- New Age International Publishers
2. Surveying and Levelling ---- N. N. Basak, Tata Mc-Graw Hill
3. Surveying Vol. I & II ---- Dr.K. R. Arora
4. Surveying: Theory and Practice --- James M. Anderson, Edward M. Mikhail
5. Surveying theory and practices -- Devis R. E., Foot F. S.
6. Plane and Geodetic surveying for Engineers. Vol. I -- David Clark
7. Principles of Surveying. Vol. I by J.G.Olliver, J.Clendinning
8. Surveying, Vol. I & II by S. K. Duggal,TataMc-Graw Hill

Suggested Reading:

http://www.bis.org.in/sf/wrd/p_449.pdf
http://www.bis.org.in/sf/wrd/WRD10(491).pdf
http://www.bis.org.in/sf/wrd/WRD10(491).pdf
http://sbq.com.au/member/board-publications/code-of-practice/
http://usa.autodesk.com/adsk/servlet/pc/index?id=3091031&siteID=123112
http://www.cadacademynoida.com/?page=civileng3
http://www.sitetopo.com/

Home Assignments: (Any Four)

1. Base line measurement and offsetting
2. Calculation of included angles and true bearings for a polygon.

3. Reduction of levels by rise and fall and H.I. method
4. Traversing and omitted measurements
5. Setting out of compound/transition curve (any one method)
6. Solution of three point problem by graphical and mechanical methods

Note: Continuous Evaluation will be based on home assignments.

Geotechnical Engineering (CVUA22175)

Teaching Scheme
Credits : 3
Lectures : 3 Hrs./week
Practical: NA
Tutorial: NA

Examination Scheme
Formative Assessment : 50Marks
Summative Assessment : 50 Marks

Course Objectives:

- To describe soil properties, classification and its behavior under stress
- To learn methods for measurements and determination of index and engineering properties of soil and rock
- To study the interaction between water and its effect on engineering behavior of soil

Course Outcomes

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

1. **classify** the different types of soil/rock and describe engineering properties
2. **describe** the concept of stress and its influence on soil properties.
3. **describe** influence of water flow on engineering properties of soil
4. **determine** compaction properties and calculate shear strength parameters of soil.
5. **analysis** lateral pressure of soil on retaining structure.
6. **describe** soil slopes and their failure mode

Unit I - Introduction to soil and rock mechanics

Need for soil and rock mechanics studies, Soil as an engineering material - Scope of Geotechnical engineering. Major soil deposits of India, Index properties of soil and rock, Three phase soil system, Soil minerals, Soil structures, Weight volume relationship, Index properties of soil and rock. Methods of determination of index properties rock and soil and its significance, Classification of soil and rocks.

Unit II - Permeability and Seepage

Soil water, permeability definition and necessity of its study, Darcy's law, factors affecting permeability. Laboratory measurement of permeability – Constant head method and Falling head method as per IS 2720. Field test for determination of permeability test as per IS. Permeability of stratified soil deposits.
Seepage and Seepage Pressure, quick sand phenomenon, critical hydraulic gradient, General flow equation for 2-D flow (Laplace equation), Flow Net, properties and application, Flow Net construction for flow under sheet pile and earthen dam.

Unit III - Compaction and Stress Distribution

Introduction, Standard Proctor test, Modified Proctor test, Zero air void line. Factors affecting compaction. Effect of compaction on soil properties. Field compaction methods and compaction equipment's for different types of soil, Placement water content, Field compaction control.
Geostatic stress, Boussinesq's theory with assumptions for point load (with numerical), equations for circular load, line load and strip load, Pressure Distribution diagram on a horizontal and vertical plane, Pressure bulb and its significance. Westergaard's theory, equivalent point load method, Approximate stress distribution method.

Unit IV - Shear Strength of soil

Mohr's stress circle, Mohr-Coulomb failure theory. The effective stress principle- Total stress, effective stress and neutral stress / pore water pressure. Peak and Residual shear strength, factors affecting shear strength.
Stress-strain behavior of sands and clays. Direct Shear test, Triaxial Compression test, Unconfined Compression test, Vane Shear test. (Different drainage conditions for shear tests). Sensitivity and thixotropy of cohesive soils.

Unit V - Earth Pressure

Introduction, Rankine's state of Plastic Equilibrium in soils- Active and Passive states due to wall movement, Earth Pressure at rest. Rankine's Theory- Earth pressure on Retaining wall due to submerged backfill (With Numerical), Backfill with uniform surcharge (With Numerical), backfill with sloping surface, layered backfill.
Graphical methods of Determination Earth Pressure.

Unit VI - Stability of slopes and strength of rocks

Classification and failure of slopes, Finite slope stability by Swedish circle method with slip circle and method of slices, Soil stabilization, its necessity and methods.
Types and functions of geo-synthetics, Role of geotechnical engineering in environmental protection
Rock quality designation, Laboratory methods to determine strength of rocks, Influence of geological conditions on construction of Dams and Tunnel.

Text books:

1. Soil Mechanics and Foundation Engineering by Dr.B.C.Punmia, Laxmi Publications
2. Geotechnical Engineering by Shashi K. Gulati & Manoj Datta, Tata McGraw Hill
3. Principles of Soil Mechanics and Foundation Engineering by V.N.S. Murthy, UBS Publishers
4. Soil Mechanics-Principles and Practice-Graham Barnes-Palgrave MacMillan

Reference books:

1. Soil mechanics and engineering practice – By Terzaghi, Peck and Mesri
2. Soil mechanics- Lambe and Whitman, John Wiley & Sons
3. Physical and Geotechnical Properties of Soils by Joseph.E.Bowles, International Students Edition
4. Geotechnical Engineering—C.Venkatramaiah—New Age International Publishers
5. Principles of Geotechnical Engineering—Braj M.Das—Cengage Learning
6. Basic and Applied Soil Mechanics by Gopal Ranjan and A.S.R.Rao, Newage International

Psychology (CVUA22176)

Teaching Scheme
Credits : 3
Lecture:3hrs/ week
Practical: NA
Tutorial: NA

Examination Scheme
Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Course Objectives:

- To introduce concepts related to human psychology to the students.
- To make the students aware of the necessity and applications of human psychology such as human resource development.
- To impress upon the students the necessity of better coordination, team work, and productivity using appropriate training, development and emotional intelligence

Course Outcomes:

After completing the course, students will be able to:

1. Describe human nervous system and the working of human brain.
2. Recognize relationship between human emotions, behavior, productivity
3. Understand attributes of personality, personality development and necessity of life-long learning.
4. Predict the effects of group dynamics and gender psychology in an industry/ organization.
5. Design and analyze psychological tests for human resource management.
6. Identify training and development needs of the staff in an organization.

Unit I –Introduction and Basic Concepts

Definition, nature and Goals of Psychology as a Science. History and Branches of Psychology. Various perspectives – Structuralism, Functionalism, Gestalt, Psychoanalysis, Behaviorism, Humanistic, Cognitive, Bio-psycho-socio-cultural
Methods – Introspection, Observation, Experimental, Survey and Case Study

Unit II – Emotions, Frustration and Motivation

Gender, Culture and Emotions. Biological changes and emotions. Emotional Quotient (EQ) – concept, measurement and significance. Frustration, Sources of Frustration. Perspectives on motivation, Types of motivation, Motivational conflicts.
Counseling and conflict management.

Unit III– Learning, Memory and Personality Development

Learning – definition, process and types. Memory – basics, theories of forgetting and methods of improving memory.
Attitude and attitude change. Personality – attributes and traits. Personality development – nature, theories.

Unit IV – Industrial and Engineering Psychology

Industrial Psychology: Meaning, subject matter and functions of Industrial Psychology. Group Dynamics – meaning and characteristics. Individual and group behavior patterns.
History and scope of Engineering psychology, Human Performance. Time and Motion Study, Person-Machine System, Work space design

Unit V–Human Resource Management
Introduction to the processes of recruitment, selection and Human Resource Management (HRM). Feedback and corrective/ preventive actions. Job Analysis, Competency mapping and performance appraisal. Assessment of Employee behavior: Interviews, psychological testing and assessment centers.
Unit VI - Training and Development
Meaning, objectives, need and significance of training and development in Civil Engineering. Processes, steps and identification of job competencies. Training need identification. Designing and implementation of training and development programs. Modes and techniques of training. Computer Based Training (CBT) and learning – multimedia, online/ distance/ e-training, etc. Feedback and evaluation of training.
Continuous Evaluation shall be based on: **(i)**the level of participation and enthusiasm shown by the student, **(ii)**level of understanding of the portion taught, and **(iii)**exercises/ home assignments, conduct and analysis of psychological tests/ case studies etc.
Text books: 1. Introduction to Psychology by Morgan, King and Robinson, 7th e., McGraw-Hill 2. Psychology by C. Wade and C. Tavris, Pearson Education 3. Tests, Measurements and Research Methods in Behavior Sciences by A. K. Singh, Patna: Bharati Bhavan. 4. Ciccarelli, S. K., & Meyer, G. E. (2010).Psychology: South Asian Edition. New Delhi: Pearson Education. 5. Schultz, D. and Schultz, S. E. (2006). Psychology and work today. 8th ed. N.D.: Pearson Education
Reference books: 1. The Ego and Id by Sigmund Freud, W. W. Norton and Co. Inc. 2. Human Cognition by Guenther R. K., New Jersey: Prentice Hall. 3. Theories of Personalities by C. S. Hall, G. Lindzey, and J. B. Campbell, 4th e., Wiley India
e-Resources: http://ocw.mit.edu/ans7870/9/9.00SC/MIT9_00SCF11_text.pdf

Lab Practice II (CVUA22177)

Teaching Scheme
Credits : 3
Lecture: NA
Practical: 6hrs / week
Tutorial: NA

Examination Scheme
Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Course Objectives:

To impart the knowledge of various tests to determine fluid properties
To impart the knowledge of various tests to determine soil properties
To impart hands on skill in the field of Plane Surveying

Course Outcomes:

1. Upon the completion of the course, the students will be able to:
2. Conduct the tests to study fluid properties and fluid behavior
3. Conduct the tests on closed conduit fluid and open conduit fluid
4. Plot profile of the ground using Leveling Instruments
5. Plot the contour map using Radial Contouring Method
6. Conduct the tests to study soil properties and soil behavior
7. Review field geotechnical investigation report or Use software related to Geotechnical Engineering

Unit I –Fluid Mechanics – I

1. Measurement of viscosity by Redwood viscometer
2. Measurement of pressure using different pressure measuring devices
3. Determination of stability of floating bodies using ship models.
4. Drawing of flow net by electrical analogy for flow below the weir with sheet pile
5. Drawing of flow net by electrical analogy for flow below the weir without sheet pile
6. Experimental verification of Bernoulli's theorem with reference to loss of energy
7. Calibration of Venturimeter
8. Calibration of Orificemeter
9. Plotting the pattern of laminar flow using Heleshaws apparatus
10. Determination of friction factor for a given pipe
11. Measurement of surface tension for given fluid

Unit II Surveying

Total four practical to be performed of the following. First three are compulsory. Any one of 4^{th} and 5^{th} .

1. Study and use of Prismatic compass and observing bearings of lines of traverse
2. Study and use of 20" Vernier Theodolite and measurement of -
   a. Horizontal angle by repetition method and
   b. Vertical angle
3. Differential levelling by using Digital level and introduction to Auto level.

4. Study and use of Tachometer for
   a. Working out constants of instrument
   b. finding horizontal and vertical distance
5. Study and use of Plane Table surveying and its methods
   a. Radiation
   b. Intersection

Projects: All compulsory

1. Profile levelling : Drawing L-section and C- section for a road of minimum 200m length
2. Radial contouring: Plotting of contours from two stations minimum 60m apart.
3. Theodolite traversing : Plotting traverse and finding out area traverse using 20" Vernier transit Theodolite

Unit III – Geotechnical Engineering

The term work shall consist of a journal giving details of at least 10 out of 12 of the following experiments / assignments. Sr. No 13 and 14 are compulsory.

1. Specific gravity determination by Pycnometer /density bottle.
2. Sieve analysis, particle size determination and IS classification as per I.S.Codes.
3. Determination of Consistency limits and their use in soil classification. as per I.S.Codes.
4. Field density test by a) Core cutter b) Sand Replacement
5. Determination of coefficient of permeability by a) constant head and b) variable head method.
6. Direct shear test.
7. Unconfined compression test.
8. Vane Shear test.
9. Standard Proctor test / Modified Proctor test.
10. Differential free swell test.
11. Demonstration of Triaxial test
12. Swelling Pressure test

13) Any one of the following assignments-

a) Review of any field geotechnical investigation report.

b) Construction of pressure bulb by using any geotechnical engineering software.

14. Assignments on the following topics

a) Rebhann's and Cullman's graphical method for determination of earth pressure.

b) Solution of problems on shear strength parameters using graph.

Text books:

1. Hydraulics & Fluid Mechanics by Modi and Seth, Standard Book House
2. Theory and Applications of Fluid Mechanics—K.Subramanya- Tata McGraw
3. Surveying and Levelling by Vol. I and Vol. II – T.P.Kanetkar and S.V.Kulkarni
4. Surveying, Vol. I & II by Dr.B.C.Punmia, Ashok K. Jain, ArunK.Jain
5. Soil Mechanics and Foundation Engineering by Dr.B.C.Punmia, Laxmi Publications
6. Geotechnical Engineering by Shashi K. Gulati & Manoj Datta, Tata McGraw Hill

Reference books:

1. Fluid Mechanics-Yunus Cengel, JhonCimbala- Tata Macgraw Hill,New Delhi
2. Fluid Mechanics by .R.J.Garde, A.J Mirajgaonkar, SCITECH Publication
3. Plane Surveying----A.M.Chandra---- New Age International Publishers
4. Surveying and Levelling ---- N. N. Basak, Tata Mc-Graw Hill
5. Geotechnical Engineering—C.Venkatramaiah—New Age International Publishers
6. Principles of Geotechnical Engineering—Braj M.Das—Cengage Learning

Civil Engineering Practices and Skill-II (CVUA22178)

Teaching Scheme
Credits: 1
Lecture: NA
Practical:2 hrs./week
Tutorial: NA

Examination Scheme
Formative Assessment: 50 Marks
Summative Assessment : 50 Marks

Course Objectives:

- To introduce to the students various surveying skills, which are necessary for a Civil Engineer to be a successful professionals

Course Outcomes:

Upon completion of the course, students will have an ability to:

1. Demonstrate skills necessary for operating various surveying instruments.
2. Apply concepts of surveying in setting out works
3. Conduct the test on fresh concrete and hardened concrete
4. Apply IS code method to design concrete mix

Surveying skills

1. Linear measurement skills: Ranging, extending a line, measurements with tapes
2. Field measurement of area: Cross staff survey, tape survey.
3. Total Station for various measurements: Leveling, Distance measurement
4. Angular measurement skills: 1" Optical Theodolite
5. Nautical Sextant for locating a Sounding Station
6. Permanent adjustment for 20" vernier transit Theodolite
7. Setting out simple circular curve (Rankine's method), Foundation for building

Testing of Concrete Skills

1. Workability of concrete: slump test, compaction factor, Vee -Bee test, flow table
2. Effect of admixture on workability of concrete
3. Split tensile strength of concrete
4. Flexural strength of concrete
5. NDT test by Rebound hammer or Ultrasonic Pulse velocity method.
6. Concrete mix design by IS code method.(Using software as well as manually)
7. Mix Design of special concrete (Self compacting concrete, Light Weight Concrete)

Text books:

1 Surveying and Levelling by Vol. I and Vol. II – T.P.Kanetkar and S.V.Kulkarni
2. Surveying and Levelling by Subramanian, Oxford University Press.
3 Surveying, Vol. I & II by Dr.B.C.Punmia, Ashok K. Jain, ArunK.Jain
4.Surveying for Engineers-John Uren & Bill Price—Palgrave Macmillan
5. Concrete Technology --M.S. Shetty, S. Chand Publications.
6. Concrete Technology -- A R Santhakumar, Oxford University Press.
7. Concrete technology -- M. L. Gambhir, Tata Mcgraw Hill Publications

Reference books:

1. Plane Surveying----A.M.Chandra---- New Age International Publishers
2. Surveying and Levelling ---- N. N. Basak, Tata Mc-Graw Hill

Project Management (CVUA22179)

Teaching Scheme
Credits: 2
Lectures : 2 Hrs. /week
Practical: NA
Tutorial: NA

Examination Scheme
Formative Assessment : 50 Marks

Summative Assessment: 50 Marks

Course Objectives :

- To make students conversant with the importance of project management in construction industry.
- To make students analyze and solve problems on network analysis, resource allocation and updating
- To make students conversant with the concept of materials management and project appraisal.
- To explain the students the importance of TQM in construction projects.

Course Outcomes:

At the end of the course the students will have an ability to:

1. **Develop** knowledge about management, project life cycle and importance of organizational structure of a project.
2. **Demonstrate** the use of project planning, scheduling, monitoring and control techniques for a project
3. **Demonstrate** the use of project monitoring and control techniques
4. **Understand** the necessity of materials management and equipment management
5. **Use** techniques to appraise a project.
6. **Understand** the importance of Total quality management in construction Industry.

Unit I - Introduction to project management.

Importance, objectives & functions of management , Categories of project , Project--- life cycle Concept and Cost Components , Project management Institute and Certified Project Management Professionals (PMP), Importance of organizational Structure in Management- Authority / Responsibility Relation.

Unit II - Project planning and scheduling

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

Unit III - Project Monitoring and control

Resource Allocation – Resource Smoothening and levelling, Network Crashing – Time- Cost –Resource optimization, Project Monitoring- Updating , Earned Value.

Unit IV - Project Resources

Objectives of Materials management – Primary and secondary Material Procurement Procedures- material requirement- raising of indents, receipts, Inspection, storage, delivery, record keeping– Use of Excel sheets, ERP software, Inventory control- ABC analysis, EOQ, Introduction to Equipment Management – Fleet Management, productivity studies, Equipment down time, sizing

Unit V - Project appraisal

Types of Appraisals such as political, social, environmental, techno-legal, financial and Economical,

Criteria for project selection - benefit - cost analysis, NPV, IRR, Pay-back period, Break Even analysis, Fundamental and Application Component, Study of Project Feasibility report and Detailed Project Report (DPR) , Role of Project Management Consultants.

Unit VI - Total quality Management

TQM – Necessity, advantages, Difference between, quality control, quality assurance, total quality control and total quality management (TQM). Benchmarking in TQM, Kaizen in TQM, Process based approach for achieving TQM, Quality manual – Importance, Introduction to ISO.

Home Assignment.: Assignments on:

1. Use of Project Management Softwares – MSProject / Primavera for a housing project scheduling for minimum 25 activities
2. Assignment on network crashing/resource allocation
3. Assignment on ABC analysis/ EOQ.
4. Assignment on Project economics.
5. Assignment on Project appraisal
6. Assignment on construction equipment

Text books:

1. Construction Engineering and Management by S. Seetharaman, Umesh Publications, New Delhi.
2. Total Project Management – The Indian Context by P. K. Joy Macmillan India Ltd.
3. PERT and CPM Principles and Applications by L. S. Srinath, Affiliated East West Press Pvt. Ltd. New Delhi.
4. Total Quality Management-Dr. Gunmala Suri and Dr. Puja Chhabra Sharma-Biztantra
5. Quality control and Total Quality Management by P.L.Jain- Tata McGraw Hill Publ.company
6. Materials Management–Gopalkrishnan&Sunderasan,Prentice Hall Publications.

Reference books:

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