BACHELOR OF TECHNOLOGY

(B. TECH.)

Civil Engineering

SYLLABUS

(CBCS)

Effective From

2015-16

Department of Civil Engineering
Faculty of Engineering & Technology
Jamia Millia Islamia
New Delhi-110025
www.jmi.ac.in

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PREFACE

The revision and modification of the syllabus is a continuous process. The department was established in 1985 and a workshop of prominent engineers and educational list was held to develop the curriculum for the B-Tech in Civil engineering. The syllabus was later modified and published in the printed form in 1993. Since then a number of revisions have taken place both in the course structure and course content keeping in view the current trends in civil engineering education and demands of the industry. Recently, Jamia has introduced the Choice Based Credit System (CBCS) to all of its UG and PG courses. In this context, the latest version of the course structure and syllabus has been to incorporate the CBCS. This syllabus is an outcome of a thorough revision of course structure and course content with inputs from subject experts and professionals. The syllabus has been designed to provide a solid foundation in the core areas of civil engineering namely; structural engineering, geo-technical engineering, environmental engineering, water resources engineering, civil engineering materials, transportation engineering, surveying and GIS and construction management keeping in view the latest developments in these subject areas. I wish to acknowledge the hard work put in by the faculty members and stakeholders in the updating and revision of syllabus. I also wish to convey my sincere thanks to the subject experts who gave their valuable inputs in finalizing this syllabus.

(Mohammad Shakeel)
HOD, Civil Engineering

Department of Civil Engineering: a brief overview

The Department of Civil Engineering is one of the oldest and the largest department in the Faculty of Engineering & Technology. The department has produced several eminent engineers who have made important contributions in the planning and execution of many important Civil Engineering projects in India as well as abroad.

The Department offers two undergraduate courses in Civil Engineering. The Department also offers Master's programme with specialisations in Environmental Engineering and Earthquake Engineering. These courses are supported with strong doctoral programmes in all the major specialisations of Civil Engineering. The Department is known for its reputed faculty with expertise in diverse fields. Presently, the department has 22 highly qualified, experienced, sincere and dedicated faculty members, actively participating in research and consultancy work.

The Department has established a state of the art experimental facilities and laboratories in different fields of Civil Engineering. It has received the prestigious funding under FIST from DST and SAP from UGC.

The faculty also renders technical advice on live engineering problems to various Government and Private Sector companies throughout the country. These live projects are effectively used as training desk for our students at undergraduate and postgraduate levels. RITES, Military Engineering Services, Municipal Corporations of Delhi, Faridabad, Gurgaon, Gaziabad, NOIDA, PWD, CPWD, DDA, HUDA, Jal Nigam etc. regularly hire services for technical advice and vetting of designs of infrastructure projects.

International and national conferences, seminars and special lectures are a regular feature of the Department to impart education and training. The Department has active collaboration with academics and industry such as University of Applied Sciences Erfurt (Germany), Wessex Institute (UK), University of Waterloo (Canada), Asian Institute of Technology (Bangkok) and Steel Authority of India (INDIA).

Leading MNCs and public sectors are regular recruiter of our students and many students have been selected in Engineering Services. Large numbers of students qualify the GATE examination with good ranks to go for higher studies. Several of our alumni pursued higher education in foreign countries like USA, UK, Germany, Canada, Australia and France and have been appointed as faculty members and consultants abroad.The Department strongly believes in continuous efforts to strive for excellence by exploring new frontiers of knowledge, imparting the latest technical knowledge to the students and conducting high quality research.

The department has formulated the curriculum for the B. Tech. program in consultation with various stake holders keeping in mind the current industry practices and future scenarios in civil engineering.

FACULTY OF ENGINEERING & TECHNOLOGY
JAMIA MILLIA ISLAMIA, NEW DELHI

VISION

To become a leading engineering institute through knowledge creation, acquisition and dissemination for the benefit of society and industry.

MISSION

1. To develop a center of excellence by imparting quality education to produce technically sound and research oriented professionals to face the emerging challenges of society and industry.
2. To enhance knowledge by innovative teaching, engaging in cutting edge research and developing linkage with industry.
3. To impart ethical, social and environmental values to produce competent engineers for the service of mankind.
4. To inculcate technological capabilities through continuous interaction with academia and industry in emerging areas for sustainable development.

DEPARTMENT OF CIVIL ENGINEERING

VISION

To emerge as center of excellence for education and research in Civil Engineering and to produce professionally competent and ethically sound engineers of global standards, ready to serve the community and the nation with dedication.

MISSION

1. To provide rigorous hands on civil engineering education through learner centric teaching pedagogy.
2. Establish state-of-the art facilities for teaching and research in civil engineering domain.
3. Motivate students to develop low-cost and sustainable ethical solutions to problems faced by the society.
4. Provide opportunities to students to enable them to develop leadership and interpersonal skills.

Programme Educational Objectives (PEOs)

The department of civil engineering in consultation with stake holders has formulated Programme Educational Objectives (PEOs) that are broad statements describing the career and professional accomplishment that the programme is preparing its graduates to achieve in few years, subsequent upon to receiving the degree. The PEOs of B. Tech. program in civil engineering are as follows:

1. To train and equip graduates in civil engineering with professional skills for successful careers dealing with analysis, design and management of infrastructural projects both in India and abroad
2. To develop core competency in the civil engineering field so as to formulate, analyse and solve civil engineering and allied problems using the principle of mathematics and science.
3. To provide the students with a comprehensive and balanced understanding of the several branches of civil engineering such as structural engineering, geotechnical engineering, transportation engineering, and hydraulic and water resources
4. To inculcate in students high ethical standards, effective oral and written communication skills, to work as part of teams on multidisciplinary projects in diverse professional environments, and to relate engineering issues to the society and nation.
5. To provide student with an academic excellence, leadership, management skills and life-long learning needed for a successful professional career.

Program Outcomes (POs)

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 modelling 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 (PSOs)

Upon successful completion of the Bachelor of Technology Program in Civil Engineering, the students should be able to:

PSO1: Analysis and design of foundations and superstructures for residential and commercial buildings using commercial software

PSO2: Design of hydraulic structures, highways, railways, airways, docks and harbors

PSO3: Design, test and evaluate water, sewerage and industrial effluent conveying and treatment systems

PSO4: Survey, map and plan layouts for buildings, roads, and hydraulic structures using modern tools such as the total station

COURSE STRUCTURE 2015

B. Tech. (Civil)

Semester I

Course Code	Course Title	Total Number of contact hours				Credits
		Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
AS-101	Communication Skills	3	--	--	3	3
AS-151	Language Lab	--	--	2	2	1
AS-102	Engineering Physics - I	2	1	--	3	3
AS-152	Engineering Physics Lab. - I	--	--	2	2	1
AS-103	Engineering Chemistry - I	2	1	--	3	3
AS-153	Engineering Chemistry Lab. - I	--	--	2	2	1
AS-104	Engineering Maths - I	3	1	--	4	4
CE-101	Basics of Civil Engineering	2	1	--	3	3
ME-101	Basics of Mechanical Engineering	2	1	--	3	3
EE-101	Basics of Electrical Engineering	2	1	--	3	3
ME-151	Workshop Practice	--	--	4	4	2
Total		**16**	**6**	**10**	**32**	**27**

Semester II

Course Code	Course Title	Total Number of contact hours				Credits
		Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
AS-201	Human Resource Management	3	1	-	4	4
AS-202	Engineering Physics - II	2	1	--	3	3
AS-252	Physics Lab. - II	--	--	2	2	1
AS-203	Engineering Chemistry - II	2	1	--	3	3
AS-253	Chemistry Lab. - II	--	--	2	2	1
AS-204	Engineering Maths. - II	3	1	--	4	4
AS-205	Innovative Sciences & Technology	3	1	--	3	4
EC-201	Basics of Electronics and Communication	2	1	--	3	3
CS-201	Fundamentals of Computing	2	1	--	3	3
ME-250	Engineering Graphics	--	--	4	4	2
Total		**17**	**7**	**8**	**32**	**28**

Semester III

Course Code	Course Title	Total Number of contact hours				Credits
		Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CE-301	Fluid Mechanics	3	1	-	4	4
CE-351	Fluid Mechanics Lab.	-	-	2	2	2
CE-302	Solid Mechanics	3	1	-	4	4
CE-352	Solid Mechanics Lab.	-	-	2	2	2
CE-303	Engineering Geology	4	-	-	4	4
CE-353	Engineering Geology lab.	-	-	2	2	2
CE-304	Civil Engineering Materials	4	-	-	4	4
CE-354	Civil Engineering Materials Lab.	-	-	2	2	2
CE-305	Numerical Methods	3	1	-	4	4
Total		**17**	**3**	**8**	**28**	**28**

Semester IV

Course Code	Course Title	Total Number of contact hours				Credits
		Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CE-401	Structural Analysis - I	3	1	-	4	4
CE-451	Structural Analysis Lab. - I	-	-	2	2	2
CE-402	Hydraulics	3	1	-	4	4
CE-452	Hydraulics lab.	-	-	2	2	2
CE-403	Building Construction	4	-	-	4	4
CE-404	Estimating and Costing	3	1	-	4	4
CE-454	Civil Engineering Drawing	-	-	2	2	2
CE-405	Surveying	3	1	-	4	4
CE-455	Surveying Lab.	-	-	2	2	2
Total		**16**	**4**	**8**	**28**	**28**

Semester V

Course Code	Course Title	Total Number of contact hours				Credits
		Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CE-501	Structural Analysis-II	3	1	-	4	4
CE-502	Design of Concrete Structures	3	1	-	4	4
CE-552	Design of Concrete Structure Lab.	-	-	2	2	2
CE-503	Open Channel Flow	3	1	-	4	4
CE-504	Geotechnical Engineering	3	1	-	4	4
CE-554	Geotechnical Engineering Lab	-	-	2	2	2
CE-505	Environmental Engineering - I	3	1	-	4	4
CE-555	Environmental Engineering Lab - I	-	-	2	2	2
CE-556	Surveying Camp	-	-	2	2	2
Total		**15**	**5**	**8**	**28**	**28**

Semester VI

Course Code	Course Title	Total Number of contact hours				Credits
		Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CE-601	Advanced Structural Analysis	3	1	-	4	4
CE-602	Transportation Engineering	3	1	-	4	4
CE-652	Transportation Engineering Lab.			2	2	2
CE-603	Design of Steel Structures	3	1	-	4	4
CE-653	Design of Steel Structures Lab			2	2	2
CE-604	Engineering Hydrology	3	1	-	4	4
CE-605	Environmental Engineering - II	3	1	-	4	4
CE-655	Environmental Engineering Lab - II	-	-	2	2	2
Total		**15**	**5**	**6**	**26**	**26**

Semester VII

Course Code	Course Title	Total Number of contact hours				Credits
		Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CE-701	Foundation Engineering	3	1	-	4	4
CE-702	Design of Structures	3	1	-	4	4
CE-752	Design of Structures Lab.	-	-	2	2	2
CE-703	Water Resources Engineering	3	1	-	4	4
CE-704	Engineering Economics & Construction Management	4	-	-	4	4
CE-754	Construction Management Lab	-	-	2	2	2
CE-71*	Elective-I	4	-	-	4	4
CE-756	Summer Practical Training	-	-	2	2	2
CE-755	Minor Project	-	-	4	4	4
Total		**17**	**3**	**10**	**30**	**30**

Semester VIII

Course Code	Course Title	Total Number of contact hours				Credits
		Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CE-801	Irrigation Engineering	3	1	-	4	4
CE-80*	Elective – II	4	-	-	4	4
CE-80*	Elective – III	4	-	-	4	4
CE-813	Project	-	-	8	8	8
Total		**11**	**1**	**8**	**20**	**20**
Grand Total		**124**	**34**	**66**	**224**	**215**

SEMESTER I

COMMUNICATION SKILLS
AS-101

L: 3 T: 0 P: 0

COURSE OUTCOMES

1. Developing the concepts of communication skills/soft skills
2. Developing the syntactical concepts of grammar
3. Command over professional/technical writing skills
4. Developing a sense interpretation through literature and its social/political and ethical aspect
5. Proficiency in language handling/delivery through English phonetics and accent mechanism

COURSE CONTENTS

Unit-I: THE ART OF COMMUNICATION

English Communication, Technical, Verbal & Non-Verbal Communication, Barriers in Communication, The Art of Communication; Reading, Writing, Listening, Speaking and Strategies to overcome challenges in effective communication.

Unit- II: FUNDAMENTALS OF ENGLISH SYNTAX

Basics of Parts of Speech, Determiners, Use of tenses, Transformation of sentences
Active- Passive; Direct-Indirect; Simple-Compound-Complex sentences, Use of
Prepositions, Discourse Markers, Subject Verb Concord, Use of Conjunctions, Use of Verbs.

Unit-III: WRITING

Formal & informal letters, unmade communication and Demand Communication Note Making, Report writing, Book Reviews, Abstracts and Research Proposals, creative writing, Email correspondences, Résumé writing, Executive summery.

Unit-IV: **WORD VOCABULARY & PHONETICS**

Word formation, foreign roots (Etymology) , Suffix, Prefix, Antonyms, Synonyms, Homonyms, one word substitution, Idioms and Phrases, Acronyms, IPA Symbols, Vowels and Consonants, Place and Manner of Articulations, Phonetic transcription and Accentuation (theoretical insight).

Unit V: Literature

Poetry

Soapnut Leaves- Chaaso
Where the Mind is Without Fear- Rabindranath Tagore
The Express- Stephan Spender
Amalkanti-Nirendranath Chkrabarti
Road Not taken- Robert Frost

Prose

Of Studies- Francis Bacon,
Vanishing Animals- Gerald Durrell
Fitin : Old man and the Sea – E Hemmingnoy
The Child- Munshi Premchand

Prescribed Text Books:

1. *The Joy of Reading*: Orient Blackswan Pvt. Ltd, New Delhi
2. *Fluency in English*: Macmillan Publishers, New Delhi
3. Intermediate Grammar Usage and Composition : M.L.Tikoo and Subramanian , Orient Blackswan Pvt. Ltd, New Delhi
4. A Text Book of English Phonetics for Indian Students: T. Balasubramanian, Macmillan Publishers, New Delhi.
5. Practical English Usage: Michael Swan, Oxford University Press.

Suggested Reading:

1. The Oxford Guide to effective Writing and Speaking Skills: John Seely, Oxford University Press
2. English Pronouncing Dictionary: Daniel Jones, Cambridge University Press.
3. Technical communication Principles and Practice: Meenakshi Raman and Sangeeta Sharma, Oxford.

ENGINEERING PHYSICS – I
AS – 102

L: 2 T: 1 P: 0

COURSE OUTCOMES

1. Enhancing the concepts of conservative and non-conservative forces
2. Understanding the basics of optics and introduction to lasers including their applications in field
3. Expanding the concepts of electromagnetism and its various applications
4. Exploring the basics of quantum ideas: photoelectric effect, Compton effect, Planck's hypothesis etc.
5. Understanding the physics of solids.

COURSE CONTENTS

Unit – I: PHYSICS OF MOTION

Inertial and non-inertial frames, conservation principles of momentum and energy; many particle systems, rocket motion, simple harmonic motion, damped harmonic motion.

Unit – II: OPTICS

Two views about nature of light, concept of coherence, interference of light, single slit and N-slits diffraction, hydrogen atom spectrum, diffraction grating and spectral resolution.

Unit – III: ELECTROMAGNETISM

Cylindrical coordinates, Gradient, divergence and curl, line integral, surface integral and volume integral, Lorentz force, Gauss's law, Ampere's Law, Maxwell's equations, electromagnetic waves and Poynting vector.

Unit – IV: QUANTUM IDEAS

Difficulties of classical Physics, Planck hypothesis, wave particle duality, photoelectric effect, Compton effect, uncertainty principle and its implications, wave packets, group velocity and phase velocity, Davisson Germer experiment.

Unit – V: PHYSICS OF MATERIALS

Classifications of materials, crystal structure, unit cell and lattice parameters, Miller indices, Bragg's law and X-ray diffraction, classical free electron theory, its success and failures, Wiedemann Franz law, Maxwell Boltzmann distribution.

ENGINEERING CHEMISTRY – I
AS – 103

L: 2 T: 1 P: 0

COURSE OUTCOMES

1. Understanding the instrumental methods of analysis
2. Exploring the chemical methods and phase rule
3. Expanding the knowledge of electrochemistry and surfactants
4. Understanding the mechanism, classification, properties and applications of polymers
5. Understanding composites and nanomaterials

COURSE CONTENTS

Unit – I: CHEMICAL AND INSTRUMENTAL METHODS OF ANALYSIS

Gravimetric Analysis; Digestion and its Importance, Favorable Conditions for Precipitation, Volumetric Methods of Analysis; Expression of concentration of solutions Acid-Base (pH metry and conductometry), Redox, Precipitation and Complex metric Titrations. Chromatography; Definition and Different Types of Chromatography, Fundamentals of Spectroscopy; Principles and Applications of UV-Visible, Infra-Red and Atomic Absorption Spectrometry.

Unit – II: ELECTROCHEMISTRY AND SURFACTANTS

Electrolytic and Galvanic cell, Electrode Potential, Standard Electrode Potential, EMF series, Nernst Equation, Cell emf Measurement, Reversible and Irreversible cell, Thermodynamic Overview of Electrochemical Processes, Conductance, Cell Constant and its Determination. Surface Active Agents, Soaps, Types and Advantages of Detergents, Critical Miceller Concentration, Hydrophilic and Hydrophobic Interactions, HLB values, Fricoohesity of Surfactant Solutions.

Unit – III: MOLECULAR STRUCTURE AND PHASE RULE

Valence Bond Theory, Molecular Orbital Theory, Molecular Orbital of Polyatomic Molecules, Molecular orbital Theory of Solids, crystal structure, Semiconductors and Superconductors. Phase Rule; Phase Rule Applications to One and Multiple Component systems, Fe-C Phase Equilibrium Diagram, Types of Alloys, Ferrous and Nonferrous Alloys.

Unit – IV: POLYMERS

Basics of polymer chemistry, Molecular weight, Glass transition temperature and Melting point, Methods of polymerization, Structure property relationship, Thermoplastics and Thermosets, Fabrication of polymers-Compression, Injection, Extrusion and transfer Moulding. Synthesis, Properties and uses of polyethylene, Polyvinyl Chloride, Poly Methyl Methacrylate, Urea formaldehyde resin and Melamine formaldehyde resin, Elastomers and Conducting polymers.

Unit – V: NANOMATERIALS AND COMPOSITES

General Introduction, Fullerenes, Carbon nanotubes, Nanowires, Electronic and Mechanical properties, Synthesis of nanomaterials, Top down and Bottom up approaches, Applications of nanomaterials. Adhesives and their classification, Composites; their Compositions, Characteristics and types.

ENGINEERING MATHEMATICS – I
AS – 104

L: 3 T: 1 P: 0

COURSE OUTCOMES

1. Tracing the curve and understanding its behaviour at the point of infinity (Asymptote).
2. Learning the concepts of successive differentiation and the expansion of functions in form of series.
3. Finding maxima and minima of a function of two and more variables and the concept of Eigen values.
4. A study of ordinary differential equations and its applications.
5. Learning the concepts of partial differential equations with applications.

COURSE CONTENTS

UNIT I: CURVE TRACING & APPLICATIONS OF DEFINITE INTEGRALS

Two Dimensional curve tracing in Cartesian, polar and parametric forms, Double points & points of inflexion, Oblique and parallel asymptotes, Finding length, volume and surface area of the curve in Cartesian, polar and parametric forms.

Unit-II: TECHNIQUES OF ONE VERIABLE CALCULUS & PARTIAL DIFFERENTIATIONS

Leibnitz's theorem; n^{th} derivative of F(x) at x=0, Maclaurin's expansion of F(x), Formation of Intrinsic and pedal equations, Partial derivatives and their geometrical interpretation, Total derivative, Total differential coefficient, change of variables i.e. use of Jacobeans.

Curvature and radius of curvature in Cartesian, polar and parametric and implicit forms, Radius of curvature at the origin, centre and chord of curvature, and evolutes of the curves.

Unit-III: CALCULUS OF SEVERAL VARIABLES & LINEAR ALGEBRA

Taylor's expansion of a function of one & two variables, Leibnitz's rule for differentiation under the sign of integration, Maxima and minima of a function of two and more variables including Lagrange's method.

Consistency of a system of simultaneous linear equations using rank, Eigen values and Eigen vectors of a square matrix, Properties of Eigen values, Applications of Cayley-Hamilton theorem and diagonalization of a matrix, vector space, basis, linear dependence and independence of vectors, Linear transformations and related problems

Unit-IV: ORDINARY DIFFRENTIAL EQUATIONS

Orthogonal and lsogonal trajectories of a family of curves, Complementary function, particular integral and general solution of ordinary linear differential equations of higher order with constant and variable coefficients (Cauchy and Legendre forms).

Method of variation of parameters Method of undetermined coefficients and solutions of simultaneous differential equations with constant coefficients.

Unit-V: PARTIAL DIFFERENTIAL EQUATIONS

Introduction to partial differential equations, Change of independent variables in P.D.E., Complete

solution of homogeneous and non-homogeneous L.P.D.E. of higher order with constant and variable coefficients,
Solutions of one dimensional wave equation, one dimensional heat conduction equations and two dimensional Laplace (Cartesian and polar forms) equation using method of separation of variables.

Text/ Reference Books:

1. A.B. Mathur & V.P. Jaggi : A text book of "Engg. Maths. & Advanced Engg. Mathematics"
2. V.P.Mishra: "Concept of Engineering Mathematics" (Revised Edition)
3. B.S. Grewal: "Engineering Mathematics & Higher Engineering Mathematics"
4. B.V. Ramana: "Higher Engineering Mathematics".
5. R.K. Jain and S.R.K. Iyengar : "Advanced Engineering Mathematics", 4th Edition
6. Dr. J.S.Bindra & K.S. Gill, "Applied Mathematics" S.K. Kataria & Sons, Ansari Road, Darya Ganj, Delhi-110002

BASICS OF CIVIL ENGINEERING
CE-101

L: 2 T: 1 P: 0

COURSE OUTCOMES

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

1. Determine the engineering properties of the materials and solids.
2. Analyze the internal forces for statistically determinate and compound members.
3. Apply the concept of compound stresses for axial, flexure, shear and torsion.
4. Apply the concept of principal strain and strain tensor for the analysis of different structural members.
5. Apply the concepts of shear force, bending moment, axial force for statically determinate beams.

COURSE CONTENTS

Unit-I: Stresses & Strains: Introduction, normal stress & strain, shear stress & strain, relationship between stress and strain, Uniaxial tension test: Stress-Strain diagrams for different materials, Mechanical properties of materials: isotropy, homogeneity, continuity, elasticity, brittleness, yielding, plasticity, work hardening, ductility, hardness, toughness, creep, relaxation, fatigue; Uniaxial deformations: Saint Venant's principle, principle of superposition, free body diagrams, bars of uniform cross sections.

Unit-II: Uniaxial Deformations: Bars of variable cross sections, compound/ composite bars, temperature stresses.

Unit-III: Analysis of Stresses: tensor notations, equilibrium equations, transformation of stresses, invariants of stress tensor, plane stress condition, principal stresses, maximum shear stress and their planes, Mohr's circle.

Unit-IV: Analysis of Strains: transformation of strains, invariants of stain tensor, plane strain condition, principal strains, maximum shear strain and their planes; Strain Rosettes; Stress –Strain relationship, generalized Hooke's law, relation between elastic constants.

Unit-V: Structures and Their Forms: Loads, idealization of structures, supports and connections, elastic and linear behaviour of structures, determinate and indeterminate structures, SF & BM: relation between B.M., S.F. and loads, S.F. & B.M. diagrams in statically determinate simply supported (without overhang) and cantilever beams subjected to concentrated loads and UDL

Text Books

• Engineering Mechanics of Solids By E.P. Popov, Pearson Education.
• Solid Mechanics by S.M.A. Kazimi, Tata McGRAW HILL.
• Mechanic of Materials by R.C. Hibbeler, Pearsons Education

Reference Books

• Mechanics of Materials by Beer & Jonhson, Dewolf, McGRAW HILL.
• Strength of Materials by S. Timoshenko, CBS Publisher
• Strength of Materials by R. K. Rajput, S Chand

BASICS OF MECHANICAL ENGINEERING
ME – 101

L: 2 T: 1 P: 0

COURSE OUTCOMES

1. Understanding various thermodynamic systems, properties and other related concepts
2. Expanding the knowledge of reversible and irreversible cycles
3. Learning the basics of first law and second law equations and related theories with numerical
4. Studying the kinematics of fluid flow
5. Understanding the dynamics of fluid flow

COURSE CONTENTS

Unit-I: Thermodynamics systems, Properties, Thermal equilibrium, Zeroth Law of thermodynamics and concept of temperature. Work, displacement work in various Quasi-state systems, First law of thermodynamics, application to cyclic process, Internal energy, Enthalpy. Pure substance, control volumes, Application of first law to non-cyclic process, Steady Flow energy equation.

Unit-II: Reversible and Irreversible process, Second law of thermodynamics, Kelvin-Planck and Clausius statement and their equality. Entropy generation, Entropy balance equation for closed and open systems.

Unit-III: First law and second laws equations, Maxwell's relation, Carnot cycle. Definition and properties of fluids, Classification of fluids, Normal and shear stresses in fluids.

Unit-IV: Kinematics of fluid flow; Types of flow, flow pattern, Velocity and rotation, acceleration of fluid particle, velocity potential function, Differential equation of conservation of mass.

Unit-V Dynamics of ideal fluids flow; Euler's equation of motion, Bernoulli's equation and its application, Flow measuring device, Venture-meter, orifice-meter and nozzle meter, pilot-static tube, hydraulic co-efficient, Flow through pipes, Major and Minor losses in pipe flow.

Text books:

1. Engineering Thermodynamics by: P. K. Nag, TMH.
2. Fundamental of classical thermodynamics by: Wan- Wylen&sontag, John wiley&sons.
3. Engineering thermodynamics by: Spalding & code.
4. Engineering Mechanics: Statics and Dynamics: by J. L. Meriam and L. G. Kraige, John Wiley & Sons, Inc.

5. Engineering Mechanics: Dynamics: 12th Edition by R. C. Hibbeler, Prentice Hall 6. Engineering Mechanics: by K.L. Kumar, Tata Mc Graw Hill.

BASICS OF ELECTRICAL ENGINEERING
EE-101

L: 2 T: 1 P: 0

COURSE OUTCOMES:

1. To analyse circuit systems using direct application of Kirchoff current and voltage laws along with Ohms law
2. To understand basic concept of "*j*" operator, RLC series circuit, reactive power, true power and apparent power
3. To prepare the students to have basic knowledge of transformers, the equivalent circuit model of single phase transformers, transformer parameters using open circuit and short circuit tests, compute transformer efficiency and voltage regulation
4. Construction and understanding of working principles of DC generators and motors.
5. The ability to select a suitable measuring instrument for a given application like PMMC and MI

COURSE CONTENTS

Unit-I:

Fundamentals of electric circuits, Kirchhoff's laws, mesh analysis, node analysis, delta-star and star-delta conversion, classification of network elements, Thevenin's theorem, Nortan's theorem maximum power transfer theorem, superposition theorem.

Unit-II:

Single phase AC circuits, average and effective values of sinusoids, solution of R,L,C series circuits, the j operator, complex representation of impedances, phasor diagram, concept of power factor, power factor improvement, power in complex notation, solution of parallel and series-parallel circuits, resonance. Introduction to balance three phase AC circuits.

Unit-III:

Ampere's circuital law, B-H curve, solution of magnetic circuits, hysteresis and eddy current losses. Relays as an application of magnetic force. Transformers- construction, e.m.f. equation, ratings, phasor diagram for no load and full load, equivalent circuit, regulation and efficiency calculations, open circuit and short circuit tests, Introduction to Auto-Transformer.

Unit-IV:

Introduction to Electromechanical Energy Conversion, DC motors- construction, e.m.f. and torque equations, characteristics of DC generators and motors, speed control of DC motors. DC motor starter- working principle, ratings. Introduction to three phase induction motor, Introduction to alternator and synchronous motor and their applications.

Unit-V:

PMMC instruments, shunts and multipliers, multi-meters, moving iron ammeters and voltmeters, dynamometer wattmeter, AC watt-hour meters, extension of instrument ranges.

Text Book:

- D.C. Kulshrestha, "Basic Electrical Engineering", Tata McGraw Hill.

- T.K. Nagsarkar&M.S.Sukhija, “Basic Electrical Engineering”, Edition 2008, Oxford University Press.

Reference books:

- V. Del Torro, Electrical Engineering Fundamentals, Second Edition, Prentice Hall of India Pvt. Ltd.
- E. Hughes, Electrical Technology, English Language Book Society Publication with Longman.
- H. Cotton, Advanced Electrical Technology, Issae Pitman, London.
- S.S. Parker, Problems in Electrical Engineering, Asia Publications.
- I. J. Nagarath, “Basic Electrical Engineering”, 2nd Edition, Tata McGraw Hill.

WORKSHOP PRACTICE
ME-151

L: 0 T: 0 P: 4

COURSE CONTENTS

I FOUNDRY: Mould cores, core prints, gates runner, risers, chaplets, common defects in casting, defects due to mould, metal pouring, solidification.

II METAL JOINING: Oxy acetylene gas welding equipment, types of flame, electric arc and contact welding, electrodes and equipments for AC and DC welding, electrode coating functions and constitutes, common welding defects.

III METAL CUTTING OPERATION AND TOOLS: Common metal cutting machine like lathe, milling, shaper, slotter and drill, lathe operations like turning, chamfering, facing, taper turning and knurling, material for lathe tools and other tools, bench grinder and use.

Related Labs:

1. Gas welding: simple joint like joint.
2. Electric Arc Welding: Simple joints like butt joint.
3. Tin Smithy: Mechanical joining, jobs like box, tray, funnel and soldering of joints.
4. Turning: Plane turning, taper turning, threading, knurling, facing and chamfering on the same job.
5. Shaping: Surface finishing at right angles.
6. Milling: Making a slot two or three surface finishing at angles of 1200C.
7. Drilling: Making drilled holes in plates or flats and grinding the corner of a plate to round.

Text books/ Reference books:

1. Elements of Workshop Technology by, Choudhary Vol. 1 & 2. Media promoters and publisher, 1996.
2. Workshop Technology, Vol. 1-3 by W A J Chapman, ELB. S

SEMESTER II

HUMAN RESOURCE MANAGEMENT
AS-201

L: 3 T: 1 P: 0

COURSE OUTCOMES

1. Forming a foundation of human resource management
2. Understanding the procedure of acquisition of human resources
3. Making clear the importance of appraisals and evaluation in human resource
4. Learning importance of training and development of human resource
5. Analysing the management of job stress and employee health and well being

COURSE CONTENTS

Unit-I: Foundation of Human Resource Management (HRM): Meaning, definition, nature and scope, characteristic, objectives, Opportunities and challenges in HRM, HRM functions.

Unit-II :Acquisition of Human Resources –*Human Resource Planning (HRP)*: need, objectives, determinates, HRP models, HRP process, type of HRP, benefits; *Job Analysis (JA)*: sources, methods, process, uses, importance; job description, job specification; *Recruitment and selection:* sources, process, barriers, objectives, objectives of selection, selection tests, interview, induction, placement and employee socialization.

Unit-III: Appraising and evaluating Human Resources –*Performance Appraisal (PA)and feedback:* approaches, methods/techniques of PA, process of PA, interview, elements, designing and conducting PA; *Job Evaluation (JE):* principles, process, methods of JE, importance and limitations.

Unit-IV: Development of Human Resources –*Human Resource Development (HRD):* functions, benefits, importance, barriers to HRD; *Training and Development*: models, methods, training process, training evaluation and barriers.

Unit-V: Employees Health & Well being –Job stress and Job Burnout: Nature, Causes and consequences; *Stress:* Nature, Causes and consequences; *Management of Stress:* Personal and organizational based strategies; *Burnout:* Nature, symptoms, causes, relationship with stress, burnout and job satisfaction management of burnout.

Text Books:

- Gary Dessler (2015), Human Resource Management, Person Prentice Hall of India, New Delhi
- VSP Rao, Human Resource Management, Text & Cases (2nd edition), Excel Books, New Delhi

Reference Books:

- Tapomony Deb, (2009), Managing Human Resource and Industrial Relations (First edition), Excel Books, New Delhi

- John M. Ivancevich (2005), Human Resource Management 93rd edition) Tata McGraw Hill Publishing Co. Ltd., New Delhi

ENGINEERING PHYSICS – II
AS – 202

L: 2 T: 1 P: 0

COURSE OUTCOMES

1. Learn to apply relativity in describing physics of motion
2. Appreciate the importance of lasers and grasp the physical bases
3. Learn the calculation methods of quantum theory
4. Apply quantum ideas to explain behaviour of materials
5. Appreciate physics conservation laws and be acquainted with new areas

COURSE CONTENTS

UNIT- I: RELATIVITY

Difficulties of classical theory, idea of ether, Michelson Morley Experiment, Galilean transformations, postulates of special theory of relativity, Lorentz transformations, Einstein velocity addition theorem, time dilation, length contraction, relativistic mass, momentum and energy, natural units, principle of equivalence.

Unit -II: LASERS

Principle of laser action, Einstein's transition probabilities, lifetime of transitions, rate equation for atomic transition, optical resonators, ruby laser, He-Ne laser, general characteristics of lasers, applications of lasers.

Unit -III: QUANTUM THEORY

Schrodinger equation, time dependent and independent forms, wave function, probabilistic interpretation, one-dimensional problems, particle in a box, elementary treatment of harmonic oscillator, potential barrier and possibility of tunnelling.

Unit -IV: PHYSICS OF MATERIALS

Bose Einstein statistics, Fermi Dirac statistics, semiconductors, intrinsic and extrinsic, carrier concentration, origin of energy gap, Kronig Penney model, Basics of semiconductor devices and applications, Electrical & optical properties.

Unit -V: FRONTIERS OF PHYSICS

Basic interactions, symmetry, invariance and conservation laws, elementary particles and their classification, accelerator physicsand applications, last Nobel prize in Physics, its back ground, significance and possibilities of future developments.

ENGINEERING CHEMISTRY – II
AS – 203

L: 2 T: 1 P: 0

COURSE OUTCOMES

1. Understanding importance of use of water in industries, softening methods and problems on water treatment
2. Understanding basis of fuels analysis and their combustion
3. Exploring the corrosion and protection
4. Understanding environment and pollution
5. Understanding environmental biochemistry

COURSE CONTENTS

Unit -I: WATER TREATMENT:

Water Quality Parameters (BIS & WHO Standards), types of hardness, Units, Determination of hardness by EDTA method, Alkalinity of water & its significance, Numerical problems, Problems with boiler feed water and its treatment; Scale & Sludge formation, Boiler corrosion, Caustic Embrittlement, Priming & foaming, Softening methods; Lime-soda, Zeolite & Ion Exchange processes, Numerical problems, Chlorination of water, Coagulation, Sedimentation and Desalination.

Unit -II: ENERGY RESOURCES:

Types of fuels, Calorific values, (HCV & LCV) and determinations by Bomb and Boys gas calorimeter, Numerical problems, Coal; Types of coal, Analysis of coal, Liquid Fuel; Refining of petroleum, Knocking, Octane and Certance Values, Pollution from fossil fuels, Combustion and Problems. Renewable; (Solar Cells, Rechargeable Batteries, Fuel Cells) and Non-renewable of energy; (Wind Energy, Geothermal Energy, Ocean Energy) resources of Energy.

Unit -III: CORROSION AND ITS PROTECTION:

Corrosion; Definition and its scope, Chemical Corrosion, Electrochemical Corrosion, Mechanism of Chemical and Electrochemical Corrosion, Types of Corrosion; Intergranular Corrosion, Soil Corrosion, Waterline Corrosion, Differential Aeration Corrosion, Galvanic and Concentration Cell Corrosion, Factors affecting corrosion, Protection of corrosion.

Unit-IV: ENVIRONMENTAL CHEMISTRY:

Environment and its Segments, Zones of Atmosphere, Air Pollution: Air pollutants and their resources; Aerosol and its Types, RSPM, SPM, Acid rain, Green House Effect, Global warming, Ozone Layer Depletion, Water Pollution; Sources of water pollution, Sewage Treatment, Determination and Significance of COD, BOD, TOC. Noise Pollution, Soil Pollution, Radioactive Pollution and e-Waste.

Unit-V: ENVIRONMENTAL BIOTECHNOLOGY:

Biotechnology and its applications, fermentation, production of alcohol and vitamins, Biotechnology for environmental Protection, Biological indicators, biosensors, bioremediation, Phytoremediation, bio-pesticides, bio-fertilizers, bioreactors, Social issues, biodiversity and its conservation.

ENGINEERING MATHEMATICS – II
AS – 204

L: 3 T: 1 P: 0

COURSE OUTCOMES

1. Tracing of 3D curves and evaluation of multiple integrals by change of variables/change of order of integration.
2. Learning the concepts of non-linear ordinary and partial differential equations.
3. Study of analytical functions, residues and conformal mapping.
4. Solutions of system of differential equations, integral equation, Integro-differential equations, difference equations using Laplace transformation.
5. Learning of theory of Fuzzy Mathematics with its applications.

COURSE CONTENTS

Unit-I: SOLID GEOMETRY & MULTIPLE INTEGRALS

Formation of equations of cylinder and cone under the given geometrical conditions, Tracing of some quadric (or Conicoids) three dimensional surfaces.

Evaluation of multiple integrals by change of order of integration, Change of variables i.e. Use of Jacobian & Applications of multiple integrals in finding plane area, mass, centre of gravity, centre of pressure, moment of inertia, product of inertia, curved surface area and volume.

Unit-II: ORDINARY & PARTIAL DIFFERENTIAL EQUATIONS

Ordinary point and regular singular point, Series solutions of ordinary differential equations of second order with variable coefficients (polynomials) by the method of Frobenius; Lagrange's method of undetermined multipliers for the solution of linear partial differential equations of first order solution of non-linear partial differential equations of first order by means of transformations and Charpits methods.

Unit-III : COMPLEX ANALYSIS

Analytical function, C-R equations in Cartesian and polar forms, Geometrical representation of $\omega=F(z)$, Determination of conjugate harmonic function, Milne – Thomson meyhod and related problems; Evaluation of complex integrals using Cauchy's integral theorem, Cauchy's integral formula for the n^{th} order derivative of an analytic function.

Taylor series, Maclaurin series and Laurent series expansions of functions, Conformal mapping, sufficient condition for conformality of $W=f(z)$, some standard transformations; zeros, singularities and residues of an analytic function, Application of Cauchy's residue theorem in solving contour integrals and evaluation of real definite integrals using residue method.

Unit-IV: LAPLACE TRANSFORM & ITS APPLICATIONS

Laplace and inverse Laplace transforms of some well-known elementary functions and Special functions, Change of scale property, First and second shifting theorems, Laplace transforms of Derivative, Integral, $t^n f(t)$, $f(t)/t$, Convolution theorem & Periodic function.

Applications of Laplace and inverse Laplace transform in finding the particular solutions of ordinary linear differential equations with constants and variables coefficients, system of differential equations, integral equation, Integro-differential equations, difference equations and, conversion of differential equations into integral equations & vice versa.

Unit-V: FUZZY MATHEMATICS

Fuzzy set, elements of Fuzzy logic, Relations including operations, reflexivity, symmetry and transivity, Pattern classification based on fuzzy relations, fuzzy analysis including metric spaces, distance between fuzzy sets, area perimeter, height, width of fuzzy subsets, continuity & integrals.

Text/ Reference Books

1. A.B. Mathur & V.P. Jaggi: "Engineering. Mathematics & Advanced Engineering Mathematics" (two volume)
2. V.P.Mishra: "Concept of Engineering Mathematics" (Revised Edition)
3. B.S. Grewal: "Engineering Mathematics & Higher Engineering Mathematics",43rd Edition
4. B.V. Ramana: "Higher Engineering Mathematics".
5. R.K. Jain and S.R.K. Iyengar : "Advanced Engineering Mathematics" 4th Edition

INNOVATIVE SCIENCE & TECHNOLOGY
AS-205

L: 3 T: 1 P: 0

COURSE OUTCOMES

1. Understanding the concept of nanotechnology
2. Learning the applications of nanotechnology in multiple disciplines
3. Understanding the concepts of biological sciences, genetics, biological indicators and biosensors
4. Exploring the field of advanced biological sciences and biotechnology
5. Exploring nano-biotechnology and its various applications

COURSE CONTENTS

Unit-I: Introduction to Nanotechnology

Introduction to Nanotechnology, Theoretical Basis of nanotechnology, Quantum confinement and size effect, Classification of Nano materials: Nano wires, Quantum Well and Quantum Dots, Properties of Nano materials, Carbonaceous Nano materials and their examples. Molecular Nanotechnology, Green Nanotechnology.

Unit-II: Applications of Nanotechnology

MicroelectromechanicalSystems(MEMS)&NanoeletromechanicalSystems(NEMS), Nanorobotics,Nanofluidics,Micro-gearsandNano-gears,NanocompositesandtheirapplicationsNanomaterialsforCivilEngineers, Nano-paints, Light and flexible Civil Engg. Structures based on carbon Nano materials, Nano-memories. Nano-sensors. Nano-transistors, Introduction to organic electronics.

Unit-III: Introduction to Biological Sciences

Introduction to the cell as a unit of life, Principles involved in the maintenance of life processes, Ultra-structure and function of cellular components-Prokaryotic and Eukaryotic cells, cell wall, plasma membrane, endoplasmic reticulum, Biomolecules- Carbohydrates. Lipids, Amino Acids, proteins, Nucleic Acids, Tissue Systems. Metabolism, Chromosomes and CellDivision.BasicGenetics-biologicalindicators,bio-sensors,Mutation-causes.typesandeffect.

Unit-IV: Advanced Biological Sciences

Introduction to microbiology, Industrial microbiology, introduction to immunology, Introduction to molecular genetics, Structure of RNA aid DNA, Concept of Gene, Gene regulation, Basic concepts of biotechnology: Tot potency and cell manipulation, Classifications of biotechnologies.

Unit-V: Nanobiotechnology

Introduction to Nano biotechnology, Nano biotechnology in medicine: regenerative medicine, Targeted drug delivery. Nanotechnology in pharmacy, Nano biotechnology in Ayurveda, Alternative medicines. Nan biotechnology in Agricultural, industrial Nan biotechnology, Nan imaging, Cancer treatment using Nanotechnology.

BASICS OF ELECTRONICS & COMMUNICATION
EC– 201

L: 2 T: 1 P: 0

COURSE OUTCOMES

1. Studying semiconductor diodes and their various characteristics
2. Expanding the ideas: construction and working of BJTs and introducing JFET
3. Exploring various types of operational amplifiers
4. Understanding the idea of feedback and thus studying various electronic instruments
5. Learning various parameters of communication systems

COURSE CONTENTS

Unit -I: Semiconductor Diodes:

P-N junction diode, V-I characteristics, static and resistance, linear and non-linear applications of diodes; half wave, full wave and bridge rectifiers, zener diode, characteristics and its use as a voltage regulator, AND, OR, NAND, NOR and Ex-OR gates.

Unit-II: TRANSISTORS (BJT & JFET):

Bipolar junction transistor (BJT) , biasing and amplifier action, load line analysis of transistor amplifier, BJT amplifier configurations and their comparison using small signal h-parameter model, Junction field Effect transistor (FET), biasing and amplifier action.

Unit -III: OPERATIONAL AMPLIFIER:

Op-am- basics, practical op-ampcircuits, inverting and non-inverting amplifier, summing amplifier, integrators and differentiators.

Unit-IV: FEEDBACK AND ELECTRONIC INSTRUMENTS:

Feedback concept, Barkhausen Criteria of oscillation, Wein Bridge and phase shit oscillator, cathode Ray oscilloscope (CRO), electronics multimeters.

Unit -V: COMMUNICATION SYSTEMS:

Introduction to modulation, amplitude modulation generation of AM waves, demodulation of AM wave, introduction to FM.

FUNDAMENTAL OF COMPUTING
CS- 201

L: 2 T: 1 P: 0

COURSE OUTCOMES

1. Students will able to understand the basics of computer, generation & types of computer, its components and number system
2. Students will able to understand the concept of algorithms, flowchart and c programming language
3. Students will able to develop c programs for string manipulation, sorting and searching techniques
4. Students will able to describe the functions, structure and different types of operating systems
5. Students will able to understand basics of networking, internet and database management systems

COURSE CONTENTS

Unit 1: BASICS OF COMPUTERS

Computer fundamentals, Bits and Bytes, CPU, Memory, Types of memory, Input and output devices, I/O devices, Operating system, applications software's, system software. Number system, decimal number system, Binary number system, octal number system, hexadecimal number system. Generation of computer, Classification of computer,

Unit 2: C PROGRAMMING

Algorithms, flow chart, The C character set, constants, variable, keywords, operator and expressions, decision controls, if and else, conditional operator, for loop, while loop and do-while loop,, switch case, user defined functions, call by value and by reference, array, and single dimensional, 2D matrix, multidimensional arrays

Unit 3: SEARCHING AND SORTING

Strings, library string functions, pointers and structures, searching and sorting, linear search, binary search, sorting techniques: bubble sort, selection sort

Unit 4: OPERATING SYSTEM

OS definition, role of OS in computer system, multi programming, time sharing OS, multitasking OS, multiprocessing OS, real time system OS , client server computing, distributed OS, function of OS (user interface, GUI, program execution, I/O management, Resource management,

Unit 5: NETWORKING & DBMS

Network, communication models, transmission media, connection topologies, LAN, WAN, MAN, ISO-OSI model of networking, Internet, ISP, WWW, Email, URL, Web browsers, websites, intranet, DBMS, DBMS applications, Advantage of DBMS, Data abstraction.

Books:

- Reema Thareja, "Computer Fundamentals & Programming in C", Oxford University Press
- Ashok Kamthane, "Programming with C ".
- M N Doja, "Introduction to Computers and Information Technology"
- C Programming by Yaswant Kanetkar

ENGINEERING GRAPHICS
ME-250

L: 0 T: 0 P: 4

COURSE CONTENTS

Unit-I:

ORTHOGRAPHIC PROJECTION: Conversion of pictorial/ isometric views into orthographic views of machine block. Identification of surface in orthographic views. Some practice on auto-Cad package.

Unit-II:

ISOMETRIC PROJECTION: Isometric scale, isometric projection of solids, missing line and missing views. Isometric view of simple objects when their orthographic views are given. Preparation of isometric views using Auto-Cad package.

Unit-III:

SECTIONING: Conventional representation in section of engineering materials. Methods of sectioning, sectional views of machine components, brackets, bushed bearing and foot step bearing. Unit IV FASTENERS: Sketches of different types of threads, permanent fasteners (riveted and welded joints), temporary fasteners (nut and bolt assembly, studs, keys. etc.)

Unit-IV:

BUILDING DRAWINGS: Symbols of electrical and sanitary items. Terminology used in building drawing, plan and elevation of 2/3- rooms building using Auto-CAD package, from corrosion, refractories, their manufacturer and properties: neutral, acid and basic refractors; glass its types and manufacture.

SEMESTER III

FLUID MECHANICS
CE-301

L: 3 T: 1 P: 0

COURSE OUTCOMES

At the end of the course, the student should be able to:

1. develop relationships between different fluid properties and apply them to practical problems
2. analyze the stability of floating and submerged bodies using the principle of floatation.
3. apply the concepts of kinematics to solution of fluid flow problems.
4. apply the concepts of rotational mechanics for the analysis of source, sink, doublet, and flow past stationary and rotating cylinders.
5. apply Bernoulli's energy equation to solve real world problems.

OURSE CONTENTS

Unit-I:

Introduction: Real and ideal fluids, concept of continuum approximation, properties of fluids, equation of state, coefficient of compressibility, bulk modulus of elasticity, Newtonian and non-Newtonian fluid, surface tension, capillarity, concept of viscosity, effect of temperature on viscosity.

Unit-II:

Fluid Static: Pascal's law, devices based on Pascal's law, hydrostatic law, pressure variation in isothermal and adiabatic condition; Manometers: Simple and differential manometers, relative equilibrium; Forces on submerged plane, inclined and curved surfaces; Buoyancy; Stability of floating and submerged bodies, meta center and meta centric height.

Unit-III:

Fluid Kinematics: Kinematics of fluid Motion, Eulerian and Lagrangian description, type of motion, concept of control volume and control surface, streamline, path line, streak line and stream tube, continuity equation in Cartesian coordinate and polar coordinate, one and two dimensional flows, acceleration of fluid element, linear momentum equation and its application- forces on pipe bends.

Unit-IV:

Fluid Rotation: Vorticity and angular velocity in terms of velocity field, irrotational flow, velocity potential and stream function, flow net and its uses, free and forced vortex motion, ideal fluids flow, source and sink, doublet, flow past a stationary and rotating cylinder, Magnus Effects.

Unit-V:

Fluid dynamics: Naivier- Stoke's equation, Euler's equation of motion and integration along streamline; Bernoulli's equation, physical significance of different heads, Bernoulli's equation for isothermal and adiabatic flow; Application of Bernoulli's equation: pitot tube, , venturi meter, orifice meter, mouth pieces; Calibration of flow measuring devices and its applications, Concept of kinetic energy, and momentum correction factors; Flow through an orifice; Flow over a weir and notch; Time required for emptying of tank.

Textbook

1. Frank. M. White, Fluid Mechanics, McGraw-Hill, 7th edition, 2011

References book

1. John F. Doughlas, Janusz M. Gasiorek, John A. Swaffield, and Lynne B. Jack. Fluid Mechanics, Pearson, 2012
2. Bruce R. Munson, Donald F. Young, and Theodore H. Okiishi, Fundamentals of Fluid Mechanics, 5th Edition, John Wiley and Sons, 2006
3. Robert W. Fox, Philip J. Pritchard, Alan T. McDonald, Introduction to Fluid Mechanics, Wiley, 6th ed., 2003
4. A.K .Jain Fluid Mechanics, Standard Publishing House, Delhi,

SOLIDS MECHANICS
CE-302

L: 3 T: 1 P: 0

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

1. analyse behaviour of structural elements subjected to different types of stresses
2. analyse different types of beams subjected to bending action
3. apply theory of pure bending to determine stresses in different types of structural elements
4. determine slopes and deflection in beams using Macualay's and direct integration methods
5. analyse compression members under axial and flexural loading

COURSE CONTENTS

Unit-I: Thin Cylindrical shells: Longitudinal and hoop stresses, volumetric strains; Thick Cylinders: Lame's equations, stresses due to internal and external pressure; Torsion: Circular and noncircular shafts, power transmitted by shafts; Concept of strain energy and resilience; Theories of failure.

Unit-II: Shear force and Bending moment: SF and BM Diagrams for simply supported over-hanged and cantilever beams subjected to moments and varying loads; SF, BM & Torque Diagrams for inclined beams & brackets subjected to concentrated load, udl, moments and varying loads.

Unit-III Bending in beams: Bending theory, bending equation, bending stresses in rolled steel and built up sections; Shear stresses in beams: shear flow, shear centre, variation of shear stresses in beam cross-section.

Unit-IV: Deflection of beams: Direct integration and Macaulay's methods for simply supported and cantilever beams subjected to concentrated loads, uniformly distributed loads, varying loads and moments.

Unit-V: Columns and struts: Columns and struts subjected to compression and bending, middle third & middle fourth rules, core or kernel of sections, masonry column, dams and retaining walls; Long columns: Euler's, Rankine's and Secant formulae.

Text Books

1. Engineering mechanics of solids, E. P. Popov, Pearson Education.
2. Solids Mechanics, S. M. A. Kazimi, Tata McGRAW HILL.
3. Mechanics of Materials, R. C. Hibbeler, Pearsons.

References:

1. Mechanics of Materials, Beer & Jonhston, Dewolf, McGRAW HILL.
2. Strength of Material, S. Timoshenko.
3. Strength of Materials, R. K. Rajput.

ENGINEERING GEOLOGY
CE-303

L: 4 T: 0 P: 0

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

1. get the knowledge of earth and its mineral matter
2. get the knowledge of rock and its physical and engineering properties
3. get the knowledge of tectonic activity with details of earthquake
4. get the knowledge of natural land use and soil
5. get the knowledge of site investigation for various types of Civil Engineering projects\

COURSE CONTENTS

Unit-I:

Study of the internal structures such as crust, mantle and core of the earth. Mineral matter and physical properties of the rock forming minerals like metallic and nonmetallic minerals. Significance of minerals in Civil Engineering practices.

Unit-II:

Study of rocks, mode of formation and Classification of Igneous rocks. Physical and Engineering properties of igneous rocks. Relevance of Igneous rocks in civil engineering practices. Mode of formation and classification of Sedimentary Rocks. Physical and Engineering properties of Sedimentary rocks. Relevance of sedimentary rocks in Civil Engineering practices. Mode of formation and classification of metamorphic rocks. Physical and Engineering properties of metamorphic rocks. Relevance of metamorphic rocks in civil engineering practices.

Unit-III:

Study of Tectonic activity of the earth. Explanation of Fold, Fault, Joint and unconformities. Types of Fold, Fault, Joint and unconformities. Relevance of Fold, Fault, Joint and unconformities in Civil Engineering practices.

Unit-IV:

Weathering and erosion. Natural agencies of Weathering and Erosion. Types of Weathering. Formations of various types of landforms. Glacial land forms, wind landforms and fluvial landforms. Significance of various landforms in Civil Engineering practices. Formations of various types of soils.

Unit- V:

Site investigation Techniques. Geological Investigation for Dam site and reservoir, bridges, tunnels and building. Landslide and land subsidence. Study of earthquake, classification of earthquake, earthquake zoning in India. Rocks as engineering material. Hydrologic cycle and study of ground water.

Textbooks

1. A Text Book of Geology by P. K. Mukharji
2. Geology for Engineers By Dr. D.S. Arora
3. Engineering Geology Prabin Singh
4. Geology for Engineers by Krenin & Judd

References

1. Geology and Engineering, by Legeet, McGrawHill Book Company, 1998.
2. Geology for Engineers, by Blyth, ELBS, 1995

CIVIL ENGINEERING MATERIALS
CE-304

L: 4 T: 0 P: 0

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

1. understand the properties of different types of cement.
2. design concrete mixes and conduct tests on cement and aggregates.
3. use different types of special concretes in construction of structures.
4. understand and use properties of bricks, stones and wood in building construction.
5. understand and use properties of flyash, paints, varnishes, gypsum and water proofing materials in building constructions.

COURSE CONTENTS

Unit-I:

Cement: Compounds and prepositions, types of Portland cement, pozzolanic cement , high alumina cement and other types, hydration mechanism and hydration products, setting and hardening, curing, strength of hardened cement, grade of cement, tests on cements, relevant BIS codes.

Unit-II:

Aggregates: Properties of coarse & fine aggregates, tests on aggregates, relevant BIS codal provisions, concrete: Ingredients of concrete, properties of fresh and hardened concrete, strength of concrete, W/C ratio of porosity, additives and their types, concrete mix design.

Unit-III:

Special Concretes: Reinforced cement concrete, polymer concrete, fibre reinforced concrete, ferrocement, light weight concrete, roller compacted concrete, ready mix concrete, self compacting concrete, high performance concrete, bacterial concrete.

Unit-IV:

Bricks & Stones: Forms of bricks, properties of bricks and stones, tests on bricks and stones, relevant BIS codes, timber: structure of wood, defects in timber, seasoning, preservation, plywood and its manufacturing.

Unit-V:

Other materials: Fly ash paints & varnishes, gypsum, tar, bitumen & asphalt, nano materials, smart materials, composite materials, geosynthetics, heat & sound insulating materials, water proofing materials.

Textbook

1. Building Materials by S.K. Duggal
2. Engineering Materials by S.C. Rangwala
3. Concrete Technology by M L Gambhir
4. Properties of concrete by A M Neville

Reference Books

1. Engineering Materials by R K Rajput
2. Civil Engineering Materials by Neil Jackson
3. Design of concrete mixes by Krishna Raju N, CBS publishers
4. Concrete Technology by Neville A.M and Brooks. J.J. PEARSON education.
5. Concrete properties and manufacturing by Akroyd T.N.W, Pergamon press

NUMERICAL METHODS
CE-305

L:3 T:1 P:0

COURSE OUTCOMES

1. Students will be able to interpolate values of a function at a given intermediate value to formulate most of the application problems in science and engineering.
2. Student will be able to interpolate values of successive derivations of a tabulated function and single integral as well as multiple integral provides.
3. The students will be able to find roots of algebraic and transcendental non-linear equations involving one and more variables.
4. The students will be able to solve complex system of simultaneous linear equations and to fit variety of curves.
5. The students will be able to solve higher order differential equation numerically and boundary value problems.

COURSE CONTENTS

Unit-I: INTERPOLATION WITH EQUAL & UNEQUAL INTERVALS OF THE ARGUMENT

Newton-Gregory, Gauss, Stirling and Bessel Formulae, Aitken & cubic spline interpolation methods for equal intervals; Newton's divided difference and Lagrange's formulae for unequal intervals; Inverse interpolation using. Lagrange's formula, method of successive approximation and double interpolation.

Unit-II: NUMERICAL DIFFERENTIATION & NUMERICAL INTEGRATION

Numerical successive differentiation using Forward, Backward, Central difference interpolation formulae. Newton's divided difference formula. Review of Trapezoidal, Simpson's 1/3 and 3/8 rules, Numerical integration using Boole's rule, Weddle's rule, Gauss-Legendre, Lobatto, Radau and

Gauss-Chebyshev rules. Errors in Quadrature formulae, Romberg integration and Numerical double integration.

Unit-III: NUMERICAL SOLUTIONS OF ALGEBRAIC & TRANSCENDENTAL EQUATIONS

Bisection, Regula-False position, Newton-Raphson & Graeffe's Root-Squaring method for the solution of non-linear algebraic & transcendental equations involving one variable, rate of Convergence and error analysis of the methods, Newton-Raphson method for the solution of a system of non-linear equations of two variables.

Unit-IV: NUMERICAL SOLUTION OF A SYSTEM OF SIMULTANEOUS LINEAR EQUATIONS & CURVE FITTING

Gauss Elimination & Gauss-Jordan methods, III conditioned linear system, Gauss-Seidal and Crout methods for the solution of a system of linear equations in four unknowns; General curves (linear, quadratic, exponential and other non-linear functions) fitting using methods of least squares.

Unit-V: NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS & BOUNDARY VALUE PROBLEMS

Numerical approximate solutions of a system of simultaneous and higher order differential equation using Taylor's series method, Picard's method and Runge-Kutta fourth order method; Runge-Kutta, Fehlberg method, Modified Euler and Milne methods; Solution of boundary value problems using finite differences method and cubic spline method.

Books:

1. M.K. Jain, S.R.K. Iyengar & R.K. Jain: "Numerical Methods for Scientific and Engineering Computation", 4th Edition, New
2. Age International Publisher, Daryaganj, New Delhi-01
3. S.S.Sastry: "Introductory Methods of Numerical Analysis", 4th edition, Prentice Hall of India, Jhilmil House, Patparganj, New
4. Delhi.
5. Steven C. Chapra & Raymond P. Canal, "Numerical Methods for Engineers", Tata McGraw Hill Book Co.
6. V. Rajaraman, "Computer Oriented Numerical Methods", Prentice Hall of India Pvt. Ltd.
7. Madhumangal Pal, "Numerical Analysis for Scientists & Engineers, Theory & C Programs", Narosa Publishing House, Daryaganj, New Delhi – 110002.
8. Shanta Kumar M, "Computer Based Numerical Analysis", Khanna Publishers, Delhi – 110002.
9. B.S. Grewal, "Numerical Methods in Engineering & Science with Programming in C/C++", Khanna Publishers.
10. Radhey S. Gupta; "Elements of Numerical Analysis", Macmillan India Ltd.

SEMESTER IV

STRUCTURAL ANALYSIS-I
CE-401

L: 3 T: 1 P: 0

COURSE OUTCOMES

Upon successful completion of the course a student should be able to:

1. understand the concept of load calculations for structural analysis
2. identify determinate, indeterminate, stable and unstable structures
3. apply different methods for the determination of slope and deflection in determinate structures
4. determine forces in determinate trusses, beams and frames
5. plot influence lines for beams trusses and three-hinged arches.

COURSE CONTENTS

Unit-I:

Forms of Structures: beams, trusses, arches, cables, industrial frames, multistory building frames, shell structure etc.; Loads: DL, imposed loads (LL, WL, seismic load, snow load, erection load etc.); Idealization of structures; types of supports; stability and static determinacy & indeterminacy to beams & frames; free body diagram; Arch structures: 3-hinged parabolic & circular arches, thrust, radial shear and bending moment diagram, spandrel braced arches.

Unit-II:

Deflection of beams: Moment area method, conjugate beam method, application of these methods to statically determinate beams & frames; Flexural stiffness of beam with far end pinned & fixed, carry over factor, fixed beams, propped cantilever beam.

Unit-III:

Energy methods: Forms of elastic strain energy, axial stress, shearing stress, multi-axial state of stress; Impact load, suddenly applied load, gradually applied load, static load, quasi-static load; Strain energy in members: axial loaded members, under bending, under shearing, circular members under torsion; Law of conservation of energy: virtual work, virtual work on rigid body, virtual work on elastic body; Betti's law and Maxwell's law of reciprocal deflection, application of virtual work on beams (application of product integral table); flexural stiffness of beam with far end pinned; Deflection of statically determinate rigid frames.

Unit-IV:

Deflection of pin jointed plane trusses: Method of virtual work; Unit load method; Castigliano's theorems, application of Castigliano's theorems to brackets, lamp posts & curved members; Deflection of truss due to temperature variation; fabrication error and camber.

Unit-V:

Influence Line for Statically determinate structures: Influence Lines, Influence Lines for Beams, Qualitative Influence Lines, and Influence Lines for trusses and three-hinged arches.

Textbook

1. Structural Analysis, by R. C. Hibbeler, Pearsons
2. Structural Analysis by C. S. Reddy, Tata McGrawHill

References

1. Intermediate Structural Analysis by C. K. Wang, Tata McGrawHill
2. Structural Analysis by Pandit & Gupta, Tata McGrawHill
3. Structural Analysis, by T.S., Thandavamoorthy, Oxford Higher Education

HYDRAULICS
CE-402

L: 4 T: 0 P: 0

COURSE OUTCOMES

At the end of the course, the student should be able to:

1. apply concepts of similitude to model investigation
2. analyse laminar and turbulent flow through circular pipes
3. apply momentum equation for the solution of practical problem
4. analyse pipe flow problems through network of pipes
5. design and conduct experiments on pumps and turbine.

COURSE CONTENTS

Unit-I:

Dimensional and Model Analysis: Dimensional analysis and its utility; Buckingham's pi-theorem and Raleigh's method and their application to fluid flow problems; Dimensionless parameter in fluid flow and their relevance; Similarities: Application of dynamic similarity to model investigations, scale ratio for distorted model.

Unit-II:

Laminar flow: Flow through circular pipes, flow through parallel plates and coaxial cylinders, power absorbed in viscous flow, concept of friction factor, measurement of viscosity, Reynolds's number and its significance; Boundary Layer: Boundary layer along a thin plate and its characteristics, laminar and turbulent boundary layer, laminar sub- layer; Displacement, energy and momentum thickness, separation of boundary layer and its control, drag and lift.

Unit-III:

Turbulent Flow: Nature of turbulent flow and its origin, Reynolds's stress, Prandtl's mixing length hypothesis; Momentum integral equation; Hydro dynamically smooth and rough boundaries, Velocity distribution for turbulent flow in smooth and rough pipes; Friction factor in smooth and rough pipes, Moody's diagram, and Colebrook's equation.

Unit-IV:

Pipe flow: Hazen William & Darcy Weisbasch equation, minor and major losses, hydraulic gradient and total energy line; Pipes in series and parallel; Concept of equivalent length, Dupuits equation; Siphon, water hammer, two reservoir problem, pipe network, Hardy cross method, Time of emptying a reservoir through a pipe, power transmission through pipes.

Unit-V:

Pumps: Reciprocating Pumps, working principal of both double and single reciprocating pump, indicator diagram frictional loss, centrifugal pump, their advantages over reciprocating pump, classification of centrifugal pump, operation of centrifugal pump in series and parallel. Turbine: General layout of hydroelectric power plant, impulse and reaction turbines, efficiency of turbines, classification based on discharge, head and specific speed, unit power and unit discharge.

Textbook

1. Robert L Daugherty, Fluid Mechanics with Engineering Applications, McGraw-Hill

References book

1. John F. Doughlas, Janusz M. Gasiorek, John A. Swaffield, and Lynne B. Jack. Fluid Mechanics, Pearson, 2012
2. Bruce R. Munson, Donald F. Young, and Theodore H. Okiishi, Fundamentals of Fluid Mechanics, 5th Edition, John Wiley and Sons, 2006
3. Modi, P. N. and Seth, S. M. Hydraulics and Fluid Mechanics, Standard Publishing House, Delhi, 2009
4. A.k. Jain Fluid Mechanics, Standard Publishing House, Delhi,

BUILDING CONSTRUCTION
CE-403

L: 4 T: 0 P: 0

COURSE OUTCOMES

At the end of the course, the student should be able to:

1. understand various types of foundation, their functions and essential requirements
2. understand different types of masonry structure and their construction methods
3. apply the knowledge of different types of floors, roofs, stairs and escalators in civil engineering
4. understand various types of doors, windows, lintels, arches, building finishes and formworks with their applications
5. apply the knowledge of damp proofing treatment and sound insulation techniques in buildings

COURSE CONTENTS

Unit-I:

Foundation: Functions of Foundations, Essential requirements of a good Foundation, Types of Foundations; Shallow Foundations, Deep Foundations.

Unit-II:

Masonry: Stone Masonry and Brick Masonry, Different terms used in Masonry, Bond and its types, Composite Masonry, Panel Walls, Load Bearing Walls, Compound Walls, Cavity Walls, Partition Walls.

Unit-III:

Floors and Roofs: Flooring: General Considerations, Different types of Floorings, Flat-Floor and Flat-Roof Construction, Different types of Upper Floors.
Sloped Roofs: Types of Sloped Roofs.
Stairs and Escalators: Requirements of a good stair, Location and Types.

Unit-IV:

Doors and Windows: Doors, Windows and Ventilators; Location, Size, Classification and details.
Lintels and Arches: Different types.

Building Finishes: Plastering, Pointing, Painting and Polishing, White/Color washing, Plastic Paints. Formwork: Shuttering and Scaffolding.

Unit-V:
Damp Proofing and Water Proofing: Treatment of Floors, Walls and Basement, Miscellaneous Topics- Fire Protection, Thermal and sound Insulation of Buildings.

Textbook

1. Building Construction by BC Punmia & AK Jain
2. Building Construction by PC Varghese
3. Building Construction & Material by Gurcharan Singh
4. Building Construction by Sushil Kumar

ESTIMATING AND COSTING
CE-404

L: 3T: 1 P: 0

COURSE OUTCOMES

1. Students will be familiar with planning of residential buildings.
2. Students will be able to understand the various methods for estimation of buildings.
3. Students will be familiar with the contract system in the civil engineering.
4. Students will be able to understand the computation of earth work and different types of earth works
5. Students will be able to understand the importance of valuation in construction, rent fixation and tenders.

COURSE CONTENTS

Unit-I:
Introduction: Definition of estimate, Quantity Survey, plinth area, covered area and floor area estimates, data required for the preparation of estimate, types of estimate, methods of estimating, long wall short wall method and center line method, units of measurements and degree of accuracy in estimating (as per 27- 1984)

Unit-II:
Building Estimates: Preliminary estimates of building by given plinth area, floor area and covered area, various forms used in estimating, estimation of two room building by long wall short wall method and center line method.

Unit-III:
Analysis of rates, purpose of analysis rate, to fix up rate per unit of an items, requirement of rate of analysis for materials and labor (skilled & unskilled), factors affecting rate of analysis of rate for concrete work, brick work and plastering.

Unit-IV:
Estimate of multistory building, tender, tender notice, tender form, tender documents, notice inviting tender (NIT), global tender, informal tender, unbalanced tender, abstracting, methods of taking out quantities, computation of earth work.

Unit-V:

Importance of valuation in construction, credential of valuer, classification of value- definition, assessed value, book value, market value, salvage value, scrape value and capitalized value, valuation & purpose of valuation, terms used in valuation.

Textbook

1. Estimating and costing by B N Datta, S S Dutta and Co.
2. Estimating and costing for civil Engineering by G S Birdie
3. Building Drawing by Shah, Kale and Patki
4. Estimating and Costing in Civil Engineering Theory and Practice, by Dutta B.N

SURVEYING
CE-405

L: 3 T: 1 P: 0

COURSE OUTCOMES

Upon successful completion of the course, a student should be able to:

1. apply the fundamental of surveying and measurement of distances to real world problem.
2. apply different techniques of measurement of elevations to real world problem.
3. establish control points and plot topographical maps.
4. compute area and volume from ground data and maps.
5. set out horizontal and vertical curves on the ground.

COURSE CONTENTS

Unit-I:

Classification of surveying, basic principles, measurement of horizontal distance by conventional methods, sources of errors; Measurement of angles and bearings, traversing and triangulation survey Use of theodolite, computation of coordinates

Unit-II:

Leveling: definition of terms, leveling principle, methods of booking and reduction of levels, errors in leveling, curvature and refraction correction, Trigonometrical levelling

Unit-III:

Topographical survey: characteristics, plotting and uses of contours; Tacheometric survey-stadia tacheometry and tangential tacheometry ; Total station: basic components, fundamental and advance measurement functions

Unit-IV:

Computation of area by different methods, estimation of volume of earthwork; Setting out of building and tunnel; Reconnaissance, preliminary and detailed survey for canals, highways, railways, sewer lines

Unit-V:

Elements and geometry of horizontal curve, setting out of simple curve by linear and angular methods, compound, reverse and transition curves, Basics of vertical curves, setting out of vertical curve

Textbook

1. Elementary Surveying, Charles D. Ghilani, Paul R. Wolf. 14th Edition, Prentice Hall, 2014.
2. Surveying-Bannister, Raymond and Baker, Pearson Education

References

1. Surveying and Leveling, T. P. Kanetkar and S.V.Kulkarni Vol.1 & 2, Vidhyarthi Griha, Prakashan, Pune
2. Plane and Geodetic Surveying for Engineers, David Clark and Jackson J. E., CBS Publications and distributors, New Delhi.
3. Advanced Surveying, Agor, Khanna Publications, Delhi.

SEMESTER V

STRUCTURAL ANALYSIS-II
CE-501

L: 3 T: 1 P: 0

COURSE OUTCOMES

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

1. analyse indeterminate beams, frames and trusses (degree one & two) by using Force/ Flexibility/ Compatibility/ Consistent Deformation Methods.
2. analyse the beams for symmetrical/ unsymmetrical bending; and analyse cables; suspension bridges with three & two hinged stiffeneing girders.
3. analyse continuous beams/ intermediate beams and frames (sway problems) by using Three Moment Theorem and Slope Deflection Methods.
4. analyse fixed beams/ portal frames by Column Analogy method and analyse Indeterminate Trusses, Mill Bents, portal frames, continuous beams and building frames by Cantilever and Portal methods.
5. analyse different structures by developing Stiffness/ Displacement matrices.

COURSE CONTENTS

Unit-I:
Introduction: Force/flexibility/ compatibility/ consistent deformation method of analysis; Superposition, compatibility & equilibrium, flexibility coefficients, flexibility matrices, application of the method to indeterminate beams, frames and trusses to degree one & two.

Unit-II:
Unsymmetrical bending : Introduction, double symmetric beams with skew loads, pure bending, shear flow and shear center; Analysis of cables; Analysis of suspension bridges with three & two hinged stiffening girders.

Unit-III:

Indeterminate Structures : Continuous beam- Three Moment Theorem; Slope deflection method and its application to analysis of indeterminate beams & frames, yielding of supports, sway problems.

Unit-IV:
Column analogy method: Application to fixed beams, properties of symmetrical analogous column, analysis of portal frames.
Approximate analysis of statically indeterminate structures: Indeterminate Trusses, Mill Bents, portal frames, continuous beams and building frames, cantilever method and portal method.

Unit-V:
Stiffness/ Displacement method, Development of stiffness matrix for pin jointed structure and frames, development of method for a structure having forces at all degrees of freedom, development of method for a general case, direct stiffness method.

Textbook

1. Intermediat Structure Analysis By C.K. Wang, Tata McGraw-Hill.
2. Structure Analysis By Pandit & Gupta, Tata McGraw-Hill.
3. Basic Structural Analysis By C.S. Reddy, Tata McGraw-Hill.
4. Structure Analysis By Thandavamoorthy, Oxford

References

1. Structure Analysis By Norris & Wilbur.
2. Basic Concepts of Structure Analysis By Beaufait, F.W.
3. Examples in Structural Analys By William M. C. McKenzi.

DESIGN OF CONCRETE STRUCTURE
CE-502

L: 3 T: 1 P: 0

COURSE OUTCOMES

Upon successful completion of the course student should be able to:

1. understand the importance of RC structural design basic concept, working stress method.
2. apply the theory of limit state design of RCC structural members using first principles.
3. have adequate understandings of relevant Shear.
4. gain knowledge about Indian standards, use of design charts & table for design of beams and slabs.

COURSE CONTENTS

Unit-I:
Characteristic strength, stress-strain relationship for concrete and steel, IS specifications (IS 456, 875 & 1893), characteristic imposed loads, DL, EL & WL. Design philosophies – Working stress method and limit state method. Strength and serviceability requirements, Analysis and design for flexure of singly / doubly rectangular and flanged beam sections – by working stress method.

Unit-II:
Analysis and design for flexure of singly / doubly rectangular and flanged beam sections – by limit state method. Serviceability limit states for deflection and cracking, requirements for curtailments and detailing of reinforcement, minimum / maximum tension and compression reinforcement, minimum & maximum spacing of bars; Introduction and use of design aid (SP-16), calculation of deflection.

Unit-III:
Bond stress: flexural & anchorage bond stress, design bond stress, development length, anchorage length; Behaviour of beams in shear, design for shear & torsion as per limit state method; Reinforcement detailing.

Unit-IV:
Complete design of a cantilever and simply supported beam with and without overhang; Design of continuous beams with Rectangular, T & L sections; Introduction to slabs: rectangular slab, one way simply supported & continuous slab and their design; Comparison of manual design with the software available.

Textbook

1. R. C. C. Design by Pillai and Menon, Tata McGraw Hill
2. Reinforced Concrete Design by S. N. Sinha, Tata McGraw Hill
3. Limit State Design by P. C. Verghese, Prentice Hall
4. Reinforced Concrete Limit State Design , Ashok K Jain Namechand & Bros Rorkee

References

1. Structural Analysis by Norris, Wilbur
2. "Code of Practice for Plain and Reinforced Concrete", BIS, New Delhi, IS456-2000.
3. "Design Aids for Reinforced Concrete to IS 456", Special Publication (SP16), BIS New Delhi,1980.
4. "IS: 1343- 1980, IS Code Of Practice For Prestressed Concrete", BIS, New Delhi, 1980

OPEN CHANNEL FLOW
CE-503

L: 3 T: 1 P: 0

COURSE OUTCOMES
Upon successful completion of the course a student should be able to:
1. understand geometrical properties of channel sections of different shape.
2. apply the concept of specific energy in the analysis of channel transitions.
3. understand and analyze flow profiles on different sloped channels.
4. analyze rapidly flow problems with focus on practical applications to real-world problems.
5. understand the importance of devices used in the measurement of flow through channels.

COURSE CONTENTS
Unit-I:

Introduction: classification of open channel flow. Geometric properties of channel section, Velocity and Pressure distribution in Channel Flow, Kinetic energy and momentum correction factors. Uniform flow, Application of Manning's and Chezy's formulae.

Unit-II:
Specific Energy: Critical Flow, Specific Energy and Force. Transitions in channels, channel with a hump, transition with change in width, choking flow. Channel conveyance, section factor for critical flow and uniform flow computations. Most economical section of a channel.

Unit-III:
Gradually varied flow: Gradually varied flow equation, assumptions and different forms of the equation, characteristics and classification of flow profiles. Analysis of flow profiles on mild, steep, horizontal and adverse slopes. Solution of the gradually varied flow equation, Graphical integration method, Direct step method and standard step method.

Unit-IV:
Rapidly varied Flow: Hydraulic Jump, its definition and types. Momentum equation for the jump, Characteristics of jump in horizontal rectangular channel, Computation of energy loss and length, location of jump, and pressure distribution. Energy dissipaters

Unit-V:
Measuring Devices in Open Channel: Flow in channels with sharp & broad crested weir. Flow measurement with non rectangular weirs; Triangular, circular and parabolic weir. Discharge using linear proportional weir, Sutro weirs, Quadratic weir, Ogee spillway and sluice gate.

Textbook

1. Open channel flow by V.T Chow. McGraw Hill.

References

1 Flow in Open channels by K Subramanya.Tata McGraw- Hill.
2 Flow in Open channels by RangaRaju.Tata McGraw- Hill.

GEOTECHNICAL ENGINEERING
CE 504

L: 3 T: 1 P:0

COURSE OUTCOMES
The students will be able to

1. understand soil identification, index properties and their determination, and phase diagram of the soil.
2. solve 1-D, and 2-D problems of flow through soils.
3. calculate vertical stresses in the soils due to overburden and applied loads
4. interpret compaction and consolidation characteristics of different soils.
5. evaluate shear strength parameters of the soils and their application in geotechnical problems.

COURSE CONTENTS
Unit-I: Classification and Properties

Origin and formation of soils, Soil Structure and Fabric, Three Phase System and Phase Relationships, Classification: Unified and IS Classification System, Index Properties

Unit-II: Flow Through Soils
Permeability, one dimensional flow, Darcy's Law, Two dimensional flow, Flow nets, uplift pressure, piping

Unit-III: Stresses in Soil
Total, Neutral and Effective Stresses, Seepage Force, Quicksand condition, Stress Distribution under applied loads: Boussinesq's and Westergaard's Equations, Newmark's Chart

Unit-IV: Compaction and Consolidation
Compaction: Lab and Field Compaction, Proctor Compaction Tests; Compressibility, One dimensional consolidation and its time rate.

Unit-V: Shear Strength and Lateral Earth Pressure
Shear Strength: Mohr-Coulomb strength criteria, Direct and Triaxial shear tests, Vane Shear Test, Unconfined Compression Test, Drainage Conditions, Stress Paths, Shear Strength Parameters; Lateral Earth Pressures: Active, Passive and Pressure at rest, Rankine's and Coloumb's Theories.

Books:

1. Soil Mechanics and Foundation Engineering by K R Arora, Standard Publishers Distributor
2. Soil Mechanics and Foundation by Punmia, Jain and Jain; Laxmi Publications (P) Ltd.
3. Engineering Properties of Soils by S K Gulati, Tata McGrawhill

ENVIRONMENTAL ENGINEERING – I
CE-505

L: 4 T: 0 P: 0

COURSE OUTCOMES

Upon successful completion of the course a student should be able to:

1. understand various important parameters required for design of water supply systems
2. understand design of various components of water supply systems
3. understand important water quality parameters
4. understand basic principles and design philosophies of various treatment operations and process
5. understand advanced methods of water treatment

COURSE CONTENTS

Unit-I:
Water demand: Types of demands, factors affecting per capita demand, variations in demand; Population forecasting; Sources of water supply: estimation of water quantity, factors governing the selection of source; Water conservation measures.

Unit-II:
Intakes: Types of intakes, factors governing the location of intake; Reservoirs: types of reservoirs, capacity of reservoir; Water distribution system: requirements of a good distribution system,

methods of distribution, layout and design of water supply systems; Pipes: types of pipes for transporting water, pipe appurtenances, testing of pipelines.

Unit-III:
Water Quality: Physical chemical and microbiological water quality parameters and their significance; Water borne diseases and their control; drinking water quality criteria and standards; Natural processes occurring for self-cleansing of water bodies; Engineered systems of water treatment

Unit-IV:
Aeration: Mechanics of gas transfer, types of aerators, applications of aeration; Sedimentation: theory of sedimentation, design of sedimentation tank, types of sedimentation tanks; Coagulation: theory of coagulation, types of coagulants and coagulant aids, and flocculation, design of flocculation tank.

Unit-V:
Water softening: Chemical precipitation, ion exchange; reverse osmosis; Filtration: theory of filtration, types of filters and their classification, filter operations; disinfectioning: types of disinfectants, chlorination; Site selection for treatment plant; layout considerations for treatment plant; Operation and maintenance of treatment plants.

Textbooks

1. Modi PN, Water Supply Engineering (Environmental Engieering – I), Standard Book House, 2010
2. Garg Santosh Kumar, Water Supply Engieering

References

1. Qasim Syed R, Motely Edward M, Zhu Guang, Water Supply Engineering, PrenticHall of India 2006
2. Peavy Howard S, Rowe Donald R, Tchobanglous Geroge, Environmental Engineering, McGraw Hill Education (India) Pvt Ltd 2013
3. Sincero Arcadio P, Sincero Gregoria A, Environmental Engineering – A Design Approach, Prentice Hall of India 2010
4. Gray NF, Water Technology – An Introduction for Environmental Scientists and Engineers, Elsvier, 2nd Ed.
5. Davis Machenzie L, Water and Wastewater Engineering – Design Principles and Practice, McGraw Hill Education (India) Pvt Ltd 2014
6. CPHEEO, Manual on Water Supply and Treatment, Central Public Health and Environmental Engineering Organization, Ministry of Urban Development, Government of India.
7. Walter J, Weber Jr, Physicochemical Processes for Water Quality Control, John Wiley & Sons, 1972

SEMESTER VI

ADVANCE STRUCTURAL ANALYSIS
CE-601

L: 3 T: 1 P: 0

COURSE OUTCOMES

1. To analyze structures subjected to rolling loads.
2. To analyze beams, portal frames and gable frames using moment distribution method
3. To analyze beams using plastic theory
4. To apply basic concepts of structural dynamics for the analysis of structures
5. To analyze the behavior of two-hinged and fixed arches

COURSE CONTENTS

Unit-I:

ILD and its application: Single concentrated load, UDL (shorter and longer than span), two concentrated loads, series of concentrated loads for maximum shear force at a section, BM under a given load, maximum BM at a given section, absolute maximum shear & moment in beams; Muller Breslau principle and its application

Unit-II:

Moment distribution method: Member stiffness factor, joint stiffness factor, carry over factor, distribution factor, procedure for analysis, application to continuous beams and frames with and without sway, symmetrical and unsymmetrical frames

Unit-III:

Plastic Analysis: Basis of plastic theory, bending of beams symmetrical about both axes, fundamental conditions for plastic analysis, rigid plastic analysis, analysis of beams and frames

Unit-IV:

Structural Dynamics: Introduction, various terms used in the vibration analysis: Simple harmonic motion, free or natural vibrations, damping, damping coefficient, mass and stiffness.

Unit-V:

Two-hinged and hingeless arch: analysis of symmetrical arch, temperature effect, elastic centre method

Text Books

1. Intermediate Structural Analysis by C. K. Wang, Tata McGrawHill
2. Structural Analysis by Pandit & Gupta, Tata McGrawHill
3. Strength of Materials by B C Punmia
4. Structural Analysis by B C Punmia

Reference Books

1. Structural Analysis by Norris, Wilbur
2. Structural Dynamics by M Mukhopadhyaya
3. Dynamics of Structures by Chopra
4. Earthquake Resistant Design of Structures By Pankaj Agarwal and Manish Shrikhande, Publication, Prentice Hall of India Pvt. Ltd.
5. Seismic Analysis of Structures by T K Datta, Wiley

Software or other Requirement

- STAAD Pro

TRANSPORTATION ENGINEERING
CE-602

L: 3T: 1 P: 0

COURSE OUTCOMES

Upon successful completion of the course students should be able to:

1. gain knowledge on highway planning, alignment surveys and project preparation.
2. learn basic concepts of highway geometrics and geometric design of roads and intersections.
3. understand basic concepts, analysis and design of traffic flow and traffic facilities.
4. gain knowledge of different highway materials and their characteristics. Design of mix and flexible pavements using IRC Codes.
5. Design the rigid pavements using IRC Codes. Gain knowledge of construction, maintenance and drainage of highways.

COURSE CONTENTS

Unit-I:

Introduction: Importance of Transportation, Different modes of transportation, Brief history of road development around the world. Twenty year road development plans, Necessity of highway planning, Road patterns, Preparation of Master Plan and its phasing, Highway alignment, Engineering and other surveys for highway location, Highway projects evaluation.

Unit-II:

Highway Geometric Design: Introduction Design speed, Highway cross – section elements, Analysis of sight distances, Design of horizontal and vertical alignments – all pertinent elements, Types of intersection, Principles of intersection design.

Unit-III:

Traffic Engineering: Traffic characteristics, traffic studies – volume, speed, origin and destination, parking and accident studies, Traffic controls- traffic signs, marking and traffic signals, Highway capacity, Signal design.

Unit-IV:

Highway Materials: Subgrade soil, aggregates and bituminous material; different tests on these materials. Bituminous mix design, pavement types, Soil stabilized roads. Pavement design: Introduction, Design parameters, Design of flexible pavement (IRC method).

Unit-V:

Design of rigid pavement (IRC method), construction of WBM road, bituminous pavements and cement concrete pavement, Highway maintenance and drainage.

Textbooks

- Highway Engineering by Khanna, Justo and Veeraragavan, Nem Chand and Bros, Roorkee.
- Transportation Engineering by Chakroborty and Das, PHI.
- Relevant IRC codes.

References

- Transportation Engineering and Planning by Papacostas and Prevedouros, PHI.
- Pavement analysis and design by Y H Huang, Pearson Prentice Hall.
- Specifications for roads and bridges by MoRTH (Ministry of Road Transport and Highways, Govt of India, V Revision)

DESIGN OF STEEL STRUCTURES
CE-603

L: 3 T: 1 P: 0

COURSE OUTCOMES

Upon successful completion of the course student should be able to:

1. learn the concept of analysis and design of steel structures.
2. analyze and design of bolted and welded connections.
3. analyze and design of tension members with different failure criteria.
4. analyze and design of columns/buit up columns with various configurations and end conditions.
5. analyze and design of laterally supported and unsupported beams.

COURSE CONTENTS

Unit-I:

Design of Connections: Common steel structure, advantages and disadvantages of steel structures, type of steel, rolled steel sections, special considerations in steel design, design philosophy, limit state design, design strength, deflection and serviceability limits, stability checks; Riveted, bolted and welded connections, classification of bolts and types of bolted connections, **IS 800-2007** specifications for design of bolted connections, worked examples on design of bolted joint, shear capacity and tension resistance of bolts **(IS-1364)**, design examples of fillet and butt weld connections, design of eccentric bolted and welded connections.

Unit-II:

Design of Tension members: Design strength of tension member due to yielding of gross section, rupture strength of critical section and block shear, tension splices and lug angles; design of bolted and welded connections for ties subjected to both bending and axial tension.

Unit-III:

Design of Compression members: Shape of compression members, buckling class of cross–section, slenderness ratio, design compressive stresses and strengths, use of IS800-2007 tables for design stresses, design of compression members, design of laced and battened columns, design of column splices; Column bases: design of slab base and gusseted base.

Unit-IV:

Design of Beams: Behavior of beam in flexure, section classification, plastic moment carrying capacity of a section, bending and shear strengths of laterally supported beams, design of laterally supported beams, deflection limits, web buckling and web crippling, design of built-up beams, design strength of laterally unsupported beams, effective lengths for lateral torsional buckling, design of laterally unsupported beams.

Textbook

- LimitState Design of Steel Structures, SK Duggal, Tata Mac-Graw-Hill Publication-2010.
- Limit-State-Design of Steel Structures by N. Subramanium, OxfordUniversity Press-2009
- Strength of Materials by B C Punmia.

References

- IS 456-2000: Code of practice for plain and R. C. BIS, New Delhi.

- I.S.800:2007,"Code for general construction in steel structures," Bureau of Indian Standards,Manak Bhavan,9,Bhadur Shah Zafar Marg, New Delhi.
- I.S.875 (part I to part V)," Code Of Practice For. Design Loads," Bureau of Indian Standards,Manak Bhavan,9,Bhadur Shah Zafar Marg, New Delhi.
- I.S.226," Steel for general structural purposes," Bureau of Indian Standards,Manak Bhavan,9,Bhadur Shah Zafar Marg, New Delhi.
- I.S.808:1989,"Code for Classification of Hot Rolled Steel ," Bureau of Indian Standards,Manak Bhavan,9,Bhadur Shah Zafar Marg, New Delhi.
- I.S.226," Steel for general structural purposes," Bureau of Indian Standards,Manak Bhavan,9,Bhadur Shah Zafar Marg, New Delhi.
- I.S.808:1989,"Code for Classification of Hot Rolled Steel ," Bureau of Indian Standards,Manak Bhavan,9,Bhadur Shah Zafar Marg, New Delhi.
- I.S.816:1969," Code of practice for use of metal arc welding for general construction in mild steel," Bureau of Indian Standards,Manak Bhavan,9,Bhadur Shah Zafar Marg, New Delhi.

ENGINEERING HYDROLOGY
CE-604

L: 4 T: 0 P: 0

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

1. understand various components of hydrological cycle
2. estimate various abstractions from precipitation such as evaporatranspiration and infiltration
3. derive relationship between rainfall and runoff using statistical techniques and plot stage-discharge relationship
4. derive unit hydrographs of different durations, and develop synthetic unit hydrographs
5. apply the technique of flood routing for the mitigation of floods in channels

COURSE CONTENTS

Unit-I:

Precipitation: Hydrologic cycle, India's water balance, World's Water balance, Types and Forms of precipitation. Measurement of precipitation. Adequacy of rain gauges. Adjustment and filling in of missing data, consistency of rainfall record. Average rainfall over an area. Frequency Analysis.

Unit-II:

Evaporation: Evaporation process and its estimation, Transpiration, Evapotranspiration, measurement of evapotranspiration- Penman, Thornwaite and Balaneycriddle methods. Evaporation Control.

Infiltration: Infiltration Process, factors affecting infiltration, measurement of infiltration, infiltration indicies

Unit-III:

Surface Runoff: Factors affecting runoff. Rainfall – runoff relationships, empirical equations. Flow duration Curve. Mass curve

Stream Gauging:Mesurement of stage, velocity. Direct and indirect methods of stream flow measurement. Rating curve, Stage discharge relationship.

Unit-IV:
Hydrograph: Factors affecting hydrograph, base flow separation. Unit hydrograph. Derivation of unit hydrograph for simple and complex storms. Unit hydrograph of different durations. Synthetic unit hydrograph.

Unit-V
Flood: Flood flow formulae, Design flood Frequency analysis using external type and log Pearson type III distribution. Flood Routing: Basic equation, Hydrologic storage routing in reservoirs and channels.

Textbook
Engineering Hydrology by K Subramanya, Tata McGraw- Hill.

References

1. Elementary Hydrology by V. P. Singh, Prentice Hall
2. Hydrology for Engineers by Linsely R. k. Tata McGraw- Hill.
3. Hand book of Applied Hydrology by V.T. Chow. Tata McGraw- Hill.

ENVIRONMENTAL ENGG - II
CE-605

L: 3 T: 1 P: 0

COURSE OUTCOMES
Upon successful completion of the course, following outcomes should be expected:

1. Student should be able to understand the importance of wastewater treatment and reuse & safe disposal
2. Students will have adequate understanding of the mechanisms of wastewater treatment
3. Students will have understanding of disposal of treated effluent and its reuse
4. Students will understand the importance of sludge treatment and its reuse
5. Students will be able to analyze and design the treatment facility and safe sludge handling

COURSE CONTENTS

Unit-I:
Wastewater Engineering: An overview; constituents in wastewater, different sources of wastewater: domestic, industrial and storm water; types of sewerage and drainage system; Estimation of wastewater flow rates and its variations: Estimation of peak, average and lean flow; drainage discharge; Hydraulics of sewers; Design of wastewater collection systems; Design of storm water drains, Rainwater harvesting system and its design

Unit-II:
Wastewater Characteristics: Physical, chemical and microbiological characteristics of wastewaters; typical characteristics of sewage: decay of sewage relative stability, population equivalent, effluent discharge standards; Eutrophication; Response of streams to biodegradable organic waste: dissolved oxygen balance and its modeling, factor affecting steam flow rejuvenation

Unit-III:

Classification of Treatment Process: Primary, secondary and tertiary treatment; types of screens and its design, assessment of head loss through screen, classification of grit chambers, its application and design, oil and grease removal; Design of primary and secondary clarifiers/ sedimentation tank; Tertiary Treatment: Polishing techniques used after secondary treatment/ effluents

Unit-IV:
Secondary/ Biological Treatment of Sewage: Theory of biological treatment: Microbial growth kinetics, suspended and attached growth systems: Aerobic Treatment - Activated Sludge Process and its modifications, Trickling Filter/ Bio Towers and Rotating Biological contractors; Anaerobic Treatment - Upflow Anaerobic Sludge Blanket Process

Unit-V:
Sludge Management and its Disposal: Regulation for reuse and disposal of solids; Sudge thickening and its digestion; Low cost sanitation: decentralized wastewater treatment - stabilization ponds, aerated lagoons, oxidation ditch; Reuse of treated effluents; Concepts of zero discharge

Books

1. Environmental Engineering, Peavy, Rowe & Tchobanoglobus, McGraw Hill
2. Introduction to Environmental Engineering, Davis & Cornwell, McGraw Hill
3. Wastewater Engineering Treatment & Reuse, Metcalf & Eddy, McGraw Hill, USA
4. Environmental Engineering- A design Approach ,Sincero & Sincero, Prentice Hall of India
5. Wastewater Treatment Plants: Planning, Designing and Operation, S.R.Qasim, CRC Press, USA
6. Wastewater Treatment for Pollution Control and Reuse, Soli J. Arceivala & Asolekar, Tata McGraw Hill, India
7. Post Treatment of Anaerobically Treated Effluents, V.K.Tyagi, Abid Ali Khan, Anwar Khursheed, A.A.Kazmi, Ng Wun Jern, IWA Publishing, UK

SEMESTER VII

FOUNDATION ENGINEERING
CE-701

L: 4 T: 0 P: 0

COURSE OUTCOMES

Upon successful completion of the course a student should be able to:

1. understand the importance of Foundation Engineering.
2. have adequate understandings of foundation and load transfer to the sub soils at shallow depth.
3. design deep foundation, Pile foundation, Well foundation.
4. gain competent knowledge about earth pressure theory as well as introductory soil dynamic concept.
5. analyse for the static and dynamic load on machine foundations.

COURSE CONTENTS

Unit-I: Retaining Structures
Introduction to Coulomb's earth pressure theory for cohesive and granular soil, graphical methods.

Classification of earth retaining structures (Rigid and Flexible). Analysis & Design of Sheet pile walls, bulkheads, and anchored sheet pile.

Unit -II: Soil Investigation and Bearing Capacity
Purpose, extent, and methods of site investigation; Boring and sampling techniques, Samplers, Boring records; Plate load test; Penetration tests; Introduction to Geophysical methods. Introduction to foundation & bearing capacity of soils; load-settlement curve; types of shear failures of foundation soils;Terzaghi's and Meyerhof's bearing capacity Theories; effect of water table fluctuations, shape, size, depth of footing, andinclination of loading.

Unit- III: Shallow Foundations
Types and general requirements of shallow foundation; Bearing capacity consideration, settlements of foundations, I.S. Code recommendations. (I.S. 6403, 8009). Design of shallow foundations.

Unit- IV: Deep Foundations
Types, purpose and classification of pile foundations: Construction of piles, pile load test, load capacity and settlement of piles;Design of Pile foundations, use of relevant I.S. Code (I.S. 2911: Part I-IV); Well foundation: Types, element and construction well foundation, principles of design.

Unit- V: Soil Dynamics & Machine Foundations
Introduction to soil dynamic, definitions, spring mass system, single degree of freedom system, free and forced vibration of damped and undamped systems; Types & criteria for design of machine foundations. Analysis and design of block foundation; Vibration isolation (active and passive method).

Textbook

1. Design of foundation and Retaining Structures By S. Prakash, G Ranjan & S Saran; Sarita Pracashan, Meerut
2. Soil Dynamics By Shamsher Prakash; McGra Hill, London
3. Soil Mechanics and Foundations By B C Punmia & Ashok Kumar Jain; Laxmi Publications, Delhi
4. Environmental Engineering – A Design Approach, Sincero & Sincero, Prentice Hall of India

References

1. Basic and applied soil mechanics, Gopal Ranjan and Rao A.S.R., New Age International Publishers
2. Geotechnical Engineering, Venkatramiah, New Age International Publishers
3. Geotechnical Engineering, Shashi K. Gulhati and Manoj Dutta, Tata McGraw-Hill Publishing Company Limited, New Delhi.
4. Foundation Engineering, Leonards G.A., McGraw Hill
5. Foundation Design, Teng W.C., PHI

DESIGN OF STRUCTURES
CE-702

L: 3 T: 1 P: 0

COURSE OUTCOMES
Upon successful completion of the course a student should be able to:
1. assess the load criteria and design of RCC slab and staircases.
2. design reinforced concrete short and long columns subjected to uni-axial and bi-axial

compression.

3. select the most suitable section shape and size for Plate girder and design according to specific design criteria.
4. analyse and design roof trusses & estimation of wind load. Design of gantry girder for different loading combinations.

COURSE CONTENTS

Unit-I:

Design of slabs and stairs: Various type of slabs and their behavior, design of two- way rectangular slabs with different boundary conditions, use of moment coefficients, provision for corner reinforcement; Design of stairs.

Unit-II:

Design of Columns: Columns, various cross sections, effective length, slenderness ratio, short and long columns, design of columns under axial compression, uni-axial and bi-axial compressions, uses of interaction curves ofSP16 for column design.

Unit-III:

Plate girder: Elements of plate girder, self weight of plate girder, economical depth, size of flanges, shear buckling resistance of web, end panel design, anchor forces, design of connections between flanges and web plates, design of bearing and intermediate stiffeners, and their connections with web; Design of plate girders.

Unit-IV:

Roof Trusses: Types of roof trusses, loads on trusses:wind load estimation, snow load, live load and load combinations,bracings, spacing of trusses, purlins, sheetings, analysis of trusses, grouping of members, design of members, bolted joints and end bearings.

Gantry Girder: Loads for gantry girders, position of moving load for maximum effect, profile of gantry girders, limitation on vertical deflection, design procedure of gantry girder.

Textbook

1. Limit State Design of Steel Structures, SK Duggal.Tata Mac-Graw-Hill Publication-2010.
2. Limit-State-Design of Steel Structures by N.Subramanium-2009, Oxford University Press.
3. Limit State Design of Concrete Structures by Verghees, Vol. 1.

References

1. Reinforced Concrete Design, by S U Pillai and Devdas Menon, Tata-McGraw-Hill
2. Publishing Company Limited, New Delhi.
3. Comprehensive Design of RCC Structures, by B C Punmia, A K Jain and A K Jain, Laxmi Publications (P) Ltd, New Delhi
4. Design of Reinforced Concrete Structures, by SRamamrutham, Dhanpat Rai
5. Publishing Company, New delhi,
6. Limit State Theory and design of reinforced Concrete, by V L Shah and
7. S R Karve, Structures Publications, Pune, 2011
8. Reinforced Concrete Structures, by Park R and Paulay T, John Wiley & Sons, Inc.,
9. New York, 1975
10. IS 456: 2000 Plain and Reinforced Concrete- Code of Practice, Bureau of Indian Standards, New Delhi

WATER RESOURCES ENGINEERING
CE 703

L: 3T: 1 P: 0

COURSE OUTCOMES

1. Apply the concept of sustainable development to the management of water resources projects
2. Analyze water resource systems using linear and dynamic programming, and conduct financial analysis of projects
3. Analyze and design components of flood control infrastructure with environmental and societal considerations
4. Identify, formulate, analyze, and solve problems related to hydropower production
5. Apply appropriate techniques for the analysis and design of complex river training works

COURSE CONTENTS

Unit-I:
Water resources of India, global water resources, surface and ground water resources, multipurpose uses of water purposes served by water resources development projects, impact of climate change on water resources, single and multipurpose projects, consumptive, non-consumptive, and partial consumptive use, firm yield, secondary yield, estimation of reservoir yield and storage capacity of reservoirs

Unit-II:
Sediment transport: Mechanism of sediment transport, sediment load, bed load, suspended load, reservoir sedimentation, trap efficiency, capacity-inflow ratio, measures for control of reservoir sedimentation, estimation of useful life of reservoir

Unit-III:
Floods and their management, Probable maximum flood, standard project flood, flood estimation techniques, classification of methods of flood control, flood plain management, flood damages, methods for estimation of flood damages, national policy on flood control

Unit-IV:
General arrangement of hydroelectric projects, hydropower development of India and the world, major hydroelectric projects in India, comparison with thermal and nuclear plants, environmental issues related to hydropower production, firm and secondary power, power duration curves, reliability of hydropower production, illustrative examples

Unit-V:
River morphology; classification of rivers and river training works, methods of river training works, marginal embankments, guide bunds, groynes, cutoffs, bank pitching and launching aprons, design of guide bunds.

Text Books:

1. Water Resources Engineering, R. K. Linsley et al.
2. Water Resources Engineering, Larry W Mays
3. Water Resources Engineering, S K Garg
4. Water Resources Engineering, P. N. Modi

Reference Books

1. Water Resources Engineering, Ralph A. Wurbs, Wesley P. James, Prentice Hall
2. Applied Hydrology, V. T. Chow et al.
3. Water Resources Systems Planning and Management“,Chaturvedi, M.C. Tata McGraw HillPub. Co., N Delhi
4. Water Resources Systems“,Hall. W.A. and Dracup, Tata McGraw Hill Pub. N Delhi

ENGINEERING ECONOMY& CONSTRUCTION MANAGEMENT
CE-704

L: 4 T: 0 P: 0

COURSE OUTCOMES

Upon successful completion of the course students should be able to:

1. understand and calculate economic equivalence and to be able to Identify and use some Excel functions commonly applied in engineering economics.
2. evaluate most engineering project proposals using a well-accepted economic analysis techniques.
3. understand structure of construction organization and its functions, labour laws and to be able to understand the use and selection of construction equipment
4. understand the use of basic network technique of PERT in construction management.
5. understand the use of basic network technique of CPM in construction management.

COURSE CONTENTS

Unit-I:

Basic concepts of engineering economics, cash flow diagram, minimum attractive rate of return, single payment, uniform series and gradient series factors – their derivation and use, nominal and effective interest rates, use of multiple factors, depreciation and depletion, present worth comparison of equal and different lived alternatives**.**

Unit-II:

Capitalized cost calculation, annual worth (AW) evaluation using salvage sinking fund, salvage present worth and capital recovery plus interest method, comparing alternatives by AW, rate of return evaluation by present worth and AW method, benefit/ cost ratio analysis

Unit-III:

Overview of construction industry, structure of construction organization and its functions, management functions and responsibilities, labour relations, construction equipment: power shovel hoe, bulldozer, dumper, trailers, and tractors, rollers, sheep foot roller, batching plants.

Unit-IV:

Planning, scheduling , basic network techniques, Gantt charts, PERT Network, time estimates, probability distribution, time computations, earliest expected time, latest allowable occurrence time, network analysis, slack, critical path.

Unit-V:

CPM network, floats, crashing a network, introduction to precedence networks.

Textbooks

1. Engineering Economy by Leland T. Blank, Anthony J. Tarquin, McGraw-Hill Book Company, New Delhi.
2. PERT and CPM by L.S.Srinath ,Affilated East-West Press Pvt. Ltd, New Delhi.

References

1. Construction Planning, Equipment and Methods by Robert L. Peurifoy, William B. Ledbetter, Clifford J. Schexnayder, McGraw-Hill Book Company, New Delhi.
2. Fundamentals of Construction Management and Organization by Kwaku A. Tenah Jose M. Guevara Reston Publication Co., Inc.,A Prentice-Hall Company Reston, Virginia

3. Construction Planning, Equipment and Methods by Robert L. Peurifoy, William B. Ledbetter, Clifford J. Schexnayder, McGraw-Hill Book Company, New Delhi.C

SYLLABUS FOR ELECTIVES

ADVANCE TRANSPORTATION ENGINEERING
CE-711

L: 4 T: 0 P: 0

COURSE OUTCOMES

Upon successful completion of the course students should be able to:

1. build concept in different means of public and private transportation, sustainability and design of public transit network .
2. understand basic concepts, analysis and design of railway track.
3. understand basic concepts, analysis and design of railway track geometrics, stations, yards, signaling and metro railway.
4. analyse and design aspects of airports, runway, taxiway and air traffic control.
5. understand basic concepts of water transportation and bridge engineering.

COURSE CONTENTS

Unit-I

Urban transportation problems, Transportation and urban growth, Mass transit system, Comparison of different transit modes, Transit and environment, Transit and urban sustainability, Route design and scheduling of transit system.

Unit-II:

Introduction of railways, Railway Track, gauge, Track components – Rail, rail fittings, fixtures, Sleepers and ballast requirements and specification per kilometer of track, Formation and cross-section details, drainage, track defects.

Unit-III:

Geometric design of track, Points and Crossing, Station and Yards, Level crossing, Signaling and control, Suburban Railways, Metro railways system, Modernization of railways, Underground Railways and Tunneling.

Unit-IV:

Aircraft Characteristics, airport planning, site selection and configuration, Obstruction and zoning, Runway and taxiway design, Basic runway length and corrections, geometric design elements, Visual aids – marking and lighting, air traffic control and aids, Airport capacity.

Unit-V:

Sea Port, Harbors, Types and selection of site, Break-waters, Jetties, Wharves. Navigation aids: Buoys and light houses, Inland water transportation.
Components and classification of bridges, site investigation, waterway design.

Textbook

- Urban Mass Transportation Planning, A. Black, McGraw Hill.
- Railway Engineering by Chandra and Agarwal, Oxford University Press.
- Railway Engineering by Saxena and Arora, Dhanpat Rai Publications.

- Air Transportation Planning and Design by Saxena, CBS Publisher.

References

1. Planning and Design of Airports by Horonjeff and McKelvey, McGraw Hill.
2. Dock and Harbour Engineering, Oza and Oza, Charotar Publisher.
3. Bridge Engineering, Ponnuswamy, Tata McGraw Hill.

ARCHITECTURE AND TOWN PLANNING
CE712

L: 4 T: 0 P: 0

COURSE OUTCOMES

Upon successful completion of the course students should be able to:

1. understand the brief history and basic principle of architecture.
2. understand basic architectural design.
3. apply the basic concepts of town planning.
4. implement the concept of land use and town planning.
5. understand master plan and its implications.

COURSE CONTENTS

Unit-I:

Brief history of Architecture, Egyptian, Greek, Roman and Indian architecture. Evolution of various structural forms. Impact of materials on building forms and construction techniques.

Unit-II:

Philosophy of architectural design: scale, form, texture, balance, skyline, unity, harmony, contrast, proportion. Colour in architecture, site selection and orientation of residential buildings.

Unit –III:

Evolution of human settlements: Factors and Forces. Utopian concepts of city planning: garden city, vertical city, broad acre city, linear city, Super Block and neighbourhood unit concepts.

Unit-IV:

Concepts for spatial arrangement of land uses: concentric zone, sector and multiplenuclei concepts, and their applicability to Indian conditions Density in residential and non-residential areas. Land use classification system. Surveys for town planning.

Unit-V:

Master plans; case studies: one for a new town plan and one for master plan of an existing city. Zoning and sub-division regulations and building byelaws. Agencies for implementation of master plans. Public participation. Problem of slums. Approaches for environmental improvement of slums.

Books:

1. A history of Architecture by Sir Banister Flechure.
2. A General History of Architecture by Bruce All Sopp.
3. Architecture by John Gloag.
4. The principles of Architecture Composition by Howard Robertson.
5. Indian Architecture by Percy Brown.

6. The Urban Pattern. City Planing and Design by Arthur B. Galion and Simon Eisner.

EARTHQUAKE RESISTANT DESIGN
CE 713

L: 4 T: 0 P: 0

COURSE OUTCOMES

Upon successful completion of the course students should be able to:

1. understand the concept of strong seismic motion and dynamics of structure.
2. understand the effects and behaviour of structures under earthquake.
3. gain adequate knowledge on seismic terminology and lateral forces on structures
4. learn ductile detailing of RCC structures, earthquake resistant design of masonry buildings as well as retrofitting

COURSE CONTENTS

Unit – I:

Strong motions and Dynamics of Structure:Strong motions, Introduction, Terminology of Strong Motion, Nature of Ground Motion: source effect, Path effect, site effect. Amplitude, peak ground acceleration, vertical acceleration, seismometer and other seismic instruments.

Dynamics of Structure, modelling of Structure, lumped mass approach, equation of Motion, mathematical and structural modelling, System of Multiple Degrees of Freedom, Responses Spectrum.

Unit – II:

Effects and Behavior of structures under Earthquake: Introduction, Natural time period of site and structure, Liquefaction of soil, Restoring force, Damping, Effects of Structural Irregularities (vertical, plan and mass). Seismoresistant Building Architecture, Building Characteristics. Introduction of IS 1893:2002, Design Philosophy, Use of IS 1893:2002 and Determination of Design Lateral Forces: Equivalent Static Lateral force Method.

Unit – III:

Determination of Lateral Forces: Use of IS 1893:2002, Determination of Design Lateral Forces: Response Spectrum Method, Time History Method.(eigen values and eigen vectors, modal participation factors, modal mass, Use of ABS, SRSS, CQC methods)

Unit – IV:

Ductile detailing of RCC Structures, Earthquake Resistant Design of Masonry Buildings and Retrofitting: Ductility Considerations: Introduction, Assessment of Ductility, Factors Affecting Ductility, Ductility Factors, Ductile Detailing as per Use of IS 13920: 1993, Load transfer mechanism of joints

Earthquake Resistant Design of Masonry Buildings and Retrofitting: Behavior of masonry building under earthquake, lateral Load Analysis of Masonry Buildings. Design of brick masonry wall under vertical and laterals loads, concepts of Repair, Restoration and Strengthening of existing buildings, Methods of Retrofitting

Books:

1. Earthquake Resistant Design of Structures by Pankaj Agarwal and Manish Shrikhande, Prentice Hall of India Pvt. Ltd.

2. Elements of Structural Dynamics by Glen V. Berg, Prentice Hall Englewood Cliffs, New Jersey
3. Dynamics of Structures by Anil K. Chopra, Pearson Education
4. Geotechnical Earthquake Engineering by Steven L. Kramer, Pearson Education

SEMESTER VIII

IRRIGATION ENGINEERING
CE801

L: 3 P: 1 T: 0

COURSE OUTCOME

Upon the completion of course, students will be able to

1. underline the irrigation needs and planning ;
2. estimate water requirements of crops and irrigation water requirements;
3. design the canal system and identify the needs of various hydraulic structures;
4. analyze the subsurface flow and be able to design weir, canal falls, cross drainage works;
5. assess the remedial measures for water logging and design of lined canal.

COURSE CONTENTS

Unit- I:

Irrigation in India – Necessity, scope of irrigation, irrigation schemes, ongoing projects, engineering aspects of project planning; Water application – crop types, water requirements and its estimation, water application efficiencies and techniques of field irrigation.

Unit – II:

Design of Alluvium Channels, Silt theories – problems of silting and scouring, Kennedy's theory, design procedure, drawbacks, Lacey's silt theory, channel design procedure, drawbacks, Comparison between Kennedy's and Lacey's theory, Lacey's non-regime equation, L-section of a channel, balancing depth, Use of Garret's diagram, Cross-section of irrigation channels.

Unit – III:

Weirs and barrages – components, functions, causes of failure; Bligh's creep theory, Lanes's weighted creep theory, Khosla's theory, pressure calculations, Design – sloping glacis weir and protection works.

Unit – IV:

Water logging – effects of water logging, causes of water logging and their remedial measures. Canal lining – advantages, types of lining, and design of lined channels. Regulation works. Canal falls, types of falls, Design of Sarda type fall.

Unit V:

Cross-Drainage works, Types of works, factors affecting the suitability of CD works, classifications of aqueducts and siphon aqueducts, Design- maximum flood discharge, water way, transitions, head losses, uplift pressures etc.

Text Books

1. Irrigation, Water Resources and Power Engineering by P.N. Modi , Standard Book House, Delhi , Latest edition.
2. Irrigation Engineering and Hydraulic Structures by S.K. Garg, Khanna Publishers, Lates edition

Reference Book

1. Irrigation and Water Resources Engineering by G.L. Asawa, New Age International Publishers
2. Theory and Design of Irrigation Structures by By Varshney and Gupta, Vol. I and II,
3. Hydraulic Structures by Novak, P. , AIB Moffat and Nalluri and R Narayanan, Taylor and Francis
4. NPTEL

SYLLABUS FOR ELECTIVES

CONSTRUCTION PROJECT MANAGEMENT
CE-805

L: 4 T: 0 P: 0

COURSE OUTCOMES

Upon successful completion of the course students should be able to:

1. understand basic concepts of project management, project organization, and estimate project cost for the client
2. use construction planning and application of computers in scheduling and resource leveling
3. evaluate project cost and bidding strategy and management of resources.
4. apply basic concepts of project cost and risk in construction and project monitoring

COURSE CONTENTS

Unit-I:

Basic concepts of project management, project organization, client's estimation of project cost, construction contract

Unit-II:

Construction planning: Ladder network, precedence network, the line of balance, network technique advantages, Project scheduling and resource levelling, network crashing and cost-time trade-off. Computer applications in scheduling and resource levelling.

Unit-III:

Contractor's estimation of cost and bidding strategy, Construction equipment management, Construction material management.

Unit-IV:

Project cost and value management, risk in construction, Project monitoring and control system. Computer applications in Monitoring and reporting, construction quality management, construction safety management

Textbooks

1. Construction Project Management, Theory and Practice by Kumar NeerajJha, Pearson

Education, New Delhi.
2. Scheduling Construction Projects by Sanra Christian Weber, Pearson Education, New Delhi.

References

1. Peter Fewings, “Construction Project Management”, Taylor and Francis,U.K.
2. Peurifoy, R.L., Ledbetter, W.B.andSchexnayder, C., " Construction Planning,Equipment and Methods ", 5th Edition, McGraw Hill, Singapore, 1995.
3. Sharma S.C. " Construction Equipment and Management ", Khanna Publishers New Delhi, 1988.
4. Deodhar, S.V. " Construction Equipment and Job Planning ", Khanna Publishers, New Delhi, 1988.
5. Dr. Mahesh Varma, " Construction Equipment and its Planning and Application ",Metro-politan Book Company, New Delhi-, 1983.
6. Prasanna Chandra, " Pojects-Planning Analysis Selection Implementation & Review Fourth Edition ",Tata Mc Graw Hill Publishing Co., Ltd., New Delhi., 1995.
7. Joy.P.K.,, " Total Project Management - The Indian Context (Chapters 3- 7) ", New Delhi ,Macmillan India Ltd., 1992.
8. United Nations Industrial Development Organisation (UNIDO) " Manual for the preparation of Industrial Feasibility Studies ", (IDBI Reproduction) Bombay, 1987.

ADVANCE STRUCTURAL DESIGN
CE-807

L: 4 T: 0 P: 0

COURSE OUTCOMES

Upon successful completion of the course a student should be able to:

1. design different types of footings and retaining walls
2. design different types of water tanks
3. design different types of bridges and culverts
4. analyse and design prestressed concrete structures

COURSE CONTENTS

Unit-I:

Foundation and their types**:** Detailed design of Isolated and combined footing, design of wall footings. Retaining walls: Cantilever and Counter fort type, their design using limit state method.

Unit-II:

Water tanks: Design criteria, material specifications and permissible stresses; IS 3370 (Pt. 1, Pt.2, Pt. IV) 2009; Design of circular and rectangular water tanks resting on ground & underground using working stress approach, cracking width in immature concrete and mature concrete in flexure and direct tension.

Unit-III:

Bridges: Introduction, various types, super-structures, sub-structures, IRC loadings; Design of deck slab; Design of T-beam Bridge. Introduction to prestress concrete bridge.

Unit-IV:

Prestressed concrete: Methods and systems, anchorages, prestress losses, analysis and design of sections for flexure based on working stress.

Textbook

1. Pillai S. Unnikrishna and Menon Devdas, Reinforced Concrete Design, McGraw-Hill, 3rd edition, 2015.

References

1. Lin, T.Y. and Burns H. Ned, Design of Prestressed Concrete Structures, Wiley, 2012
2. Victor D. J. 5th Edition, Essentials of Bridge Engineering, Wiley, 2006
3. Raju N. Krishna, Design of Reinforced Concrete Structures, CBS Publishers and Distributers Pvt Ltd, 4th ed., 2016
4. Sharma N., Reinforced Cement Concrete Design, Katson Books, 2014.

ADVANCE ENVIRONMENTAL ENGINEERING
CE-808

L: 4 T: 0 P: 0

COURSE OUTCOMES

Upon successful completion of the course a student should be able to:

1. understand the significance of air pollution and its impact identification
2. analyze and solve problems of air pollutants dispersion
3. design solutions for air pollution control devices
4. identify, formulate, and analyse problems related to solid waste and its management
5. analyze the impacts of projects on environment and its management plan

COURSE CONTENTS

Unit-I:

Air pollution: Meteorology, plume rise, plume behavior, dispersion of pollutants, factors affecting dispersion, Gaussian dispersion model, assumptions, applications and limitations.

Unit-II:

Introduction to air pollution control devices: Particulate and gaseous contaminants, constructional features, working principle, design of control devices for particulate and gaseous contaminants.

Unit-III:

Solid wastes: Physical and chemical characteristics of solid waste, generation, collection and disposal of solid waste, land filling operations.

Unit-IV:

Noise pollution: Definition, fundamental concepts, sources and effects of noise, measurement techniques, noise pollution control and current standards.

Unit-V:

Introduction to environmental impact assessment: Objectives, attributes of EIA, different techniques of EIA, impact assessment and environmental management plan.

Text Books

1. Environmental Pollution Control engineering by CS Rao, Published by Wiley Science
2. Air Pollution: Its Origin And Control by Wark Kenneth Jr. , Wayne T. Davis, Cecil F. Warner Printice Hall
3. Air Pollution Control Engineering, 2nd Edition by Neol De Nevers, Mc Graw Hill
4. Environmental Engineering, Howard S Peavy , Donald R Rowe , George Tchobanoglows, Published by Tata McGraw-Hill, New Delhi

References

1. Textbook Of Noise Pollution And Its Control by S.C. Bhatia, Atlantic Publisher
2. Introduction To Environmental Engineering And Science by Glibert M. Masters published By Dorling Kinderslay India
3. Environmental Impact Assessment by PR Trivedi, PHP Publisher
4. An Introduction to Ecology and Environmental Science by P.C. Prabhu, C. Udayasoorian, G. Balasubramanian by Abhijit Publications

GROUND WATER ENGINEERING
CE809

L: 4 T: 0 P: 0

COURSE OUTCOMES

Upon successful completion of the course a student should be able to:

1. learn different terminologies related with groundwater hydrology.
2. learn techniques of groundwater balance.
3. understand the principle and design of rain water harvesting structures.
4. understand the techniques of drilling techniques.

COURSE CONTENTS

Unit-1:

Hydrologic Cycle , Concept of Groundwater in Hydrologic Cycle, Sub Surface Strata Analysis as Aquiclude, Aquitord , aquifuge and Aquifers Explanation of Unconfined, semi –confined and Confined Aquifers, Perched Aquifers. Geophysical methods for Groundwater Exploration , Resistivity System, Application of Schlumberger and Wenner's configurations.

Unit-II:

Groundwater Balance Study. Concept of Gross Recharge, Recoverable recharge , Draft and Status of Groundwater Analysis using NABARD's Norms and Local Norms . Numerical problems on Groundwater balance Equation and Status of Groundwater Stage of development. Analysis of Categories of Groundwater as White Category,Grey and Black Category.

Unit-III:

Principle and Definition of Rainwater Harvesting. Classification and Determination of Rainwater Harvesting. Numerical Problems on Rainwater Harvesting. Feasibility and Design of Rainwater Harvesting. Case Study on Rainwater Harvesting.

Unit-IV:

Introduction of Drilling techniques. Drilling in Alluvium and Soft Rock area, Reverse Rotary Drilling and Direct Rotary drilling methods,Calayx method, Driiling in Hard Rock area, DTH method and Woodex Method, Percussion Drilling. Geophysical Logging and Tube well design.

Reference books:

1. Groundwater Hydrology: Devid Keith Todd,
2. Hydrogeology : K.R. Karanth
3. Groundwater : H. M. Ragunath