FACULTY OF ENGINEERING

Scheme of Instruction & Examination

and

Syllabi

B.E. V and VI Semester

of

Four Year Degree Programme

in

CIVIL ENGINEERING

(With effect from the Academic Year 2018 - 2019)
(As approved in the Faculty Meeting held on 26 June 2018)

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2018

SCHEME OF INSTRUCTION & EXAMINATION
B.E. V - Semester
(CIVIL ENGINEERING)

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	P/D	Contact Hrs/Wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1	**PC 501 CE**	Reinforced Cement Concrete	3	1	-	4	30	70	3	3
2	**PC 502 CE**	Theory of Structures – I	3	1	-	4	30	70	3	3
3	**PC 503 CE**	Concrete Technology	3	-	-	3	30	70	3	3
4	**PC 504 CE**	Hydraulic Machines	3	-	-	3	30	70	3	3
5	**PC 505 CE**	Transportation Engg. – I	3	-	-	3	30	70	3	3
6	**PC 506 CE**	Environmental Engineering	3	-	-	3	30	70	3	3
7	**PC 507 CE**	Water Resource Engg. – I	3	-	-	3	30	70	3	3
8	**PE-I**	Professional Elective – I	3	-	-	3	30	70	3	3
Practical/Laboratory Courses										
9	**PC 551 CE**	Fluid Mechanics Lab – II	-	-	2	2	25	50	3	1
10	**PC 552 CE**	Transportation Engineering Lab	-	-	2	2	25	50	3	1
11	**PC 553 CE**	Environmental Engineering Lab	-	-	2	2	25	50	3	1
			24	**02**	**06**	**32**	**315**	**710**		**27**

Professional Elective – I		
S. No.	Course Code	Course Title
1	**PE 501 CE**	Advanced Concrete Technology
2	**PE 502 CE**	Hydropower Engineering
3	**PE 503 CE**	Infrastructure Engineering
4	**PE 504 CE**	Soft Computing Skills in CE

PC: Professional Course **PE**: Professional Elective
L: Lecture **T**: Tutorial **P**: Practical **D**: Drawing
CIE: Continuous Internal Evaluation **SEE:** Semester End Examination (Univ. Exam)

Note:
1. Each contact hour is a Clock Hour
2. The duration of the practical class is two clock hours, however it can be extended wherever necessary, to enable the student to complete the experiment.

Course Code	Course Title						Core / Elective
PC 501 CE	**REINFORCED CEMENT CONCRETE**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Concrete Technology	3	1	0	0	**30**	**70**	3

Course Objectives

- Understand the design philosophies of working stress method and limit state method.
- Introduce the Indian standard codes of practice for Reinforced Concrete
- Understand the design of concrete structural elements using limit state method as per Indian code of practice.

Course Outcomes

- Understand properties of constituent materials of concrete.
- Design beams for flexure with working stress method according to IS: 456-2000.
- Design beams for flexure, shear and torsion and compute deflections with limit state design philosophy according to IS: 456-2000.
- Perform yield line analysis of slabs and design slabs according to IS: 456-2000.
- Design columns and footings with limit state method according to IS: 456-2000.

UNIT-I

Introduction to Reinforced Cement Concrete: Applications of Concrete- Need for Reinforcement in Concrete-Types and Properties of Concrete and Steel - Tests on concrete and steel – RCC as a material – Basic requirements of an RCC Structure – stability, strength, serviceability and durability.

Design Philosophies: Development of design philosophies-Working stress method (WSM), Ultimate load method, and limit state method (LSM) relative merits and demerits. Basic concepts and terminology of WSM and LSM – Working stress, limit state, characteristic loads and strengths, Partial safety factors. Stress strain relationship for concrete and steel; stress blocks (generalized, rectangular, parabolic and Whitney's)

Working Stress Method: Theory of bending in RCC beams; balanced, under reinforced and over reinforced sections; Analysis and design of singly and doubly reinforced rectangular sections.

UNIT-II

Design of Beams:

Limit State of Collapse (Flexure):

Assumptions, Analysis and design for flexure failure in tension and compression singly reinforced, doubly reinforced rectangular and flanged beams. Anchorage and development length, Curtailment of reinforcement in beams

UNIT-III

Limit State of Collapse in Shear and Torsion: analysis and design for shear and torsion.

Limit State of Serviceability: Check for deflection and cracking.

Limit State of Durability: Provisions made in the code. Detailing of reinforcement in beams

UNIT-IV

Analysis and Design of Slabs: Definition of a Slab – Types of Slabs-one way, two-way simply supported and Continuous rectangular slabs subjected to only uniformly distributed loads. IS Code method-Design of solid rectangular slabs as per IS 456; Detailing of reinforcement in slabs; Check for serviceability of Slabs

Introduction to Yield Line Theory for Slabs: Assumptions – Patterns of Yield lines – Analysis and design of a simply supported rectangular two-way slab using yield line approach.

Design of Stairs: Design and detailing of dog legged stairs.

UNIT-V

Analysis and Design of Columns: Assumptions, Design of axially loaded circular, square and rectangular columns; Uniaxial and biaxial bending of columns - interaction diagrams. Design of columns subjected to axial load & bending

Analysis and Design of Footings: Design of isolated square, rectangular and circular footings as per IS Code.

Suggested readings:

1) Krishna Raju N. and Pranesh R.N., Reinforced Concrete Design, New Age International Pvt. Ltd., 2003.
2) Varghese P.C, "Limit State Design of Reinforced Concrete", Prentice Hall of India, 2008.
3) Subramanian N., "Design of Reinforced Concrete Structures", Oxford University Press, 2013.
4) Punmia B.C., Ashok K. Jain, Arun K. Jain, "Limit State Design of Reinforced Concrete", Laxmi Publications (P) Ltd. , 2012.
5) Ramamrutham, "Design of Reinforced Concrete Structures", Dhanpat Rai Publishing Co., 2015.
6) Neelam Sharma "Reinforced Cement Concrete Design". S K Kataria & Sons, New Delhi, 2014.

Relevant IS Codes:

1) IS: 456-2000, "**Code of Practice for Plain and Reinforced concrete"**, Bureau of Indian Standards, New Delhi, India.
2) SP 16, "**Design Aids for Reinforced Concrete to IS 456:1978",** Bureau of Indian Standards, New Delhi, India
3) SP 24, **"Explanatory Handbook on Indian Standard Code of Practice for Plain and Reinforced Concrete to IS 456:1978"**, Bureau of Indian Standards, New Delhi, India
4) SP 34, "**Handbook on Concrete Reinforcement and Detailing (With Amendment 1)",** Bureau of Indian Standards, New Delhi, India
5) IS: 875-1987, "**Code of Practice For Design Loads (Other Than Earthquake) For Buildings And Structures Parts (1, 2, 3, 4 & 5)"**, Bureau of Indian Standards, New Delhi, India

Course Code	Course Title						Core / Elective
PC 502 CE	**THEORY OF STRUCTURES – I**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Strength of Materials	3	1	0	0	**30**	**70**	3

Course Objectives

- Understand the advantage of statically indeterminate structure over the statically determinate structure.
- Understand basic methods for the analysis of statically indeterminate beams and frames and know the difference between different methods.
- Evaluate the displacements and redundant forces using energy principles.
- Identify the various straining action in arches and analyze them with varying degrees of indeterminacy

Course Outcomes

- Solve statically indeterminate beams and portal frames using classical methods
- Sketch the shear force and bending moment diagrams for different loading condition for indeterminate structures.
- Calculate the deflections in beams and pin jointed trusses.
- Analyze the three hinged and two hinged arches.

UNIT - I

Slope Deflection Method: Application of the method to continuous beams with and without sinking of supports, single bay - portal frames (Degree of freedom not exceeding three), loading on each span may be point load(s) or uniformly distributed load on whole span, shear force and bending moment diagrams.

UNIT - II

Moment Distribution Method: Application of the method to continuous beams with and without sinking of supports, portal frames (static indeterminacy not exceeding three), loading on each span may be point load(s) or uniformly distributed load on whole span, shear force and bending moment diagrams.

UNIT - III

Kani's Method: Application of the method to continuous beams with and without support sinking, portal frames (static indeterminacy not exceeding three), and loading on each span may be point load(s) or uniformly distributed load on whole span, shear force and bending moment diagrams.

UNIT - IV

Strain Energy Method: Deflections of statically determinate trusses and frames using unit load method. **Redundant Trusses and Frames:** Analysis of plane trusses with one degree of redundancy (internal / external) and plane frames with one degree of redundancy, Lack of fit and temperature effect.

UNIT - V

Elastic Theory of Arches: Eddy's theorem, three hinged parabolic and segmental arches, determination of horizontal thrust, bending moment, normal thrust and radial shear for static loading, influence lines for horizontal thrust, bending moment, normal thrust and radial shear. **Two Hinged Arches:** Parabolic and segmental, determination of horizontal thrust, bending moment, normal thrust and radial shear for static loading.

Suggested readings:

1) D.S. Prakash Rao, "***Structural Analysis - A Unified Approach"***, University Press, 1996
2) B.C. Punmia and A.K. Jain, "***Theory of structures",*** Laxmi Publications, New Delhi, 2004.
3) G .S, Pandit, S. P. Gupta and R. Gupta, "***Theory of Structures",*** – *Vol. I & II*, Tata McGraw Hill, New Delhi, 1999.
4) C.S.Reddy,***"Basic Structural Analysis"***, Tata McGraw-Hill Publishing Co. Ltd., 3rd Edition, New Delhi, 2010.
5) S.S.Bhavikatti,***"Structural Analysis"*** – *Vol. I & II*, Vikas publication House Pvt. Ltd., 4th Edition, 2011.
6) Ramamrutham. S., ***"Theory of Structures",*** Dhanpath Rai & Sons, New Delhi, 2014.

Course Code	Course Title						Core / Elective
PC 503CE	**CONCRETE TECHNOLOGY**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Building Materials	3	0	0	0	**30**	**70**	3

Course Objectives

- Understand the characteristics and behavior of the concrete
- Describe design aspects of mix design with of different methods
- Impart knowledge regarding the different types of special concretes
- Introduction of Particulate Mechanics further to the solid and fluid mechanics

Course Outcomes

- Functional role of ingredients in production of high quality concrete
- Explain the properties of fresh and hardened properties of concrete
- Design concrete mixes and apply statistical quality control techniques to prepare quality concrete

UNIT - I

Constituents of Concrete:

Cement: Types of cements and their composition- manufacture of Portland cement - hydration of cement and hydration product, Structure of hydrated cement- heat of hydration, Gel theories, tests on properties of cements.

Aggregate: Classification of aggregates, particle shape and texture, bond strength of aggregates and its influence on strength of concrete, porosity, absorption and moisture content and their influence, soundness of aggregate, alkali aggregate reaction, sieve analysis and grading of aggregate, tests on properties of aggregates.

Properties of Fresh Concrete: Mixing and hatching, workability, factors effecting workability, various test procedures, segregation and bleeding, vibration of concrete, types of vibrators and their influence on composition, analysis of fresh concrete.

UNIT - II

Properties of Hardened Concrete: Strength of concrete, water cement ratio, Gel space ratio, effective water in the mix, short term and long term properties of concrete, test and procedure, influence of various parameters on strength of concrete, relationship between various mechanical strengths of concrete, curing of concrete, maturity concept, influence of temperature on strength of concrete, stress-strain curves for concrete, durability of concrete.

Strength of Concrete - Shrinkage and temperature effects - creep of concrete - permeability of concrete - durability of concrete - Corrosion - Causes and effects - remedial measures- Thermal properties of concrete - Micro cracking of concrete.

UNIT - III

Mix Design of Concrete: A basic consideration, process of mix design, factors influencing mix proportions-mix design by ACI method and IS code method, design of high strength

concrete, quality control, various methods of mix design, IS code method, British and ACI methods

UNIT - IV

Admixtures Used in Concrete: Classification of admixtures, Chemical and mineral admixtures. Influence of various admixtures on properties of concrete. Admixtures used in preparation of self compacting concrete. Applications, concept of ready mix concrete, fly ash concrete- properties and proportion of fly ash, applications, silica fume, rice husk ash concrete.

UNIT - V

Special Concrete: High strength concrete, ferro-cement mass concrete, light- weight concrete, high density concrete, poly-polymer modified concrete, pre-stressed concrete, self-consolidating concrete, cellular concrete, nano concrete, recycled aggregate concrete, geo polymer concrete, their specialties and applications, Fibre reinforced concrete: Need for fibre reinforced concrete (FRC), Mechanism of FRC, types of Fibres, Fibre shotcrete.

Suggested readings:

1) Mehta, P. K. and Paulo, J. M. M. **"*Concrete Microstructure-properties and Material*."** McGraw-Hill Publishers, 1997.
2) Neville, A.M. and Brooks, J.J. **"*Concrete Technology*"** Pearson Education Ltd., India, 2nd Edition, New Delhi, 2010.
3) Shetty, M.S. **"Concrete Technology, Theory & Practice."** S.Chand and Co. Pvt., Ltd, 2004.
4) Krishna Raju, N**. "*Design of Concrete Mix*."** CBS Publishers, 2012.
5) Gambhir, M.L. **"*Concrete Technology*."** Tata McGraw Hill, 2004.
6) Santha Kumar, A. R., **"*Concrete Technology*."** Oxford University press, New Delhi, 2007.

Course Code	Course Title						Core / Elective
PC 504 CE	**HYDRAULIC MACHINES**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Fluid Mechanics I & II	3	0	0	0	**30**	**70**	3

Course Objectives

- Concepts of dimensional analysis and model studies
- Introduction to velocity triangles due to impact of jets
- Knowledge of forces and efficiencies in the hydraulic turbines
- Study of pumping devices under different conditions of operation

Course Outcomes

- Application of basic principles in the design of Hydraulic Machines
- Assimilation of turbine/pump laws and constants for the hydraulic design
- Knowledge about selection of hydraulic turbines and pumps

UNIT - I

Dimension Analysis and Model Studies: Dimensional analysis and a tool in experimental hydraulics, Buckingham's Pie theorem, applications, geometric, kinematic and dynamic similarity, similarity laws, significance of Reynolds, Froude and Mach similarity laws, different types of models and their scale ratios.

UNIT - II

Impact of Jets: Force exerted by a fluid jet on a stationary, and moving flat, and curved vanes striking symmetrically, and tangentially at one of the ends

UNIT - III

Hydraulic Turbines: Classification, specific speed, velocity triangles, power developed, efficiencies, principles of design of impulse and reaction turbines, turbine laws and constants, characteristic curves, selection of turbines.

UNIT - IV

Centrifugal Pumps: Components, work done and efficiency, minimum starting speed, Euler head equation, specific speed and characteristic curves of centrifugal pump, pumps in series and parallel.

UNIT - V

Reciprocating Pumps: Classification, work done, effect of acceleration of the piston on velocity and pressure in the pipes, effect of variation of velocity on friction in pipes, pressure diagram, air vessels, indicator diagram with air vessels.

Suggested readings:

1) S. K. Som, and Biswas, G, ***"Fluid Mechanics and Fluid Machines"***, Tata McGraw-Hill Publishing Co., 3rd Edition, New Delhi, 2011
2) Yuan, S. W**.,** ***"Foundation of Fluid Mechanics"***, Prentice-Hall India Pvt. Ltd., New Delhi, 1976
3) C.S.P. Ojha, R.Berndtsson, P.N. Chandramouli, ***"Fluid Mechanics and Machinery",*** Oxford University Press, New Delhi, 2010
4) A.K.Mohanty, ***"Fluid Mechanics"***, Prentice-Hall India Pvt. Ltd., New Delhi,1994
5) P.N. Modi,*"Hydraulics and Fluid Mechanics Including Hydraulics Machines"*, Standard Book House, New Delhi, 2013.
6) Sukumar Pati, ***"Fluid Mechanics And Hydraulic Machines",*** 1st Edition, Mcgraw Higher Education, 2012

Course Code	Course Title						Core / Elective
PC 505 CE	**TRANSPORTATION ENGINEERING – I**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Surveying	3	0	0	0	**30**	**70**	3

Course Objectives

- Understand the need of highways and its classification as per IRC codes
- Design the highway geometrics as per standard code of practice
- Study various traffic studies including analysis and design
- Understand various material characteristics and its applications in field.
- Design pavements and its maintenance as per prevailing IRC codes

Course Outcomes

- Express the fundamentals of highway planning and perform geometric design of a transportation facility
- Compute key elements on various traffic studies, present and analyse traffic data
- Interpret basic concepts of material characterization as per standard specifications including mix designs.
- Design flexible and rigid pavements as per IRC guidelines
- Employ various construction techniques adopted in field, identify the causes of various pavement failures and suggest appropriate treatment.

UNIT - I

Highway Alignment and Geometric Design: History of highway engineering, factors to be considered for highway alignment, engineering surveys, obligatory points. Geometric design - Highways classification as per IRC and its standard dimensions, carriageway, shoulders, medians, right of way, footpaths, cycle tracks, service roads, frontage roads, sight distance stopping sight distance, overtaking sight distance. Chamber, horizontal curves, super - elevation, transition curve, extra widening, gradient, grade compensation and design of vertical curves.

UNIT - II

Traffic Engineering: Objectives of traffic studies, traffic characteristics, volume, speed, density, headways and relationship among them. Traffic volume studies, speed and delay studies, intersection delay studies, highway capacity and level of service concept as per HCM 2000, origin and destination studies, intersection improvement studies at grade, need of grade separated intersection, channelization, rotary planning and design, concept of signal design, parking and accident studies.

UNIT-III

Pavement Material Characterization: Types of pavements and factors to be considered for pavement design. Aggregates –physical properties of aggregates such as gradation and size, toughness and abrasion resistance, durability and soundness, particle shape and surface texture, specific gravity, cleanliness and deleterious materials; chemical properties - stripping

of aggregates and alkali aggregate reaction Binders – Types of paving binders – bitumen, tar, cutback, emulsion, modified binders, evaluation of rheological behavior of bitumen by flash and fire point test, penetration test, softening point test, ductility test, Fras breaking point test, viscosity test , Specific gravity test , measurement of aging using thin film oven test, elastic recovery test, separation test Gradation of bituminous binders- penetration grading, Viscosity grading and performance grading. Blending of aggregates by Rothfuch's method and 0.45 power gradation, bituminous mix design by Marshall Stability test

UNIT-IV

Pavement Design: Pavement types, factors to be considered for pavement design, structural difference between flexible and rigid pavement design., Flexible pavement design - concept of layer theory, design wheel load, ESWL, EALF, vehicle damage factor, design by CBR developed by US corps of engineers, IRC cumulative standard axles method (IRC - 37: 2002). Rigid design Pavement concept, by analysis stress load wheel westergaard, modulus of sub grade reaction and other characteristics of concrete, radius of relative stiffness, longitudinal and transverse joints. Load and temperature stress-critical wheel, dowel bars and tie bars functions, construction joints, expansion joints, contraction joints.

UNIT – V

Pavement Construction: Construction of Water bound Macadam, Wet Mix Macadam and Granular sub base roads. Construction of Dense Bituminous macadam, Bituminous Macadam, Semi-Dense Bituminous Concrete, Bituminous Concrete, Built-up spray grout, Open Graded Premix Carpet, Mix Seal Surfacing, prime coat, tack coat, seal coat as per MORTH specifications.

Pavement Evaluation and Maintenance: Pavement failures – types, causes and remedies, Maintenance of bituminous and cement concrete pavements.

Suggested readings:

1) Khanna S.K., Justo C.E.G., Veeraraghavan A., "***Highway Engineering***", 10th Edition, Nem Chand & Bros, 2015
2) Kadiyali L.R., "***Traffic Engineering and Transportation Planning"***, Khanna Publishers, 2016.
3) Nicholas J. Garber Lester A. Hoel, ***"Traffic and Highway Engineering"***- III edition, Cengage publication Indian Edition, 2006.
4) Yoder E.J., Witczak M.W.***,"Principles of Pavement Design",*** John Wiley & Sons –Indian edition. 2008
5) Srinivasa Kumar R., "Pavement Design", Orient Blackswan Pvt. Ltd., New Delhi, 2013.
6) Partha Chakroborty and Animesh Das, ***"Principles of Transportation Engineering***" 1st Edition, PHI Learning, 2009.
7) Relevant IRC and IS codes

Course Code	Course Title						Core / Elective
PC 506 CE	**ENVIRONMENTAL ENGINEERING**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	0	0	0	**30**	**70**	3

Course Objectives

- Fill the gap between general introductory environmental science and the more advanced environmental engineering
- Explain the different sequential unit operations of water and wastewater treatment Processes
- Provide necessary engineering principles for analyzing the environmental issues
- Motivate the present

Course Outcomes

- Students will understand the impact of engineering solutions in a global, economic, environmental and societal context.
- Students will have an ability to design environmental engineering systems that include considerations such as risk, uncertainty, sustainability and environmental impacts.
- Students will have the ability to speak before a group, effectively convey information to technical and non-technical audiences.

UNIT-I

Introduction: Necessity of protected water supply and sanitation, Water demand and per capita consumption, factors affecting population forecasts.

Water Supply: Sources of water and quality parameters, standards of potable water, infiltration pipes & galleries, intake structures pipes, joints, valves & pumps. Water distribution systems and solution of a simple network using hardy cross method.

UNIT-II

Treatment of Water: Clarification sedimentation – Principles. Design of sedimentation tanks, coagulation and flocculation, design of a clariflocculator. Filtration – Types of filters and filter media. Design principles of slow and rapid sand filters. Backwash mechanisms. Pressure filters. Disinfections – Necessity and methods, Chlorination of water supplied, action of chlorine, break point chlorination. Ozone and U-V radiations, Removal of hardness, tastes & odor control.

UNIT-III

Domestic Sewage: Quantity estimation, quality parameters – BOD, COD and TOC. Sewerage systems, ultimate disposal of sewage, Land and water bodies, Sewage conveyance – Sewer types and appurtenances, Velocity in sewers, Design of a simple sewerage system. Storm water sewers – Storm water estimation by rational method.

UNIT-IV

Waste Water Treatment: Preliminary treatment, screens, grit chambers. Primary treatment – Sedimentation – rectangular and circular sedimentation tanks, Secondary treatment – sewage filtration – trickling design. Activated sludge process – design parameters, secondary clarifier. Design aspects of a sewage treatment facility.

UNIT-V

Sludge: Sludge digestion and disposal methods – septic tanks – design parameters and working principles. Low cost waste treatment – oxidation ponds, RBC.

Solid Waste: Types, source and composition of solid waste, Methods of collection, transportation and disposal

Suggested readings:

1) Fair. G. M. and Geyer. J. C. "***Water and Wastewater Engineering*** ", Vol. I & II. John Wiley & Sons Inc., New York, 2010.
2) White. J.B., ***"Wastewater Engineering"***, 2nd Edition, Edward Arnold. London, 1978
3) Hammer. M. J. and Hammer. M. J. Jr**.,*"Water and Wastewater Technology",*** Prentice-Hall of India Pvt. Ltd., New Delhi, 1998
4) Metcalf & Eddy. ***'Wastewater Engg; Treatment, Disposal Reuse'***, Tata McGraw-Hill Publishing Company Limited, New Delhi,1995
5) Sasi Kumar, K. and Sanoop Gopi Krishna., ***'Solid waste Management'***, Prentice-Hall of India Pvt. Ltd., New Delhi, 2009
6) Gilbert, M. Masters , ***'Introduction to Environmental Engineering and Science'***, Prentice-Hall of India Pvt. Ltd., New Delhi, 1995

Course Code	Course Title						Core / Elective
PC 507 CE	**WATER RESOURCE ENGINEERING – I**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Fluid Mechanics	3	0	0	0	**30**	**70**	3

Course Objectives

- Creating an awareness about water rights and water quality management principles
- Description regarding planning and design aspects of different types of water storage and regulatory systems
- Imparting knowledge regarding the fixation of different levels of reservoirs

Course Outcomes

- Awareness about water rights and water quality management principles
- Application of principles of planning and design to different types of water retention and regulatory systems
- Knowledge regarding the fixation of different levels of reservoirs

UNIT - I

Water Resources Projects: Single and multipurpose projects, general principles of irrigation water rates, components of water allocation systems, riparian rights, groundwater rights, environmental and water quality management aspects of reservoir system operations.
Storage works: Purpose, selection of site, zones of storage, computation of storage capacity, fixation of different levels of reservoirs (L WL, FRL, MWL), evaporation reduction techniques.

UNIT - II

Dams: Classification of dams, selection of site for a dam, physical factors governing the selection of types of a dam.
Gravity dams : Forces acting on a gravity dam, modes of failure and criteria for structural stability of gravity dams, principal and shear stresses, gravity method of stability analysis, elementary and practical profiles of a gravity dam, high and low gravity dams, functions, and types of galleries in gravity dams, foundation treatment for gravity dams.

UNIT - III

Earth Dams: Types of earth dams, causes of failure of earth dams, criteria for the safe design of an earth dam, computation of seepage from flow net, phreatic line in an earth dam (for homogeneous sections with and without filter cases), design of earth dams to suit available materials, embankment and foundation seepage control measures.

UNIT - IV

Tank Irrigation: Types, site selection, causes for the failure of tank weirs, design of tank weirs, and general specifications for the construction of tank weirs.

Spillways: Different types of spillways, energy dissipation below spillways, different types of spillway crest gates, stilling basin appurtenances (descriptive details only).

UNIT - V

Energy Dissipators: Design of different types (1-7) of energy dissipation arrangements as per USBR guidelines

Suggested readings:

1) Wurbs, R A. and James, W.P., ***'Water Resources Engineering',*** Prentice-Hall of India, New Delhi, 2002.
2) U.S. Bureau of Reclamation, ***'Design Manual for Concrete Gravity Dams',*** Denver, 1976
3) U. S. Army Corps of Engineers, ***'Engineering and Design',*** CECW-ED Publication, 1995
4) Punmia B.C. and Pande Lal B.B., ***'Irrigation and Water Power Engineering'***, Lakshmi Publishers, New Delhi, 1993.
5) Garg S.K., ***'Irrigation Engineering and Hydraulic Structures'***, Standard Book House, New Delhi, 2010
6) Satya Narayana Murty Challa, ***"Water Resources Engineering: Principles and Practice"***, 1st Edition, New Age International, 2000.

Course Code	Course Title						Core / Elective
PC 551 CE	**FLUID MECHANICS – II Lab**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Fluid Mechanics	0	0	0	2	**25**	**50**	1

Course Objectives

- Practical applications of open and curved channels
- Application of force concepts on jets and hydraulic machines
- Determination of characteristic curves of turbines and pumps

Course Outcomes

- Competence in understanding floe phenomenon in open channels
- Ability to analyze the force acting due to jets concept and it's application in hydraulic machines.
- Competence in working principles of hydraulic pumps and turbines

List of Experiments:

1. Determination of roughness coefficient in an open channel
2. Determination of a vane coefficient
3. Study of universal characteristic curves of a Pelton wheel
4. Study of universal characteristic curves of a Francis turbine
5. Determination of super elevation in an open channel
6. Determination of basic characteristics of a hydraulic jump
7. Verification of Froude's Model law in an open channel
8. Determination of critical slope of an open channel
9. Study of main characteristic curves of a Centrifugal pump
10. Study of universal characteristic curves of a Kaplan turbine

Note: *At least ten experiments should be conducted in the Semester*

Suggested readings:

1) S. K. Som, and Biswas, G, ***'Fluid Mechanics and Fluid Machines'***, Tata McGraw-Hill Publishing Co., New Delhi, 1998
2) Yuan, S. W., ***'Foundation of Fluid Mechanics'***, Prentice-Hall India Pvt. Ltd., New Delhi, 1976
3) C.S.P. Ojha, R.Berndtsson, P.N. Chandramouli, *'Fluid Mechanics and Machinery'*, Oxford University Press, New Delhi, 2010
4) A.K.Mohanty, ***'Fluid Mechanics',*** Prentice-Hall India Pvt. Ltd., New Delhi,1994
5) P.N. Modi, ***'Hydraulics and Fluid Mechanics Including Hydraulics Machines'***, Standard Book House, New Delhi, 2013.

Course Code	Course Title						Core / Elective
PC 552 CE	**TRANSPORTATION ENGINEERING Lab**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Transportation Engineering (Co-Requisite)	0	0	0	2	**25**	**50**	1

Course Objectives

- Know the properties of various road materials
- Create the awareness about various traffic studies in the field
- Impart knowledge on mix design of bitumen and CBR test etc.,

Course Outcomes

- Characterize the pavement materials.
- Perform quality control tests on pavement material and pavements.
- Conduct traffic studies for estimation of traffic flow characteristics.

List of Experiments:

A) Tests on Bitumen

1. Penetration Test.
2. Ductility Test
3. Softening point test
4. Specific gravity test
5. Viscosity test
6. Flash and fire point test

B) Tests on Road Aggregate

7. Aggregate crushing value test
8. Los Angeles abrasion test
9. Aggregate impact value test
10. Aggregate shape test (flakiness & elongation)
11. Specific aggregate
12. Water Absorption
13. Soundness

C) Experiments on Traffic

14. Traffic Volume study (a) at mid-section (b) at intersection
15. Spot speed stu.
16. Speed and delay study
17. Origin and Destination Study

D) Miscellaneous Tests (Demonstration Only)

18. Marshal stability test
19. Determination of C.B.R.
20. Preparation f representative sample by coning and quartering.
21. Benkelman beam test
22. Bitumen extraction test
23. Stripping value test
24. Stone polishing value test

Note: *At least ten experiments should be conducted in the Semester*

Suggested readings:

1) Relevant IS and IRC Codes of Practice.
2) Relevant ASTM and AASHTO Codes of Practice
3) Khanna, S. K. and Justo, C.E.G., Highway Material Testing (laboratory manual). Nem Chand & Bros, Roorkee (2000)

Course Code	Course Title						Core / Elective
PC 553 CE	**ENVIRONMENTAL ENGINEERING Lab**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Environmental Engineering Theory (Co-Requisite)	0	0	0	2	**25**	**50**	1

Course Objectives

- Characterization of water and wastewater to ensure security and well-being of humanity
- Verify the efficiency of certain water treatment processes

Course Outcomes

- Students will have the ability to: locate, compile and use information; design and perform experiments to satisfy specific information needs; and critically analyze and interpret data and present results.

List of Experiments:

1. a) Determination of total dissolved solids
   b) Determination of total suspended solids
   c) Determination of fluorides
2. Determination of pH and EC
3. Determination of total hardness
4. Determination of alkalinity
5. Determination of chlorides
6. Determination of sulphates
7. Determination of MPN
8. Determination of residual chlorine
9. Determination of optimum alum dosage
10. Determination of BOD
11. Determination of COD

Note: *At least ten experiments should be conducted in the Semester*

Suggested readings:

1) Fair. G. M. and Geyer. J. C. "***Water and Wastewater Engineering*** ", Vol. I & II. John Wiley & Sons Inc., New York, 2010.
2) White. J.B., ***"Wastewater Engineering"***, 2nd Edition, Edward Arnold. London, 1978
3) Hammer. M. J. and Hammer. M. J. Jr.***,"Water and Wastewater Technology",*** Prentice-Hall of India Pvt. Ltd., New Delhi, 1998
4) Metcalf & Eddy. ***'Wastewater Engg; Treatment, Disposal Reuse'***, Tata McGraw-Hill Publishing Company Limited, New Delhi,1995
5) Sasi Kumar, K. and Sanoop Gopi Krishna., ***'Solid waste Management'***, Prentice-Hall of India Pvt. Ltd., New Delhi, 2009.
6) Gilbert, M. Masters , ***'Introduction to Environmental Engineering and Science'***, Prentice-Hall of India Pvt. Ltd., New Delhi, 1995

Course Code	Course Title						Core / Elective
PE 501 CE	**ADVANCED CONCRETE TECHNOLOGY**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Concrete Technology	3	0	0	0	**30**	**70**	3

Course Objectives

- To impart knowledge on properties of concrete
- Understand the non-conventional construction materials ad elements
- Performance Criteria for Concrete Durability

Course Outcomes

- The learner will be able to design high performance concrete mixes of different grades and also use the special concretes.

UNIT – I

Introduction: different types of cementitious materials, different types of cements and pozzolanas, energy efficient cement burning technologies. Admixtures and Construction Chemicals: Benefits of admixtures, type of admixtures, plasticizers, action of plasticizers, super- plasticizers, classification of super plasticizers, effect of super-plasticizers, doses of super plasticizers, super plasticizers-cement compatibility, waterproofing admixture, antibacterial and similar admixtures

UNIT – II

Strength of Concrete: Factors affecting the strength, curing of concrete, autogenious healing, strength in tension, failure in compression, failure under multi-axial stress, micro cracking, aggregate cement paste interface, effect of age on strength of concrete, relationship between compressive and tensile strength, bond between concrete and reinforcement, failure strength of concrete, impact strength, electrical and acoustic properties of concrete, temperature effects in concrete.

UNIT – III

Durability of Concrete: Causes of inadequate durability, transportation mechanism in concrete, diffusion, absorption, water permeability of concrete, air and vapour permeability, carbonation, acid attack on concrete, sulphate attack on concrete, efflorencence, effect of sea water on concrete, alkali-silica reaction, type of cracking, action of frost, air entrainment, effect of de-icing agent, chloride attack, threshold content of chloride ions, influence of blended cement on corrosion, other factors affecting corrosion of reinforcement, test for penetrability of concrete to chlorides, stopping corrosion

UNIT – IV

Special Concrete and Concreting Techniques: Introduction, light weight concrete, ultra light weight concrete, vacuum concrete, mass concrete, roller compacted concrete, concrete with different cementitious materials like flyash, GGBS, silica fume, rice husk ash, shotcrete or guniting, ferrocement, fiber reinforced concrete, polymer concrete composites, sulphur

concrete, jet cement concrete, gap graded concrete, high performance concrete, self compacting concrete, foamed concrete

UNIT – V

Ferro Cement: Introduction to Ferro cement design principals, materials used, manufacture of Ferro cement elements, Type of members commonly used, use of Ferro cement in rehabilitation of Structures.

Fiber Reinforced Concrete: Various types of fibers like glass, steel, asbestos etc. Physical & Mechanical Properties, use of Fiber Reinforced Concrete in structural elements

Polymers and Polymer Concrete: Physical and mechanical properties and its use in Civil Engineering

Light Weight Concrete: Various types of light weight aggregate, physical and mechanical properties. Introduction to structural plastics and similar elements Smart materials, Environment friendly materials

Suggested readings:

1) A.M.Neville, "***Properties of Concrete"***, ELBS publications Oct 1996.
2) P.K.Mehta and P.J.Monteiro***, "Concrete: Micro Structure, Properties and Materials",*** 4th Edition, Mc. Graw-Hill Publishing Company Ltd. New Delhi, 2014.
3) M.S.Shetty, "***Concrete Technology"***, S.Chand & Co., 2009.
4) A.R. Santhakumar***, "Concrete Technology",*** Oxford University Press Oct 2006.
5) N.Krishna Raju, ***"Design of Concrete Mixes"***, CBS Publications, 2000.
6) Rafat Siddique, "***Special Structural Concretes"***, Galgotia Publications 2000.
7) Relevant BIS Codes

Course Code	Course Title						Core / Elective
PE 502 CE	**HYDRO POWER ENGINEERING**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Water Resources Engineering	3	0	0	0	**30**	**70**	3

Course Objectives

- An overview of hydro power development
- Exposure to the principles involved in the design of surge tanks and penstocks
- Description regarding the concepts of speed and pressure regulation

Course Outcomes

- Planning for hydro power development projects
- Application of principles involved in the design of surge tanks and penstocks

UNIT – I

General: Comparison with other methods of power generation, Site investigation and location of water power plant, Study of stream flow data for power estimation - Pondage and storage, and load prediction. Development of power: Different types of layout, component parts of waterpower schemes.

UNIT – II

Water Conductor System: Intake – Various types, Hydraulics of Intakes, gates and their operations. Powerhouse: General arrangements and criteria for fixing power house dimensions, including mechanical & electrical equipment details.

UNIT – III

Pipe Networks: Analysis by Hardy Cross Method, and Newton Raphson Method, Joining and laying of pipes and pipe specials (Cast Iron, Ductile Iron, Pre stressed Concrete, and HDPE). Penstocks and Pressure Shafts: Classification, Hydraulic design, Economical diameter of Steel Penstocks

UNIT – IV

Hydraulic Transients and Surge Tanks: Introduction, effect of rapid valve closure, unsteadies compressible flow, surge protection, and method of characteristics to water hammer. Water Hammer theory – Joukowsky's method, and Allieve's method

UNIT – V

Anchor Blocks: Various types and design of simple anchor blocks, Design of simple surge tanks, and method of characteristics to the design of surge tanks.

Pressure Regulation: General features, auxiliary devices, automatic and remote control devices, governor improvement methods, performance characteristics and speed regulation of different turbines

Suggested reading:

1) Modi, P.N., ***'Irrigation Water Resources and Water Power Engineering'***, Standard Book House, New Delhi, 1988
2) Bhave, P.R., Gupta, R., ***'Analysis of flow in water distribution networks'***, Narosa Publishing House, New Delhi,2006
3) Creager W. P., and Justin J.D., ***'Hydroelectric Hand Book',*** John Wiley and Sons Inc., New York,1959
4) Barrows, H.K., '***Water Power Engineering',*** Tata McGraw-Hill Publishing Company, New Delhi,1980
5) EI-Wakil, M.M., 'Power Plant Technology', McGraw-Hill Book Company, New York, 1984

Course Code	Course Title						Core / Elective
PE 503 CE	**INFRASTRUCTURE ENGINEERING**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	0	0	0	**30**	**70**	3

Course Objectives

- To examine the power sector infrastructure requirements including maintenance issues.
- To review various infrastructures needs of roads, railways, water ways and airports in the country.
- To discuss various communication systems and postal services infrastructure requirements.
- To consider the possibilities for housing and construction demand as per the country needs and scope of privatization.

Course Outcomes

- To explain professional issues related to power sector infrastructure needs and maintenance strategies.
- To describe and evaluate roads, railways, waterways and airways infrastructure in any country
- To distinguish different types of communications systems and postal services in the context of infrastructure. To demonstrate importance of housing sector and privatization in the present day context.

UNIT-I

An Overview of Infrastructure Engineering: Urban Infrastructure and Rural Infrastructure in general. An Introduction to Special Economic Zones, Organizations and Players in the field of Infrastructure, The Stages in an Infrastructure Project, Concept of Lifecycle., etc., An Overview of Infrastructure Projects in power Sector, Water Supply and Sanitation Sector, Road, Rail, Air and Port Transportation Sectors and Telecommunications.

UNIT-II

Public and Private Sector Role in Infrastructure Development: A Historical Overview of Infrastructure Privatization. The Benefits of Infrastructure Privatization, Problems with Infrastructure Privatization , Challenges in Privatization Water Supply, Power, Infrastructure, Road Transportation Infrastructure in India – Case studies preferable.

UNIT-III

Infrastructure Planning and Implementation: Mapping and Facing the Landscape of Risks in Infrastructure Projects, Core Economic and Demand Risks, Political Risks, Socio-Environmental Risks, Cultural Risks in International Infrastructure Projects, Legal and Contractual Issues in Infrastructure, Challenges in Construction and Maintenance of Infrastructure – Case studies preferable.

UNIT-IV

Environmental and Social Impact Assessment Aspects: Categories, Attributes and Parameters, Identification of Environmental and Social Impacts over Project Area and over Project Cycle. Special Considerations Involving Land and Water Interrelationships - Environmental Laws and Regulations, Introduction to B-O-T, BOOT projects & PPP Projects

UNIT-V

Strategies for Successful Infrastructure Project Implementation: Risk Management Framework for Infrastructure Projects, Shaping the Planning Phase of Infrastructure Projects. Governments Role in Infrastructure Implementation, An Integrated Framework for Successful Infrastructure Planning and Management - Infrastructure Management Systems and Future Directions.

Suggested readings:

1) Grigg, Neil, "***Infrastructure Engineering and Management"***, Wiley, 1988.
2) Haas and Hudson, Zaniewski, ***"Modern Pavement Management"***, Krieger, Malabar, 1994.
3) Hudson, Hasnuddin***, "Infrastructure Management: Integrating Design, Construction, Maintenance, Rehabilitation and Renovation",*** McGraw Hill, 1997.
4) Anjaneyulu, Y & Manickam, V, ***"Environmental Impact Assessment Methodology"***. B.S. Publications, Hyderabad, 2012.
5) P. Chandra, ***"Projects: Planning, Analysis, Selection, Financing, Implementation and Review"***, Tata McGraw-Hill, New Delhi, 2009.
6) A. S. Goodman and M. Hastak, ***"Infrastructure Planning Handbook: Planning, Engineering, and Economics",*** McGraw-Hill, New York, 2006.

Course Code	Course Title						Core / Elective
PE 504 CE	**SOFT COMPUTING SKILLS IN CIVIL ENGINEERING**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	0	0	0	**30**	**70**	3

Course Objectives

- Impart the knowledge of various soft computing techniques
- Understand programming concept and optimization Techniques
- Know the applications of soft computing techniques in Water Resources Engineering

Course Outcomes

- Competence in understanding the optimization principles
- Able to solve simple numerical problems and applications using L.P., D.P.
- The students will be able to understand some of the soft computing techniques like Neural Network, Fuzzy Logic techniques in water Resources

UNIT - I

Optimization Techniques: Introduction, one dimensional Un-constrained minimization , Linear Programming, Generalized formation for simple problems, Solution to Linear Programming by Simplex method, Big M method, two-phase linear programming. Formulation of Linear Programming problems for simple case studies in water resources.

UNIT - II

Dynamic Programming: Introduction to dynamic programming. Bellman's p1inciple, General principles of recursive optimization. Method of forward dynamic programming and back ward dynamic programming. Formulation of recursive relationship for water resources problems (allocation problem, capacity expansion and net works).

UNIT- III

Artificial Neural Networks: Fundamental concepts, Biological Neural networks, Basic Models in Neural Networks, Comparison of Biological Neuron and artificial neuron, terminology of neural networks. Supervised Learning networks and calculation of error Back propagation networks (algorithm and architectures)

UNIT - IV

Fuzzy Sets: Introduction to fuzzy sets and classical sets, fuzzy set operations and properties.Fuzzy relations, fuzzy membership functions, Fuzzy logic, fuzzy quantifiers and fuzzy inferences. Fuzzy rule based methods and defuzzification methods. Application of fuzzy methods in water resources

UNIT - V

Genetic Algorithms: Fundamentals of genetic algorithms, basic concepts, binary coding, fitness function, Reproduction, (Roulett wheel selection, Tournament selection). Cross over and mutation operations, convergence of algorithm. Simple applications in water resources

Suggested readings:

1) Raja Sekharan, S. and Vijaya Laxmi Pai, G.A. ***"Neural Networks, Fuzzy Logic, and Genetic Algorithm"*** M/s. Prentice Hall, New Delhi, 2003.
2) Jang,J.S.R, Tsai Sun, C.H. and Eiji Mizutsanil. ***"Neuro-Fuzzy and Soft Computing."*** Pearson Education New Delhi, 2004.
3) Ashok. D. Belegundu and Chandraputala, T.R. ***"Optimization concepts and Applications in Engineering"*** M/s. Pearson Education New Delhi, 2002.
4) Vedula, S., Mujumdar, P.P. ***"Water resources Systems."*** McGraw-Hill publishers. New Delhi, 2005.

SCHEME OF INSTRUCTION & EXAMINATION
B.E. VI - Semester
(CIVIL ENGINEERING)

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	P/D	Contact Hrs/Wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1	**PC 601 CE**	Steel Structures	3	1	-	4	30	70	3	3
2	**PC 602 CE**	Structural Engineering Design & Detailing – I (Concrete)	3	1	-	4	30	70	3	3
3	**PC 603 CE**	Theory of Structures – II	3	1	-	4	30	70	3	3
4	**PC 604 CE**	Water Resource Engineering II	3	-	-	3	30	70	3	3
5	**PC 605 CE**	Soil Mechanics	3	-	-	3	30	70	3	3
6	**PC 606 CE**	Transportation Engineering – II	3	-	-	3	30	70	3	3
7	**PE-II**	Professional Elective – II	3	-	-	3	30	70	3	3
8	**OE-I**	Open Elective – I	3	-	-	3	30	70	3	3
Practical/ Laboratory Courses										
9	**PC 651 CE**	Soil Mechanics Lab	-	-	2	2	25	50	3	1
10	**PC 652 CE**	Concrete Technology Lab	-	-	2	2	25	50	3	1
11	**PW 661 CE**	Survey Camp	-	-	-	-	-	50	3	2
Total			**24**	**03**	**04**	**31**	**290**	**710**	**-**	**28**

PC: Professional Course **PE**: Professional Elective **OE**: Open Elective **PW**: Project Work
L: Lecture **T**: Tutorial **P**: Practical **D**: Drawing
CIE: Continuous Internal Evaluation **SEE:** Semester End Examination (Univ. Exam)

Note -1:

1. Each contact hour is a Clock Hour
2. The duration of the practical class is two clock hours, however it can be extended wherever necessary, to enable the student to complete the experiment

Note-2:

* The students have to undergo a Summer Internship of four weeks duration after VI semester and credits will be awarded in VII semester after evaluation.

****** Subject is not offered to the students of Civil Engineering Department

Open Elective-I:

S.No	Course Code	Course Title
1	OE601CE	Disaster Management**
2	OE602CE	Geo Spatial Techniques**
3	OE601CS	Operating Systems
4	OE602CS	OOP using Java
5	OE601IT	Database Systems
6	OE601EC	Principles of Embedded Systems
7	OE602EC	Digital System Design using HDL Verilog
8	OE601EE	Reliability Engineering
9	OE602EE	Basics of Power Electronics
10	OE601ME	Industrial Robotics
11	OE602ME	Material Handling
12	OE632AE	Automotive Safety & Ergonomics

Professional Elective – II

S.No.	Course Code	Course Title
1	PE 601 CE	Earthquake Resistant Design of Buildings
2	PE 602 CE	Wastewater Treatment
3	PE 603 CE	Ground Improvement Techniques
4	PE 604 CE	Watershed Management

Course Code	Course Title						Core / Elective
PC 601 CE	**STEEL STRUCTURES**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Theory of Structures	3	1	0	0	**30**	**70**	3

Course Objectives

- Know the IS codal provisions as applicable for the designs.
- Understand the material behavior and basics of design of steel structures.
- Learn the design of various members along with the connections.
- Explain the design principles of roof trusses.

Course Outcomes

- Learn IS codal provisions and basics of design of steel structures
- Learn the design of different types of connections.
- Learn the design of tension, compression members, column bases and beams.
- Learn the design of roof trusses.

UNIT - I

Materials and Specifications: Chemical composition of steel, types of Structural Steel, Residual stresses, Stress Concentration.

Basis of Structural Design: Codes and Specifications, Design Philosophies, working Stress Method, Limit State Method.

Loading and Load Combinations: Characteristic Loads, Dead Loads, Imposed Loads, Earthquake Loads, Wind Loads and Load Combinations. Partial safety factors for materials and loads.

Bolted Connections (Limit state method): Bolted Connections, Behavior of Bolted Joints, Design Strength of Ordinary Black Bolts, Design Strength of High Strength Friction Grip Bolts, Pin Connections, Simple Connections and Eccentric Connections

Welded Connections (Limit State Method): Advantages of Welding, Types of Welds and Joints, Simple Connections and Eccentric Connections.

UNIT - II

Working Stress Method: Permissible Stresses, Slenderness Ratio, Net Area of Cross Section, Design of tension members, Design of Simple Compression Members

Design of Tension Members (Limit State Method): Types of Tension Members, Design of Strands, Slenderness Ratio, Modes of Failure, Factors Effecting Strength of Tension Members, Design of Tension Members (Angles, Other sections and Rods), Lug Angles, Tension Member Splice.

UNIT - III

Design of Beams (Limit State Method): Types of Beams, Section Classification, Lateral Stability of Beams, Buckling of Real Beams, Behavior of Beams in Bending, Design of Laterally Supported and Unsupported Beams, Design of Compound Beams, Shear Strength of Beams, Maximum Deflection, Web Buckling and Web Crippling, Biaxial Bending and Unsymmetrical Bending.

UNIT - IV

Design of Compression Members (Limit State Method): Introduction, Possible Failure Modes, Behavior of Compression Members, Elastic Buckling of Slender Compression Members, Behavior of Real Compression Members, Sections of Compression Members, Effective Length, Design of Compression Members with Single Section and Built-up Sections (Symmetric in both directions), Lacing and Battening, Column Splices.
Design of Column Bases (Limit state method): Design of Slab Base and Gusseted Base for Columns.

UNIT - V

Design of Roof Trusses (Limit State Method): Types of Trusses, End Bearings, Spacing of Trusses and Purlins, Estimation of Loads with different Roof Coverings, Self-weight of Truss, Wind Effects, Design of Purlins for Dead Load, Imposed Load and Wind Loads. Detailed Design of Roof Trusses including Joints and Supports (only Angular Trusses)

Suggested Reading:

1) Subramanian. N, "***Design of Steel Structures"***, Oxford University Press, 2008.
2) Duggal S.K., ***"Design of Steel Structures"***, Tata McGraw Hill Publishing, 2009.
3) Shiyekar M.R., ***"Limit State Design in Structural Steel"***, PHI Learning Pvt. Ltd., 2010.
4) Bhavikatti, S.S., **"*Design of Steel Structures*",** I.K. International Publishing House Pvt. Ltd. 2010.
5) P. Dayaratnam, ***"Design of Steel Structures",*** S. Chand & Co. New Delhi, 2012.
6) Galyord & Gaylord, ***"Design of Steel Structures",*** Tata Mc Graw Hill Education, 2012.
7) Indian Standard Code – IS – 800-2007.

Course Code	Course Title						Core / Elective
PC 602 CE	**Structural Engineering Design & Detailing – I (Concrete)**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Theory of Structures	3	1	0	0	**30**	**70**	3

Course Objectives

- Know the IS codal provisions as applicable for the designs.
- Understand the material behavior and basics of design of steel structures.
- Learn the design of various members along with the connections.
- Explain the design principles of roof trusses.

Course Outcomes

- Learn IS codal provisions and basics of design of steel structures
- Learn the design of different types of connections.
- Learn the design of tension, compression members, column bases and beams.
- Learn the design of roof trusses.

UNIT-I

Combined Footing and Retaining Walls: Limit state design & detailing of combined rectangular and trapezoidal footings and retaining walls – cantilever and counter fort types.

UNIT-II

Water Tanks: Elastic Design & Detailing for RCC circular land rectangular ground level and over-head tanks-Design of staging. Design of Intze tanks

UNIT-III

Bridges: IRC loadings; Elastic design and detailing of (i) RC bridge deck slab using effective width methods and Pigeaud's method, (ii) Slab Bridges, and (iii) T-beam bridges.

Suggested Reading:

1) Ramanatham, S., *"**Design of Reinforced Concrete Structures"***, Dhanpat Rai & Sons, 2002.
2) Vazirani and Ratwani, ***"Concrete Structures",*** Khanna Publishers, 1998.
3) Krishna Raju, N., ***"Structural Design and Drawing: Reinforced Concrete",*** Universities Press, 1992.
4) Prakash Rao, D.S., ***"Design principles and Detailing of Concrete Structures",*** Tata McGraw-Hill Publishing Co. Ltd. 1995.
5) Johnson Victor, D., ***"Essentials of Bridge Engineering"***, Oxford & IBH Publishing Co., New Delhi, Fourth Edition, 1991
6) Ponnuswamy, S., ***"Bridge Engineering",*** Tata McGraw Hill, New Delhi, 2017.
7) Relevant BIS Codes – IS – 800-2007.

Course Code	Course Title						Core / Elective
PC 603 CE	**THEORY OF STRUCTURES – II**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Theory of Structures-I	3	1	0	0	**30**	**70**	3

Course Objectives

- Understand the analysis of structural elements subjected to moving loads & the analysis of road/railway bridges and gantry girders.
- Explain the concepts involved in the analysis of suspension cable bridges.
- Illustrate the matrix methods of structural analysis for computer applications.
- Brief about the software package **Staad-pro.**

Course Outcomes

- Sketch ILD for bending moment and shear force, for determinate girders for different position of loading system and for different sections of girder
- Analyse cable suspension bridges along with three hinged stiffening girder for static loads.
- Calculate the bending moment and shear force and sketch the BMD and SFD for redundant members using force and displacement methods
- Analyse the redundant beams and frames by using software packages

UNIT - I

Curves of Maximum Bending Moment and Shear Force: for simply supported girders traversed by (l) single point load, (2) two point loads, (3) uniformly distributed-load longer/shorter than span, enveloping parabola and EUDL (4) several point loads

Moving Loads: Influence line for support reaction, bending moment and shear force at any location for simple beams. Determination of maximum bending moment and shear force for moving load systems on simply supported girders.

UNIT - II

Moving Loads on Trusses / Girders: Influence lines for forces in members of statically determinate plane framed structures under moving loads for Warren girder, Pratt truss, and Curved flange truss.

Suspension Bridges: Stresses in suspended loaded cables, length of cable, simple suspension bridge with 3-hinged stiffening girders for static load, Influence lines for horizontal and vertical components of tension in the cable, tension in the cable, bending moment and shear force.

UNIT - III

Flexibility Matrix Method: Determination of Static and kinematic indeterminacy – Equilibrium and compatibility conditions-Principles of superposition, Application of Flexibility Matrix Method to continuous beams, plane trusses, plane frames and ortho grid structures (Static indeterminacy not exceeding three) - Effect of temperature, Lack of fit and Pre-stressing forces

UNIT - IV

Stiffness Matrix Method: Application of Stiffness Matrix Method to continuous beams, plane trusses, plane frames and ortho grid structures (Degree of freedom not exceeding three). Construction of stiffness matrix for frames - Direct Method

UNIT – V

Direct Element Method: Development of stiffness matrices for bar, truss and beam elements Application of direct element method to problems of axially loaded bars, continuous beams, plane trusses and plane frames to obtain joint displacements and member end forces Developing shear force and bending moment diagrams. Introduction to software package STAAD Pro

.

Suggested Readings:

1) S.B. Junarkar and Shah, ***"Mechanics of structures",*** Charotar Pub, House, 2001
2) D.S. Prakash Rao, **"*Structural Analysis - a Unified Approach",*** University Press, 1991
3) B.C. Punmia and A.K. Jain, **"*Theory of Structures",*** Laxmi Publications, New Delhi, 2004.
4) Pandit, G .S., S. P. Gupta and R. Gupta, ***"Theory of Structures," Vol. I & II ,*** Tata McGraw Hill, New Delhi, 1999.
5) J. M. Gere & William Weaver**, "*Matrix Analysis of Framed Structures",*** 2nd Ed., D Van Nostand, New Jersey, 1980.
6) S.S. Bhavikatti,***"Structural Analysis"*** *– Vol. I & II,* Vikas publication House Pvt. Ltd., 4th Edition, 2011.

Course Code	Course Title						Core / Elective
PC 604 CE	**WATER RESOURCE ENGINEERING – II**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Water Resources Engineering-I	3	0	0	0	**30**	**70**	3

Course Objectives

- Introduction to different concepts of canal design
- Description of design aspects of different types of weirs and regulatory systems
- Imparting knowledge regarding the different types of cross drainage structures

Course Outcomes

- Assimilation of the various concepts of canal design
- Application of design aspects of different types of weirs and regulatory systems
- Knowledge regarding the different types of cross drainage structures

UNIT - I

Canals: Alignment, classification of alluvium canals and their functions, Regime concept of Kennedy's and Lacey's theories, design of canals based on Kennedy's and Lacey's method, use of Garrett's diagrams for the design of canals, lining of canals, methods of lining and design of lined canals.

UNIT – II

Weirs: Components of diversion head works, types of weirs – fixation of still level of head sluice, scouring sluice and crest level of weir, afflux and top level of flood banks, , design of head regulator, design of vertical drop and sloping glacis weir, design for surface flow and sub - surface flow, length, level and thickness of downstream apron, upstream and downstream cutoffs, protection works.

UNIT - III

Seepage Forces: Causes of failure of structures on permeable foundations, piping, rupture of floor, undermining, remedial measures, computation of uplift forces by Bligh’s theory, Khoshla’s theory, analytical method, and significance of exit gradient.

UNIT - IV

Canal Falls: Definition, location, types of falls, design of trapezoidal notch fall, cylinder fall, vertical drop fall and glacis fall.

Regulators and Modules: Head regulator and cross regulators, canal escapes, canal outlets and modules-proportionality, sensibility and flexibility.

UNIT – V

Cross Drainage Works: Definition, classification, design of aqueducts, syphon aqueducts, super passages, and canal syphons, inlets and outlets-selection of cross drainage works.

Suggested readings:

1) Punmia, B.C., Pande B. and Lal, B., ***'Irrigation and Water Power Engineering'***, Standard Book House, New Delhi, 2016.
2) Garg, S.K., ***'Irrigation and Hydraulic Structures'***, Khanna Publishers, New Delhi,1993.
3) Modi P.N., ***'Irrigation and Water Resources and Water Power Engineering'***, Standard Book House, New Delhi, 1983
4) S. K. Sharma **"*Irrigation Engineering & Hydraulic Structures*"** S. Chand Publishers, New Delhi 2016.
5) N. N. Basak, ***"Irrigation Engineering"***, Mcgraw Higher Education, 1999.

Course Code	Course Title						Core / Elective
PC 605 CE	**SOIL MECHANICS**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Engineering Geology	3	0	0	0	**30**	**70**	3

Course Objectives

- Introduction of Particulate Mechanics further to the solid and fluid mechanics
- Characterization and classification of soils based on laboratory and field experiments
- Understand Seepage, Strength and Compressibility characteristics of soils and learn the analysis of applications involving them

Course Outcomes

- Competence in understanding the soil and the mechanisms associated with it.
- Ability to analyze the systems involving soil mechanics
- Competence for application of principles of soil mechanics in Foundation Engineering to be learned in the next semester.

UNIT - I

Origin and Classification of Soils: Soil as a pseudo-elastic three phase particulate medium Physical Properties of soil: Weight ratios (Water content, Density, Unit weights, Specific Gravity); Volume ratios (void ratio, porosity, degree of saturation, relative density); Interrelationships, Laboratory tests for determination of Index properties. Classification and Identification of soils for general and engineering purposes as per IS: 1498-1970.

UNIT - II

Soil Moisture States: Held and Free moisture

Capillarity in Soils: Surface tension and capillary rise in soil, Capillary tension, Capillary pressure. pF value.

Permeability of Soils: Darcy's law for flow through soils - validity of Darcy's Law - Factors affecting permeability - Laboratory tests for determination of co-efficient of permeability (constant head, variable head permeability tests) - Field tests (Pumping in and pumping out tests) - Equivalent permeability of stratified soils.

Seepage in Soils: Seepage flow, seepage pressure - Flow nets - Locating phreatic line in a homogeneous earthen dam using Kogeny's parabola - Computation of seepage quantity.

Stress in Soils: Total, effective and neutral stress distribution in different ground conditions

Quick Sand Phenomena: Critical Hydraulic gradient, Remedial measures

UNIT-III

Compaction Process: Compaction Mechanism; factors affecting compaction. Laboratory determination of compaction characteristics-standard and modified Proctor tests- IS Light and Heavy compaction tests; Field surface compaction : compaction equipment, procedure, quality control

Consolidation Process: Spring analogy - Void ratio and effective stress (e Vs logP) relationship – Terazaghi's theory of one dimensional consolidation - assumptions and derivation of GDE – Computation of magnitude of settlement and time rate of settlement.

UNIT - IV

Shear Strength: Significance of Shear Strength in Soils - Mohr - Coulomb equation - shear parameters - Laboratory tests for determination of shear strength - Direct shear test, Tri-axial compression test, Un-confined compression test, Vane shear test, Factors affecting shear strength of cohesion-less and cohesive soils.

UNIT - V

Earth Pressure: States of Earth Pressure - Active, passive, at rest condition; Rankine's theory: computation of active and passive earth pressure in c-less and cohesive soils; Coulomb's Wedge theory: Rehbhan's graphical solution: stability of earth retaining gravity wall.

Slope Stability: Definition and classification of slopes -types of slope failure - Factors of safety with respect to cohesion, angle of shearing resistance, Height - Analysis of stability of slope using Swedish slip circle method and Taylor's stability number.

Suggested readings:

1) Lambe, T.W. and Whitman, R.V., ***"Soil Mechanics",*** John Wiley & Sons Inc., NY, 1969.
2) Donald. P. Coduto, "Geotechnical Engineering", Mc Graw Hill Publications
3) Venkataramaiah, C., ***"Geotechnical Engineering",*** New Age Publishers, 2006.
4) Murthy, V.N.S., ***"Soil Mechanics and Foundation Engineering".*** Dhanpat Rai & Sons, 2006.
5) Arora, K.R., ***"Soil Mechanics and Foundation Engineering",*** Standard Publishers Distributors, revised and enlarged sixth edition, 2007.
6) S.P. Brahma, ***"Foundation Engineering",*** Tata McGraw Hill Publishing Company Limited, New Delhi, 1985.
7) Relevant IS Codes.

Course Code	Course Title						Core / Elective
PC 606 CE	**TRANSPORTATION ENGINEERING – II**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Transportation Engineering-I	3	0	0	0	**30**	**70**	3

Course Objectives

- Impart knowledge on the basics of railway with respect to alignment, components, geometric design, construction and maintenance of track.
- Introduce principles of airport engineering with respect to planning and geometric design

Course Outcomes

- Describe the requirements of alignment and its surveys and explain the permanent way components with its functions
- Design the elements of railway track
- Present the techniques for construction and maintenance of railway track
- Elucidate the requirements of airport layout and explain aircraft characteristics
- Draw wind rose diagrams and determine the corrected runway length

UNIT I

Introduction to Railway Engineering: Classification of railway lines in India, Different gauges on Indian Railways, Railway alignment – Requirements of an Ideal alignment , surveys for railway alignment - Traffic, Reconnaissance, Preliminary and Final location surveys. Permanent way: Permanent way component parts and its functions. Rails – various types, functions, creep in rails, creep measurement, coning of wheels, Track fittings and fastenings, Sleepers- various types, merits and demerits, ballast, various types and sub grade preparation.

UNIT II

Geometric Design: Details of geometric design, Gradients, grade compensation, Circular curves, Super elevation, safe speed on curves, Transition curves, widening of gauge on curves, Vertical curves, Check rails, Points and Crossing, Level Crossing: Important terms, switches, Tongue rails, Crossing, Turnouts, Layout of turnout, Classification of level crossings.

UNIT-III

Track Construction – Stages in construction of railway track – earthwork, plate laying and laying of ballast Maintenance of track: Necessity of maintenance, Maintenance of railway track – Maintenance of surface rails, Maintenance of track alignment, Maintenance of gauge, Maintenance of proper drainage and Maintenance of track components

UNIT IV

Airport Planning: Introduction to air transportation, air craft types and its characteristics. Terminal area and airport lay-out- building functions and planning considerations, vehicular circulation and parking area, apron and hangar, typical airport layouts.

UNIT V

Runway Design: Site selection of an airport as per ICAO, orientation of runway by wind rose diagrams, basic runway length determination including corrections, geometric design, types of airports as per landing & take-off and dimensions

Suggested readings:

1) Satish Chandra and Agarwal M. M., ***"Railway Engineering",*** Oxford Publishers, 2013.
2) Khanna. S.K., Arora, M.G. and Jain. S.S., ***"Airport Planning and Design"*** Nem Chand & Bros, Roorkee, India, 2012.
3) Saxena S. C. and Arora S. P., ***"A Text Book of Railway Engineering",*** Dhanpat Rai and Sons, 2010.
4) Mundrey J. S., ***"Railway Track Engineering",*** Tata McGraw Hill, 2009.
5) Rangwala, ***"Railway Engineering"*** Charotar Publishers, 2015.
6) R. Srinivasa Kumar, "***Transportation Engineering (Railways, Airport, Docks & Harbour",*** Universities Press, 2014.

Course Code	Course Title						Core / Elective
PE 601 CE	**Earthquake Resistant Design of Buildings**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
RCC & SEDD -I (Concrete)	3	0	0	0	**30**	**70**	3

Course Objectives

- Learn the causes of earthquake and effects of ground motion and modeling of structures.
- Study the response spectra and structural dynamics of MDOF systems.
- Discover the different analysis and design approaches like equivalent lateral force method and inelastic time history analysis.
- Be trained in the ductile detailing of reinforced concrete structures as per IS 4326 and IS 13920.
- Learn the seismic analysis of masonry buildings.

Course Outcomes

- Apply the concepts of structural dynamics of MDOF systems for analysis of structures.
- Model and analyse the structures to resist earthquake forces by different methods.
- Design the various structural elements resisting earthquake forces as per IS Codes.
- Practice ductile detailing of reinforced concrete and masonry buildings as per codal provisions.

UNIT-I

Earthquake Ground Motion: Engineering seismology - Seismic zoning map of India - Strong motion studies in India - Strong motion characteristics - Evaluation of seismic design parameters. Structural Dynamics: Initiation into structural dynamics - Dynamics of SDOF systems - Theory of seismic pickup - Numerical evaluation of dynamic response - Response spectra - Dynamics of MDOF systems.

UNIT-II

Concepts of Earthquake Resistant Design of RCC Structures: Basic elements of earthquake resistant design - Identification of seismic damages in RCC buildings - Effect of structural irregularities on performance of RCC buildings during earthquakes - Earthquake resistant building architecture.

UNIT-III

Seismic Analysis and Modeling of RCC Structures: Code based procedure for determination of design lateral loads - Infill walls - Seismic analysis procedure as per IS 1893 code - Equivalent static force method - Response spectrum method - Time history analysis - Mathematical modeling of multi-storey RCC buildings.

UNIT-IV

Earthquake Resistant Design of RCC Structures: Ductility considerations - Earthquake resistant design of multi-storey RCC buildings and shear walls based on IS 13920 code - Capacity based design.

UNIT-V

Earthquake Resistant Design of Masonry Structures: Identification of damages and non-damages in masonry buildings - Elastic properties of structural masonry - Lateral load analysis of masonry buildings - Seismic analysis and design of one-storey and two-storey masonry buildings.

Suggested readings:

1) Bruce A Bolt, ""***Earthquakes***", W.H. Freeman and Company, New York, 2004.
2) C.A. Brebbia, "***Earthquake Resistant Engineering Structures***", WIT Press, 2011.
3) Mohiuddin Ali Khan, ***"Earthquake Resistant Structures: Design, Build and Retrofit",*** Elsevier Science & Technology, 2012.
4) Pankaj Agarwal and Manish Shrikhande, ***"Earthquake Resistant Design of Structures",*** Prentice Hall of India, New Delhi, 2009.
5) T. Paulay and M.J.N. Priestley, ***"Seismic Design of Reinforced Concrete and Masonry Buildings"***, John Wiley and Sons, 1992.
6) S.K. Duggal, ***"Earthquake Resistant Design of Structures",*** Oxford University Press, New Delhi, 2007

Course Code	Course Title						Core / Elective
PE 602 CE	**WASTEWATER TREATMENT**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Environmental Engineering	3	0	0	0	**30**	**70**	3

Course Objectives

- Description of different units of primary treatment and their relative importance
- Illustration about various techniques of natural and mechanical systems of sewage disposal
- Knowledge of disposal methods for conservation of water quality in lakes, rivers, and oceans

Course Outcomes

- Planning for wastewater treatment facilities and conservation of ecological systems
- Selection of appropriate technologies for natural and mechanical systems of sewage disposal

UNIT – I

Planning in Domestic Wastewater Treatment: Outline of unit processes, different types of treatment methods, primary treatment, screening, neutralization, equalization, flocculation, sedimentation, flotation, nitrification - dentitrification systems. Environmental impact and others considerations in planning treatment facilities

UNIT – II

Aerated Lagoons: Design of facultative aerated, aerobic flow through dual powered aerated and extended aeration lagoons

UNIT – III

Waste Stabilization Ponds: Types of ponds, factors affecting pond ecosystem, design of aerobic and anaerobic stabilization ponds.

UNIT – IV

Design of Wastewater Irrigation Systems: Rapid infiltration system, over land flow systems, vermiculture and sludge calculations.

UNIT – V

Effluent Disposal: Receiving water standards, disposal into lakes, rivers, mathematics of mass transport, diffusion-advection, and hydraulic models of physical systems. (Continuous flow stirred tank, reactor model, and plug flow reactor model) disposal into the ocean, outfall design.

Suggested readings:

1) Metcalf and Eddy, '***Wastewater Engineering Treatment, Disposal Reuse'***, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1995.
2) Soli J Arceivala, ***'Wastewater Treatment for Pollution Control'***, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1998.
3) Kiely Gerard, ***'Environmental Engineering'***, McGraw-Hill International Limited, London, 1998.
4) Hammer, M.J. and Hammer, M.J. Jr. '***Water and Wastewater Technology'***, Prentice-Hall of India Pvt. Ltd., New Delhi, 1998.
5) Mackenzie L. Davis, ***"Water and Wastewater Engineering***" Tata McGraw - Hill Education.

Course Code	Course Title						Core / Elective
PE 603 CE	**GROUND IMPROVEMENT TECHNIQUES**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Engineering Geology, Soil Mechanics	3	0	0	0	**30**	**70**	3

Course Objectives

- To understand the objectives, necessity and scope of ground improvement techniques
- To learn different methods of insitu densification of cohesive, cohesion less soils
- To learn the classification, functions and applications of Geosynthetics in ground improvement
- To learn the process of identification of necessity for ground improvement, finding alternative methods and recommendation of the ideal technique through case studies

Course Outcomes

- Ability to understand the necessity of ground improvement and potential of a ground for improvement
- To gain comprehensive understanding about the improvement of insitu cohesive soils as well as Cohesion less soils
- Competence to analyze an in-situ ground, identification of ground improvement techniques feasible, selection of the ideal method, its planning , design, implementation and evaluation of improvement level

UNIT-I

Introduction: Need for ground improvement, applications, factors affecting - different mechanical, chemical, static and dynamic techniques - mechanical stabilization - blending of aggregate - Rothfunt's - Testing.

UNIT-II

Chemical Stabilization: Lime, cement, bitumen, factors influencing -Design approach, construction procedure, laboratory testing, additives. Suspension and solution grouts, principles, methods, equipment, applications, compaction grouting, jet grouting.

UNIT-III

Cohesionless Soils: In situ densification, vibro techniques -Mechanisms. Factors affecting, suitability number, compacting piles, vibro replacement process

UNIT-IV

Cohesive Soils: In situ densification, Pre-loading - Dewatering - sand drains. Sandwicks, geodrains, ropedrains, band drains-stone columns, lime piles - thermal and vacuum methods.

UNIT-V

Geotextiles: Woven and non-woven fabrics. Types, functions and application – Geo-textiles, geo-grides test on geo-textiles. Reinforced earth principles and factors governing design

Suggested readings:

1) J.E. Bowles – "***Foundation Design & Analysis",*** McGraw-Hill Edition 1995.
2) P. Purushottam Raj, "***Ground Improvement Techniques"***, Laxmi Pub., 1999.
3) F. S. Fang, "***Handbook of Foundation Engineereing",*** CBS Pub., 1985.
4) Rao, G.V. and Raju, G.V.S.S., "***Engineering with Geosynthesis",*** Tata McGraw-Hill Pub. Co., 1990
5) Koerner, R.M., ***"Designing with Geosynthetics"***, 3rd Edition, Prentice Hall, 1997.
6) Gulati, S.K., ***"Geotechnical Engineering"*** McGraw Hill Education (India), Pvt. Ltd., Noida.

Course Code	Course Title						Core / Elective
PE 604 CE	**WATERSHED MANAGEMENT**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Hydrology and Water Management	3	0	0	0	**30**	**70**	3

Course Objectives

- Description about the concept of watershed and watershed management systems
- Introduction to the characteristics of watershed parameters
- Enhancing the working knowledge to create the data base of watershed using geospatial techniques

Course Outcomes

- Application of Watershed Management practices in conservation vital natural resources like land and Water.
- Awareness on proper use of all available resources of a watershed for optimum production with minimum hazards

UNIT-I

Definition and Concept of Watershed: Concept of watershed development, objectives of watershed development, need for watershed development in India, Integrated and multidisciplinary approach for watershed management.

UNIT-II

Characteristics of Watershed: Size, shape, physiographic, slope, climate, drainage, land use, vegetation, geology and soils, hydrology and hydrogeology, socio-economic characteristics, basic data on watersheds.

UNIT-III

Principles of Erosion: Types of erosion, factors affecting erosion, effects of erosion on land fertility and land capability, estimation of soil loss due to erosion, Universal soil loss equation. Measures to Control Erosion: Contour techniques, ploughing, furrowing, trenching, bunding, terracing, gully control, rock fill dams, brushwood dam, Gabion.

UNIT-IV

Water Harvesting: Rainwater harvesting, catchment harvesting, harvesting structures, soil moisture conservation, check dams, artificial recharge, farm ponds and percolation tanks. Land Management: Land use and land capability classification, management of forest, agricultural, grassland and wild land, reclamation of saline and alkaline soils.

UNIT-V

Ecosystem Management: Role of Ecosystem, crop husbandry, soil enrichment, inter mixed and strip cropping, cropping pattern, sustainable agriculture, bio-mass management, dry land agriculture, silvi pasture, horticulture, social forestry and afforestation. Applications: Planning of watershed management activities, peoples participation, preparation of action plan,

administrative requirements. Social aspects of watershed management, community participation, private sector participation, industrial issues, socio-economy, integrated development, water legislation and implementations, case studies, applications of geospatial techniques in watershed management systems.

Suggested readings:

1) Wurbs R. A. and James W. P., ***'Water Resources Engineering'***, Prentice-Hall of India, New Delhi, 2002
2) Haan C.T., H.P. Johnson, D.L. Brakensiek, ***'Hydrologic Modeling of Small Watersheds'***, ASAE, Michigan, 1982.
3) Majumdar D.K., ***'Irrigation and Water Management'***, PrenticeHall of India, New Delhi, 2000.
4) Murthy, J.V.S., ***'Watershed Management',*** New Age International Publishers, New Delhi, 1998.

Course Code	Course Title						Core / Elective
PC 651 CE	**Soil Mechanics Lab**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Soil Mechanics (Co-requisite)	0	0	0	2	**25**	**50**	1

Course Objectives

- Expose the students to different types of soils
- Experience the concepts of soil mass, soil solids, and soil structure.
- Understand the laboratory test procedures and appreciate the suitability of each test.
- Make the students to relate theoretical concepts in doing lab tests.

Course Outcomes

- Competence in performing the laboratory experiments on soil specimen, analyse the results, interpret and validate the same
- Greater insight in to the soil behavior and hence enhanced understanding of soil mechanics
- Ability to model a field application in the laboratory to take up research

Determination of Index Properties:

1. Determination of Specific Gravity of soil solids using "Density bottle" method
2. Determination of Specific Gravity of Soil Solids using "Pycnometer" method
3. Determination of water content using "Pycnometer" method
4. Determination of Liquid limit using Casgrande's standard LL device
5. Determination of Liquid limit using Cone Penetration apparatus
6. Determination of Plastic limit
7. Sieve Analysis for plotting Particle size distribution curve.
8. Determination of Field Density using Sand Replacement Method

Determination of Engineering Properties:

9. Determination of Compaction Characteristics
10. Determination of Co-efficient of Permeability by "Constant Head Permeameter test"
11. Determination of Co-efficient of Permeability by "Variable Head Permeameter test"
12. Determination of shear strength, parameters by "Direct Shear Test"
13. Determination of shear strength Cohesive soils by "Unconfined Compression Test"
14. Determination of shear strength by conducting "Vane Shear Test"

Demonstration of Test Procedure:

1. Consolidometer test
2. Tri-axial compression Test
3. Laboratory Plate Load Test
4. Reverse Osmosis Test
5. Quick Sand Model
6. Cyclic Tri-axial Test Facility

Note: *At least ten experiments should be conducted in the Semester*

Suggested readings:

1) IS: 2720 – Relevant Parts.
2) Lambe, T.W., **"*Soil Testing for Engineers*",** Wiley Eastern Ltd., New Delhi, 1969.

Course Code	Course Title						Core / Elective
PC 652 CE	**Concrete Technology Lab**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Concrete Technology	0	0	0	2	**25**	**50**	1

Course Objectives

- Determine behavior of materials through physical tests.
- Infer suitability of materials in construction.
- Able to prepare concrete as per the standards

Course Outcomes

- Exposure to a variety of established material testing techniques.
- Design and prepare concrete mix using Indian Standard method
- Knowledge in Non-destructive tests on concrete

List of Experiments:

1. (a) Determination of Specific gravity of cement
   (b) Determination of unit weight /bulk density of cement
2. Determination of normal consistency of cement
3. (a) Determination of initial setting time of cement
   (b) Determination of final setting time of cement
4. (a) Preparation of mortar cubes for compressive strength
   (b) Tests on mortar cubes for compressive strength
5. Fineness of cement by sieving and by air permeability method
6. (a) Determination of specific gravity of fine aggregate
   (b) Determination of bulk density of fine aggregate
7. (a) Determination of specific gravity of coarse aggregate
   (b) Determination of bulk density of coarse aggregate
8. Tests on bulking of sand
   (a) Laboratory method (b) Field method
9. Determination of fineness modulus of fine aggregate
10. Determination of fineness modulus of coarse aggregate
11. Tests on workability of concrete
    (a) Slump (b) Compaction factor
12. Tests on hardened concrete
    (a) Compressive strength (b) Flexural strength
13. Non-destructive testing of concrete structures demonstration of rebound hammer, UPV System, profometer corrosion meter and IR camera.

Note: *At least ten experiments should be conducted in the Semester*

Suggested readings:

1) Mehta, P. K. and Paulo, J. M. M. **"*Concrete Microstructure-Properties and Material*."** McGraw- Hill Publishers, 1997.
2) Neville, A.M. and Brooks, J.J. **"*Concrete Technology*"** Pearson Education Ltd., India, New Delhi, 2003.
3) Shetty, M.S**. "*Concrete Technology, Theory & Practice*."** S.Chand and Co. Pvt., Ltd, 2004.
4) Krishna Raju, N. **"*Design of concrete mix*.**" CBS Publishers, 1985.
5) Gambhir, M.L. **"*Concrete Technology*."** Tata McGraw Hill, 2004.
6) Remedios, A. P. (2008). **"*Concrete Mix Design hand book*."** Himalya Publishing House, Hyderabad.

Course Code	Course Title						Core / Elective
PW 661 CE	**SURVEY CAMP**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Surveying	0	0	0	0	-	**50**	2

Course Objectives

- Field exercises with modern surveying equipment including GPS and Total Station.
- All aspects of executing and plotting of field surveys
- Work in a team and make effective presentations 4. Capturing topographical features

Course Outcomes

- Apply the principles and operate various advanced surveying instruments.
- Compute the differences in elevation drawn and utilize contour plots, and volumes for earthwork.
- Interpret the need for accurate and thorough note taking in field work to serve as a legal record.
- Practice working as a team member and lead a team
- Demonstrate professional behavior in conducting the experiments and presenting the results effectively

Course Content:

A one week (6 days, 36 hours) surveying camp should be organized in the intervening period of V semester and the commencement of VI semester. The work has to be graded for 50 Sessional marks by a committee consisting of the Head of the Department and 2 - 3 senior faculty members. The surveying camp should expose the students to all the aspects of planning, organizing and conducting a field survey, and plotting of the same.