

**B.Tech. – CIVIL ENGINEERING****B.Tech. –III Year I Semester**

S.No.	Category	Title	L	T	P	Credits
1	Professional Core	Water Resources Engineering	3	0	0	3
2	Professional Core	Design of Reinforced Concrete Structures	3	0	0	3
3	Professional Core	Geotechnical Engineering	3	0	0	3
5	Professional Elective-I	a) Advanced Structural Analysis	3	0	0	3
		b) Ground Improvement Techniques				
		c) Watershed Development And Management				
6	Open Elective-I	a) Building Services	3	0	0	3
		b) Green Buildings				
		c) Construction technology and management				
7	Professional Core	Geotechnical Engineering Lab	0	0	3	1.5
8	Professional Core	Fluid Mechanics & Hydraulic Machines Lab	0	0	3	1.5
9	Skill Enhancement course	Estimation, Specifications & Contracts	0	1	2	2
10	Engineering Science	Tinkering Lab	0	0	2	1
11	Evaluation of Community Service Internship		-	-	-	2
Total			15	1	10	23

**B.Tech. III Year II Semester**

	Category	Title	L	T	P	Credits
1	Professional Core	Design of Steel Structures	3	0	0	3
2	Professional Core	Transportation Engineering	3	0	0	3
3	Professional Core	Environmental Engineering	3	0	0	3
4	Professional Elective-II	a) Earthquake Resistant Design Of Structures	3	0	0	3
		b) Geotechnical Engineering-2				
		c) Transportation Safety And Environment				
5	Professional Elective-III	a) Bridge Engineering	3	0	0	3
		b) Hydraulics and irrigation structures				
		c) Repair and Retrofitting of structures				
6	Open Elective-II	a) Disaster management	3	0	0	3
		b) Watershed Management				
7	Professional Core	Environmental Engineering Lab	0	0	3	1.5
8	Professional Core	Transportation Engg. Lab	0	0	3	1.5
9	Skill Enhancement course	Building Information Modelling	0	1	2	2
10	Audit course	Technical paper writing & IPR	2	0	0	-
Total			20	1	8	23
Mandatory Industry Internship of 08 weeks duration during summer vacation						

## III Year-I Semester

L	T	P	C
3	0	0	3

**WATER RESOURCES ENGINEERING****COURSE OBJECTIVES:****Students will have**

- To Explain Engineering Hydrology And Its Applications, Types And Forms Of Precipitation,
- To Explain the Abstractions From Precipitation
- To Explain Hydrograph, Separation Of Base Flow, Unit Hydrograph, ,S-Hydrograph,IUH
- To Explain Ground Water Occurrence, Aquifer Parameters, Types Of Wells, State Of low Into Wells
- To Explain Consumptive Use, Duty And Delta, Factors Affecting Duty, Methods Of Irrigation, Water Logging

**COURSE OUTCOMES:****Students will get ability to**

1. understand the process of hydrologic cycle, types and forms of precipitation,
2. understand about the abstractions from rainfall
3. analyze about hydrograph, unit hydrograph, s-hydrograph,IUH
4. determine ground water Occurrence, aquifer parameters, types of wells, and the discharge into a well
5. describe consumptive use, duty and delta and methods of irrigation, water logging

**UNIT – I**

**Introduction-** hydrologic cycle, water-budget equation, world water balance, applications in engineering. **Precipitation-** forms of precipitation, measurement of precipitation, rain gauge network, mean precipitation over an area, depth-area-duration relationships, maximum intensity/depth-duration-frequency relationship, Probable Maximum Precipitation (PMP).

**UNIT – II**

**Abstractions from precipitation-** evaporation process, evaporimeters, analytical methods of evaporation estimation, reservoir evaporation and methods for its reduction, Interception, depression storage, infiltration, infiltration capacity, measurement of infiltration, classification of infiltration capacities, infiltration indices.

**UNIT – III**

**Hydrograph:** hydrograph, factors affecting runoff hydrograph, components of hydrograph, base flow separation, effective rainfall, unit hydrograph, S-hydrograph, IUH.

**UNIT – IV**

**Groundwater and well hydrology-** forms of subsurface water, saturated formation, aquifer properties, geologic formations of aquifers, well hydraulics: steady state flow in wells, equilibrium equations for confined and unconfined aquifers, aquifer tests.

**UNIT – V**

**Water withdrawals and uses**–Analysis of surface water supply, Water requirement of crops, duty and delta; Quality of irrigation water; Soil-water relationships, root zone soil water, infiltration, consumptive use, estimation of evapo-transpiration, irrigation requirement. Methods of applying water to the fields: surface, sub-surface, sprinkler and trickle / drip irrigation. Water logging: causes, effects and remedial measures.

**Text Books:**

- Engineering Hydrology, K Subramanya, Edition: 5, 2020, Mc-Graw Hill.
- Ground Water 3rd Edition 2007 By H M Raghunath, New Age International

**Reference Books:**

- Irrigation and Water Resources & Water Power by P.N. Modi, 11th edition (15 March 2019), Standard Book House.

## III Year-I Semester

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## DESIGN OF REINFORCED CONCRETE STRUCTURES

### Course Objectives:

#### The objective of the course is to

- Explain the basics concepts of Limit state design.
- Describe the design of flexure.
- Explain the basic concepts such as shear, bond.
- Explain all types of simply supported slabs in detail.
- Explain the classification of columns. Explain isolated square and rectangular footing.

### Course Outcomes:

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

1. Understand the concepts of limit state method.
2. Design of T-beam and doubly reinforced section
3. Demonstrate and design the basic concepts such as shear and bond.
4. Design different types of simply supported slabs by limit state method.
5. Design short columns by limit state method. Design different types of isolated footings by limit state method.

### UNIT-I

**Introduction of Limit State Design:** Working Stress method (concepts) limit state design- Basic statistical principles- characteristic loads – characteristic strength – partial load and safety factors – representative stress – strain curves for cold worked deformed bars and mild steel bars. Based on IS Code: 456-2000. Comparison of Limit state method with working stress and ultimate load method. Assumptions in limit state design – stress – block parameters. Analysis of singly reinforced beams by LSM method.

### UNIT-II

**Design for Flexure** limiting moment of Resistance, limit state design and analysis of doubly reinforced rectangular beams and T -beam sections with examples.

### UNIT – III

**Shear, Torsion and Bond:** Limit state analysis and design of section for shear and torsion – concept of bond, anchorage and development length, I.S. code provisions.

### UNIT – IV

**Slabs:** Classification of slabs, design and detailing one - way slabs, two - way slabs, and continuous one way slabs using Coefficients (conventional) of IS code- all with respect to simply supported only.

### UNIT-V

**Design of Compression Members:** Slenderness ratio, effective length of a column, design of short - under axial loads, uniaxial and biaxial bending (Use of SP 16), Design of slender column, P-M interaction (Only for Demonstration) – I S Code provisions.

**Footings:** types of footings. Distribution of base pressure. General Design considerations for footings. Design of Isolated rectangular, square footing.

**NOTE:** All the designs to be taught in Limit State Method (IS456-2000)

**Text Books:**

1. Design of reinforced concrete foundations by P.C. Varghese, PHI learning private Limited, 2009.
2. Reinforced concrete design by N. Subramanian, Oxford publication, New Delhi, 2017.
3. Reinforced concrete design by S.Unnikrishna Pillai &Devdas Menon, Tata Mc.GrawHill, New Delhi, 2016.

**References:**

1. Reinforced Concrete Structures by Park and Pauley, John Wiley and Sons, 1975.
2. Reinforced concrete structural elements – behaviour, Analysis and design by P.Purushotham, Tata Mc.Graw-Hill, 1994.
3. Limit state designed of reinforced concrete – P.C.Varghese, Printice Hall of India, NewDelhi, 2008.
- 4.Fundamentals of Reinforced concrete design by M.L. Gambhir, Printice Hall of India Private Ltd., New Delhi, 2006.

III Year-I Semester

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
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## **GEOTECHNICAL ENGINEERING**

### **COURSE OBJECTIVES**

Students will have

- Understand the soil formation and determine the index properties of these soils and classify them
- To impart the concept of seepage of water through soils and determine the discharge of water through soils.
- To impart the principles of compaction and consolidation of soils and determine the magnitude and the rate of consolidation settlement.
- Analyze the stress below the soils under different conditions.
- To enable the student to understand the concept of shear strength of soils, determine the shear parameters of sands and clays and the areas of their application. To study and calculate the effective stress of soils at different depths

### **COURSE OUTCOMES:**

After completion of this course students will be able to

1. Determine the index properties of soils, classify them and establish their inter-relationships.
2. Illustrate seepage of water through soils and determine the discharge of water through soils
3. Analyze the stress below the soils under different conditions
4. Determine the magnitude and the rate of consolidation settlement
5. Calculate the effective stress of soils at different depths. Determine the shear parameters of sands and clays and the areas of their application

### **UNIT I:**

#### **Type of Soils, Index Properties:**

Inter-relationships and Soil Characterization Types of soil and soil formation, Geological cycle, Phase diagrams, Basic terms, Functional relationships based on index properties, Physical characterization of soil-Dry and Wet sieve analysis, Atterberg's Indices, Soil Structures, Soil Water and its types, Standard nomenclature & IS Soil Classification, Numericals.

### **UNIT II:**

#### **Permeability and Seepage:**

Darcy's law and its validity, Factors affecting permeability, Laboratory permeability tests, Permeability of stratified soil masses, Seepage pressure, 2-D flow and Laplace's equation, Flow net construction, Quick condition, Piping Failure.

### **UNIT III:**

#### **Effective Stress And Pore Water Pressure:**

Introduction, Stresses when No Flow Takes Place Through the Saturated Soil Mass, Stresses When Flow Takes Place Through the Soil from Top to Bottom, Stresses When Flow Takes Place Through the Soil from Bottom to Top, Effective Pressure Due to Capillary ,

### **UNIT IV:**

#### **Compaction & Consolidation of soil:**

Definitions, Differentiate between compaction and consolidation, Compaction mechanism and

proctor tests, field compactions methods, factors affecting compaction, Consolidation mechanism through spring analogy, fundamental definitions, Terzaghi's one dimensional consolidation theory (only formula), Time factor, pre-consolidation pressure, consolidation

**UNIT V:**

**Stress Distribution:**

Causes of stresses in soil, Boussinesque's and Westergard's equation, Pressure Bulb, Stress distribution on horizontal and vertical planes, Stresses due to different shapes of footings, New-mark's influence chart, Numericals.

**Shear Strength of Soil:**

Mohr's strength theory, Mohr- coulomb's strength theory, Modified Mohr coulomb's theory, shears parameters through lab and field tests based on drainage conditions, Numericals. Tests will be covered in lab sessions.

**Text Books:**

- 1 Basic and Applied Soil Mechanics by Gopal Ranjan&ASR Rao, New age International Pvt . Ltd, New Delhi, Third edition, 2016
2. Soil Mechanics and Foundation Engg. By K.R. Arora, Standard Publishers and Distributors, Delhi, 2009.
3. Soil Mechanics and Foundations by B.C.Punmia, Ashok Kumar Jain and Arun Kumar Jain, Laxmi, publications Pvt. Ltd., New Delhi, Sixteenth edition, 2017.
4. Principles of Geo technical Engineering by B. N. Das and K.Sobhan, Cengage India Private Limited; Ninth edition, 2017

**References:**

1. Geotechnical Engineering by C. Venkataramiah, New age International Pvt . Ltd, ( 2002).
2. Soil Mechanics – T.W. Lambe and Whitman, Mc-Graw Hill Publishing Company, Newyork.
3. Geotechnical Engineering by Purushotham Raj
4. Fundamentals of soil mechanics by D.W.Taylor
5. Geotechnical Engineering by Manoj Dutta & Gulati S.K – Tata Mc.Grawhill Publishers New Delhi.

**III Year-I Semester**

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**ADVANCED STRUCTURAL ANALYSIS**  
**(Professional Elective– I)**

**Course Objectives:****The objective of the course is**

- To study slope deflection methods.
- To study moment distribution method.
- To learn problems on continuous beams and single bay portal frames by Kani's method.
- To study stiffness method applied to continuous beams.
- To study flexibility method applied to continuous beams portal frames. To study the plastic theory for different types of beams.

**Course Outcomes:****Students will get ability to:**

1. Analyze the moments of the members by slope deflection methods.
2. Analyze the moments of the members by distribution method
3. Analyze problems on continuous beams and single bay portal frames by Kani's method.
4. Analyze continuous beams by stiffness method
5. Analyze continuous beams and portal frames by flexibility method. To apply the plastic theory for different types of beams

**UNIT – I**

**Slope deflection method:** Assumptions in slope deflection method -application to the analysis of statically indeterminate beams with and without settlement of supports – rigid jointed plane frames with and without side sway.

**UNIT – II**

**Moment Distribution method** – Stiffness and carry over factors – Distribution factors – Analysis of continuous beams with and without sinking of supports – story portal frames – including Sway.

**UNIT – III**

**Kani's method-** Analysis of continuous beams – including without sinking and with sinking-analysis of single bay portal frames with and without sway.

**UNIT – IV**

**Stiffness Method-**Introduction- Analysis of continuous beams- portal frame non sway analysis. (Maximum of two unknowns). Simple space structures.

**UNIT – V**

**Flexibility Method-**Introduction- Analysis of continuous beams- Simple rigid frame non sway analysis. (Maximum of two unknowns).

**Introduction to Plastic Analysis:** Introduction-Assumption in plastic theory-plastic hinge-plastic moment or collapse moment-collapse load- load factor- shape factor- collapse load for Different types of beams i.e. simply supported beam with central point load- simply supported beam with udl,

**TEXT BOOKS:**

1. Structural Analysis by C.S. Reddy, Tata McGraw-Hill, New Delhi, 3<sup>rd</sup> edition 2010.
2. Structural Analysis (Matrix Approach) by Pundit and Gupta – Tata Mc.Graw Hill publishers, 2<sup>nd</sup> edition, 2008.
3. Strength of Materials and mechanics of solids Vol-2 by B.C. Punmia, Laxmi Publications, New Delhi, 10<sup>th</sup> edition, 2009.
4. Comprehensive Structural Analysis-Vol.I&2 by Dr. R. Vaidyanathan& Dr. P.Perumal-Laxmi Publications pvt. Ltd., New Delhi, 3<sup>rd</sup> edition 2016.
5. Statistical indeterminate structures by C.K.Wang, 1953.
6. Analysis of Structures – Vol. I & 2 by Bhavakatti, Vikas publications, 4th edition, 2010.
7. Indeterminate Structural Analysis by K.U. Muthu, H. Narendra, MagantiJanardhana, M. Vijayanand, I K International Publishing House, 2014

**REFERENCES:**

1. Theory of Structures by S.P. Timoshenko and D. H. Young, Tata Mc.Graw Hill publishers 2002.
2. Analysis of structures by Vazrani&Ratwani – Khanna Publications, 1994.
3. Theory of structures by Ramamutham, Dhanpatirai publications, 2014.
4. Structural analysis by T.S ThandavaMoorthy, Oxford University Press, 2011.
5. Structural analysis by R.C.Hibbler, 6<sup>th</sup> edition 2006.
6. Basic structural analysis by Muttu&Janarthan, 3<sup>rd</sup> edition 2019.

**III Year-I Semester**

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**GROUND IMPROVEMENT TECHNIQUES**  
**(Professional Elective– I)**

**COURSE OBJECTIVES:**

- To explain in-situ densification techniques for granular and cohesive soils at surface level and at deeper level.
- To explain methods of stabilization for different types of soils.
- To illustrate different dewatering techniques to improve soil properties.
- To explain about geo synthetics and its applications and reinforced earth.
- To understand components of reinforced earth.
- To describe expansive soils and foundation considerations on expansive soils.

**COURSE OUTCOMES:**

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

1. Explain in-situ densification methods for granular and cohesive soils at surface level and at deeper level.
2. Explain methods of stabilization and applications.
3. Illustrate different dewatering techniques to improve soil properties.
4. Explain about geo synthetics and its applications.
5. Explain components of reinforced earth.
6. Illustrate different grouting methods under different conditions in soils.

**UNIT – I****In situ densification methods**

In situ densification methods in granular Soils: Vibration at the ground surface and at depth, Impact at the Ground Surface and at depth. In situ densification methods in Cohesive soils: Preloading, Vertical drains – Sand Drains and geodrains – Stone columns – thermal methods.

**UNIT – II**

**Stabilization of Soils:** Methods of stabilization-mechanical-cement-lime-bituminous and polymer stabilization-chemical stabilization with calcium chloride, sodium silicate and gypsum.

**UNIT – III**

**Dewatering:** Dewatering-sumps and interceptor ditches- single and multi stage well points- vacuum well points-Horizontal wells-criteria for selection of fill material around drains-electro osmosis.

**UNIT –IV**

**Geosynthetics:** Types, functions and applications of geotextiles (woven; nonwoven; knitted) geogrids, geonet, geomembranes, gabions, geocells and geosynthetic clay liners.

**UNIT - V**

**Reinforce earth** – principles – components of reinforced earth – design principles of reinforced earth walls – stability checks – soil nailing.

**Grouting:** Objectives of grouting- grouts and their applications- grouting methods- stages of grouting-hydraulic fracturing in soils and rocks- post grouttest.

**TEXT BOOKS:**

1. Hausmann M.R. (1990), Engineering Principles of Ground Modification, McGraw-Hill International Edition.
2. Raj, P. Purushothama (2005), Ground improvement techniques., Laxmi Publications, NewDelhi

**REFERENCES:**

1. Moseley M.P. (1993) Ground Improvement, Blackie Academic and Professional, Boca Taton, Florida, USA.
2. Xanthakos P.P, Abramson, L.W and Brucwe, D.A (1994) Ground Control and Improvement, John Wiley and Sons,New York, USA.
3. Robert M. Koerner, Designing with Geosynthetics, Prentice Hall New Jercy,USA

## III Year-I Semester

L	T	P	C
3	0	0	3

**WATERSHED DEVELOPMENT AND MANAGEMENT**  
(Professional Elective– I)

**COURSE OBJECTIVES:**

- To explain the concept, objectives, need & Integrated and multidisciplinary approach of watershed development, characteristics of watershed
- To explain the principles of erosion which include Types, factors affecting, Effects, estimation of soil loss of erosion etc.,
- To explain the different measures to control erosion which include contour techniques, ploughing, furrowing, trenching, bunding, terracing, gully control works, rock fill dams, brushwood dam, Gabion structures.
- to discuss the water harvesting which include Rainwater Harvesting, catchment harvesting, harvesting structures, soil moisture conservation, check dams, artificial recharge, farm ponds, percolation tanks
- To explain the Land management which include Land use and Land capability classification, management of forest, agricultural, sustainable agriculture, dry land agriculture, Reclamation of saline and alkaline soils. To discuss the Ecosystem management which include Role of Ecosystem, crop husbandry, soil enrichment, inter, mixed and strip cropping, cropping pattern, , bio-mass management, , silvi pasture, horticulture, grassland and wild land social forestry and afforestation.

**COURSE OUTCOMES:**

1. Understand concepts and characteristics of watershed management.
2. Discuss principles of erosion
3. Understand various measures to control erosion.
4. Describe about rain water harvesting and its structures.
5. Describe about land management.
6. Describe about ecosystem management.

**UNIT-I**

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

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

**UNIT-II**

**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, revised universal soil loss equation.

**UNIT-III**

**Measures to control erosion:** Contour techniques, ploughing, furrowing, trenching, bunding, terracing, gully control works, rock fill dams, brushwood dam and Gabion structures.

**UNIT-IV**

**Water harvesting:** Rainwater harvesting and harvesting structures, catchment harvesting, harvesting structures, soil moisture conservation, check dams, artificial recharge, farm ponds,

percolation tanks.\

#### **UNIT-V**

**Land management:** Land use and Land capability classification, management of forest land, management of agricultural land, sustainable agriculture, dry land agriculture, Reclamation of saline and alkaline soils.

**Ecosystem management:** Role of Ecosystem, soil enrichment, cropping pattern, management of grassland and wild land, social forestry and afforestation.

#### **TEXT BOOKS:**

1. JVS Murthy (2017), Watershed Management, 2<sup>nd</sup> edition, New Age International Publishers.
2. R. Awurbs and WP James (2015), Water Resource Engineering, 1<sup>st</sup> edition, Prentice Hall Publishers.

#### **REFERENCE:**

1. VVN Murthy (2013), Land and Water Management, 6<sup>th</sup> edition Kalyani Publications.
2. D.K.Majumdar (2014), Irrigation and Water Management, 2<sup>nd</sup> revised edition, PrinticeHallIndia.

**III Year-I Semester**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**BUILDING SERVICES  
(Professional Elective– I)**

**Objectives of the Course:**

- Building services are the essential services provided in the buildings for improving functioning of the buildings in efficient manner for the desired use of the building.
- The electrical services, mechanical services such as air conditioning, lighting, ventilation, fire protection, acoustics and sound insulations, elevators, escalators, as well as civil engineering services such as water supply, sanitary services, etc. have become most essential services for residential, industrial, high rise, hotels, motels, monumental buildings.
- The main objective of the course is to teach students about these services.
- No building can be put into effective utilisation without all these services.
- To develop skills in the students to prepare plan for various types of services in the building.

**UNIT-I****Introduction to Building Services:**

Definitions, Objective and uses of services, Applications of services for different types of building considering, Classification of building services, Types of services and selection of services, Natural and artificial lighting- principles and factors, Necessity of Ventilation, Types of ventilation – Natural and Mechanical, Factors to be considered in the design of Ventilation.

**UNIT-II****Electrical Services and Layout in Different Types of Building:**

Technical terms and symbols for electrical installations and accessories of wiring, Types of insulation, electrical layout for residence, small work shop, show room, school building, etc.

**UNIT-III****Mechanical Services in Buildings:**

Introduction of mechanical services

**Lift:** Definition, Types of Lifts, Design Considerations, Location, Sizes, Component parts

**Elevators & Escalators:** Different types of elevators and Escalators, Freight elevators, Passenger elevators, Hospital elevators, Uses of different types of elevators Escalators.

**Air Conditioning:** Definition, Purpose, Principles, Temperature Control, Air Velocity

Control, Humidity Control, Air Distribution system, Cleaners, Filters, Spray washers, Electric preceptors, Types of Air Conditioners, (Central type, Window Type, Split Unit

#### **UNIT-IV**

Introduction, Causes of fire and Effects of fire, General Requirements of Fire Resisting Building as per IS: 1642:1989 and NBC 2005, Characteristics of Fire Resisting Materials, Maximum Travel Distance, Fire Fighting Installations for Horizontal Exit, Roof Exit / Fire Lifts, External Stairs

#### **UNIT-V**

##### **Miscellaneous Services and Green Buildings Provisions:**

Plan for Rain Water Harvesting in the New Buildings, Concept of GREEN Buildings, Components of GREEN Building, Components of Grey Water System, Management of Grey Water System and Distribution Pattern, Solar Power System

##### **Textbook Reference Books:**

1. R.Udaykumar; A textbook on Building Services; EswarPress, Chennai
2. S.M.Patil; Building Services; Seem a Publication, Mumbai Revised edition
3. Bureau of Indian Standards; National Building Code of India–2005; BIS, New Delhi
4. Dr.B.C.Punmia; Building Construction; Laxmi Publications(P)Ltd., New Delhi
5. P.C.Varghese; Building Construction; PHI Learning(P) Ltd., New Delhi
6. P.S.Gahlot; Building repair and Maintenance Management; CBS Publishers & Distribution(P) Ltd

##### **Indian Codes of Practice:**

1. IS:1642:1989, Code of Practice for Fire Safety of Building
2. NBC2016, National Building Code of India

**III Year-I Semester**

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**GREEN BUILDINGS**  
**(Open Elective– I)**

**Course objectives:** This course will enable students to:

- Understand the Definition, Concept & Objectives of the terms cost effective construction and green building
- Apply cost effective techniques in construction
- 3. Apply cost effective Technologies and Methods in Construction
- Understand the Problems due to Global Warming
- State the Concept of Green Building Understand Green Buildings

**Course outcome**

- Select different building materials for construction
- Apply effective environmental friendly building technology
- Analyze global warming due to different materials in construction
- Analyse buildings for green rating
- Use alternate source of energy and effective use water

**UNIT-I**

**Introduction to the concept of cost effective construction** -Uses of different types of materials and their availability -Stone and Laterite blocks- Burned Bricks- Concrete Blocks- Stabilized Mud Blocks- Lime Pozzolana Cement- Gypsum Board- Light Weight Beams- Fiber Reinforced Cement Components- Fiber Reinforced Polymer Composite- Bamboo- Availability of different materials- Recycling of building materials- Brick- Concrete-Steel-Plastics-Environmental issues related to quarrying of building materials.

**UNIT-II**

**Environment friendly and cost effective Building Technologies** - Different substitute for wall construction Flemish Bond - Rat Trap Bond – Arches – Panels - Cavity Wall - Ferro Cement and Ferro Concrete constructions – different pre cast members using these materials - Wall and Roof Panels – Beams – columns - Door and Window frames - Water tanks - Septic Tanks - Alternate roofing systems - Filler Slab - Composite Beam and Panel Roof - Pre-engineered and ready to use building elements - wood products - steel and plastic - Contributions of agencies - Costford - Nirmithi Kendra - Habitat

**UNIT-III**

**Global Warming** – Definition - Causes and Effects - Contribution of Buildings towards Global Warming - Carbon Footprint – Global Efforts to reduce carbon Emissions Green Buildings – Definition - Features- Necessity – Environmental benefit - Economical

benefits - Health and Social benefits - Major Energy efficient areas for buildings – Embodied Energy in MaterialsGreen Materials- ComparisonofInitialcostofGreenV/sConventionalBuilding-Lifecyclecostof Buildings.

#### **UNIT-IV**

**Green Building rating Systems-** BREEAM – LEED - GREEN STAR -GRIHA ( Green Rating for Integrated Habitat Assessment) for new buildings – Purpose - Key highlights - Point System with Differential weight age. Green Design – Definition - Principles of sustainable development in BuildingDesign-CharacteristicsofSustainableBuildings– SustainablymanagedMaterials- IntegratedLifecycledesignofMaterialsandStructures(Conceptonly)

#### **UNIT-V**

##### **Utility of Solar Energy in Buildings**

Utility of Solar energy in buildings concepts of Solar Passive Cooling and Heating of Buildings. Low Energy Cooling. Case studies of Solar Passive Cooled and Heated Buildings.

##### **Green Composites for Buildings**

Concepts of Green Composites, Water Utilisation in Buildings, Low Energy Approaches to Water Management. Management of Solid Wastes. Management of Sullage Water and Sewage. Urban Environment and Green Buildings. Green Cover and Built Environment.

##### **Text Books**

1. HarharaIyer G,Green Building Fundamentals,NotionPress
2. Dr.Adv.HarshulSavla, Green Building: Principles & Practices

**III Year-I Semester**

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**CONSTRUCTION TECHNOLOGY AND MANAGEMENT****(Open Elective– I)****COURSE OBJECTIVES:**

1. To explain the basics of scientific management and project planning, clearance and procedures
2. To explain project scheduling CPM PERT
3. To explain project monitoring and controlling and reporting techniques
4. To explain work study and work measurement
5. To explain safety engineering, safety policies and practices
6. To explain administration of incentive schemes

**COURSE OUTCOMES:**

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

1. illustrate the basics of scientific management and project planning, clearance and procedures
2. demonstrate project scheduling CPM PERT
3. illustrate project monitoring and controlling and reporting techniques
4. appreciate work study and work measurement
5. sensitize safety engineering, safety policies and practices
6. illustrate administration of incentive schemes

**Unit–1**

**Basics of Management:** Modern scientific management, Management Functions, Management Styles, SWOT Analysis in construction

**Project Management:** Basic forms of organization with emphasis on Project and matrix structures; project life cycle, planning for achieving time, cost, quality, project feasibility reports based on socio-techno-economic environmental impact analysis, project clearance procedures and necessary documentation for major works like dams, multistoried structures, ports, tunnels, Qualities, role and responsibilities of project manager, Role of Project Management Consultants, Enterprise Resource Planning (ERP)

**Unit 2**

**Project Scheduling:** Construction Scheduling, Work break down structure, activity cost and time estimation in CPM, PERT,RPM (Repetitive Project Modeling) techniques. Precedence Network Analysis, software in Construction scheduling (MSP, primavera, Construction manager).

**Unit 3**

**Project Controlling:** Monitoring and Control, Crashing, Resource Leveling, Updating. Site mobilization – demobilization aspects, various Resources management based on funds availability, coordinating, communicating & reporting Techniques, Application of MIS to construction, Training forConstruction Managers ,Engineers , Supervisors

**Unit -4**

**Work Study:** Definition, Objectives, basic procedure, method study and work measurement, Work study applications in Civil Engineering.

**Method study** – Definition, Objective, Procedure for selecting the work, recording facts, symbols, flow process charts, multiple activity charts, string diagrams.

**Work measurement** – Time and motion studies, Concept of standard time and various allowances, time study, equipment performance rating. Activity sampling, time-lapse , photography technique, Analytical production studies

#### **Unit -5**

**Safety Engineering:** Causes of Accidents on various sites, safety measures and safety policies to be adopted, determination of safety parameters, personal protective equipment. Workmen Compensation Act, Minimum wages act.

**Safety Organization** –Safety Policy, Safety Record Keeping, Safety Culture, Safety and First Line Supervisors, Middle Managers, Top Management Practices, Sub contractual obligation, Project Coordination and Safety Procedure

**Administration of Incentive Schemes:** Necessity, Merit rating, job evaluation, installation, modification and maintaining of incentive schemes based on implementation experience.

#### **Text Books**

1. Construction Project planning & Scheduling By Charles Patrick, Pearson, 2012
2. Chitkara, K.K., Construction Project Management, Tata McGraw Hill Publishing Co, Ltd., New Delhi, 1998.
3. Punmia, B.C., Project Planning and Control with PERT and CPM, Laxmi Publications, new delhi, 1987.

#### **Reference books**

1. Construction Planning & management By P S Gahlot & B M Dhir , New Age International Limited Publishers
2. Construction Project planning & Scheduling By Charles Patrick, Pearson, 2012
3. Construction Project Management Theory & practice --- Kumar Neeraj Jha, Pearson, 2012
4. Construction management Fundamentals by Knutson, Schexnayder, Fiori, Mayo, Tata McGraw Hill, 2nd Edition, 2011

**III Year-I Semester**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>3</b>	<b>1.5</b>

**GEOTECHNICAL ENGINEERING LAB****COURSE OBJECTIVES:**

Students will have

- To know how to find Atterberg's Limits, Field Density, Relative density of sand.
- To know how to do Grain size analysis, compaction test, CBR Test.
- To know how to do Unconfined Compression test, Triaxial Compression test.
- To know how to do Direct Shear test, Vane Shear test etc.,
- To know how to determine Consolidation of soil.

**COURSE OUTCOMES:**

Get ability to

1. Evaluate Atterberg's limits and Differential free swell for clayey soils.
2. Examine relative density, dry density & moisture contents in the field and laboratory by core cutter, sand replacement and compaction tests.
3. Determine permeability of soils
4. Analyze coarse and fine grain sizes in laboratory.
5. Determine shear strength and shear strength parameters by vane shear, tri-axial, direct shear & unconfined compression tests in laboratory.
6. Measure CBR value and consolidation settlement & swell pressure in laboratory.

**LIST OF EXPERIMENTS**

1. Atterberg's Limits.
2. Field Density-Core cutter and Sand replacement methods
3. Relative Density of Sand
4. Grain size analysis - Sieve Analysis and Hydrometer analysis
5. Permeability of soil - Constant and Variable head tests
6. Compaction test
7. Consolidation Test
8. CBR test
9. Unconfined Compression test
10. Direct Shear test.
11. Vane Shear test.
12. Differential free swell (DFS)

**III Year-I Semester**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>3</b>	<b>1.5</b>

**FLUID MECHANICS & HYDRAULIC MACHINES LAB****COURSE OBJECTIVES:**

Students will have

- to study how to calibrate of venturimeter& orifice meter.
- to study how to determine of coefficient of discharge for a small orifice and external mouth piece by a constant head method.
- to study how to calibrate of Trapezoidal Notch and /or Triangular Notch.
- to study how to determine Coefficient of loss of head in a sudden contraction and friction factor and impact of jet on vanes.
- To study how to determine efficiency of Pelton wheel turbine, centrifugal pump and reciprocating pump.

**COURSE OUTCOMES:**

After completion of this course students will be able to

1. Evaluate Coefficient of discharge of Venturimeter and Orifice meter.
2. Examine Coefficient of discharge for a small orifice and external mouth piece by a constant head method.
3. Compute Coefficient of discharge of Trapezoidal Notch and /or Triangular Notch.
4. Determine loss of head in a sudden contraction and friction factor and force exerted by jet on vanes.
5. Measure efficiency of Pelton wheel turbine
6. Calculate efficiency of centrifugal pump and reciprocating pump.

**LIST OF EXPERIMENTS**

1. Calibration of Venturimeter
2. Calibration of Orifice meter.
3. Determination of Coefficient of discharge for a small orifice by a constant head method.
4. Determination of Coefficient of discharge for an external mouth piece by constant head method.
5. Calibration of contracted Trapezoidal Notch and /or Triangular Notch.
6. Determination of Coefficient of loss of head in a sudden contraction and friction factor.
7. Impact of jet on vanes.
8. Performance test on Pelton wheel turbine
9. Efficiency test on centrifugal pump.
10. Efficiency test on reciprocating pump.

**III Year-I Semester**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>1</b>	<b>2</b>	<b>2</b>

**ESTIMATION, SPECIFICATIONS & CONTRACTS****COURSE OBJECTIVES:**

1. To identify standard specifications for detailed estimation of building.
2. To estimate earthwork excavation for roads and canals.
3. To determine the rates of various aspects of buildings.
4. To compute the cost of the various items of civil works.
5. To recognize preparation of the tenders and Valuation of buildings.

**COURSE OUTCOMES:**

**After the completion of the course, students will be able to**

1. Prepare detailed and abstract estimate of buildings.
2. Compute earthwork excavation for roads and canals.
3. Estimate the cost of the various items of civil works.
4. Estimate reinforcement for bar bending and prepare bar bending schedules.
5. Understand the basics of BIM
6. Prepare tenders and Valuation of buildings.

**UNIT – I**

**General items of work in Building:** Standard Units, Principles of working out quantities for detailed and abstract estimates - Detailed Estimates of Buildings.

**UNIT – II**

**Earthwork for roads and canals:** Lead and Lift – Types of methods – Mid Sectional area method – Mean sectional area method – Simpson’s rule method

**UNIT – III**

**Rate Analysis:** Standard specifications for different items of building construction. Working out data for Brick Masonry, R.R. Masonry, Plastering, Plain Concrete, R.C.C., and Distempering.

**UNIT-IV**

**Reinforcement bar bending schedule:** Footing, Pedestal, column, plinth beam, slab beam and slab and bar requirement schedules.

**UNIT – V**

**Contracts** – types of contracts- tenders – Tender Schedule–.BIM-Basics of BIM – Advantages and Dis advantages of BIM – Objects of BIM

**Valuation** - Valuation of buildings – Depreciation –Types of Depreciation of industrial building, commercial Buildings-Private Buildings.

**TEXT BOOKS**

1. B.N. Dutta (2016), Estimating and Costing, 28th Revised Edition, UBS publishers
2. G.S. Birdie (2014) Estimating and Costing, Sixth edition, Dhanpat Rai Publishing Company Private

Limited

3. Bimal Kumar (2016), A Practical Guide to Adopting BIM in Construction Projects, Whittles Publishing

**REFERENCES:**

1. Standard Schedule of rates and standard data book by public works department.
2. I. S. 1200 (Parts I to XXV – 1974/ method of measurement of building and Civil Engineering works.
3. M. Chakraborti (2010), Estimation, Costing and Specifications, 24<sup>th</sup> Edition, M.K. Publishers
4. National Building Code, 2016

**REFERENCE CODE BOOKS:**

1. ISO 19650-1:2018
2. ISO 19650-2:2

**III Year-I Semester**

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**TINKERING LAB****Course Objectives:**

- To develop a mindset for innovation, creativity, and problem-solving through hands-on activities.
- To introduce students to basic tools, components, and systems used in prototyping (electronics, mechanical, software).
- To encourage interdisciplinary thinking and collaborative project development.
- To provide exposure to modern tools such as Arduino, Raspberry Pi, sensors, 3D printing, and simple mechanical assemblies.
- To build confidence in experimenting with ideas and transforming them into working prototypes.

**List of Experiments**

1. Familiarization with lab tools – Breadboard, multimeter, soldering station, power supply.
2. Basic electronic circuits – Series, parallel circuits, use of resistors, capacitors, LEDs.
3. Introduction to Arduino – Writing and uploading simple sketches.
4. Sensor interfacing – Temperature, light, motion, ultrasonic sensors.
5. Actuator control – Servo motor, DC motor, relay modules.
6. Serial communication – Between Arduino and PC.
7. Simple IOT application – Sending data to cloud (e.g., using ThingSpeak or Blynk).
8. Mobile App Integration – Basic app to control devices using Bluetooth.
9. Mechanical prototyping – Introduction to 3D printing and simple CAD modeling.

**Textbooks**

1. "Getting Started with Arduino" – Massimo Banzi and Michael Shiloh.
2. "Make: Electronics – Learning Through Discovery" – Charles Platt.
3. "Exploring Arduino" – Jeremy Blum.

**Reference Books:**

1. "Practical Electronics for Inventors" – Paul Scherz and Simon Monk.
1. "Arduino Cookbook" – Michael Margolis and Brian Jepson.
2. "Make: Sensors" – Tero Karvinen, Kimmo Karvinen, and Ville Valtokari.
3. "Python Programming for Raspberry Pi" – Tim Cox (if Raspberry Pi is included).

E resources: Arduino ([www.arduino.cc](http://www.arduino.cc)), Raspberry Pi ([www.raspberrypi.org](http://www.raspberrypi.org)), Instructables ([www.instructables.com](http://www.instructables.com)), and Tinkercad.

**Course Outcomes**

**At the end of the course, students will be able to:**

- Identify and use basic electronic components and prototyping tools.
- Design and implement simple circuits and embedded systems using microcontrollers.
- Use sensors and actuators to create interactive systems.
- Apply mechanical fabrication techniques using 3D printers and simple mechanical tools.
- Collaborate effectively to build innovative, interdisciplinary prototypes or mini-projects.

- Present and communicate their design ideas and implementation clearly.

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## DESIGN OF STEEL STRUCTURES

### COURSE OBJECTIVES:

The objective of the course is to

- Understand the basics concepts of bolted connections and designs welded connections
- Design supported, unsupported and plated simply supported beams
- Explain designing tension members as per IS codes
- Explain designing of compression members as per IS code provisions
- Explain designing of welded plate girder

### COURSE OUTCOMES:

Students will get ability to

1. Design IS code bolted connections and designs welded connections.
2. Design beams including detailing.
3. Design tension members including detailing.
4. Design compression members including detailing.
5. Design plate girder including detailing.

#### UNIT – I

**Basics of bolted/riveted connections:** Bolted/riveted connections, Types of bolts, Types of bolted joints, Failure of bolted joints, Specifications of bolted joints, Design of bolted connections.

**Welded connections:** Introduction, Advantages and disadvantages of welding- Strength of welds-Butt and fillet welds. IS Code requirements? Design strength of fillet welds subjected to moment acting in the plane and at right angles to the plane of the joints.

#### UNIT – II

**Beams:** Allowable stresses, design requirements as per IS Code-design of laterally supported and unsupported beams. Design of plated beams.

#### UNIT –III

**Tension members:** Introduction, Types of tension members, Net sectional Area, Effective net area, Types of failures, Design of tension members.

#### UNIT – IV

**Design of Compression members:** Introduction, Effective length of columns, Slenderness ratio, Design of compression members, Built-up sections- Design of lacings and battens. Design Principles of Eccentrically loaded columns and splicing of columns.

#### UNIT – V

**Plate Girder:** Introduction, Elements of plate girder, Design consideration – I S Code recommendations, Design of plate welded plate girder- post-critical method, stiffeners.

**NOTE-** All Designs should be in LIMIT STATE Method

#### Text Books:

1. Limit state design of steel structures by S.K. Duggal, Tata Mcgraw Hill, New Delhi, 2<sup>nd</sup> edition, 2017.
2. Design of Steel Structures by Ramachandra. Vol – 1, Scientific Publishers, 2016.
3. Design of Steel structures by Limit state method as per IS-800:2007, S.S.Bhavakatti, I K International Publishing House Pvt. Ltd, 4<sup>th</sup> edition, 2014.
4. Steel Structures and Design and practices by N.Subramanya, Oxford publications, 2010.
5. Structural Design and Drawing by N.Krishna Raju; University Press, 2009.

**Reference Books:**

1. Comprehensive Design of Steel structures, by B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, Laxmi Publications, New Delhi, 2<sup>nd</sup> edition, 2015.
2. Structural design in steel by SarwarAlamRaz, New Age International Publishers, New Delhi, 2018.
3. Design of Steel Structures by Arya and Azmani, Nem Chand Publisher, 2011.

**IS Codes:**

- 1) IS-800 – 2007, 2) IS – 875 – Part I, II & III, and 3) Steel Tables.

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## TRANSPORTATION ENGINEERING

### COURSE OBJECTIVES:

#### The objective of the course is to

- Explain about highway development and planning in India, highway alignment and engineering surveys.
- Explain about various elements of highway geometric design.
- Explain about highway materials such as soil, aggregates, bitumen and bituminous mix design.
- Explain about construction of different types of roads and highway maintenance.
- Explain about basic traffic engineering characteristics such as volume, speed, density, accidents and about Intersections. Explain about Highway Capacity.

### COURSE OUTCOMES:

#### On completion of the course, the students able to:

1. Understand the importance of highway development and different road classifications.
2. Evaluate the Geometric design elements of the highway.
3. Identify and gain knowledge about highway materials used in highway construction.
4. Understanding the mechanism of different types of roads and their construction.
5. Apply basic parameters of traffic, parking studies, road accident analysis and identifying grade and grade separated intersections. Analyse about Highway Capacity.

### UNIT I

**Highway development and planning:** Invention of wheel - Different modes of transportation, role of highway transportation in India, Necessity for Highway Planning - Different Road Development Plans - Classification of Roads, Road Network Patterns.

**Highway Alignment:** Alignment - Factors controlling Alignment, Engineering Surveys for Highways - Drawings and Reports.

### UNIT II

**Geometric design:** Importance of Geometric Design, Highway Cross Section Elements – Pavement Surface Characteristics, Sight Distance - Stopping Sight Distance, Overtaking Sight Distance and Intermediate Sight Distance.

**Design of Horizontal Alignment** - Design of Super elevation and Extra widening, Design of Transition Curves, Design of Vertical Alignment, Grade Compensation.

### UNIT III

**Highway materials:** Soil, Aggregate, Bitumen and Tar, Tests on aggregates –Aggregate Properties and their Importance, Tar properties - Differentiation between Tar and Bitumen, Bitumen - different forms of bitumen - tests on bitumen - Bituminous Concrete, requirements of Design Mix - Marshalls Method of Bituminous Mix design, Modified Hubbard Field method of mix design.

### UNIT IV

**Highway Construction:** Construction of Roads -Earthen roads, W.B.M. Roads, Bituminous Roads - distresses; Cement Concrete roads -Tie bars and Dowel bars, distresses. Highway Maintenance, Highway drainage –Arborical culture –Street lighting.

### UNIT V

**Traffic engineering:** Elements of Traffic Engineering - Vehicle & Road User Characteristics, Accessibility & Mobility concept, Traffic Volume studies & methods, Speed Studies – Time Mean Speed, Space Mean Speed, Travel time and Delay studies, Origin - Destination studies,

**Highway capacity:** Highway capacity and level of service (LOS) - capacity of urban and rural roads, PCU

concept and its limitations.

**TEXTBOOKS:**

- 1.S.K.Khanna, C.E.G.Justo& A. Veeraragavan “Highway Engineering”, Nemchand& Bros., 10th Edition, 2017.
2. Dr. L.R.Kadiyali and Lal “ Traffic Engineering & Transport Planning” Khanna Publications, 7th Edition, 2012.
3. V.N.Vazirani and S.P.Chandra, “Transportation Engineering- Vol. I”, Khanna Publications, 4th Edition, 1994.

**REFERENCES:**

1. S.P.Bindra, “Highway Engineering” Dhanpat Rai & Sons. – 4th Edition (1981)
2. ITE Hand Book, Highway Engineering Hand Book, Mc Graw - Hill
3. Indian Road Congress, Ministry of Road Transport and Highways, and Special Publications

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## ENVIRONMENTAL ENGINEERING

### Course Objectives:

This course enables the students:

1. To describe the importance of water quality and quantity and interpret the design of water supply systems.
2. To apply the appropriate technologies for water treatment.
3. To interpret the concepts of water supply systems designing and management.
4. To explain the impacts of sewage and select conveyance systems for sewage and storm water.
5. To identify and apply suitable process for the sewage treatment and sludge management.

### Course Outcomes:

After completion of this course, students will be able to:

1. Examine and explain various sources of water, water quality and quantity estimation.
2. Analyze the appropriate water treatment technology.
3. Interpret the concepts of water supply systems designing and management.
4. Understand and determine the fundamentals of wastewater generation, conveyance system, wastewater quality and different discharge standards.
5. Explain and illustrate various methods of wastewater and sewage sludge treatment.

### Unit-I:

**Introduction:** Sources of Water - Comparison from quality and quantity – intakes, infiltration galleries. Waterborne diseases - protected water supply - population forecasting methods, design period - types of water demand - factors affecting – fluctuations - fire demand - storage capacity, drinking water quality standards: IS 10500.

### Unit-II:

**Water Treatment Process, Filtration and Disinfection:** Layout and general outline of water treatment units – Aeration, sedimentation – principles – design factors – coagulation - jar test, flocculation, clarifier design – coagulants – feeding arrangements. Filtration – theory – working of slow and rapid gravity filters – multimedia filters – design of filters – troubles in operation – disinfection – theory of chlorination, chlorine demand – other disinfection practices.

### Unit-III:

**Water Supply Systems:** Requirements - methods and layouts - Design of distribution systems - Hardy Cross and equivalent pipe methods - Service reservoirs - Capacity by Mass Curve Method. Joints, sluice valves, air valves. Scour valves and check valves, water meters.

### Unit-IV:

**Conservancy and Water Carriage Systems:** Sewage and storm water estimation - characteristics of sewage – decomposition of sewage, examination of sewage – B.O.D. Equation. C.O.D. Design of sewers – shapes and materials – sewer appurtenances, manholes – inverted siphon – catch basins – flushing tanks – ejectors, pumps and pump houses.

### Unit-V:

**Layout and General Outline of Waste Water Treatment Plants and Disposal of Sewage:** Waste water treatment plant – Flow diagram – primary treatment - design of screens – grit chambers – skimming tanks – sedimentation tanks – biological treatment – trickling filters – Activated sludge processes (ASP). Sludge digestion – factors effecting – design of Digestion tank – Sludge disposal by drying - septic tanks working principles and design – soak pits.

**Text Books:**

1. Water Supply Engineering: Environmental Engineering - Vol. I, by S.K. Garg, Khanna Publishers, New Delhi
2. Sewage Disposal and Air Pollution Engineering: Environmental Engineering - Vol. II, S.K. Garg, Khanna Publishers, New Delhi
3. Elements of environmental engineering by K.N. Duggal, S. Chand Publishers, 1996
4. Water supply and sanitary Engineering by G.S. Birdi, Birdie J. S Dhanpat Rai & Sons Publishers, 2010.
5. Water Supply Engineering, Vol. 1, B.C.Punmia, Ashok Kr. Jain, Arun Kumar Jain, Laxmi Publications Pvt.Ltd New Delhi, 2 edition, 1994
6. Environmental Engineering, Peavy, H., Rowe, D.R, Tchobanoglous, G. Mc-Graw - Hill International

**Reference Books:**

1. Manual on Sewerage and Sewage Treatment Systems, Part A, B and C. Central Public Health and Environmental Engineering Organization, Ministry of Urban Development.
2. Encyclopedia of Environmental Science and Engineering, McGraw-Hill, Inc.3rd edition-1993.
3. Water Supply Engineering: S. K. Garg, Khanna Publishers, New Delhi.
4. Water supply: Don D. Ratnayaka Malcolm, J. Brandt, Michael Johnson, 6th edition, 2009
5. Manual on Water Supply and Treatment. Ministry of Urban Development, New Delhi
6. Metcalfe and Eddy. Wastewater Engineering, Treatment, Disposal and Reuse, Tata McGraw-Hill, New Delhi.
7. Water and Wastewater Engineering – designs, principle and practice, Mackenzie L. Davis. McGraw-Hill Education

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## EARTHQUAKE RESISTANT DESIGN OF STRUCTURES (Professional Elective– II)

### Course Outcomes:

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

- Discuss the equations of motion for undamped free vibrations for SDOF and 2DOF systems
- Explain the engineering seismology including causes and effects of earthquakes
- Analyse a multi-storeyed structure using Equivalent Static Method and Response Spectrum methods
- Assess various irregularities in buildings
- Apply the provisions of IS:13920 and IS:4326 to building structures

### UNIT-I

#### STRUCTURAL DYNAMICS:

Introduction–Physical and Mathematical Modelling–Discrete and continuum Modelling. Laws of Equilibrium–Newton’s Law of Motion–D’Alembert’s Principle and Principle of virtual displacement.- Types of Dynamic Loading.

Single Degree of Freedom System (SDOF)–Undamped Free Vibrations–Damped Free Vibrations (concept only).

Two Degree of Freedom System (2DOF)–Undamped Free Vibrations–Determination of Natural frequencies and Mode shapes.

### UNIT-II

#### ENGINEERING SEISMOLOGY:

Introduction- Internal structure of earth – Chemical properties – Physical properties – Continental drift theory–Plate tectonics–Movement of plate boundaries–Movement of Indian plate – Faults – Types of faults – Elastic Rebound theory.

Earthquakes – Earthquake terminology – Classification of Earthquakes – Causes and effects of Earthquakes –Earthquake waves – Quantification of Earthquakes – Intensity and Magnitude – Recording Earthquakes.

### UNIT-III

#### EARTHQUAKE RESISTANT DESIGN:

Reviews of latest I.S : 1893 (Part 1) provisions for buildings - General principles and design criteria – Assumptions – Design Acceleration spectrum – Horizontal seismic coefficient –Design acceleration – Seismic zones of India – Importance factor – Response reduction factor – Design lateral force – Design imposed loads for Earthquake force calculation –Seismic weight – Analysis by Equivalent Static Method and Dynamic Method (Response Spectrum Method) – Storey drift limitation.

### UNIT-IV

#### BUILDING CONFIGURATIONS:

Introduction–Regular and Irregular Buildings.

Plan Irregularities–Torsion Irregularity–Re-entrant corners-Floor slabs having excessive cut-outs or openings- Out of plane offsets in Vertical Elements – Non-parallel Lateral Force system.

Vertical Irregularities – Stiffness Irregularity (soft storey) – Mass Irregularity – Vertical Geometric Irregularity – In-plane discontinuity in Vertical Elements resisting lateral force – strength Irregularity(weak storey) –Floating or stub columns–Irregular Modes of Oscillation in two Principle Plan Directions.

## **UNIT-V**

### **DUCTILE DESIGN AND DETAILING:**

Review of Latest IS:13920 provisions

General specifications – Beams – Columns – Shear walls. Special confining reinforcement.

Review of Latest IS:4326 provisions- General principles–Special Construction features relating to separations of structures (above ground only).

### **TEXTBOOKS:**

1. A.K. Jain “Dynamics of Structures with Mat Lab Applications” Pearson India Education Series Pvt.Ltd., Delhi, 2016
2. Pankaj Agarwal & Manish Shrikhande, “Earthquake Resistant Design of Structures”, 5<sup>th</sup> Edition Prentice Hall of India, New Delhi, 2011.
3. S.K.Duggal, “Earthquake Resistant Design of Structures”, Oxford University Press, 1<sup>st</sup> Edition, 2012.

### **REFERENCES:**

1. Chopra A.K., “Dynamics of Structures”, 5<sup>th</sup> Edition, Pearson Education, Indian Branch, Delhi, 2007.
2. Mario Paz, “Structural Dynamics - Theory and Computations”, 6<sup>th</sup> Edition, Pearson Education, 2005.
3. IS 456: 2000 Indian Standard Plain and Reinforced Concrete – Code of Practice, Bureau of Indian Standard, New Delhi. (or latest).
- 4, IS 1893 (Part 1): 2016, Indian Standard “Criteria for Earthquake Resistant Design of Structures, Part 1, General provisions and Buildings (six revision) Bureau of Indian Standard, New Delhi. (or latest).
5. IS 13920: 2016 Indian Standard “Ductile Design and Detailing of Reinforced Concrete Structures, subjected to Seismic forces - Code of Practice, Bureau of Indian Standard, New Delhi. (or latest).
6. IS 4326: 2013 Indian Standard “Earthquake Resistant Design and Construction of Buildings - Code of Practice, Bureau of Indian Standard, New Delhi. (or latest).

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**GEOTECHNICAL ENGINEERING-2**  
**(Professional Elective– II)**

**Course Objective:**

- To provide a coherent development to the students for the courses in sector of Geotechnical Engineering & Soil Improvement Techniques etc.
- To present the foundations of many basic Engineering tools and concepts related Geotechnical Engineering.
- To give an experience in the implementation of Engineering concepts which are applied in field of Geotechnical Engineering
- To involve the application of scientific and technical principles of planning, analysis, design of foundation along with soil improvement techniques.

**UNIT-I**

**Stability of slopes:**

Infinite and finite slopes, factor of safety, type of slope failure, stability of infinite slopes, finite slopes forms of slip surfaces, limit equilibrium method and critical stage instability analysis, effects of tension crack and submergence, C-analysis-method of slices, Taylor's stability no., use of Bishop's method.

**UNIT-II**

**Earth Pressure:**

Types of lateral earth pressure, Rankine's and Coulomb's earth pressure, theory and their application for determination of lateral earth pressure under different conditions, Rebhann's and Culmann's Graphical methods of determination of lateral earth pressures.

**Basics of foundation:**

Types of foundation, Factors affecting the selection of type of foundations, steps in choosing types of foundation.

**UNIT-III**

**Subsurface Investigation:**

Objectives of exploration, planning of exploration program, soil samples and soil samplers, field penetration tests : SPT, SCPT, DCPT. Introduction to geophysical methods, Bore log and report writing.

**UNIT-IV**

**Bearing Capacity of Shallow Foundation:**

Introduction, significant depth, design criteria, modes of shear failures. Detail study of bearing capacity theories (Prandtl, Rankine, Terzaghi, Skempton), bearing capacity determination using IS Code, Presumptive bearing capacity. Settlement, components of settlement & its estimation, permissible settlement, allowable bearing pressure. Bearing capacity by use of penetration test data and by plate load test. Bearing capacity of raft. Factors affecting bearing capacity including Water-Table. Contact pressure under rigid and flexible footings. Floating foundation. Types of pavements & its design.

## **UNIT-V**

### **Pile Foundations :**

Introduction, load transfer mechanism, types of piles according to their composition, their method of installation and their load carrying characteristics, piles subjected to vertical loads- pile load carrying capacity from static formula, dynamic formulae (ENR and Hiley), penetration test data & Pile load test. Pile group: carrying capacity, efficiency and settlement. Negative skin friction. Under reamed pile foundation-its concept, design& field installation.

### **Text Books:**

1. P.PurushothamaRaj;SoilMechanicsandFoundationEngineering;PearsonEducation.
2. Alamsingh; Soil Mechanics & Foundation Engineering; CBS Publishers & Distributors, Delhi
3. Taylor D. W.; Fundamentals of Soil Mechanics; Asia Publishing House, Mumbai
4. V.N.S. Murthy; Soil Mechanics & Foundation Engineering; CRS Press, Taylor & Francis Group, New York
5. GopalRanjan, Rao A.S.R.; Basic and applied soil mechanics; New age int.(p)ltd.
6. Das Braja M; Principles of Geotechnical Engineering; Thomson Asia Pvt. Ltd.

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**TRANSPORTATION SAFETY AND ENVIRONMENT  
(Professional Elective– II)**

**UNIT-I**

Trends in roads and highways development. Problem of road accidents in India. Characteristics of road accidents. Causes of accidents. Global and Indian road safety scenario. Factors responsible for success stories in road safety. Role of highway professionals in highway safety.

**UNIT-II**

Planning of roads for safety. Land use planning and zoning. Development control and encroachment. Network hierarchy. Route planning through communities. Access control. Traffic segregation. Traffic calming designing for safety: road link design, alignment design. Cross-sectional elements. Traffic control devices. Road side safety. Road side facilities. Some critical elements. Junction design Basic principles. Selection of junction type. Factors affecting safety at various junction types. Elements to improve road safety. Provisions for vulnerable road users.

**UNIT-III**

Road safety audit. Concepts of road safety audit, Road safety auditors & key personnel in RSA. Organizing and conducting a road safety audit. Example and commonly identified. Issues during RSA, Road safety audit report. Development of cost-effective of road safety audit accident investigation and prevention. Basic strategies for accident reduction. Significance of accident data. Accident investigation and identification of potential sites for treatment. Problem diagnosis. Selection of countermeasures. Example of selection of counter measures. Detailed design and implementation of countermeasures.

**UNIT-IV**

Monitoring and evaluation non-engineering measures for road safety, behavioral counter measures, education. Training and publicity. The goal of police traffic control activities. Strategy for road safety management by police. Role of NGOs in road safety. Legal framework for road safety transport related pollution, noise pollution, air pollution, effects of weather conditions, vehicular emission parameters, pollution standards.

**UNIT-V**

EIA requirements of highway projects, world bank guidelines, EIA practices in India. Fuel crisis and transportation, factors affecting fuel consumption, fuel economy in various modes of transportation, various types of alternative fuels.

**Recommended Books:**

- (i) Traffic Engg. And Transport Planning by L.R. Kadiyali, Khanna Publishers, Delhi.
- (ii) Highway Engg. By S.K. Khanna & C.E.G. Justo, New Chand Bros., Roorkee.

**III Year-II Semester**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**BRIDGE ENGINEERING  
(Professional Elective– III)**

**Course Outcomes:**

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

- Discuss the IRC standard live loads and design the deck slab bridge.
- Analyse and box pipe culverts for the given loading and detail the box culverts.
- Design and detail the T-Beam bridges.
- Design and check the stability of piers and abutments.
- Discuss about the construction techniques of precast members.

**UNIT-I****GENERAL CONSIDERATIONS FOR ROAD BRIDGES:**

Introduction – Site selection – Soil exploration for site – Selection of bridge type – Economical span – Number of spans – Determination of HFL – General arrangement drawing.

**STANDARDS SPECIFICATIONS FOR ROAD BRIDGES:**

Width of carriageway- Clearances- Loads to be considered- Dead load– I.R.C. standard live loads- Impact effect- Review of I.R.C. loadings- Application of live loads on deck slabs – Wind load– Longitudinal forces- Centrifugal forces- Horizontal forces due to water currents.

**UNIT-II****CULVERTS:**

Introduction, Analysis and design of box culverts- slab culverts – pipe culverts- Reinforcement detailing and bar bending schedule need to be prepared.

**UNIT-III****REINFORCED CONCRETE T-BEAM BRIDGES:**

Introduction– Analysis and Design of T – Beam Girder bridges- Reinforcement detailing and bar bending schedule need to be prepared.

**UNIT-IV****DESIGN OF SUBSTRUCTURE:**

Analysis and Design of Abutments and pier- Reinforcement detailing to be prepared.

## **UNIT-V**

### **BRIDGEBEARINGS:**

Bearings, forces on bearings, types of bearings design of elastomeric bearings, basics for selection of bearings. Construction techniques for Via-Ducts, Methods of erection - Pre-cast girders, Launching procedures, design of launching girders.

#### **TextBooks:**

1. Johnson victor D, Essentials of Bridge Engineering, 7<sup>th</sup> Edition, Oxford, IBH Publishing Co., Ltd., 2006.
2. Ponnuswamy, Bridge Engineering, 4<sup>th</sup> Edition, McGraw-Hill Publication, 2008.
3. Krishnam Raju N., Design of Bridges, 4<sup>th</sup> Edition, Oxford and IBH Publishing Co., Ltd., 2008.

#### **References:**

1. Vazirani, Ratvani & Aswani, Design of Concrete Bridges, 5<sup>th</sup> Edition, Khanna Publishers, 2006.
2. Jagadish T.R. & M.A. Jayaram, Design of Bridge Structures, 2<sup>nd</sup> Edition, 2009.
3. Swami Saran, Analysis and Design of sub-structures, 2<sup>nd</sup> Edition, Oxford IBH Publishing co Ltd., 2006.

**III Year-II Semester**

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3	0	0	3

**HYDRAULIC AND IRRIGATION STRUCTURES**  
**(Professional Elective– III)**

**Course Objectives:**

- To Study Modes Of Failure, Stability Analysis And Design Of Gravity Dam And Earth Dams.
- To Study Various Types Of Spillways And Their Suitability, Energy Dissipation Below Spillways
- To Study Seepage Theories And Their Applications In The Design Of Weirs On Permeable
- Foundations. To Study Functions, Types And Suitable Locations For Canal Falls, Canal Regulators And Cross Drainage Works.
- To Study about Component Parts and Their Functions.

**Course Outcomes:**

At The End Of The Course The Student Will Be Able To:

- Analyze The Stability Analysis And Design Of Gravity Dam And An Earth Dam.
- Suggest A Suitable Spillway At A Dam Site And Understand The Criteria For Design Of Stilling Basin For Energy Dissipation Under Spillway.
- Understand The Functions And Suitable Locations Of Canal Outlets, Canal Falls, and Canal Regulators And Cross Drainage Works And Design Of Weirs.
- Understand The Functions Of Component Parts Of A Hydroelectric Power Scheme.

**SYLLABUS****Unit-I**

Storage Works: Classification of Dams, Factors Governing Selection of Types of Dam, Selection of Site, Preliminary Investigation.

Gravity Dams: Forces acting on a Gravity Dam, Stability Criteria, Modes of Failure – Elementary and Practical Profiles, Stability Analysis, Principal and Shear Stress – Construction Joints, Openings in Dams – Galleries, Foundation Treatment of Gravity Dam.

Earth Dams: Types, Foundation for Earth Dams, Design of Earth Dams, Causes for Failure of Earth Dams, Criteria for Safe Design, Phreatic Line, Seepage Analysis – Seepage Control Through Body and Foundation.

**Unit-II**

Spillways: Essential Requirements, Spillway Capacity, Components, Types of Spillways and Their Working, Design of Ogee Spillway, Energy Dissipation Below Spill Way, Scour Protection, Use of Hydraulic Jump as Energy Dissipater – Design of Stilling Basins – USBR and IS Standard Basins; Spillway Crest Gates – Different Types.

**Unit-III**

Diversion Head Works: Types, Location and Components, Effects of Construction of Weirs on Permeable Foundation, Bligh's, Lanes and Khosla's Theories, Method of Independent Variables,

Design Principles of Weirs and Barrages, Design of Weirs on Permeable Foundations, Design of Vertical Drop Weir, and Silt Control Devices.

#### Unit-IV

Regulation Works: Canal Falls – Definition, Necessity and Location, Classification of Falls, Design Principles of Syphon Well Drop, Notch Fall, Sarada Fall, Straight Glacis Fall; Offtake Alignment; Cross Regulator and Distributary Head Regulator – Design of Cross Regulator and Distributor Head Regulator.

#### Unit-V

River Training Works: River Training and its Objectives, Classification of River Training Works, Marginal Embankment, Guide Banks, Groynes, Cutoffs, Bank Pitching, Launching Aprons, Miscellaneous Types of River Training Works.

Water Power Engineering: Development of Hydro Power in India, Assessment of Available Power, Utilization Factor, Load Factor, Diversity Factor, Storage and Pondage; Types of Hydro Power Schemes; Components of Hydel Schemes – Fore Bay, Intake Structure, Trash Racks, Surge Tanks; Water Hammer Pressure, Substructure and Superstructure of Power House..

#### **Text Books**

1. Irrigation and Water Power Engineering by Punmia, B.C. and P.B.B. Lal, Laxmi Publications Pvt. Ltd.
2. Irrigation Water Resources and Water Power Engineering by Modi, P.N., Standard Book House.
3. Irrigation and Hydraulic Structures by Garg, S.K., Khanna Publishers.

#### **Reference Book**

1. Hand book of Applied Hydrology, Chow, V.T., McGraw-Hill Book Co. of a hydel project.



**III Year-II Semester**

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<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**REPAIR AND RETROFITTING OF STRUCTURES****(Professional Elective– III)****Course Objectives:**

To learn various distress and damages to concrete and masonry structures

- To understand the importance of maintenance of structures
- To study the various types and properties of repair materials
- To assess the damage to structures using various tests
- To learn the importance and methods of substrate preparation
- To learn various repair techniques of damaged structures, corroded structures

**Course Outcomes:**

At the end of the course student will be able to

- Understand the properties of fresh and hardened concrete.
- Know the strategies of maintenance and repair.
- Get an idea of repair techniques.
- Understand the properties of repair materials
- Understand the retrofitting strategies and techniques

**Unit-I**

Materials: Construction chemicals, Mineral admixtures, Composites, Fibre reinforced concrete, High performance concrete, polymer-impregnated concrete.

**Unit-II**

Techniques to test the existing strengths: Destructive and non destructive tests on concrete.

**Unit-III**

Repairs of Multistory structures: Cracks in concrete, possible damages to the structural element-beams, slab, Column, Footings, etc., Repairing techniques like Jacketing, Grouting, External prestressing, Use of chemical admixtures, Repairs to the fire damaged structures.

**Unit-IV**

Foundation problems: Settlement of shallow foundations – repairs, sinking of piles, wells – repairs.

**Unit-V**

Corrosion of Reinforcement: Preventive measures – coatings –use of SBR modified cementitious mortar, Epoxy resin mortar, Acrylic modified cementitious mortar, flowing concrete.

**Reference Books**

1. Deterioration, Maintenance and Repair of Structures” by Johnson, McGraw Hill.
2. Concrete Structures: Repairs, water proofing and protection” by Philip H. Perkins, Applied sciences publications Ltd., London, pp.302.

3. Durability of concrete structure: Investigation, Repair, Protection” Edited by Geoffmang., E. & FN SPON, An imprint of Chapman & Hall, pp.270.
4. Deterioration, maintenance and Repair of structures” by Johnson, McGraw Hill, pp.375

**III Year-II Semester**

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**DISASTER MANAGEMENT  
(Open Elective– II)**

**Course Outcomes:**

- At the end of the course, the student shall be able to:
- Explain about concepts of disaster management and types of disasters
- Explain the Vulnerability profile of India & legal framework in India
- Discuss about early warning systems for disaster risk reductions
- Describe the policy and programmers for disaster risk reductions in India
- Demonstrate rescue and relief operation in India during disaster

**UNIT–I****INTRODUCTION TO DISASTER MANAGEMENT:**

Definitions and concepts of Hazard, Vulnerability, Risk, Resilience, Concept of Disaster Management Cycle – Response, Recovery, Mitigation and Preparedness, Introduction to Various Hazards both Natural and Man-Made Hazards – Earthquakes, Cyclones, Droughts, Floods, Volcanoes, Coastal Hazards, Landslides, Forest Fires, Industrial Accidents, Biological Disasters, etc., Climate Change, Global Warming.

**UNIT–II****DISASTER MANAGEMENT IN INDIA:**

Hazard and vulnerability profile of India, Disaster Management Act 2005, National Disaster Mitigation and Management Guideline on -National Policy on Disaster Management 2009, NDMA guidelines on Cyclones specifically, besides earthquakes, floods, urban floods, information systems, communication systems etc., Introduction to State Disaster Management Authorities.

**Disaster Management in the World Scenario:** Role of UNDRR, Role of UNISDR

**UNIT–III****HAZARD ANALYSIS:**

Estimation of potential causes, characteristics and impact of Hazards. Geological Processes leading to natural hazards, Multi- Hazard Assessment, Short term and Long Term Prediction, Early warning system for different hazards, Risk Analysis for Individuals, communities etc. Role of Remote Sensing & GIS in Disaster Management and its applications, Case Studies.

**UNIT–IV****(10 Lectures)****DISASTER RISK REDUCTION (DRR):**

Assessing Vulnerabilities, Risk Assessment, Preparation of Exposure and Risk Database, Prevention and mitigation strategies for DRR, Framework of Disaster Risk Reduction.

Capacity Building Measures, Community Participation, Contemporary studies and work towards disaster risk reduction, Disaster Risk Reduction Plan.

**UNIT-V**

**(10 Lectures)**

**RESPONSE AND RECOVERY OPERATIONS:**

Role of NDRF, Training of personnel, equipment necessary, public awareness creation, Mass Casualty Management, agencies involved in mass casualty management, Qualification and Duties of professionals, Response policy, Case Studies.

**TEXT BOOKS:**

1. H.K.Guptha,—Disaster management, 2<sup>nd</sup> Edition, University Press, 2001.
2. R.B.Singh (Ed),—Disaster Management, Rawat Publication, New Delhi, 2000.

**REFERENCES:**

1. S.Seetharaman,—Construction Engineering and Management, 4<sup>th</sup> Edition, Umesh publications, New Delhi, 1999
2. Gupta, M.C.,—Manual on Natural Disaster management in India, National Centre for Disaster Management, IIPA, New Delhi, 2002.
3. Disaster Management Guidelines. GOI-UNDP Disaster Risk Reduction Programme (2009-2012).

**III Year-II Semester**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**WATERSHED MANAGEMENT  
(Open Elective– II)**

**Course Objectives:**

- To give an overview of watershed management and principles of WSM.
- To impart knowledge on water resources and conjunction use of ground water and Surface water to meet water demand. To impart knowledge on river basin watershed management and ground water management.
- To expose students about social aspects of WSM such as public aspects participation and integrated development.
- To emphasis on conservation of water through recycle and reuse of waste water, water harvesting.
- To explain the interference of integrated watershed management for sustainable development.
- To expose students to applications of RS and GIS for watershed management.

**Course Outcomes:**

At the end of the course the student will be able to:

- Plan for sustainable development by proper use of all available water resources of a watershed for optimum production with minimum hazards to natural resources.
- Determine the various solutions to meet the water demand.
- Implement damage mitigation measures to control soil erosion.
- Adopt appropriate techniques or methods for water harvesting.
- Knowledge on determining effective watershed modeling.

**SYLLABUS****Unit-I**

Principles of Watershed Management: Basics concepts, Hydrology and water availability, Surface water, Groundwater, Conjunctive use, Human influences in the water resources system, Water demand, Integrated water resources system River basins Watershed Management Practices in Arid and Semi-arid Regions, Watershed management through wells, Management of water supply - Case studies, short term and long term strategic planning

**Unit-II**

Conservation of Water: Perspective on recycle and reuse, Waste water reclamation 25 Social Aspects of Watershed Management: Community participation, Private sector participation, Institutional issues, Socio-economy, Integrated development, Water legislation and implementations, Case studies

**Unit-III**

Sustainable Watershed Approach: Sustainable integrated watershed management, natural resources management, agricultural practices, integrated farming, Soil erosion and conservation

**Unit-IV**

Water Harvesting: Rainwater management - conservation, storage and effective utilization of rainwater, Structures for rainwater harvesting, roof catchment system, check dams, aquifer storage

#### Unit-V

Applications of Geographical Information System and Remote Sensing in Watershed Management, Role of Decision Support System in Watershed Management.

#### Text Books:

1. Murthy, J.V.S., Watershed Management in India, Wiley Eastern, New Delhi, 1994.
2. Murty, J.V.S., Watershed Management, New Age Intl., New Delhi 1998.

#### Reference Books:

3. Allam, G.I.Y., Decision Support System for Integrated Watershed Management, Colorado State University, 1994.
4. Vir Singh, R., Watershed Planning and Management, Yash Publishing House, Bikaner, 2000.
5. American Society of Civil Engineers, Watershed Management, American Soc. of Civil Engineers, New York, 1975.

**III Year-II Semester**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>3</b>	<b>1.5</b>

**ENVIRONMENTAL ENGINEERING LAB****COURSE OBJECTIVES:**

Students will have:

1. To perform sampling procedure, determine pH, Conductivity of given water sample in the laboratory
2. To determine and estimate Hardness, Alkalinity, Acidity of given water sample in the laboratory
3. To determine and estimate Dissolved Oxygen, Turbidity, Total Solids, Total Dissolved Solids, Total Suspended Solids etc., of given water sample in the laboratory
4. To determine and estimate Iron, Nitrogen, Total Phosphorous, B.O.D, C.O.D of given waste water sample in the laboratory
5. To determine Optimum Coagulant Dose, Chlorides, Chlorine Demand, Coli form of given drinking water sample in the laboratory
6. To determine Percent of Available Chlorine in Bleaching, Residual Chlorine of given drinking water sample in the laboratory

**COURSE OUTCOMES:**

Upon successful completion of this course, students will get ability to:

1. Demonstrate sampling procedure and determine pH, Conductivity of given water sample in the laboratory
2. Estimate Hardness, Alkalinity, Acidity of given water sample in the laboratory
3. Estimate Dissolved Oxygen, Turbidity, Total Solids, Total Dissolved Solids, Total Suspended Solids etc., of given water sample in the laboratory
4. Estimate Iron, Nitrogen, Total Phosphorous, B.O.D, C.O.D of given waste water sample in the laboratory
5. Determine Optimum Coagulant Dose, Chlorides, Chlorine Demand, Coli form of given drinking water sample in the laboratory
6. Determine Percent of Available Chlorine in Bleaching, Residual Chlorine of given drinking water sample in the laboratory

<b>Exp. No</b>	<b>Name of the Experiment</b>
0	Water sampling methods for lab analysis
1	pH Metric Estimation of Acid By Base
2	Determination of Total Hardness By EDTA Method
3	Determination of Acidity Of Water Sample
4	Determination of Alkalinity Of Water Sample
5	Estimation of Dissolved Oxygen in Water Sample
6	Determination of Turbidity of Water
7	Determination of Iron By Thiocyanate Colorimetry
8	Conduct metric Estimation Of Acid By Base
9	Determination of Biochemical Oxygen Demand
10	Determination of Total Solids, Total Dissolved Solids and Total Suspended Solids
11	Determination of Optimum Coagulant Dosage
12	Determination of Chloride Content in the Given Sample

- 13 Determination of the percentage of Available Chlorine in Bleaching Powder
- 14 Determination of the Residual Chlorine

**III Year-II Semester**

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0	0	3	1.5

**TRANSPORTATION ENGG. LAB****COURSE OBJECTIVES:**

Students will have

- To demonstrate tests on road aggregates which include, aggregate crushing value and Impact
- To demonstrate test on aggregate, specific gravity and water absorption, attrition test, abrasion test, shape tests to practice tests on bituminous materials which include viscosity test
- To demonstrate ductility test.
- To demonstrate softening point test
- To demonstrate flash and fire point tests
- To demonstrate penetration test, stripping test

**COURSE OUTCOMES:**

Students will get ability to:

- Determine coarse aggregate impact, crushing, abrasion and attrition values using different laboratory testing machines.
- Determine specific gravity, elongation and flakiness index values of coarse aggregates.
- Determine the attrition and water absorption of aggregate.
- Determine viscosity, flash and fire point and softening point of bitumen in laboratory.
- Determine ductility and penetration of bitumen using ductility testing machine & standard penetrometer respectively.
- Determine stripping value of bitumen in laboratory.

**LIST OF EXPERIMENTS****A) ON ROAD AGGREGATES:**

1. Aggregate Crushing value
2. Aggregate Impact Test.
3. Specific Gravity and Water Absorption.
4. Attrition Test
5. Abrasion Test.
6. Shape tests

**B) ON BITUMINOUS MATERIALS:**

1. Viscosity Test.
2. Ductility Test.
3. Softening Point Test.
4. Flash and fire point tests.
5. Penetration test
6. Stripping test

**References:**

1. S.K.Khanna&C.E.G.Justo Highway Engineering Lab manual

**III Year-II Semester**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>1</b>	<b>2</b>	<b>2</b>

**BUILDING INFORMATION MODELLING**

**III Year-II Semester**

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2	0	0	-

**TECHNICAL PAPER WRITING & IPR****Course Objectives**

1. To develop an understanding of the structure, style, and ethics of technical and scientific writing.
2. To train students in effective academic communication, including research paper, thesis, and project report writing.
3. To create awareness about various forms of intellectual property and the process of securing IP rights.
4. To provide foundational knowledge on patents, copyrights, trademarks, and design rights.
5. To sensitize students about innovation, commercialization, and legal aspects of research.

**Unit I:**

Fundamentals of Technical Writing: Basics of technical communication, Types of technical documents: research papers, project reports, theses, Structure and components of a technical paper (Abstract, Introduction, Methods, Results, Discussion), Clarity, precision, and language usage in scientific writing, Ethics in writing: plagiarism, data falsification, multiple submissions

**Unit II:**

Writing for Publication Selection of journal/conference, understanding journal impact factor, indexing, and scope, Manuscript preparation and formatting guidelines, Submission process and peer review system, responding to reviewers and revisions

**Unit III:**

Presentation and Dissemination Preparing abstracts, posters, and oral presentations, Tools for formatting and referencing (LaTeX, MS Word, EndNote, Mendeley, Zotero), Best practices for graphical and tabular data representation, Collaboration and authorship ethics, Copyright and open-access publishing

**Unit IV:**

Introduction to IPR Definition and need for Intellectual Property, Categories: Patents, Copyrights, Trademarks, Trade Secrets, and Industrial Designs, Basic principles of patentability: novelty, non-obviousness, utility, National and international IPR organizations (WIPO, IPO, USPTO, EPO), IPR protection mechanisms in India

**Unit V:**

Patent Filing and Innovation Management Patent filing process in India and abroad, Patent search using free databases (Google Patents, Espacenet, WIPO), Patent drafting basics: claims, specifications, drawings, Technology transfer and commercialization of IP, Role of incubation centers and start-up policy

**Textbooks**

1. M. Ashok Kumar & R. Murugesan, Research Methodology and IPR, Charulatha Publications.
2. R. N. Khandare, Research Methodology & IPR, S. Chand Publishing.
3. Michael Alley, The Craft of Scientific Writing, Springer.

**Reference Books**

1. B.L. Wadehra, Law Relating to Intellectual Property, Universal Law Publishing Co.
2. Deborah E. Bouchoux, Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets, Cengage Learning.
3. Day & Gastel, How to Write and Publish a Scientific Paper, Cambridge University Press.
4. Robin Jeffery & Michael Wilkinson, Publishing Research Successfully, SAGE.
5. Government of India: IPR Policy Documents and Patent Office Guidelines (available on
6. <https://ipindia.gov.in>)

**Course Outcomes**

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

- Write effective technical papers and reports that conform to academic and professional standards.
- Present technical information clearly and ethically in various formats (papers, posters, presentations).
- Understand the process of peer review and publishing in journals/conferences.
- Identify and explain different types of intellectual property and how they are protected.
- Apply knowledge of IPR to protect and commercialize their innovations responsibly.