

**Scheme of  
Examination &  
Detailed Syllabus  
of  
B.Tech (CE)  
  
Open Elective  
Courses for other  
Branches**

**OPEN ELECTIVE COURSES OFFERED FOR VARIOUS  
B.TECH PROGRAMMES  
(2023 onwards scheme)**

**Open Elective Course –I for B.Tech 5<sup>th</sup> Semester**

S.No	Course code	Course Name	Offered by	Credits
01	OE/CE/51-T	Introduction to Civil Engineering	Civil Engineering	3.0
02	OE/CE/52-T	Introduction to Fluid Mechanics	Civil Engineering	3.0
03	OE/CE/53-T	Disaster Preparedness and Planning Management	Civil Engineering	3.0
04	OE/CE/54-T	Civil Engg-Societal & Global Impact	Civil Engineering	3.0

**Open Elective Course –II for B.Tech 6<sup>th</sup> Semester**

S.No	Course code	Course Name	Offered by	Credits
01	OE/CE/61-T	Project Planning & Management	Civil Engineering	3.0
02	OE/CE/62-T	Introduction to Irrigation Engineering	Civil Engineering	3.0
03	OE/CE/63-T	Introduction to Intelligent Transport System	Civil Engineering	3.0
04	OE/CE/64-T	Remote Sensing and GIS	Civil Engineering	3.0

**Open Elective Course –III for B.Tech 7<sup>th</sup> Semester**

S.No	Course code	Course Name	Offered by	Credits
01	OE/CE/71-T	Environmental Engineering	Civil Engineering	3.0
02	OE/CE/72-T	Environmental Impact Assessment	Civil Engineering	3.0
03	OE/CE/73-T	Introduction to Industrial Waste Water Treatment	Civil Engineering	3.0
04	OE/CE/74-T	Introduction to Geosynthetics Engineering	Civil Engineering	3.0

**Open Elective Course –I**

**For**

**B.Tech 5<sup>th</sup> Semester**

## INTRODUCTION TO CIVIL ENGINEERING

Course code	OE/CE/51-T		
Category	Open Elective Course		
Course title	Introduction to Civil Engineering		
Scheme and credits	L	T	Credits
	3	-	3.0
Course Assessment Methods	<b>Internal Examination (30 marks):</b> <ul style="list-style-type: none"> <li>Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered.</li> <li>Class Performance will be measured through percentage of lectures attended (04 marks)</li> <li>Assignments, quiz etc. will have weightage of 06 marks</li> </ul>		
	<b>End semester examination (70 marks):</b> <ul style="list-style-type: none"> <li>Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks.</li> <li>A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.</li> </ul>		

### Course outcomes

Sr. No.	Course outcomes	RBT* Level
	At the end of the course students will be able to:	
CO1	Understand the properties of different types of building materials	L2(Understanding)
CO2	Realize the type of forces acting on any object.	L3(Applying)
CO3	Explain the methods to survey any field	L2(Understanding)
CO4	Explain the type of highway.	L2(Understanding)
CO5	Identify the kind of Irrigation and Water works	L3(Applying)
CO6	Identify the type of soil and foundation	L3(Applying)

\*Revised Bloom's Taxonomy Action verbs/Levels

### UNIT — I

**Construction materials: Stones** - Characteristics of good building stones-common building stones and their uses, **Bricks** - Characteristics of good bricks-classification of bricks and their uses, **Timber** - Classification of Timber and their uses. **Cement** -Types of cement and their uses.

### UNIT — II

**Components of building:** Components of sub structure and their functions-Components of super structure and their functions. **Type of forces** - compression, tension, shear, Stress & Strain. **Concrete** - Ingredients of concrete and its importance in construction. **Steel** - types of steel and its importance in construction

### UNIT – III

**Survey Engineering:** Definition and classification of surveying, linear and angular measurements, levelling,

**Highway Engineering:** Modes of transportation, Classification of highways, Classification of pavements, Super elevation.

## UNIT – IV

**Irrigation and Water supply:** Definition and classification of irrigation, Irrigation structures dams, weirs, cross drainage works, canal drops, Quality of water-Treatment methods.

**Geotechnical Engineering:** Origin of soil, types of soil, bearing capacity of soil, Types of foundation - shallow and deep.

### Recommended Books

1. B C Punmia, Ashok K Jain, Arun K Jain, (1st Edition, 2003), “Basic Civil Engineering”, Laxmi Publications (P) Ltd.
2. G K Hiraskar, (1st Edition, 2004), “Basic Civil Engineering”, Dhanpat Rai Publication

### CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	2	2	-	-	1	1	1	-	-	-	-	1	1	1	2
CO2.	2	2	-	-	1	1	1	-	-	-	-	1	1	1	2
CO3.	2	2	-	-	1	1	1	-	-	-	-	1	1	1	2
CO4.	2	2	-	-	1	1	1	-	-	-	-	1	1	1	2
CO5.	2	2	-	-	1	1	1	-	-	-	-	1	1	1	2
CO6.	2	2	-	-	1	1	1	-	-	-	-	1	1	1	2

3 –High 2-Medium 1-Low

## INTRODUCTION TO FLUID MECHANICS

<b>Course code</b>	OE/CE/52-T		
<b>Category</b>	Open Elective Course		
<b>Course title</b>	Introduction to Fluid Mechanics		
<b>Scheme and credits</b>	<b>L</b>	<b>T</b>	<b>Credits</b>
	3	-	3.0
<b>Course Assessment Methods</b>	<b>Internal Examination (30 marks):</b>		
	<ul style="list-style-type: none"> <li>• Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered.</li> <li>• Class Performance will be measured through percentage of lectures attended (04 marks)</li> <li>• Assignments, quiz etc. will have weightage of 06 marks</li> </ul>		
	<b>End semester examination (70 marks):</b>		
	<ul style="list-style-type: none"> <li>• Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks.</li> <li>• A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.</li> </ul>		

### Course outcomes

S.No	Course Outcome	RBT* Level
	At the end of the course, students will be able to:	
CO1	Outline principles of hydrostatics and explain the concept of buoyancy and state of equilibrium	L1(Remembering)
CO2	Understand the properties of fluids and their behavior under static and dynamic conditions and measure fluid pressure in a manometer	L2 (Understanding)
CO3	Use fluid measuring devices like venture meter, orifice meter, notches and mouthpiece	L3 (Applying)
CO4	Distinguish various types of flows and solve the problem on continuity equation, stream function and velocity potential function	L4(Analysing)
CO5	Evaluate Bernoulli's equation and use it to solve the problems of fluids	L5(Evaluating)
CO6	Formulate one-, two- and three-dimensional continuity equations in Cartesian coordinates	L6(Creating)

\*Revised Bloom's Taxonomy Action verbs/Levels

### Course Content

#### Unit I

**Basic Concepts and Definitions** – Distinction between a fluid and a solid; Density, Specific weight, Specific gravity, Kinematic and dynamic viscosity; variation of viscosity with temperature, Newton law of viscosity; vapour pressure, boiling point, cavitation; surface tension, capillarity, Bulk modulus of elasticity, compressibility.

#### Unit II

**Fluid Statics** - Fluid Pressure: Pressure at a point, Pascals law, pressure variation with temperature, density and altitude. Piezometer, U-Tube Manometer, Single Column Manometer, U-Tube Differential

Manometer, Micro-manometers. Pressure gauges, Hydrostatic pressure and force: horizontal, vertical and inclined surfaces. Buoyancy and stability of floating bodies.

### Unit III

**Fluid Kinematics**-Classification of fluid flow: steady and unsteady flow; uniform and non-uniform flow; laminar and turbulent flow; rotational and irrotational flow; compressible and incompressible flow; ideal and real fluid flow one, two and three dimensional flows; Stream line, path line, streak line and stream tube; stream function, velocity potential function. One-, two- and three -dimensional continuity equations in Cartesian coordinates.

### Unit IV

**Fluid Dynamics**- Surface and body forces; Equations of motion - Euler's equation; Bernoulli's equation – derivation; Energy Principle; Practical applications of Bernoulli's equation: Venturimeter, orifice meter and pitot tube; Momentum principle; Forces exerted by fluid flow on pipe bend; Vortex Flow – Free and Forced; Dimensional Analysis and Dynamic Similitude – Definitions of Reynolds Number, Froude Number, Mach Number, Weber Number and Euler Number; Buckingham's  $\pi$ -Theorem.

#### REFERENCE BOOKS

1. Fluid Mechanics and Hydraulic Machine by R. K. Bansal, Laxmi Publications.
2. Fluid mechanics and Fluid Power Engg. by D.S. Kumar, S. K. Kataria & Sons, New Delhi.
3. Hydraulics and Fluid Mechanics, P N Modi and S M Seth, Standard Book House, New Delhi.
4. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill.

#### CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	3	2	1	2	-	1	-	-	-	-	-	-	1	1	2
CO2.	2	1	1	2	2	1	-	-	-	-	-	-	1	1	2
CO3.	2	2	1	1	-	1	-	-	-	-	-	-	1	1	2
CO4.	1	1	2	2	3	1	-	-	-	-	-	-	1	1	2
CO5.	2	3	2	2	1	1	-	-	-	-	-	-	1	1	2
CO6.	2	2	1	2	1	1	-	-	-	-	-	-	1	1	2
3 –High 2-Medium 1-Low															

## DISASTER PREPAREDNESS & PLANNING

Course code	OE/CE/53-T		
Category	Open Elective Course		
Course title	Disaster Preparedness & Planning		
Scheme and credits	L	T	Credits
	3	-	3.0
Course Assessment Methods	<b>Internal Examination (30 marks):</b>		
	<ul style="list-style-type: none"> <li>• Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered.</li> <li>• Class Performance will be measured through percentage of lectures attended (04 marks)</li> <li>• Assignments, quiz etc. will have weightage of 06 marks</li> </ul>		
	<b>End semester examination (70 marks):</b>		
	<ul style="list-style-type: none"> <li>• Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks.</li> <li>• A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.</li> </ul>		

### Course outcomes

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1	Understand Categories of Disasters	L2(Understanding)
CO2	Realize the responsibilities to society	L3(Applying)
CO3	Analyze relationship between Development and Disasters	L4(Analyzing)
CO4	Apply Disaster Concepts to Management	L5(Creating)

\*Revised Bloom's Taxonomy Action verbs/Levels

### Course Contents

#### Unit I

**Introduction** - Concepts and definitions: disaster, hazard, vulnerability, risks- severity, frequency and details, capacity, impact, prevention, mitigation).

**Disasters** - Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); man-made disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills, transportation accidents, terrorist strikes, etc.); hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility.

#### Unit II

**Disaster Impacts** - Disaster impacts (environmental, physical, social, ecological, economic, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters.

#### Unit III

**Disaster Risk Reduction (DRR)** - Disaster management cycle - its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post-disaster environmental response(water, sanitation, food safety, waste management, disease control, security, communications); Roles and responsibilities of government, community, local



institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

### Unit IV

**Disasters, Environment and Development** - Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land-use changes, urbanization etc.), sustainable and environmental friendly recovery; reconstruction and development methods.

**Reference :**

1. <http://ndma.gov.in/> (Home page of National Disaster Management Authority)
2. Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.
3. Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication.
4. Ghosh G.K., 2006, Disaster Management, APH Publishing Corporation
5. Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June 2003.

**CO-PO Mapping:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	2	3	-	-	-	-	-	1	-	-	-	1	1	1	2
CO2.	-	-	-	-	-	-	3	-	2	-	-	1	1	1	2
CO3.	-	-	-	1	-	3	3	2	2	-	-	1	1	1	2
CO4.	-	-	-	-	-	-	-	-	-	1	3	2	1	1	2

3 –High 2-Medium 1-Low

## CIVIL ENGG-SOCIETAL & GLOBAL IMPACT

<b>Course code</b>	OE/CE/54-T		
<b>Category</b>	Open Elective Course		
<b>Course title</b>	Civil Engg-Societal & Global Impact		
<b>Scheme and credits</b>	<b>L</b>	<b>T</b>	<b>Credits</b>
	3	-	3.0
<b>Course Assessment Methods</b>	<p><b>Internal Examination (30 marks):</b></p> <ul style="list-style-type: none"> <li>Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered.</li> <li>Class Performance will be measured through percentage of lectures attended (04 marks)</li> <li>Assignments, quiz etc. will have weightage of 06 marks</li> </ul> <p><b>End semester examination (70 marks):</b></p> <ul style="list-style-type: none"> <li>Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks.</li> <li>A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.</li> </ul>		

### Course outcomes

S.No	Course Outcome	RBT* Level
	At the end of the course, students will be able to:	
CO1	Recall aspects of the built environment and factors impacting the quality of life	L1(Remembering)
CO2	Understand the impact that Civil Engineering projects have on the society at large and on the global arena; and use resources efficiently and effectively.	L2 (Understanding)
CO3	Apply professional and responsible judgement and take a leadership role	L3(Applying)
CO4	Examine the potential of Civil Engineering for employment creation and its contribution to the GDP	L4(Analysis)
CO5	Value the sustainability of the environment, including its aesthetics	L5(Evaluating)
CO6	Formulate energy requirement with the extent of infrastructure and analyze how they are met, comparing the past present and future.	L6( Creating)

\*Revised Bloom's Taxonomy Action verbs/Levels

### Unit I

Introduction to Course and Overview; Understanding the past to look into the future: Preindustrial revolution days, Agricultural revolution, first and second industrial revolutions, IT revolution; Recent major Civil Engineering breakthroughs and innovations; Present day world and future projections, Ecosystems in Society and in Nature; the steady erosion in Sustainability; Global warming, its impact and possible causes; Evaluating future requirements for various resources; GIS and applications for monitoring systems; Human Development Index and Ecological Footprint of India Vs other countries and analysis; Understanding the importance of Civil Engineering in shaping and impacting the world; The ancient and modern Marvels and Wonders in the field of Civil Engineering; Future Vision for Civil Engineering

### Unit II

Infrastructure - Habitats, Megacities, Smart Cities, futuristic visions; Transportation (Roads, Railways & Metros, Airports, Seaports, River ways, Sea canals, Tunnels (below ground, under

water); Futuristic systems (ex, Hyper Loop)); Energy generation (Hydro, Solar (Photovoltaic, Solar Chimney), Wind, Wave, Tidal, Geothermal, Thermal energy); Water provisioning; Telecommunication needs (towers, above-ground and underground cabling); Awareness of various Codes & Standards governing Infrastructure development; Innovations and methodologies for ensuring Sustainability.

### Unit III

Environment-Traditional & futuristic methods; Solid waste management, Water purification, Wastewater treatment & Recycling, Hazardous waste treatment; Flood control (Dams, Canals, River interlinking), Multi-purpose water projects, Atmospheric pollution; Global warming phenomena and Pollution Mitigation measures, Stationarity and non-stationarity; Environmental Metrics & Monitoring; Other Sustainability measures: Innovations and methodologies for ensuring Sustainability.

Built environment-Facilities management, Climate control; Energy efficient built environments and LEED ratings, Recycling, Temperature/ Sound control in built environment, Security systems; Intelligent/ Smart Buildings; Aesthetics of built environment, Role of Urban Arts Commissions; Conservation, Repairs & Rehabilitation of Structures & Heritage structures; Innovations and methodologies for ensuring Sustainability.

### Unit IV

Civil Engineering Projects - Environmental Impact Analysis procedures; Waste (materials, manpower, equipment) avoidance/ Efficiency increase; Advanced construction techniques for better sustainability; Techniques for reduction of Green House Gas emissions in various aspects of Civil Engineering Projects; New Project Management paradigms & Systems (Ex. Lean Construction), contribution of Civil Engineering to GDP, Contribution to employment(projects, facilities management), Quality of products, Health & Safety aspects for stakeholders; Innovations and methodologies for ensuring Sustainability during Project development.

#### REFERENCE BOOKS

1. NAE Grand Challenges for Engineering (2006), Engineering for the Developing World, The Bridge, Vol 34, No.2, Summer 2004.
2. Allen M. (2008) Cleansing the city. Ohio University Press. Athens Ohio.
3. Ashley R., Stovin V., Moore S., Hurley L., Lewis L., Saul A. (2010). London Tideway Tunnels Programme - Thames Tunnel Project Needs Report - Potential source control and SUDS applications: Land use and retrofit options
4. <http://www.thamestunnelconsultation.co.uk/consultation-documents.aspx>
5. Ashley RM., Nowell R., Gersonius B., Walker L. (2011). Surface Water Management and Urban Green Infrastructure. Review of Current Knowledge. Foundation for Water Research FR/R0014
6. Barry M. (2003) Corporate social responsibility- unworkable paradox or sustainable Paradigm Proc ICE Engineering Sustainability 156. Sept Issue ES3 paper 13550. p 129-130
7. Blackmore J M., Plant RAJ. (2008). Risk and resilience to enhance sustainability with application to urban water systems. J. Water Resources Planning and Management. ASCE. Vol. 134, No. 3, May

#### CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	-	1	2	1	1	3	2	2	2	2	1	1	1	1	2
CO2.	3	1	2	1	-	3	1	1	-	-	-	-	1	1	2
CO3.	-	-	1	1	-	1	1	2	3	2	3	2	1	1	2
CO4.	-	1	1	2	-	3	1	1	-	1	1	1	1	1	2
CO5.	-	1	1	-	-	1	3	2	-	1	-	1	1	1	2
CO6.	2	2	1	2	1	1	1	-	-	1	1	1	1	1	2

3 –High 2-Medium 1-Low

**Open Elective Course –II**

**For**

**B.Tech 6<sup>th</sup> Semester**

## PROJECT PLANNING & MANAGEMENT

<b>Course code</b>	OE/CE/61-T		
<b>Category</b>	Open Elective Courses		
<b>Course title</b>	Project Planning & Management		
<b>Scheme and credits</b>	<b>L</b>	<b>T</b>	<b>Credits</b>
	3	-	3.0
<b>Course Assessment Methods</b>	<b>Internal Examination (30 marks):</b>		
	<ul style="list-style-type: none"> <li>• Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered.</li> <li>• Class Performance will be measured through percentage of lectures attended (04 marks)</li> <li>• Assignments, quiz etc. will have weightage of 06 marks</li> </ul>		
<b>Course Assessment Methods</b>	<b>End semester examination (70 marks):</b>		
	<ul style="list-style-type: none"> <li>• Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks.</li> <li>• A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.</li> </ul>		

### Course outcomes:

Sr. No.	Course outcomes	RBT* Level
	At the end of the course students will be able to:	
CO1.	<b>Explain the construction management</b>	<b>L2(Understanding)</b>
CO2.	<b>Choose the type of contract as per the need.</b>	<b>L5(Evaluating)</b>
CO3.	<b>Explain the construction organization and planning.</b>	<b>L2(Understanding)</b>
CO4.	<b>Improve the time and cost efficiency of a project</b>	<b>L6(Creating)</b>
CO5.	<b>Extend the quality control in a project</b>	<b>L2(Understanding)</b>

\*Revised Bloom's Taxonomy Action verbs/Levels

### UNIT-I

**Construction Management:** Significance, objectives and functions of construction management, types of constructions, resources for construction industry, stages for construction, construction team, engineering drawings.

**Construction Contracts & Specifications:** Introduction, types of contracts, contract document, specifications, important conditions of contract, arbitration.

### UNIT-II

**Construction Planning:** Introduction, work breakdown structure, stages in planning-pre-tender stages, contract stage, scheduling, scheduling by bar charts, preparation of material, equipment, labour and finance schedule, limitation of bar charts, milestone charts.

**Construction Organization:** Principles of Organization, communication, leadership and human relations, types of Organizations, Organization for construction firm, site organization, temporary services, job layout.

### UNIT-III

**Network Techniques in Construction Management-I: CPM-** Introduction, network techniques, work break down, classification of activities, rules for developing networks, network development-

logic of network, allocation of time to various activities, Fulkerson's rule for numbering events, network analysis, determination of project schedules, critical path, ladder construction, float in activities, shared float, updating, resources allocation, resources smoothing and resources leveling.

**Network Techniques in Construction Management-II-PERT-** Probability concept in network, optimistic time, pessimistic time, most likely time, lapsed time, deviation, variance, standard deviation, slack critical path, probability of achieving completion time, central limit theorem.

#### UNIT-IV

**Cost-Time Analysis:** Cost versus time, direct cost, indirect cost, total project cost and optimum duration, contracting the network for cost optimization, steps in time cost optimization, illustrative examples.

**Inspection & Quality Control:** Introduction, principles of inspection, enforcement of specifications, stages in inspection and quality control, testing of structures, statistical analysis.

#### Books Recommended

1. Construction Planning & Management by P. S. Gehlot & B. M. Dhir, Wiley Eastern Ltd.
2. PERT & CPM -Principles & Applications by L. S. Srinath. Affiliated East-west Press (P) Ltd.
3. Project Planning & Control with PERT & CPM by B. C. Punmia & K. K. Khandelwal, Lakshmi Pub. Delhi
4. Construction Management & Planning by B. Sengupta & H. Guha, Tata McGraw -Hills.

#### CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	3	2	3	1	1	1	-	-	-	-	-	-	2	1	2
CO2.	1	2	3	1	1	1	-	-	-	-	-	-	2	1	2
CO3.	1	3	2	1	1	1	-	-	-	-	-	-	2	1	2
CO4.	1	3	2	2	1	1	-	-	-	-	-	-	2	1	2
CO5.	3	2	2	1	1	1	-	-	-	-	-	-	2	1	2

3 –High 2-Medium 1-Low

## INTRODUCTION TO IRRIGATION ENGINEERING

<b>Course code</b>	OE/CE/62-T		
<b>Category</b>	Open Elective Courses		
<b>Course title</b>	Introduction to Irrigation Engineering		
<b>Scheme and credits</b>	<b>L</b>	<b>T</b>	<b>Credits</b>
	3	-	3.0
<b>Course Assessment Methods</b>	<b>Internal Examination (30 marks):</b>		
	<ul style="list-style-type: none"> <li>• Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered.</li> <li>• Class Performance will be measured through percentage of lectures attended (04 marks)</li> <li>• Assignments, quiz etc. will have weightage of 06 marks</li> </ul>		
		<b>End semester examination (70 marks):</b>	
		<ul style="list-style-type: none"> <li>• Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks.</li> <li>• A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.</li> </ul>	

### Course outcomes:

Sr. No	Course outcomes	RBT* Level
	At the end of the course students will be able to:	
CO1.	Explain the necessity of irrigation.	L2(Understanding)
CO2.	Outline the soil properties pertaining to irrigation.	L2(Understanding)
CO3.	Analyze the alignment of canals.	L4(Analyzing)
CO4.	Propose the solution for the soil affected from water logging and requirement of lining of canals.	L6(Creating)
CO5.	Explain the requirement of river training works.	L2(Understanding)

\*Revised Bloom's Taxonomy Action verbs/Levels

### UNIT-I

**Introduction:** Irrigation-necessity, advantages, disadvantages, impact of irrigation on human environment , need and development of irrigation in India, crops and crop seasons, ideal cropping pattern and high yielding varieties of crops.

**Soil-water relationship:** Soil-water relationship, root zone soil water, infiltration, consumptive use, field capacity, wilting point, available moisture in soil, GCA, CCA, intensity of irrigation, delta, base period, Kor depth, core period, frequency of irrigation, duty of water, relation between delta, duty and base period.

### UNIT-II

**Irrigation methods:** Irrigation requirement, flooding methods, border strip method, check basin and furrow method, assessment of irrigation water, sprinkler irrigation, favorable conditions, sprinkler systems, hydraulics of sprinkler irrigation, planning, design and maintenance of sprinkler systems, drip irrigation-components parts, advantages and limitations, suitability of drip irrigation.

**Canal irrigation:** Component of canal distribution system, alignment of channels, losses in irrigation channels, design discharge.

### UNIT-III

**Water logging and land reclamation:** Water logging-effects, causes and measures of prevention, lining of irrigation channels, types of lining, design of lined channel land drainage, open drains, design considerations, advantages of tile drains, depth of tile drains, layout of closed drains, discharge and spacing of closed drains, diameter of tile drain, outlets for tile drains, maintenance of tile drains, purpose of land reclamation and methods of land reclamation.

### UNIT-IV

**River Training:** Classification of rivers, river training and its objectives, classification of river training works, methods of river training, marginal embankments, guide-banks, spurs, cutoffs, bank pitching and launching apron.

**Books:**

1. Irrigation, Water Resources and Water Power Engg. By P. N. Modi.
2. Fundamentals on Irrigation Engg. by Bharat Singh.
3. Irrigation Engg & Hydraulic Structures by S. K. Garg, Khanna Publishers, New Delhi
4. Irrigation Engg. By S. K. Sharma, S. Chand Publishers, New Delhi.
5. Irrigation -Theory & Practice by G.L. Asawa

**CO-PO Mapping:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	1	1	1	1	1	1	-	-	-	-	-	1	1	2
CO2.	1	2	3	3	1	1	-	-	-	-	-	-	1	1	2
CO3.	1	3	3	3	2	1	-	-	-	-	-	-	1	1	2
CO4.	1	3	3	3	1	1	-	-	-	-	-	-	1	1	2
CO5.	1	1	1	1	1	1	1	-	-	-	-	-	1	1	2

3-High 2-Medium 1-Low



## INTRODUCTION TO INTELLIGENT TRANSPORT SYSTEM

<b>Course code</b>	OE/CE/63-T		
<b>Category</b>	Open Elective Courses		
<b>Course title</b>	Introduction to Intelligent Transport System		
<b>Scheme and credits</b>	<b>L</b>	<b>T</b>	<b>Credits</b>
	3	-	3.0
<b>Course Assessment Methods</b>	<b>Internal Examination (30 marks):</b>		
	<ul style="list-style-type: none"> <li>• Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered.</li> <li>• Class Performance will be measured through percentage of lectures attended (04 marks)</li> <li>• Assignments, quiz etc. will have weightage of 06 marks</li> </ul>		
<b>Course Assessment Methods</b>	<b>End semester examination (70 marks):</b>		
	<ul style="list-style-type: none"> <li>• Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks.</li> <li>• A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.</li> </ul>		

### Course outcomes:

Sr. No.	Course outcomes: At the end of the course students will be able to:	RBT* Level
CO1	Understands the fundamentals of ITS and ITS functional areas	L2(Understanding)
CO2	Understand the communication technologies in transportation	L2(Understanding)
CO3	Able to apply the various ITS methodologies	L3(Applying)
CO4	Understand the ITS implementation in developing countries	L2(Understanding)
CO5	Able to understand and the advantages of ITS and apply the appropriate technologies for field conditions.	L3(Applying)

\*Revised Bloom's Taxonomy Action verbs/Levels

### UNIT-I

**Introduction to Intelligent Transportation Systems (ITS)** – Definition of ITS and Identification of ITS Objectives, Historical Background, Benefits of ITS - ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection.

### UNIT-II

**Telecommunications in ITS** – Importance of telecommunications in the ITS system, Information Management, Traffic Management Centres (TMC). Vehicle – Road side communication – Vehicle Positioning System.

### UNIT-III

**ITS functional areas** – Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS).

### UNIT-IV

**ITS User Needs and Services** – Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management,

Advanced Vehicle safety systems, Information Management; Automated Highway Systems - Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries

Books:

1. Intelligent Transport Systems by Pradip Kumar Sarkar, Amit Kumar Jain, PHI Learning Private Limited, New Delhi
2. Intelligent Transport Systems by R Srinivasa Kumar, Orient Blackswan Pvt. Ltd.
3. Intelligent Transport Systems: New Principles and Architectures by S. Ghosh, T.S. Lee, CRC Press.
4. Fundamentals of Intelligent Transportation system planning, Mashrur A. Chowdhury and A del Sadek, Artech House.

**CO-PO Mapping:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	3	1	1	1	1	1	-	-	-	-	-	1	1	2
CO2.	1	3	1	2	2	1	-	-	-	-	-	-	1	1	2
CO3.	1	2	1	2	3	2	-	-	-	-	-	-	1	1	2
CO4.	1	2	1	2	2	1	1	-	-	-	-	-	1	1	2
CO5.	1	2	1	2	2	1	-	-	-	-	-	-	1	1	2

3 –High 2-Medium 1-Low

## REMOTE SENSING & GIS

<b>Course code</b>	OE/CE/64-T		
<b>Category</b>	Open Elective Courses		
<b>Course title</b>	Remote Sensing & GIS		
<b>Scheme and credits</b>	<b>L</b>	<b>T</b>	<b>Credits</b>
	3	-	3.0
<b>Course Assessment Methods</b>	<b>Internal Examination (30 marks):</b>		
	<ul style="list-style-type: none"> <li>• Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered.</li> <li>• Class Performance will be measured through percentage of lectures attended (04 marks)</li> <li>• Assignments, quiz etc. will have weightage of 06 marks</li> </ul>		
	<b>End semester examination (70 marks):</b>		
	<ul style="list-style-type: none"> <li>• Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks.</li> <li>• A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.</li> </ul>		

### Course outcomes:

Sr. No	Course outcomes	RBT* Level
	At the end of the course students will be able to:	
CO1.	Explain the different concepts and terms used in Remote Sensing.	L2(Understanding)
CO2.	Outline the data conversion and Process in different coordinate systems of GIS interface.	L2(Understanding)
CO3.	Evaluate the accuracy of Data and implementing a GIS.	L5(Evaluating)
CO4.	Explain the applicability of RS and GIS for various applications	L2(Understanding)

\*Revised Bloom's Taxonomy Action verbs/Levels

### UNIT-I

**Concepts of Remote Sensing Basics of remote sensing-** elements involved in remote sensing, electromagnetic spectrum, remote sensing terminology & units, energy resources, energy interactions with earth surface features & atmosphere, atmospheric effects, satellite orbits, Sensor Resolution, types of sensors. Remote Sensing Platforms and Sensors, IRS satellites.

**Remote Sensing Data Interpretation:** Visual interpretation techniques, basic elements, converging evidence, interpretation for terrain evaluation, spectral properties of soil, water and vegetation. Concepts of Digital image processing, image enhancements, qualitative & quantitative analysis and pattern recognition, classification techniques and accuracy estimation.

### UNIT- II

**Introduction to GIS:** Introduction, History of GIS, GIS Components, GIS Applications in Real life, The Nature of geographic data, Maps, Types of maps, Map scale, Types of scale, Map and Globe, Coordinate systems, Map projections, Map transformation, Geo-referencing.

### UNIT- III

**Spatial Database Management System:** Introduction: Spatial DBMS, Data storage, Database structure models, database management system, entity-relationship model, normalization.

**Data models and data structures:** Introduction, GIS Data model, vector data structure, raster data structure, attribute data, geo-database and metadata.

### UNIT- IV

**Implementing a GIS:** Awareness, developing system requirements, evaluation of alternative systems, decision making using GIS.

**Applications of GIS:** GIS based road network planning, Mineral mapping using GIS, Shortest path detection using GIS, Hazard Zonation using remote sensing and GIS, GIS for solving multi criteria problems, GIS for business applications.

#### BOOKS:

1. Remote Sensing and GIS by Basudeb Bhatta, Oxford University Press, 2nd Edition, 2011.
2. Introduction to Geographic Information systems by Kang-tsung Chang, McGraw Hill Education (Indian Edition), 7th Edition, 2015.
3. Fundamentals of Geographic Information systems by Michael N. Demers, 4th Edition, Wiley Publishers, 2012.
4. Textbook of Remote Sensing and Geographical Information systems by M. Anji Reddy.
5. Advanced Surveying: Total Station, GIS and Remote Sensing by Satheesh Gopi, R. Sathi Kumar, N. Madhu, Pearson Education, 1st Edition, 2007.

#### CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	2	2	1	3	1	-	-	-	-	-	-	1	1	2
CO2.	1	2	2	1	3	1	-	-	-	-	-	-	1	1	2
CO3.	1	2	2	1	3	2	-	-	-	-	-	-	1	1	2
CO4.	1	2	2	1	3	1	-	-	-	-	-	-	1	1	2

3 –High 2-Medium 1-Low

# **Open Elective Course –III**

**For**

**B.Tech 7<sup>th</sup> Semester**

## ENVIRONMENTAL ENGINEERING

<b>Course code</b>	OE/CE/71-T		
<b>Category</b>	Open Elective Course		
<b>Course title</b>	Environmental Engineering		
<b>Scheme and credits</b>	<b>L</b>	<b>T</b>	<b>Credits</b>
	3	-	3.0
<b>Course Assessment Methods</b>	<b>Internal Examination (30 marks):</b>		
	<ul style="list-style-type: none"> <li>• Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered.</li> <li>• Class Performance will be measured through percentage of lectures attended (04 marks)</li> <li>• Assignments, quiz etc. will have weightage of 06 marks</li> </ul>		
	<b>End semester examination (70 marks):</b>		
	<ul style="list-style-type: none"> <li>• Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks.</li> <li>• A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.</li> </ul>		

### Course Outcome

Sr. No	Course outcomes	RBT* Level
	At the end of the course students will be able to:	
CO1.	Identify and describe various elements of water supply, sewerage and air & noise pollution.	<b>L1 (Remembering)</b>
CO2.	Differentiate between various types of pollutants with their sources, effects on environment and quantifications	<b>L2(Understanding)</b>
CO3.	Analyze the effects of different kinds of pollution and outline their respective measures for treatment.	<b>L4(Analyzing)</b>
CO4.	Design and compare sewerage systems and storm water drains.	<b>L6(Creating)</b>

### Course Content

#### UNIT I

**Water:** Water Supply systems: Need for planned water supply schemes, Sources of Water, Water demand and Potable, industrial and agricultural water requirements, Components of water supply system; Transmission of water, Distribution system, Various valves used in W/S systems, service reservoirs and design.

#### UNIT II

**Sewage:** Domestic and Storm water, Quantity of Sewage, Sewage flow variations. Conveyance of sewage: Sewers, shapes design parameters, operation and maintenance of sewers, Sewage pumping; Sewerage, Sewer appurtenances, Design of sewerage systems.

**Storm Water:** Quantification and design of Storm water; Sewage and Sludge, Pollution due to improper disposal of sewage, National River cleaning plans, recycling of sewage -quality requirements for various purposes.

#### UNIT III

**Air:** Composition and properties of air, Quantification of air pollutants, Monitoring of air

pollutants, Air pollution - Occupational hazards, Urban air pollution: automobile pollution, Chemistry of combustion, Automobile engines, quality of fuel, operating conditions and interrelationship. Air quality standards, Control measures for Air pollution, construction and limitations

#### UNIT IV

Noise: Basic concept, measurement, effects and various control methods.

Case studies on Pollution (Air, Water, Noise)

#### REFERENCE BOOKS:

1. Environmental Engineering, Vol. I, S.K Garg, Khanna Publishers, New-Delhi.
2. Environmental Pollution Control Engineering, C. S. Rao.
3. Environmental Engineering by H.S.Peavy, D.R.Rowe, G.Tchobanoglous: 1991, Tata-Mcgraw Hill
4. Manual on Water Supply and Treatment, (latest Ed.), Ministry of Works & Housing, New Delhi.
5. Integrated Solid Waste Management. Tchobanoglous, Theissen & Vigil. McGraw Hill Publication

#### CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	2	1	2	-	1	3	1	-	-	-	1	1	1	2
CO2.	1	2	1	2	-	2	3	1	-	-	-	1	1	1	2
CO3.	2	3	2	1	1	1	3	1	1	2	-	1	1	1	2
CO4.	3	2	3	1	2	-	2	1	3	2	2	1	1	1	2

3 –High 2-Medium 1-Low

## ENVIRONMENTAL IMPACT ASSESSMENT

<b>Course code</b>	OE/CE/72-T		
<b>Category</b>	Open Elective Course		
<b>Course title</b>	Environmental Impact Assessment		
<b>Scheme and credits</b>	<b>L</b>	<b>T</b>	<b>Credits</b>
	3	-	3.0
<b>Course Assessment Methods</b>	<b>Internal Examination (30 marks):</b>		
	<ul style="list-style-type: none"> <li>• Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered.</li> <li>• Class Performance will be measured through percentage of lectures attended (04 marks)</li> <li>• Assignments, quiz etc. will have weightage of 06 marks</li> </ul>		
<b>Course Assessment Methods</b>	<b>End semester examination (70 marks):</b>		
	<ul style="list-style-type: none"> <li>• Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks.</li> <li>• A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.</li> </ul>		

### Course Outcome

Sr. No	Course outcomes	RBT* Level
	At the end of the course students will be able to:	
CO1.	Identify the environmental attributes to be considered for the EIA study	L3(Applying)
CO2.	Formulate objectives of the EIA studies	L6(Creating)
CO3.	Identify the methodology to prepare rapid EIA	L3(Applying)
CO4.	Prepare EIA reports and environmental management plans	L6(Creating)

\*Revised Bloom's Taxonomy Action verbs/Levels

### UNIT- I

**Introduction:** The Need for EIA, Indian Policies Requiring EIA, The EIA Cycle and Procedures, Screening, Scoping, Baseline Data, Impact Prediction, Assessment of Alternatives, Delineation of Mitigation Measure and EIA Report, Public Hearing, Decision Making, Monitoring the Clearance Conditions, Components of EIA, Roles in the EIA Process. Government of India Ministry of Environment and Forest Notification (2000), List of projects requiring Environmental clearance, Application form, Composition of Expert Committee, Ecological sensitive places, International agreements.

### UNIT- II

**EIA Methodologies:** Environmental attributes -Criteria for the selection of EIA methodology, impact identification, impact measurement, impact interpretation & Evaluation, impact communication, Methods-Adhoc methods, Checklists methods, Matrices methods, Networks methods, Overlays methods. EIA review- Baseline Conditions -Construction Stage Impacts, post project impacts.



### UNIT- III

**Environmental Management Plan:** EMP preparation, Monitoring Environmental Management Plan, Identification of Significant or Unacceptable Impacts Requiring Mitigation, Mitigation Plans and Relief & Rehabilitation, Stipulating the Conditions, Monitoring Methods, Pre- Appraisal and Appraisal.

### UNIT- IV

**Environmental Legislation and Life cycle Assessment:** Environmental laws and protection acts, Constitutional provisions-powers and functions of Central and State government, The Environment (Protection) Act 1986, The Water Act 1974, The Air act 1981, Wild Life act 1972, Guidelines for control of noise, loss of biodiversity, solid and Hazardous waste management rules.

**Life cycle assessment:** Life cycle analysis, Methodology, Management, Flow of materials-cost criteria case studies.

**Case Studies:** Preparation of EIA for developmental projects- Factors to be considered in making assessment decisions, Water Resources Project, Pharmaceutical industry, thermal plant, Nuclear fuel complex, Highway project, Sewage treatment plant, Municipal Solid waste processing plant, Air ports.

#### TEXT BOOKS:

1. Anjaneyulu. Y and Manickam. V., Environmental Impact Assessment Methodologies, B.S. Publications, Hyderabad, 2007
2. Barthwal, R. R., Environmental Impact Assessment, New Age International Publishers, 2002.
3. Jain, R.K., Urban, L.V., Stracy, G.S., Environmental Impact Analysis, Van Nostrand Reinhold Co., New York, 1991.
4. Rau, J.G. and Wooten, D.C., Environmental Impact Assessment, McGraw Hill Pub. Co., New York, 1996.

#### CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	2	1	2	1	2	3	-	-	-	2	3	1	1	1
CO2.	1	2	1	2	1	2	3	-	-	-	2	3	1	1	1
CO3.	2	3	2	1	1	2	3	-	-	-	2	3	1	1	1
CO4.	3	2	3	1	2	2	3	-	-	-	2	3	1	1	1

3 –High 2-Medium 1-Low

## INTRODUCTION TO INDUSTRIAL WASTE WATER TREATMENT

<b>Course code</b>	OE/CE/73-T		
<b>Category</b>	Open Elective Course		
<b>Course title</b>	Introduction to Industrial Waste Water Treatment		
<b>Scheme and credits</b>	<b>L</b>	<b>T</b>	<b>Credits</b>
	3	-	3.0
<b>Course Assessment Methods</b>	<b>Internal Examination (30 marks):</b>		
	<ul style="list-style-type: none"> <li>• Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered.</li> <li>• Class Performance will be measured through percentage of lectures attended (04 marks)</li> <li>• Assignments, quiz etc. will have weightage of 06 marks</li> </ul>		
<b>Course Assessment Methods</b>	<b>End semester examination (70 marks):</b>		
	<ul style="list-style-type: none"> <li>• Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks.</li> <li>• A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.</li> </ul>		

### Course outcomes:

Sr. No	Course outcomes	RBT* Level
	At the end of the course students will be able to:	
CO1.	Identify the effect of industrial waste.	L3 (Applying)
CO2.	Analyze the characteristics of industrial waste.	L4(Analyzing)
CO3.	Propose the kind of disposal of industrial waste.	L6 (Creating)
CO4.	Identify the type and treatment of industrial waste.	L3 (Applying)

\*Revised Bloom's Taxonomy Action verbs/Levels

### UNIT-I

Effects of industrial wastes on streams, sewerage systems and wastewater treatment plants.

### UNIT-II

Minimizing the effects of industrial effluents on waste water treatment plants and receiving streams- conservation of water, process change, reuse of waste water, volume reduction, strength reduction, neutralization, equalization and proportioning.

### UNIT-III

Population equivalent. Industrial effluent standards for disposal into inland surface water sources and on land for irrigation.

### UNIT-IV

Study of the following Industries from waste generation, quality and its treatment including brief overview of manufacturing process:

Textile, tannery, sugar mill, distillery, dairy, pulp & paper, metal plating, oil refinery, nitrogenous fertilizers, thermal power plants and radio active wastes.

**Books:**

1. Industrial and Hazardous Waste Treatment by N.L.Nemerow & A.Dasgupta.
2. Industrial Effluents by N.Manivasakam.
3. Waste Water Treatment by M.N.Rao & A.K.Dutta.

**CO-PO Mapping:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	1	1	1	3	2	2	-	-	-	-	2	1	1	1
CO2.	1	1	1	1	3	2	2	-	-	-	-	2	1	1	1
CO3.	1	1	1	1	3	2	2	-	-	-	-	2	1	1	1
CO4.	1	1	1	1	3	2	2	-	-	-	-	2	1	1	1
3 –High 2-Medium 1-Low															

## INTRODUCTION TO GEO-SYNTHETICS ENGINEERING

<b>Course code</b>	OE/CE/74-T		
<b>Category</b>	Open Elective Course		
<b>Course title</b>	Introduction to Geo-synthetics Engineering		
<b>Scheme and credits</b>	<b>L</b>	<b>T</b>	<b>Credits</b>
	3	-	3.0
<b>Course Assessment Methods</b>	<b>Internal Examination (30 marks):</b>		
	<ul style="list-style-type: none"> <li>• Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered.</li> <li>• Class Performance will be measured through percentage of lectures attended (04 marks)</li> <li>• Assignments, quiz etc. will have weightage of 06 marks</li> </ul>		
	<b>End semester examination (70 marks):</b>		
	<ul style="list-style-type: none"> <li>• Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks.</li> <li>• A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.</li> </ul>		

### Course outcomes:

Sr. No	Course outcomes	RBT* Level
	At the end of the course students will be able to:	
CO1.	Identify types of Geosynthetics.	<b>L3 (Applying)</b>
CO2.	Illustrate the manufacturing methods.	<b>L2 (Understanding)</b>
CO3.	Explain the usefulness of Geogrids.	<b>L5 (Evaluating)</b>
CO4.	Identify the use of Geosynthetics in Water resources projects.	<b>L3 (Applying)</b>

\*Revised Bloom's Taxonomy Action verbs/Levels

### UNIT I

**Basic Description of Geosynthetics:** Historical Development, the Nomenclature, Function, Use around the World, Applications, Development in India.

**Raw Materials – Their Durability and Ageing:** Raw Materials, Durability, Degrading Agencies, Polymers, Biological Resistance, Chemical Resistance, Weathering Resistance

### UNIT II

**Manufacturing Methods:** Fibres, Yarn, Nonwoven Geotextiles, Woven Geotextiles, D.S.F. Fabrics.

**Geogrids- Testing and Evaluation:** Factors influencing Testing, Sampling, Physical Properties, and Mechanical Properties under Uniaxial loading, Creep Testing

### UNIT III

**Erosion Control with Geogrids:** Wind Erosion, Rain Water Erosion, Erosion Control Measures, Placement of Geogrids

**Bearing Capacity Improvement with Geogrids:** Advantages, Mechanism, Modes of Failure, Friction Coefficient, Experimental Studies.

## UNIT IV

**Application of Geosynthetics in Water Resource Projects: Case Study:** Dharoidam, Hiran II Dam, Meda Creek Irrigation Scheme, Lining of Kakarpar Canal

### Reference Books:

1. Robert M. Koerner, *Designing with Geosynthetics*, Prentice Hall.
2. G.V. Rao & G.V.S. Raju, *Engineering with Geosynthetics*, Tata MacGraw Hill.

### CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	1	1	1	3	1	-	-	-	-	-	-	1	1	1
CO2.	1	1	1	1	3	1	-	-	-	-	-	-	1	1	1
CO3.	1	1	1	1	3	1	-	-	-	-	-	-	1	1	1
CO4.	1	1	1	1	3	1	-	-	-	-	-	-	1	1	1

3 –High 2-Medium 1-Low