SYLLABUS	(SEMESTER VII)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE07TPE03A	L	T	P	CT-I	CT-II	TOTAL	70	100	3
Subject:	Environmental Geo-technology	3	0	0	15	15	30			

Course Learning Objectives:

- Learning various soil engineering for land reclamation purposes, conversion of degraded waste land in new land use.
- Understanding land degradation and soil pollution and their restoration.
- Integration of engineering techniques with ecological process for restoration of productivity.

Course Content:

UNIT-1 Soil and ground water pollutants - their sources, nature, composition and polluting effects. The physico-chemical aspects of soils contaminated by various pollutants. Effects of environment and wastes on the properties of soils.

UNIT–2 Solid and liquid wastes disposal method and management. land treatment systems.

UNIT-3 Man made changes in geotechnical environment - mining, embankments, pumping, reservoir, land fills and reclamation effects and control.

UNIT- 4 Control of contamination with use of clay barriers, geosynthetics, cut-off walls, leachate collection systems.

UNIT- 5 Stabilization - different materials and techniques in control of ground pollution and treatment.

Text Books:

1. D.E.Daniel, Geotechnical Practice for Waste Disposal, Chaman & Hall, London, 1993
2. Hsai_Yang Fang and Daniels, J.L. Introductory Geotechnical Engineering an Environmental Perspective, Taylor & Francis, Oxon., 2006.
3. Lakshmi N. Reddy, Hilary. I. Inyang – Geo-Environmental Engineering – Principles and Applications – Makcel Dekker Ink, 2000
4. Mitchell, J.K. and Soga, K., Fundamentals of Soil Behaviour, John Wiley & Sons, Inc., New Jersey., 2005.
5. Mohamed, A.M.O. and Antia, H.E., Geo-environmental Engineering, Elsevier, Netherlands, 1998.
6. Reddy, L.N. and Inyang. H. I., Geo-environmental Engineering –Principles and Applications, Marcel Dekker, Inc., New York., 2000.
7. Yong, R. N., Geo-environmental Engineering: Contaminated Soils, Pollutant Fate and Mitigation", CRC press LLC, Florida., 2001.

Course Outcomes-

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

CO-1: Understanding causes of soil pollution.

CO-2: Understand the fundamentals of soil behavior under varied environmental conditions.

CO-3: Identify contaminant transport mechanisms in soils.

CO-4: Specify site investigation techniques in the characterization of the contaminated site

CO-5: Understand remediation techniques to reclaim degraded land for conversion in to various land uses.

SYLLABUS	(SEMESTER VII)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credit
Subject Code:	CE07TPE03B	L	T	P	CT-I	CT-II	TOTAL	70	100	3
Subject:	Air Pollution Control Engineering	3	0	0	15	15	30			

Course Learning Objectives:

The objective of this course is to

- Comprehend the essential concepts of ambient air pollution and pollution control.
- Make aware of techniques and instrumentation of ambient air monitoring, establishment of ambient air monitoring stations; stack monitoring
- Explore the experimental analysis of air gaseous and particulate air pollutants; standards and limits.

Course Content:

UNIT-1: Introduction: Sources and classification of Air pollutants: Natural contaminants, Aerosols, Gases & Vapours; Primary & Secondary Air pollutants; Stationary & Mobile Sources.
Meteorology and Air pollution: Factors influencing Air pollution; Atmospheric stability & temperature inversions; Mixing height; Plume behaviour; Wind rose; Stack effluent dispersion theories; Stack height.

UNIT-2: Sampling procedures: Sampling Methods, Difficulties in sampling, Stages & considerations of air sampling, Instruments for sampling waste gases & atmosphere, sampling period & methods, High volume sampler, Stack sampling techniques, selection of sampling location, procedure for collection & sampling of particulate matter, Gaseous sampling, recent trends in sampling of stack effluents.

UNIT-3: Control of Particulates / aerosols: Objectives & types of Collection equipment; Principle, application, working, advantages & disadvantages of: i) Settling chambers, ii) Inertial separators, iii) Cyclones, iv) Filters, v) Electrostatic Precipitators & vi) Scrubbers; Choice of equipment.
UNIT-4: Control of Smoke -Gaseous Contaminants & Odour: Smoke: Sources, measurement by Ringelmann chart, miniature chart & other method; Prevention & control of smoke. Control of exhaus emissions. Gaseous Contaminants: Methods of control viz. combustion, absorption, adsorption, close collection & masking. Odour Control.

UNIT-5: Control measures for Industrial Applications: Introduction to control of air pollution by proces changes. Control measures for industries such as Cement Industry, Concrete batching plant, Asphalt concrete plant, Glass manufacture, Asbestos processing, Thermal Power plant and Coal tar industry.

Books and References

1. Air Pollution Control Engineering by Noel de Nevers, McGraw-Hill, New York, 1995

2. Air Pollution Its Origin and Control by Wark K, Warner C F and Davis W., Harper and Row, New York.
3. Air Pollution by Rao M N, Tata McGraw Hill, New Delhi.
4. Principles of Air Quality Management by Griffin R D, CRC Press, Boca Raton, USA.
5. Richard W. Boubel et.al "Fundamentals of Air pollution", Academic Press, New York, 1994.

Course Outcomes-

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

- CO1: Understand & attribute air pollution, its driving forces, meteorological influence, impacts and control options.
- CO2: Identify sampling techniques and analyze the air pollutants in ambient air & chimney.
- CO3: Determine the stack height, assess the plume behaviour and apply dispersion model for Computing pollutant concentration.
- CO4: Understand the sources, measurements and control techniques for smoke and Odour nuisance.
- CO5: Apply different control measures in Industrial air pollutant emissions.

Syllabus	(SEMESTER VII)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE07TPE03C	L	T	P	CT-I	CT-II	TOTAL	70	100	3
Subject:	Solid and Hazardous Waste Management	3	0	0	15	15	30			

Course Learning Objectives:

- To define and characterize municipal solid wastes from technical and regulatory points of view.
- To provide comprehensive ways of collection, transportation and management of different types of solid wastes.
- To classify the waste and remove hazardous wastes; apply different methods of management.
- .To introduce the most common techniques for hazardous waste disposal.
- To use laboratorial tests in sampling & characterization of solid wastes.

Course Content:

UNIT-1: Municipal Solid Waste Management: Legal and Organizational foundation: Definition of Solid Waste, Waste Generation Technological Society, Major Legislation, Monitoring Responsibilities, Sources and Types of Solid Waste, Sampling and Characterization – Determination of Composition of MSW, Storage and Handling of Solid Waste ,Future Changes in Waste Composition.

UNIT-2: Collection and Transport of Solid Waste: Collection of Solid Waste: Type of Waste Collection Systems, Analysis of Collection System, Alternative Techniques for Collection System, Separation, Processing and Transformation of Solid Waste: UNIT Operations User for Separation and Processing, Materials Recovery Facilities, Waste Transformation through Combustion and Aerobic Composting, Anaerobic Methods for Materials Recovery and Treatment, Energy Recovery.

Incinerators Transfer and Transport: Need for Transfer Operation, Transport Means and Methods, Transfer Station Types and Design Requirements, Landfills, Site Selection, Design and Operation, drainage and Leachate Collection Systems , Requirements and Technical solution, Designated Waste Landfill Remediation, Integrated Waste Management Facilities.

UNIT-3: Hazardous Waste Management: Definition and Identification of Hazardous Wastes-Sources and Characteristics, Hazardous Wastes in Municipal Waste ,Hazardous Wastes Regulations ,Minimization of Hazardous Waste-Compatibility, Handling and Storage of Hazardous Waste-Collection and Transport, e-waste Sources, Collection, Treatment and Reuse Management.

UNIT-4: Hazardous waste treatment and Design: Hazardous Waste Treatment Technologies, Design and Operation , Facilities for Physical, Chemical and Thermal Treatment of Hazardous Waste –,Solidification, Chemical Fixation and Encapsulation, Incineration, Hazardous Waste landfills: Site Selection, Design and Operation, Remediation of Hazardous Waste Disposal Sites.

UNIT-5: Laboratory Practice: Sampling and Characterization of Solid Wastes; TCLP Tests and Leachate Studies.

Text Books:

1) Integrated Solid Waste Management by George Techobanoglous et al, McGraw-Hill Publication, 1993.
2) Hazardous Waste Management by Charles A. Wentz, McGraw Hill Publication, 1995.

Reference Books:

1)Solid and Hazardous Waste Management by S.C. Bhatia, Atlantic Publishers; Edition (1 December 2007).
2) Solid and Hazardous Waste Management by M.N Rao & Razia Sultana,BS Publications, Second Edition (2020)

Course Outcomes- At the end of the course completion, the students shall be able to:

CO1 Ability to characterize municipal solid wastes from technical view.
CO2 Learn ways of collection ,transportation and management of different types of solid wastes.
CO3 Apply different methods of managements for hazardous wastes.
CO4 Develop most suitable techniques for disposal of hazardous wastes.
CO5 Learn different laboratorial tests for solid wastes.

SYLLABUS	**(SEMESTER VII)**	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE07TPE03D	L	T	P	CT-I	CT-II	TOTAL	70	100	3
Subject:	Design of Hydraulic Structures	3	0	0	15	15	30			

Course Learning Objectives:

- Recognise the different types of dams, identify its purpose and function and to select the most appropriate dam.

- To introduce and give explanation the Principles of Design of Hydraulic Structures.
- To develop understanding for Analysis of gravity dam.
- To develop understanding about Earth dam and stability analysis.
- To introduce the importance of Spillways and energy dissipation systems.

Course Content:

UNIT 1: Introduction - Classification of dams, Gravity dams, Earth dams, Arch dam, Buttress dam, Steel dams, Timber dams, selection of site for dam, selection of type of dam, investigations of dam sites, Engineering surveys, Geological investigations, Types of hydropower plants, site selection for power plant, General arrangement of a hydropower project.

UNIT 2: Principles of Design of Hydraulic Structures - Hydraulic structures on permeable foundations, Theories of subsurface floor, Khosla's method of independent variables, Exit gradient, Location of Hydraulic jump, water surface profiles, scour due to subsurface flow, Design Principles, Energy dissipation principles.

UNIT 3: Gravity Dams - Types of storage head works, Forces acting on gravity dams, Analysis of gravity dams, Profile of a gravity dam, Finite Element Method, Design of gravity dam, joints in gravity dam, Galleries in gravity dam, Adits and shafts, Construction of gravity dam, Foundation Grouting, Instrumentation of gravity dams.

UNIT 4: Earth dams - Types of earth dams, Causes of failure of earth dams, Seepage analysis, phreatic line, flow net construction, criteria for safe design of gravity dams, typical cross sections of earth dams, Stability analysis, Seepage control, and design of filters.

UNIT 5: Spillways and energy dissipation systems - Essential requirements of spillways, Required spillway capacity, component parts of spillway, Types of spillways, Design of Ogee spillway, Design of shaft spillway, Design of siphon spillway, Design of stilling basins. Hydropower structures - Storage power plant, Runoff River plant, Pumped storage plant, Water conveyance systems, Tunnels and Penstocks, Gates, Surge tanks, Power house layout.

Text Books:

1. Golze, A. R., Handbook of Dam Engineering, Von Rostrand Reinhold Co., 1977
2. Sharma, H.D., Concrete Dams, CBIP Publication, 1998.
3. Siddiqui, I H, Dams and Reservoirs: Planning, Engineering, Oxford University Press, USA, 2009.
4. Novak, P., Moffat, A. I. B., Nalluri, C and Narayan, R., Hydraulic Structures, Taylor & Francis, 2006.
5. Modi P.M., Irrigation Water Resources and Hydropower Engineering, Standard Publishing Company, New Delhi, 2000.
6. Arora K.L. Irrigation Water Resources Engineering, Standard Book Publishing Co., Delhi, 1996.

Course Outcomes-

- Define different types of dams.
- Describe the Principles of Design of Hydraulic Structures.
- Explain the concept of Gravity Dams.
- Explain the concept of Earth dams and its stability analysis.
- Describe the concept of spillways and energy dissipation systems.

SYLLABUS	(SEMESTER VII)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE07TPE03E	L	T	P	CT-I	CT-II	TOTAL	70	100	3
Subject:	Environmental Impact Assessment and Life Cycle Analysis	3	0	0	15	15	30			

Course Learning Objectives:

- Identify environmental attributes for the EIA study.
- Identify methodology and prepare EIA reports.
- Specify methods for prediction of the impacts.
- Formulate environmental management plans.
- Understand the concept of life cycle analysis (LCA) and the basic principles.

Course Content:

UNIT-1 Introduction: Historical development of Environmental Impact Assessment (EIA). EIA in Project Cycle. Legal and Regulatory aspects in India. – Types and limitations of EIA – Cross sectoral issues and terms of reference in EIA – Public Participation in EIA. EIA process- screening – scoping - setting – analysis – mitigation

UNIT–2 Components and Methods for EIA: Matrices – Networks – Checklists – Connections and combinations of processes – Cost benefit analysis – Analysis of alternatives – Software packages for EIA – Expert systems in EIA. Prediction tools for EIA – Mathematical modelling for impact prediction – Assessment of impacts – air – water – soil – noise – biological — Cumulative Impact Assessment – Documentation of EIA findings – planning – organization of information and visual display materials – Report preparation. EIA methods in other countries.

UNIT-3 Environmental Management Plan: Environmental Management Plan - preparation, implementation and review – Mitigation and Rehabilitation Plans – Policy and guidelines for planning and monitoring programmes – Post project audit – Ethical and Quality aspects of Environmental Impact Assessment.

UNIT- 4 An Introduction to Sustainability Concepts and Life Cycle Analysis (Introduction, Material flow and waste management, What it all means for an engineer? Water energy and food nexus). Risk and Life Cycle Framework for Sustainability (Introduction, Risk, Environmental Risk Assessment, Example Chemicals and Health Effects, Character of Environmental Problems)

UNIT- 5 Environmental Data Collection and LCA Methodology (Environmental Data Collection Issues, Statistical Analysis of Environmental Data, Common Analytical Instruments, Overview of LCA Methodology - Goal Definition, Life Cycle Inventory, Life Cycle Impact Assessment, Life Cycle Interpretation, LCA Software tools). Life Cycle Assessment – Detailed Methodology and ISO Framework (Detailed Example on LCA Comparisons, LCA Benefits and Drawbacks, Historical Development and LCA Steps from ISO Framework)

Text Books:

1. Anjaneyulu.Y., and Manickam. V., Environmental Impact Assessment Methodologies, B.S. Publications, Hyderabad, 2007
2. Canter, L.W., Environmental Impact Assessment, McGraw Hill Pub. Co., New York. 1997

3. David P. Lawrence, Environmental Impact Assessment: Practical Solutions to Recurrent Problems, John Wiley & Sons, 2003
4. Environmental Assessment, 2001. Ravi Jain, LV Urban, GS Stacey, H Balbach, McGraw-Hill.
5. Handbook on Life Cycle Assessment : Operational guide to the ISO standards, Kluwer Academic Publishers, 2004
6. Hosetti, B. B., Kumar A, Eds, Environmental Impact Assessment & Management, Daya Publishing House, 1998
7. Lawrence, D.P., Environmental Impact Assessment – Practical solutions to recurrent problems, Wiley-Inter science, New Jersey, 2003.
8. Petts, J., Handbook of Environmental Impact Assessment, Vol., I and II, Blackwell Science, London, 1999.
9. Rau, GJ. And Wooten, C.D., Environmental Impact Analysis Handbook, McGraw Hill 1980
10. Wathern.P., Environmental Impact Assessment- Theory and Practice, Routledge Publishers, London, 2004.

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

CO1 Identify environmental attributes for the EIA study.
CO2 Identify methodology and prepare EIA reports.
CO3 Specify methods for prediction of the impacts.
CO4. Understand EIA tools & methodologies, auditing and documentation of EIA
CO4 Formulate environmental management plans
CO5 Perform life cycle inventory analysis of products.
CO6 Develop strategies to bring energy efficiency in all stages of the product development cycle.
CO7 Formulate plans for comprehensive environmental protection, in order to comply with environmental laws

SYLLABUS

(SEMESTER-VII)

Subject Code:	**CE7TPE4X**	CREDITS:3			Internal Assessment (IA)			ESE
Subject:	Professional Elective - 4X	L	T	P	CT 1	CT 2	TOTAL	70
		3	-	-	15	15	30	

Professional Elective-4A or Professional Elective-4B or Professional Elective-4C or Professional Elective-4D or Professional Elective-4E	Any one subject to be Selected from the Professional Electives

Professional Electives Group -4	
CE07TPE04A	Engineering Hydrology
CE07TPE04B	Structural Dynamics
CE07TPE04C	Foundation Engineering
CE07TPE04D	Rock Mechanics
CE07TPE04E	Water Resources Planning & Management

SYLLABUS	(SEMESTER VII)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE07TPE04A	L	T	P	CT-1	CT-II	TOTAL	70	100	3
Subject:	Engineering Hydrology	3	0	0	15	15	30			

Course Learning Objectives:

1) To develop the fundamentals of hydrology.
2) To study the various forms of precipitation, evaporation and infiltration
3) To know the types of Hydrograph and Rainfall-Runoff correlations
4) To learn the Flood forecasting and Flood routing methods
5) To understand the fundamentals of ground water hydrology

Course Content:

UNIT-1 Introduction- Description of Hydrologic Cycle, Overview of application of hydrology in engineering. Precipitation, Infiltration and Evapotranspiration Runoff and Hydrographs,

UNIT–2 Forms of precipitation, measurement, depth-area-duration and intensity-duration frequency relations, Evaporation - process, measurement, and estimation, Infiltration process, measurement, and estimation, Evapotranspiration measurement and estimation

UNIT-3 Rainfall Runoff correlations, Flow duration curve, Mass curve, Factors affecting flow hydrograph, Unit hydrograph, its analysis, and S-curve hydrograph, Synthetic and instantaneous unit hydrographs.

UNIT- 4 Statistical analysis, Flood frequency studies, Flood forecasting, rational method, Time Area curves, Risk, reliability, and safety factor, Flood control measures. Introduction to basic routing equations, Design flood, Channel and flood routing. Introduction to HEC-RAS software.

UNIT- 5 Occurrence of groundwater, types of aquifers, aquifer properties, Darcy's law, Conductivity and Transmissivity, yield from a well under steady state conditions, Laboratory and field measurement of permeability

Text Books:

1. Engineering Hydrology K.Subramanya, Tata McGraw-Hill Education
2. Hydrology Principles, Analysis and Design H.M.Raghunath, New Age International
3. Hand Book of Applied hydrology V.T.Chow, McGraw-Hill, Inc
4. Viesmann W and Lewis G Lt (2008) "Introduction to Hydrology". Prentice Hall of India
5. Ojha,C.S.P. , Bhunya, P. and Berndtsson, R.- Engineering Hydrology, Oxford University Press Canada.
6. K. C. Patra, Hydrology and Water Resources Engg., Narosa Publishing house, New Delhi.
7. D. K. Todd, Groundwater Hydrology, John Wiley and Sons

Course Outcomes- Upon completion of this course students shall be able to

1) Describe the basic concepts of hydrology and integrate the physical hydrological processes.
2) Explain the various process, measurement, and estimation of hydrological components
3) Formulate the runoff and hydrograph's estimation and apply into engineering practices.
4) Examine the various statistical methods for Flood studies and can investigate historical datasets.

5) Understand and explain the basics of groundwater hydrology.

SYLLABUS	(SEMESTER VII)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE07TPE04B	L	T	P	CT-I	CT-II	TOTAL	70	100	3
Subject:	Structural Dynamics	3	0	0	15	15	30			

Course Learning Objectives:

1) To Introduce fundamentals of vibrations of SDOF system
2) To Impart damped and undamped system
3) To Present free and forced vibration
4) To Acquaint with free and forced vibration of MDOF system
5) To Present free and forced vibration of continuous system

Course Content:

UNIT- 1: INTRODUCTION: Comparison between static and dynamic analysis; Degrees of freedom; Undamped system; Newton's law of motion; 'D' Alembert's principle; Solution of the differential equation of motion.

UNIT-2: FREE VIBATION OF SINGLE DEGREE - OF - FREEDOM SYSTEM: Equation of motion for single degree - of - freedom system; free undamped vibration of the SDOF system; Damped single degree - of - freedom system -Viscous damping, Equation of motion, critically damped system, Over- damped system. Under-damped system and Logarithmic decrement.

UNIT-3: RESPONSE OF SDOF SYSTEM TO HARMONIC LOADING: Undamped harmonic excitation; Damped harmonic excitation; Evaluation of damping at resonance; Response to support motion; Force transmitted to the foundation. Response of SDOF system to general dynamic loading: Impulsive loading and Duhamel's integral; Numerical evaluation of Duhamel's integral — Undamped system; Numerical evaluation of Duhamel's integral -Damped system.

UNIT-4: GENERALIZED COORDINATES AND RAYLEIGH'S METHOD: Principle of virtual work; Generalized SDOF system - Rigid body; Generalized SDOF system - Distributed elasticity; Rayleigh's method; Improved Rayleigh's method.

UNIT-5: STRUCTURES MODELED AS SHEAR BUILDINGS: Stiffness equations for the shear building; Flexibility equations for the shear building; Free vibration of a shear building (Single bay two Storeyed) - Natural frequencies and normal modes. Forced motion of shear buildings (Two Storeyed): Modal superposition method; Response of a shear building to base motion; Harmonic forced excitation.

Text Books/Reference Books:

1. Dynamics of Structures by A.K.Chopra, Second edition (2001), Prentice Hall India Private Ltd
2. Dynamics of Structures by Clough, R.W. & Penzin, J., McGraw Hill, 1993.
3. Earthquake Resistant Design of Structures by Pankaj Agarwal, Manish Shrikhande , 1st edition (2006), Prentice Hall of India Private Ltd., New Delhi .