SYLLABUS

OF

M. TECH
(Environmental Engineering)
I YEAR

(CBCS)

DEPARTMENT OF CIVIL ENGINEERING

INTEGRAL UNIVERSITY
LUCKNOW

SYLLABUS AND EVALUATION SCHEME

M.Tech. (Environmental Engineering) (w.e.f. 2020-21)

Semester – I

S. No.	Course Category	Code No	Name of Subject	Periods			Credits	Evaluation Scheme				Subject Total
				L	T	P	C	Continuous Assessment (CA)			Exam ESE	
								UE	TA	Total		
1	DC	CE521	Statistics for Environmental Engineers	3	1	-	4	40	20	60	40	100
2	DC	CE522	Environmental Chemistry	3	1	-	4	40	20	60	40	100
3	DC	CE523	Environmental Microbiology	3	1	-	4	40	20	60	40	100
4	DE		Elective –I	3	1	-	4	40	20	60	40	100
5	DC	CE530	Laboratory and Field Testing	-	-	3	2	-	-	60	40	100
Total							**18**					**500**

Semester – II

S. No.	Course Category	Code No	Name of Subject	Periods			Credits	Evaluation Scheme				Subject Total
				L	T	P	C	Continuous Assessment (CA)			Exam ESE	
								UE	TA	Total		
1	DC	CE531	Solid Waste Management	3	1	-	4	40	20	60	40	100
2	DC	CE532	Design and Operations of Water and Wastewater Treatment Plants	3	1	-	4	40	20	60	40	100
3	DC	CE533	Environmental Impact Assessment	3	1	-	4	40	20	60	40	100
4	DC	CE552	Research Methodology	3	1	-	4	40	20	60	40	100
5	DC	CE535	Seminar	-	-	3	2	-	-	60	40	100
Total							**18**					**500**

UE- Unit Exam, **TA-** Teacher Assessment; **ESE –** End Semester Examination.
Note: Duration of ESE shall be 03 (Three) hours per subject

M.Tech (Environmental Engineering)

List of the Elective Paper:

Elective – I

CE524	Transport of Water and Wastewater
CE525	Industrial Wastewater Management
CE526	Air Pollution Control
CE534	Unit Operations and Processes in Water and Wastewater Treatment

Elective – II

CE621	Air and Water Quality Modeling
CE622	Ecological Engineering
CE623	Principles of Environmental Science

Elective – III

CE626	Fundamentals of Sustainable Development
CE627	Cleaner Production
CE628	Environmental Geotechnology

Elective – IV

CE631	Environmental Engineering Structures
CE632	Surface and Ground Water Modeling
CE633	Water Resources Systems Management

TA- Teacher Assessment; ESE – End Semester Examination; CT- Cumulative Test.

Note : Duration of ESE shall be 03 (Three) hours per subject.

Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	CE521	**Title of the Course**	Statistics for Environmental Engineers	**L**	**T**	**P**	**C**
Year	1st	**Semester**	1st	3	1	0	4
Pre-Requisite	NIL	**Co-requisite**	NIL				
Course Objectives	• To develop the knowledge of measures the descriptive statistics • To develop the knowledge of estimates for population proportion, sample distribution. • To develop the knowledge of testing of hypothesis of small samples. • To develop the knowledge of testing of large samples. • To develop the knowledge of different linear programming methods.						

Course Outcomes	
CO1	Student will be able to determine mean, median and able to understand principle of least squares and its respective applications.
CO2	Student will be able to determine mean, median and able to understand principle of least squares and its respective applications.
CO3	Student will be able to test small samples using-r, chi-square & f-distribution.
CO4	Student will be able to test large samples based on normal distribution.
CO5	Student will be able to do problems using graphical, sine pleas, Big M method and also can solve transportation & assignment problem.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Measures of Central Tendency & Principles of Least Squares	Measures of Central tendency, dispersion, skewness and kurtosis- Principles of least squares – Correlation and regression – rank correlation	8	CO1
2	Sampling Distributions and Estimation	Sampling distribution- point and interval estimates for population proportions, mean and variance- one- way and two – way classification.	8	CO2
3	Testing of Hypothesis of Small Samples	Sampling Distributions - t, chi-square and F distribution.	8	CO3
4	Testing of Hypothesis of Large Sample	Test based on Normal distribution, Analysis of variance-one-way and two-way classification.	8	CO4
5	Linear Programming Methods	Basic concepts – Graphical, Simplex, Big M and Two Phase methods – Transportation problem - Assignment problem.	8	CO5

Reference Books:

Freund, J.E. and Miller, I.R., "Probability and Statistics for Engineers", Prentice – Hall of India, 5th Edition, New Delhi, 1994.

Gupta, S.C. and Kapur, V.K., Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi, 1999.

Taha, H.A., "Operations Research: An Introduction", Prentice – Hall of India, 6th Edition, New Delhi, 1997.

Kapoor.V.K., "Problems and Solutions in Operations Research", Sultan Chand & Sons, New Delhi, 1997.

e-Learning Source:

https://nptel.ac.in/syllabus/105103027/

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)													
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	0	0	3	0	0	0	0	0	0	0	3	0	0
CO2	3	0	0	3	0	0	0	0	0	0	0	3	0	0
CO3	0	3	0	3	0	0	0	0	0	0	0	3	0	0
CO4	0	3	0	3	0	0	0	0	0	0	0	3	0	0
CO5	0	3	0	3	0	0	0	0	0	0	0	0	0	0

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	CE522	**Title of the Course**	Environmental Chemistry	**L**	**T**	**P**	**C**
Year	1st	**Semester**	1st	3	1	0	4
Pre-Requisite	NIL	**Co-requisite**	NIL				
Course Objectives	To develop the basic knowledge of water quality parameters and principles of physical, aquatic and bio-chemistry and their application in environmental engineering.						

Course Outcomes	
CO1	To impart the knowledge of elementary physical chemistry.
CO2	To inculcate the basic concept of aquatic chemistry and biochemistry.
CO3	To enhance the fundamentals of environmental chemicals their existence and impact.
CO4	To impart the knowledge of atmospheric chemistry.
CO5	To develop the knowledge of fundamentals of analytical principles applied in experimental analysis.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Principles of Physical Chemistry	Reversible reactions, equilibrium constant, Le-Chatelier principle. Reaction rate Order and molecularity, kinetic equations of different orders, reversible and consecutive reactions. Catalysis-type, characteristics, activation energy, mechanism of catalyst action, acid base catalysts. Photo catalysis. Adsorption-classification, adsorption of gases on solids, adsorption from solutions, ion exchange adsorption, applications, Langmuir theory.	8	CO1
2	Principles of Aquatic Chemistry and Bio Chemsitry	Water resources, sea water- composition, pH of sea water. Humic substances. Aquatic chemical reactions- microbial redox reaction, iron and manganese bacteria, nitrogen transformation bacteria. Enzymes-mechanism and factors influencing enzyme action. Biodegradation- biodegradation of carbohydrates, proteins, fats and oils and detergents. Colloidal state- stability, kinetic, optical and electrical properties.	8	CO2
3	Environmental Chemicals	Chemical speciation – speciation of lead, mercury, arsenic and chromium. Structure and property- activity relationship, fate of organics in the environment – transformation reactions- hydrolysis, elimination, oxidation, reduction and photochemical transformation. Risk evaluation of environmental chemicals, Toxic chemicals in the environment, impact on enzymes. Biochemical effects of arsenic, lead, mercury and pesticides.	8	CO3
4	Atmospheric Chemistry	Structure of atmosphere, chemical and photochemical reactions in the atmosphere. Ozone chemistry- formation and depletion of ozone layer, oxides of nitrogen and sulphur. Acid rain mechanism of formation and effects. Photochemical smog, and sulfurous smog. Greenhouse effect/global warming, greenhouse gases, effects.	8	CO4
5	Fundamentals of Analytical Principles	Analysis of water and water quality parameters -concept of pH, measurement of acidity, alkalinity, hardness, residual chlorine, chlorides, DO, BOD, COD, fluoride and nitrogen. Introduction to spectral analysis, colorimetry, fluorimety, nephlometry, turbidimetry, absorption and emission spectral methods.	8	CO5

Reference Books:

Manahan, Stanley. Environmental chemistry. CRC press, Tenth Edition 2017.
De Anil, Kumar. Environmental chemistry. New Age International, Ninth Edition, 2018.
C.N Sawyer, P.L McCarty and G.F Perkin, Chemistry for Environmental Engineering and Science, 5th ed. Tata McGraw-Hill, 2003

e-Learning Source:

https://onlinecourses.nptel.ac.in/noc22_ce55/preview

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)													
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	0	0	0	0	3	0	0	0	0	0	2	3
CO2	3	2	0	0	0	0	3	0	0	0	0	0	2	3
CO3	3	2	0	0	0	0	3	0	0	0	0	0	3	2
CO4	3	2	0	0	0	0	3	0	0	0	0	0	3	2
CO5	3	2	0	0	0	0	3	0	0	0	0	0	2	2

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	CE523	**Title of the Course**	Environmental Microbiology	**L**	**T**	**P**	**C**
Year	1st	**Semester**	1st	3	1	0	4
Pre-Requisite	NIL	**Co-requisite**	NIL				
Course Objectives	To understand the basis knowledge of microbiology of drinking and waste water and removal of harmful microorganism using different treatment process.						

Course Outcomes	
CO1	Student will be able to understand the basic of microbial, structural and functional characteristics of prokaryotes and eukaryotes cells.
CO2	Student will be able to understand the basics of metabolism and other essential requirements for the growth of microorganism.
CO3	Student will learn about different micro organism present in water and M.F techniques to control the problems caused by microorganism and algae.
CO4	Student will be able to understand the basic microbiology to treat waste water.
CO5	Student will be able to understand about ecotoxicity and removal of toxicity in waste water.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction	Microorganisms – classification, prokaryotic and eukaryotic cells, structure, characteristics, nucleic acids, DNA and RNA, replication, Recombinant DNA – Genetic Engineering.	8	CO1
2	Microbial Growth and Metabolism	Environmental factors, nutrition and metabolism, growth phases, enzymes, carbohydrate, protein, lipids metabolism, respiration, fermentation, Glycolysis, Kreb's cycle, Hexose monophosphate pathway, significance of energetics.	8	CO2
3	Microbiology of Drinking Water	Distribution of microorganisms, indicator organisms, coliforms – fecal coliforms – E.coli, Streptococcus fecalis and Clostridium welchii, differentiation of coliforms – significance – MPN index, M.F. technique, standards. Virus-concentration techniques. Algae in water supplies – problems and control.	8	CO3
4	Microbiology of Toxic Wastewater Treatment	Biodegradation of toxic pollutants – alpha oxidation, beta-oxidation, electrons transport system and oxidative phosphorylation mechanism, Microbiology of biological treatment process.	8	CO4
5	Aquatic Microbiology	Ecotoxicology – toxicants and toxicity – factors influencing toxicity, effects, acute, chronic, concentration response relationships, test organisms, toxicity testing bioconcentration – bioaccumulation – bio-magnification – bioassay – biomonitoring.	8	CO5

Reference Books:

Arun Karnwal, Abdel Rahman Mohammad Said Al-Tawaha , " Environmental Microbiology: Advanced Research and Multidisciplinary Applications ", Bentham Science Publishers (2022).

Pelczar, Jr, M.J., Chan E.C.S., Krieg, R.Noel., and Pelczar Merna Foss, Microbiology, 5th Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 1996.

Stainer, R.Y., Ingrahum, J.L., Wheelis, M.C. and Painter, P.R. General Microbiology, Mac Millan Edition Limited, London, 1989.

Pichai, R. and Govindan, V.S., Edition, Biological processes in pollution control Anna University, Madras, 1988.

e-Learning Source:

https://nptel.ac.in/courses/105107173

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)													
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	0	0	0	0	3	0	0	0	0	0	2	3
CO2	3	2	0	0	0	0	3	0	0	0	0	0	2	3
CO3	3	2	0	0	0	0	3	0	0	0	0	0	3	2
CO4	3	2	0	0	0	0	3	0	0	0	0	0	3	2
CO5	3	2	0	0	0	0	3	0	0	0	0	0	2	2

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	CE526	**Title of the Course**	Air Pollution Control	**L**	**T**	**P**	**C**
Year	1st	**Semester**	1st	**3**	**1**	**0**	**4**
Pre-Requisite	NIL	**Co-requisite**	NIL				
Course Objectives	To improve the knowledge of control measures of particulates and gaseous pollutant applicable for different industries.						

Course Outcomes	
CO1	Students are able to understand about air pollutants, meteorological effect on air pollution.
CO2	Students understand about various devices used for control of particulate matters.
CO3	Students are able to understand about various techniques to control gaseous pollutants.
CO4	Students learn about automobile and noise pollution and their controlling techniques.
CO5	Students know about various air pollution control measures at different industries.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction	Sources and classification of Air Pollutants, Effects of meteorology on Air Pollution – Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns- Atmospheric Diffusion Theories – Dispersion models, Plume rise.	8	1
2	Control of Particulate Contaminants	Factors affecting Selection of control equipments, Working of – Fabric filters, Gravity Separators, Centrifugal separators, Particulate scrubbers, Electrostatic precipitators.	8	2
3	Gaseous Pollutant Control	Absorption: principles, description of equipment-packed and plate columns, Adsorption: principal adsorbents, equipment descriptions – PSA – adsorption cycle-solvent recovery system-continuous rotary bed-fluidized bed, Condensation: contact condensers-shell and tube condensers. Incineration: hydrocarbon incineration, equipment description.	8	3
4	Automobiles Pollution Control	Air pollution due to automobiles, standards and control methods. Noise pollution causes, effects and control, noise standards. Environmental issues, global episodes, laws, acts, protocols.	8	4
5	Control Measures for Industrial Applications	Control methods – Processes based control mechanisms – mineral products – asphaltic concrete, cement plants and glass manufacturing plants; Thermal power plants, Petroleum refining and storage plants, Fertilizers, Pharmaceuticals and wood processing industry.	8	5

Reference Books:

Richard W. Boubel et al "Fundamentals of Air pollution", Academic Press, New York, 1994.

Noel de Nevers, Air Pollution control Engineering, McGraw Hill, New York, 1995.

M.N. Rao et al, "Air Pollution" Tata McGraw Hill, 1989.

S.K. Garg, "Sewage Disposal and Air Pollution Engineering", Khana Publishers, Jan 2009

e-Learning Source:

https://nptel.ac.in/courses/105102089/8

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)													
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	2	2	3	1	2	2	1	2	1	2
CO2	3	2	2	2	3	3	3	2	1	2	0	2	2	3
CO3	3	3	2	3	2	2	3	2	2	2	1	2	2	1
CO4	3	3	1	2	2	2	3	2	2	2	1	2	1	2
CO5	3	2	2	3	2	2	3	1	2	2	1	2	3	2

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	CE530	**Title of the Course**	Laboratory And Field Testing	**L**	**T**	**P**	**C**
Year	1st	**Semester**	1st	0	0	2	1
Pre-Requisite	NIL	**Co-requisite**	NIL				
Course Objectives	• Student will be able to learn how to take sample of water and waste water and to analysis the water and waste water chemically and physically. • Student will be able to learn to take air sample and analysis them for ambient air and noise pollution. • Student will be able to learn to analysis the water for microbiology test.						

Course Outcomes	
CO1	Student will be able to analyze the different physical and chemical characteristics of water and waste water
CO2	Student will be able to monitor ambient noise & air quality
CO3	Student will be able to estimate microbiological quality of water.

Experiment No.	**Content of Experiment**	**Contact Hrs.**	**Mapped CO**
1.	**Chemistry Laboratory practice:** Sampling and characterization of water and wastewater by gravimetric, volumetric and colorimetric methods –	3	CO1
2.	**Sampling-** Taking Grab and composite samples	3	CO1
3.	**Physical characteristics of water/wastewater** – Turbidity, electrical conductivity, solids	3	CO1
4.	**Chemical analysis of water** – BOD, COD, Jar Test etc.	3	CO1
5.	Analysis of soil for organic content, chloride, sulphate, pH, conductivity	3	CO1
6.	**Air Quality Laboratory practice:** Sampling and analysis of ambient air for SPM, SOx, NOx, and other pollutants.	3	CO2
7.	Analytical quality control	3	CO2
8.	Measurement of noise level	3	CO2
9.	**Microbiology Laboratory Practical's** Media preparation and inoculation – staining – environmental factors – bacteriological analysis of water, sewage, test for plate count – coliforms – fecal coliforms – E.coli– M.P.N. and Multiple tube fermentation techniques. Techniques for studying aquatic organisms –	3	CO3
10.	Estimation of heavy metals using atomic absorption spectrophotometer Estimation of Na+ and Ca2+ by flame photometer.	3	CO3

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)													
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	0	0	0	3	3	0	3	3	3	3	0	3	2	2
CO2	0	0	0	3	3	0	3	3	3	3	0	3	2	2
CO3	0	0	0	3	3	0	3	3	3	3	0	3	2	2
CO4	0	0	0	3	3	0	3	3	3	3	0	3	2	2
CO5	0	0	0	3	3	0	3	3	3	3	0	3	2	2

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2018-19							
Course Code	CE531	**Title of the Course**	**SOLID WASTE MANAGEMENT**	**L**	**T**	**P**	**C**
Year	1st	**Semester**	2nd	**3**	**1**	**0**	**4**
Pre-Requisite		**Co-requisite**					
Course Objectives	To educate the students of the basic principles and methods associated with of municipal solid waste and hazarders wastes.						

Course Outcomes	
CO1	Student will be able to characterize the solid waste.
CO2	Student will be able to analyse the best transportation system which may be used for solid waste collection.
CO3	Student will be able to identify the hazardous waste, its proper handling and storage.
CO4	Student will be able to treat the hazardous waste.
CO5	Student will be able to do the various laboratory tests on solid waste

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
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	8	CO1
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 and 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 fir 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.	8	CO2
3	Hazardous Waste Management	Definition and identification of hazardous wastes-sources and characteristics hazardous wastes in Municipal Waste – Hazardous waster regulations –minimization of Hazardous Waste-compatibility, handling and storage of hazardous waste-collection and transport.	8	CO3
4	Hazardous waste treatment and Design	Hazardous waste treatment technologies - Design and operation of 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.	8	CO4
5	Sampling and characterization of Solid Wastes	Sampling and characterization of Solid Wastes; TCLP tests and leach ate studies and other laboratory test on solid waste.	8	CO5

Reference Books:

George Techobanoglousetal, “Integrated Solid Waste Management”, McGraw-Hill Publication, 1993.
Charles A. Wentz; “”Hazardous Waste Management”, McGraw Hill Publication, 1995.
S.K. Garg, “Sewage Disposal and Air Pollution Engineering”, Khana Publishers, Jan 2009

e-Learning Source

https://nptel.ac.in/courses/104103020/42
https://nptel.ac.in/courses/120108005

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)													
PO-PSO CO	PO1	PO2	P3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	0	0	0	0	0	1	1	1	1	0	0	0	1	1
CO2	1	1	1	0	1	1	1	0	0	1	2	1	3	2
CO3	0	0	0	0	2	1	2	1	1	0	0	0	3	2
CO4	2	1	0	0	1	1	1	1	0	0	1	1	3	3
CO5	1	0	0	0	0	0	0	0	1	0	0	1	2	3

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2019-20							
Course Code	CE532	**Title of the Course**	Design And Operations Of Water And Wastewater Treatment Plants	**L**	**T**	**P**	**C**
Year	1st	**Semester**	2nd	**3**	**1**	**0**	**4**
Pre-Requisite		**Co-requisite**					
Course Objectives	To understand the basic of design of water treatment plant and waste water treatment plant along with operation, maintenance and management of treatment plants.						

Course Outcomes	
CO1	Student will be able to design different operational units of a water treatment plant.
CO2	Student will be able to design different operational units of a water treatment plant.
CO3	Student will be able to design different operational units of an industrial water treatment plant.
CO4	Student will be well versed in operation, maintenance, management of different treatment plants.
CO5	Student will be able to explain about different process of treatment plants

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Water Treatment	Design of conventional water treatment units – Aeration, chemical dosing tanks, Flash mixers, Flocculators, Sedimentation tanks, Clariflocculators, filter beds, disinfection units – hydraulic profile and layout of conventional treatment units – upgrading of existing plants – Residue management	8	CO1
2	Wastewater Treatment	Design of sewage treatment plant units – screen chamber, Grit chamber with proportional flow weir, sedimentation tank, Trickling filters (standard rate, high rate), Rotating Biological contactor, activated sludge process, oxidation ditches, aerated lagoons, waste stabilization ponds – hydraulic profile and layout of primary and secondary nits – Anaerobic treatment systems, septic tank and disposal system, Sludge management, Sludge thickening, sludge digestion, sludge dewatering (mechanical and gravity)– Upgrading existing plants – Ultimate residue disposal.	8	CO2
3	Industrial water Treatment	Design of softening plants, Demineralisers, Desalination plants, Boiler feed water treatment – Residue management.	8	CO3
4	Operation, Maintenance and Management	Operational problems – Trouble shooting, Planning, Organising and Controlling of plant operations – Training of operation personnel.	8	CO4
5	Case Studies	Conventional water and sewage treatment plants – Industrial water treatment plants – Sludge treatment facilities – Wastewater reclamation plants – Field visits.	8	CO5

Reference Books:

Manual on "Water Supply and Treatment" CPHEEO, Ministry of Urban Development, GOI, New Delhi, 1999.

Manual on "Sewerage and Sewage Treatment" CPHEEO, Ministry of Urban Development, GOI, New Delhi, 1999.

METCALF & EDDY, INC. „Wastewater Engineering, Treatment, Disposal and Reuse.
Fourth Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2002.

e-Learning Source

https://nptel.ac.in/courses/10504102/4
https://nptel.ac.in/courses/10504102/17

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)													
PO-PSO CO	PO1	PO2	P3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	0	0	0	0	0	1	1	1	1	0	0	0	1	1
CO2	1	1	1	0	1	1	1	0	0	1	2	1	3	2
CO3	0	0	0	0	2	1	2	1	1	0	0	0	3	2
CO4	2	1	0	0	1	1	1	1	0	0	1	1	3	3
CO5	1	0	0	0	0	0	0	0	1	0	0	1	2	3

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	CE533	**Title of the Course**	Environmental Impact Assessment	**L**	**T**	**P**	**C**
Year	1st	**Semester**	2nd	3	1	0	4
Pre-Requisite	NIL	**Co-requisite**	NIL				
Course Objectives	To understand the basic of principles of environmental impact assessment, its different components and methods of documentation and monitoring.						

Course Outcomes	
CO1	To inculcate the basic concept of Environmental Impact Assessment (EIA).
CO2	To impart the knowledge of components and Methods of EIA.
CO3	To enhance the fundamentals of quality control in EIA practice and evaluation.
CO4	To impart the knowledge of documentation and monitoring of developmental projects.
CO5	To edify some case studies of EIA of developmental projects at national & international level.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction	Environmental Impact Assessment (EIA) – Environmental Impact Statement (EIS) – Environmental Risk Assessment (ERA) – Legal and Regulatory aspects in India – Types and limitations of EIA – Terms of Reference in EIA. Issues of EIA – National – cross sectoral – social and cultural.	8	CO1
2	Components and Methods	Components – screening – setting – analysis – prediction of impacts – mitigation. Matrices – Networks – Checklists. Importance assessment techniques – cost benefit analysis – analysis of alternatives – methods. Prediction and assessment of impacts – air, water, soil, noise, biological, cultural, social and economic environments. Standards and guidelines for evaluation. Public Participation in environmental decision making.	8	CO2
3	Quality Control	Trends in EIA practice and evaluation criteria – capacity, building for quality assurance. Expert System in EIA – use of regulations and AQM.	8	CO3
4	Documentation and Monitoring	Document planning – collection and organization of relevant information – use of display materials – team writing – reminder checklists. Environmental monitoring – guidelines – policies – planning of monitoring programs. Environmental Management Plan. Post project audit.	8	CO4
5	Case Studies	Case studies of EIA of developmental projects.	8	CO5

Reference Books:

Glasson, John, and Riki Therivel. Introduction to environmental impact assessment. Routledge, Fifth edition, 2019.

N.S. Raman , A.R. Gajbhiye & S.R. Khandeshwar, Environmental Impact Assessment, Dreamtech Press, First Edition, 2019

e-Learning Source:

https://onlinecourses.nptel.ac.in/noc22_ar07/preview

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)													
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	0	0	0	0	0	3	0	0	0	0	0	2	3
CO2	3	0	0	0	0	0	3	0	0	0	0	0	2	3
CO3	3	0	0	0	0	0	3	0	0	0	0	0	3	2
CO4	3	0	0	0	0	0	3	0	0	0	2	0	3	2
CO5	3	0	0	3	0	0	3	0	0	0	0	0	2	2

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2020-2021							
Course Code	CE552	**Title of the Course**	Research Methodology	**L**	**T**	**P**	**C**
Year	1st	**Semester**	2nd	3	1	0	4
Pre-Requisite	NIL	**Co-requisite**	NIL				
Course Objectives	To develop critical thinking and understand the concept of gap identification for research. To identify appropriate research methods for a specific research problem and prepare professional research report						

Course Outcomes	
CO1	Develop the student's understanding of research methods and applying those methodology to solve complex research problems.
CO2	Develop student's understanding of sampling techniques for research.
CO3	Develop student's understanding of different data collection methods and their suitability.
CO4	Students will gain understanding of analyzing the quantitative data.
CO5	Students will gain understanding of analyzing the qualitative data and will learn how to write a professional research report.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Research and Problem Definition	Meaning, Objective and importance of research, Types of research, research process, Challenges in research, Philosophical worldviews in research.	8	CO1
2	Research Design	Research design, Methods of research design, Selection of a Research Design research process and steps involved, Literature Survey, Bibliometric analysis.	8	CO2
3	Data Collection	Sample Design, Sampling Methods, sampling errors, Classification of Data, Measurement and Scaling, Methods of Data Collection, data preparation.	8	CO3
4	Data Analysis and interpretation	Data analysis, Statistical techniques and choosing an appropriate statistical technique, Hypothesis, Hypothesis testing, Data processing software (e.g. SPSS etc.), statistical inference, Interpretation of results.	8	CO4
5	Technical Writing and Reporting of Research	Types of research report: Dissertation and Thesis, research paper, review article, short communication, conference presentation etc., Referencing and referencing styles, Mechanics of writing a report, Research Journals, Indexing and citation of Journals, Intellectual property, Plagiarism, Oral Presentation.	8	CO5

Reference Books:

C. R. Kothari, Gaurav Garg, Research Methodology : Methods And Techniques, New Age International Publishers; Fourth edition (1 September 2019)
Creswell, J. W., & Creswell, J. D. (2017). Research design: Qualitative, quantitative, and mixed methods approaches. Sage publications.
Sekaran, U., & Bougie, R. (2016). Research methods for business: A skill building approach. John Wiley & Sons.

e-Learning Source:

https://onlinecourses.nptel.ac.in/noc22_ge08/preview

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)													
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	0	0	0	0	0	0	0	0	0	0	0
CO2	3	3	2	0	0	0	0	0	0	0	0	0	0	0
CO3	3	3	2	3	0	0	0	0	0	0	0	0	0	0
CO4	3	3	2	3	3	0	0	0	0	0	0	0	0	0
CO5	3	3	0	0	0	0	0	3	0	3	0	0	0	0

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	CE535	**Title of the Course**	Seminar	**L**	**T**	**P**	**C**
Year	1st	**Semester**	2nd	0	0	3	2
Pre-Requisite	------	**Co-requisite**	------				
Course Objectives	• To understand organization of topic for presentation and research. • To learn the skill set required to perform research.						

Course Outcomes	
CO1	Skill to search on any topic to extract the inference.
CO2	Ability to organize – deliver presentation and report on any topic.

Unit No.	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Seminar shall be delivered preferably on the topic of dissertation or at least the area of dissertation. The concepts must be clearly understood and presented by the student. Prior to presentation, he/she shall carry out the detailed literature survey from Standard References such as International Journals and Periodicals, recently published reference Books etc. All modern methods of presentation should be used by the student. A hard copy of the report (25 to 30 pages) should be submitted to the Department before delivering the seminar. A PDF copy of the report in soft form must be submitted to the supervisor along with other details if any. Supervisor should guide concern student 2hrs /week/student for seminar.	3	CO1 and CO2

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)													
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	0	0	0	3	3	1	2	1	3	3	0	3	3	3
CO2	0	0	0	0	3	1	2	1	3	3	0	3	3	3

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**