SYLLABUS

OF

B. TECH

OF

III YEAR

B. TECH. (CBCS)

DEPARTMENT OF CIVIL ENGINEERING

INTEGRAL UNIVERSITY LUCKNOW

SYLLABUS AND EVALUATION SCHEME

Branch: Civil Engineering

(w.e.f. 2020-21)

Year – III, Semester – V

S. No.	Course Category	Code No	Name of Subject	Periods			Credits	Evaluation Scheme				Subject Total
								Sessional Exam			Exam	
				L	T	P	C	CT	TA	Total	ESE	
1	DC	CE301	Structural Analysis-II	3	1	0	4	40	20	60	40	100
2	DC	CE302	Design of Reinforced Concrete Structure-I	3	1	0	4	40	20	60	40	100
3	DC	CE303	Transportation Engineering	3	1	0	4	40	20	60	40	100
4	DC	CE304	Geotechnical Engineering-I	3	1	0	4	40	20	60	40	100
5	DC	CE305	Engineering Geology	3	1	0	4	40	20	60	40	100
6	DC	CE306	Water Resources Engineering	3	1	0	4	40	20	60	40	100
PRACTICAL / DRAWING / DESIGN												
7	DC	CE307	Structural Analysis Lab	0	0	2	1	40	20	60	40	100
8	DC	CE308	Transportation Engineering Lab	0	0	2	1	40	20	60	40	100
9	DC	CE309	Quantity Surveying & Estimation	0	0	2	1	40	20	60	40	100
Total				**18**	**6**	**6**	**27**					**900**

L – Lecture; **T –** Tutorial; **P –** Practical; **C** – Credits; **CT** – Class Test; **TA** – Teacher Assessment
Sessional Total (CA) = Class Test + Teacher Assessment

Subject Total = Sessional Total (CA) + End Semester Examination (ESE)

DC – Departmental Core
DE – Departmental Elective
OE – Open Elective

SYLLABUS AND EVALUATION SCHEME

Branch: Civil Engineering

(w.e.f. 2020-21)

Year – III, Semester – VI

S. No.	Course Category	Code No	Name of Subject	Periods			Credits	Evaluation Scheme				Subject Total
								Sessional Exam			Exam	
				L	T	P	C	CT	TA	Total	ESE	
THEORY SUBJECT												
1	DC	CE310	Environmental Engineering-I	3	1	0	4	40	20	60	40	100
2	DC	CE311	Design of Reinforced Concrete Structure-II	3	1	0	4	40	20	60	40	100
3	DC	CE312	Geotechnical Engineering-II	3	1	0	4	40	20	60	40	100
4	DE	CE313-CE317	Departmental Elective-I	3	1	0	4	40	20	60	40	100
5	DE	CE320-CE324	Departmental Elective-II	3	1	0	4	40	20	60	40	100
6	OE	-	Open Elective	3	1	0	4	40	20	60	40	100
PRACTICAL / DRAWING / DESIGN												
8	DC	CE327	Environmental Engineering Lab–I	0	0	2	1	40	20	60	40	100
9	DC	CE328	Geotechnical Engineering Lab	0	0	2	1	40	20	60	40	100
10	DC	CE329	Survey Camp	0	0	0	1	0	0	100	0	100
Total				**18**	**6**	**4**	**27**					**900**

L – Lecture; **T –** Tutorial; **P –** Practical; **C** – Credits; **CT** – Class Test; **TA** – Teacher Assessment
Sessional Total (CA) = Class Test + Teacher Assessment

Subject Total = Sessional Total (CA) + End Semester Examination (ESE)

DC – Departmental Core
DE – Departmental Elective
OE – Open Elective

List of Departmental Electives (I & II)

Departmental Elective - I

CE313	Traffic Engineering
CE314	Open Channel Flow
CE315	Matrix Methods of Structural Analysis
CE316	Sustainable Construction Techniques
CE317	Ground Improvement Techniques

Departmental Elective - II

CE320	Dock Harbor Tunnel Engineering
CE321	Design of Hydraulic Structures
CE322	Maintenance & Rehabilitation of Structures
CE323	Occupational Health and Safety Engineering
CE324	Principles of Town Planning and Architecture

Integral University, Lucknow

Effective from Session: 2015-16							
Course Code	CE301	**Title of the Course**	Structural Analysis – II	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	3	1	0	4
Pre-Requisite	CE212	**Co-requisite**	NIL				
Course Objectives	• To analyze the indeterminate structures using different methods. • To apply the Muller Breslau principle for drawing the ILD of Indeterminate structures. • To analyze the suspension bridges. • To apply the methods of analyzing of indeterminate structures by matrix method. • To give a basic idea of Plastic Theory.						

Course Outcomes	
CO1	To impart various methods of analyzing the indeterminate structures.
CO2	To enable the student how to draw the influence line diagrams of indeterminate structures and their applications.
CO3	To enable him to analyze the cables and suspension bridges.
CO4	This unit enables to understand the method of analyzing the indeterminate structures using matrix method.
CO5	To enable the student to have the basic knowledge of plastic theory.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Analysis of Linear and Two dimensional Structures	Analysis of fixed beam, continuous beam and simple frames with or without translation of joints. Slope deflection method, Moment distribution method, strain energy method.	08	CO1
2	Two Hinged Arches & Influence Line Diagram for Indeterminate Structures	Muller-Breslau's principle and its application for drawing influence line for Indeterminate beams. Analysis of two hinge arches, Influence line diagram for maximum bending moment, shear force and thrust.	08	CO2
3	Analysis of Suspension Cable & Bridge Girders	Suspension bridges, Analysis of cable with concentrated and continuous loadings, Analysis of two and three hinge stiffening girder, Influence line diagram for maximum bending moment and shear force in the stiffening girders.	08	CO3
4	Matrix Methods of Structure Analysis	Basics of force and displacement matrix, matrix method for the analysis of beams and frames.	08	CO4
5	Plastic Analysis of Structures	Basics of plastic analysis, Application of static and kinematics theorem, Plastic analysis of beams and frames.	08	CO5

Reference Books:

Theory of Structures by Pundit and Gupta, Vol. I & II, McGraw Hill Publication, New Delhi, First Edition, 2000

Basic structural analysis by CS Reddy, TMH publishing Company Ltd. New Delhi, 3rd Edition, 2010

Theory of Structures by S. Ramamrutham and R. Narayan, Dhanpat Rai Publishing Company, Delhi, 2nd Edition 2015

Analysis of statically indeterminate structures P. Dayaratnam. Affiliated East-West press Pvt. Ltd.

Indeterminate structural Analysis C.K.Wang, McGraw Hill Publications, 5th Edition 2014

Theory of structures Vol. II Vazirani and Ratwani, Sixteenth edition (2017)

e-Learning Source:

https://nptel.ac.in/courses/105104102/

	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	1	2	3	2	2	2	1	0	1	1	1	0	1	2
CO2	1	1	0	2	0	1	2	2	2	1	1	1	1	1
CO3	2	2	1	2	2	2	1	2	1	1	1	0	2	2
CO4	2	2	3	3	1	2	2	1	2	1	1	0	2	2
CO5	1	2	3	0	1	2	2	1	2	1	1	0	1	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	CE302	**Title of the Course**	Design of Reinforced Concrete Structure-I	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	**3**	**1**	**0**	**4**
Pre-Requisite	CE204	**Co-requisite**	NIL				
Course Objectives	To understand the Basic concept and procedure of Designing Reinforced Concrete Structural Components						

Course Outcomes	
CO1	Student will be able to design singly reinforced beam of different spans and loading.
CO2	Student will be able to design doubly reinforced beam of different spans and loading.
CO3	Student will be able to design beams for shear reinforcement and can determine development length.
CO4	Student will be able to design slab and design the structure for serviceability
CO5	Student will be able to design compression member (column) by limit state method.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Attributes of Structural Design	Material properties of RCC Making materials, Basic design approach, Working stress & Limit state method of design. Assumptions, Analysis and Design of a rectangular singly and doubly reinforced section by Working stress design method	08	1
2	Limit State Design of Beams	Assumption in Limit state design method, Codal recommendations, Design of a rectangular singly & doubly reinforced section, T & L sections by limit state method.	08	2
3	Behavior of RC Beams in Shear	Shear strength of beam with and without shear reinforcement, Minimum & maximum shear reinforcement, Design of beam in shear using Limit state method. Nature of bond between steel and concrete, Concept of development length and anchorage, Calculation of development length using Limit state methods.	08	3
4	Limit State Design of Slab & Stair	One way solid slabs, Simply supported and continuous. Two way slabs: Simply supported and continuous. Types of RCC stairs, loads and load effects on stairs, design of doglegged stairs. Introduction to Short term, long term deflections & Cracks in RCC.	08	4
5	Limit State Design of Compression Members	Classification of compression members, Codal provisions relating to design of RC columns, Effective length of RC column, Minimum eccentricity, Design of Axially loaded (tied and helically reinforced) short columns by Limit state method	08	5

Reference Books:

A.K. Jain "Reinforced concrete design, limit state Method", Nem Chand & Bros.; 7th Edition 2012

S .Unnikrishna. and Devdas Menon, "Reinforced concrete design", McGraw Hill Education; 3rd Edition 2009

B.C. Punmia and A.K. Jain "Limit State Design of Reinforced Concrete", Laxmi Publications,1st Edition Reprint 2007

IS 456-2000 Indian Standard "Plain & Reinforced Concrete-code of practice", BIS, New Delhi.

e-Learning Source:

http://nptel.ac.in/courses/105105105/

http://nptel.ac.in/downloads/105105104/

	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	1	2	1	0	0	1	0	0	1	3	2
CO2	3	2	2	1	2	1	0	0	1	0	0	1	2	2
CO3	3	2	2	1	2	1	0	0	1	0	1	1	3	2
CO4	3	2	3	1	2	1	0	0	1	0	1	1	3	2
CO5	3	2	3	1	2	1	0	0	1	0	1	1	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: 2018-19							
Course Code	CE303	**Title of the Course**	Transportation Engineering	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	**3**	**1**	**0**	**4**
Pre-Requisite	NIL	**Co-requisite**	NIL				
Course Objectives	• To introduce Transportation Engineering • To develop understanding of Highway design and Traffic Engineering • To develop understanding of Railway Engineering • To develop knowledge of Airport design and basics of Harbor engineering						

Course Outcomes	
CO1	Students who successfully complete this module will be able to understand factors influencing highway geometric design and will be able to perform horizontal& vertical alignment of the highway. They will also be able to apply basic science principles in determining stopping & overtaking sight distance.
CO2	Students who successfully complete this module can identify factors affecting pavement design. The student will develop ability to comprehend data from India Roads Congress codes for pavement design and stress calculations in the same.
CO3	Students are expected to identify parameters defining traffic state of transportation systems and design traffic signals, perform level of service analysis, collect & process traffic data and determine capacity of road segments.
CO4	Students develop understanding of the basic working of railway track system. They can also perform geometric design and capacity analysis of railway permanent way.
CO5	Students develop a basic understanding of factors affecting airport and runway design. They can also perform basic layout of Harbor components.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction and Geometric Design of Highways	Modes of Transportation, History of road development road types and patterns. Introduction to highway alignment and engineering surveys; Geometric design of highways –cross-sectional elements, sight distances, horizontal and vertical alignments.	08	CO1
2	Pavement Design and Highway Materials	Design factors for flexible and rigid pavements; Design of flexible pavement by CBR method; Design of rigid pavement: Westergaard's theory, load and temperature stresses, critical combination of stresses, joints. Highway materials - desirable properties and quality control tests; Design of bituminous paving mixes.	08	CO2
3	Traffic Engineering	Traffic flow studies, speed studies, travel time: delay study and O-D study, PCU, peak hour factor, parking study; Microscopic and macroscopic parameters of traffic flow, fundamental relationships; Control devices, signal design by Webster's method; Types of intersections and channelization; Highway capacity and level of service.	08	CO3
4	Railway Engineering	Introduction to Railways: Permanent way, capacity of railway track, cross-section of subgrade. Track geometry, gradient, horizontal curves, vertical curves, superelevation and safe speed on curve, widening of tracks, cant deficiency, negative superelevation and compensation for curvature on gradients, tractive resistant and tractive power. Point and crossing: Element of a turnout, detail of a switch and crossing numbers and angles of crossings, design of a turnout.	08	CO4
5	Airport and Harbour	Aircraft characteristics affecting airport planning, Site selection and design, airport layout, runway orientation, wind rose diagram. Airport runway length and corrections, taxiway and exit taxiway design. Harbours, layout and port facilities, Break waters, Jetties, wharves, navigation aids.	08	CO5

Reference Books:

SK Khanna & CG Justo, Highway Engineering, Nem Chand and Brothers, Roorkee, 4th Reprint 2015

Satish Chandra and M.M Agarwal, Railway Engineering, Oxford University Press, Delhi, 4th Edition 2014

L.R. Kadiyali, Highway Engg., Kanna Tech Publications, Delhi 6th Edition, 2014

Specification for Roads & Bridges by Ministry of Road Transport & Highways and Indian Road Congress, 2014

e-Learning Source:
http://nptel.ac.in/downloads/105101008/
http://nptel.ac.in/downloads/105101008/
http://nptel.ac.in/courses/105107123/

	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	3	0	0	1	0	1	1	0	1	0	1	1
CO2	3	1	2	1	0	0	0	1	1	0	0	0	2	3
CO3	2	1	2	0	0	0	0	1	1	0	1	0	3	1
CO4	3	0	3	0	0	1	0	0	0	0	0	0	1	1
CO5	2	0	2	0	0	1	0	0	0	0	0	0	1	1

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

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

Integral University, Lucknow

Effective from Session: 2015-16							
Course Code	CE304	**Title of the Course**	Geotechnical Engineering-I	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	**3**	**1**	**0**	**4**
Pre-Requisite	------	**Co-requisite**	------				
Course Objectives	• To impart origin, index properties and classification of soil engineering. • To Impart basics principles of flow , soil permeability through porous media and effective stress • To impart about how stress are developed and distributed in soil due different load conditions • To impart the knowledge of soil compaction ,Consolidation and their application • To impart the knowledge about shear strength of soil and their application.						

Course Outcomes	
CO1	Learner should be able to describe soil properties, relate index properties and able to classify soil.
CO2	Learner should be able to assess the permeability and formulate effective stress for different conditions.
CO3	Leaner should be able to compute stress in soil under different loading condition.
CO4	Leaner should be able to interpret compaction and consolidation characteristics of different soil and their application.
CO5	Leaner should be able to evaluate shear strength of soil.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Soil and Index Properties	Engineering Geology of Soil and its formation, Preliminary definitions of Soil Properties, phase diagram, inter-relationship, Index properties of Soil. Classification of Soils: Classification of soil systems – Particle size classification, Textural classification, AASHTO classification, Unified soil classification and Indian soil classification.	08	CO1
2	Permeability in Soil	Soil Water: Types of soil water, Capillarity in soils, Permeability of soils, Darcy's law, Determination of permeability of soils, Permeability of stratified soils, Seepage velocity, flow net, Absolute coefficient of permeability, Factors affecting permeability, Effective stress principle- Effective stress under different field conditions- Seepage pressure-Quick sand condition.	08	CO2
3	Stresses in Soil	Stresses in soils: Normal and shear Stresses on a plane, Stresses due to applied loads, Boussinesq's solution for a point load, line load, strip load, uniformly loaded circular and rectangular areas, Isobar and pressure bulb concept, stress distribution on horizontal and vertical planes, Newmark's chart and its application, contact pressure.	08	CO3
4	Compaction and Consolidation	Soil structure. Compaction of soil – Theory of compaction, laboratory compaction tests, optimum moisture content and zero air void line, Field methods and compaction control. Compressibility and Consolidation: Virgin compression curve, Normal and Over Consolidated soils, Over Consolidation Ratio, Terzaghi's one dimensional consolidation theory, Laboratory consolidation test. Determination of coefficient of consolidation by log of time fitting and square root of time fitting methods, Consolidation settlement.	08	CO4
5	Shear Strength	Introduction of Shear Strength of Soil: State of stress at a point, Mohr's stress circle. Shear strength of soil. Mohr-Coulomb failures envelop. Direct, Triaxial, Unconfined and Vane shear tests, principles of drained and undrained tests, Strength of loose and dense sands, pore pressures.	08	CO5

Reference Books:

Gopal Ranjan and A.S.R.Rao, "Basic and Applied Soil Mechanics", New Age International (P) Ltd, 2nd Edition (2005), New Delhi

K R Arora, "Soil Mechanics and Foundation Engineering", Standard Publisher Dist., 2nd Edition 2009.

V.N.S.Murty, "Soil Mechanics and Foundation Engineering", Sai Kripa Technical Consultants, 1st edition 2009.

By B. C. Punmia, Ashok Kumar Jain, "Soil Mechanics and Foundations", Laxmi Publications Ltd., 16th edition (2017), New Delhi.

e-Learning Source:

https://nptel.ac.in/courses/105105168/

https://nptel.ac.in/courses/105101201/

	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	0	2	0	0	0	0	0	0	0	0	3	2
CO2	3	3	0	2	0	0	0	0	0	0	0	0	3	2
CO3	3	3	0	2	0	0	0	0	0	0	0	0	3	2
CO4	3	3	0	2	0	0	0	0	0	0	0	0	3	2
CO5	3	3	0	2	0	0	0	0	0	0	0	0	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: 2015-16							
Course Code	CE305	**Title of the Course**	Engineering Geology	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	3	1	0	4
Pre-Requisite	------	**Co-requisite**	------				
Course Objectives	• To understand the basic knowledge of types natural materials like rocks & minerals and soil. • To understand the basic concept of earthquake, type, causes and its measurement. • To learn about dam, types, failure and its geological investigation of site. • To know the Ground water availability, zones of ground water and groundwater investigations. • To understand the basic concept of Soil profile and classification, engineering properties of soil, geological problems related with tunneling.						

Course Outcomes	
CO1	Students are able to understand and identify different type's natural materials like rocks & minerals and soil.
CO2	Students are able to understand the concept of earthquake, type, causes and its measurement.
CO3	Students are able to understand about the dam, types, failure and its geological investigation.
CO4	To understand the Ground water, zones of ground water, groundwater investigations. Concept of water shed management, Ground water Pollution, Impact of mining activity.
CO5	Students are able to understand the concept of Soil profile and classification, engineering properties of soil, geological problems connected with tunneling, geological consideration.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	General Geology	Introduction to the Earth Sciences. Elementary idea about the internal structure of the earth. The elementary knowledge and demonstration of the physical properties of the common rock forming minerals. Introduction and demonstration to the major group of rocks, mode of origin classification and properties.	08	CO1
2	Structural Geology, Earthquake and Landslides	Theory and demonstration of Strike and Dip, Out crops, volcanoes, overlaps, inliers and outliers types and classification of folds, faults, joints, unconformities Classifications, causes and effects of Earthquakes and Landslides, seismic curve, seismograph, seismogram, seismic problems of India, seismic zones of India, case histories.	08	CO2
3	Geological Investigation, Geology of Dams and Reservoirs	Interpretation of geological maps, use of aerial maps in geological surveying, Topographic maps, Geological Cross-section, outcrop patterns. Geophysical methods as applied to civil engineering for subsurface analysis. Types of dams, preliminary and detailed geological investigation for a dam site, important International and Indian examples of failure of dams and their causes, factors affecting the seepage and leakage of the reservoirs and the remedial measures.	08	CO3
4	Ground Water Geology	Ground water, zones of ground water, water table and perched water table, ground water provinces of India, water bearing properties of rocks, springs, selection of a site for well sinking and groundwater investigations. Concept of water shed management, Ground water Pollution, Impact of mining activity on ground water.	08	CO4
5	Soil formation, Rock Mechanics and Tunneling	Soil profile and classification, engineering properties of soil. Purposes of tunneling and geological problems connected with tunneling, geological consideration in road alignment, roads in complicated regions, problems after road construction, geology of bridge sites	08	CO5

Reference Books:

Subinoy Gangopadhyay "Engineering Geology" Oxford University Press (2013).

Parbin Singh. "Engineering and General Geology", Katson Publishing House (2008).

P.K.Mukerjee, "A text book of Geology", Calcutta, Word Publisher (14 January 2013).

K.M.Bangar "Principle of Engineering Geology", Standard publishers Distributors (2009).

e-Learning Source:

https://nptel.ac.in/courses/105105106/
https://web.viu.ca/earle/geol111/lecture-notes.html

	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	2	1	2	3	1	2	3	1	2	2	2	2	0	0
CO2	1	3	3	1	1	2	3	1	1	2	1	1	0	0
CO3	2	3	3	2	2	1	3	2	3	3	2	2	0	0
CO4	2	2	3	2	3	2	3	1	2	2	1	2	0	0
CO5	3	2	2	2	1	2	2	2	1	2	1	1	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: 2018-19							
Course Code	CE306	**Title of the Course**	Water Resources Engineering	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	**3**	**1**	**0**	**4**
Pre-Requisite	CE201	**Co-requisite**	NIL				
Course Objectives	Students are expected to realize the importance of water resources and its application in Civil engineering.						

Course Outcomes	
CO1	Students are able to understand about various types and forms of precipitation and its measurement, Evaporation and Evapotranspiration estimation methods.
CO2	Students are able to understand the concept of runoff, hydrographs, unit hydrograph and S- hydrograph.
CO3	Students are able to understand about peak flood estimation, its return period prediction, flood control management.
CO4	Students are able to understand the Ground water, zones of ground water and yield determination of wells.
CO5	Students are able to understand the concept of irrigation, its types, merits & demerits, water requirement of crops, soil moisture.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Hydrology	Hydrologic cycle, Precipitation types and forms, rainfall and its measurement, rain gauges, rain gauge network, presentation of rainfall data, computation of mean rainfall using arithmetic mean, Theissen polygon and Isohyetal methods , estimation of missing rainfall Infiltration – process, infiltration indices and Horton's equation; Evaporation and Evapotranspiration – Pan evaporation, empirical equations for estimating evaporation and evapotranspiration.	08	1
2	Runoff and Hydrographs	Runoff- definition, types, catchment characteristics, factors affecting runoff, methods of runoff estimation, flow duration curve and flow mass curve, stage-discharge relationship and rating curve Hydrograph Analysis: Flood hydrograph, Components of hydrograph, base flow separation, direct runoff hydrograph, Unit hydrograph theory, derivation of unit hydrograph and its duration, S-hydrograph and instantaneous unit hydrograph, Derivation of unit hydrograph for ungauged catchments using Snyder's method.	08	2
3	Analysis of Floods	Peak discharge estimation methods, Concepts of return period, flood frequency analysis, Gumbel's and Log-Pearson Type-III distributions, Flood Routing: Concepts of flow routing, hydraulic and hydrologic routing, Reservoir routing, Channel routing, Muskinghum method of channel routing and flood forecasting. Flood control management.	08	3
4	Ground Water Hydrology	Zones of ground water ,types of aquifers, aquiclude, aquifuge, aquitard, confined and unconfined aquifers, perched aquifer, aquifer properties-specific storage, specific capacity, transmissivity, Theims and Dupit theory for yield calculation in Confined and unconfined aquifers, Darcy's law, types of wells, interference of wells, well losses, recuperation test for yield determination from an open well.	08	4
5	Irrigation Engineering	Irrigation: necessity, Types of irrigation , advantages and disadvantages of irrigation, irrigation efficiencies, Consumptive use and its determination, water requirement of various crops, Duty, Delta, Base period and crop period, relationship between base period, duty and delta. Soil moisture: Hygroscopic water, capillary water, gravity water, saturation capacity, field capacity, permanent wilting point.	08	5

Reference Books:

Subramanya K., Engineering Hydrology, Tata McGraw Hill (2016)

S.K Garg, Irrigation Engineering and Hydraulic structures, Khanna publishers(2016)

P. Jaya Rami Reddy , A Textbook of Hydrology, Laxmi Publications; Third edition (2016)

Punmia B.C. & Lal P.B., Irrigation and Water Power, Laxmi Publications(2016)

e-Learning Source:

https://gradeup.co/well-hydraulics-and-aquifers-i-ed587c01-975d-11e6-bf75-9c0e0d13dead

https://www.youtube.com/watch?v=fx1uUek3Iqg
http://nptel.ac.in/courses/105104103/1

	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	2	2	1	3	1	1	0	0	0	0	1	2	0	0
CO2	3	2	2	2	2	1	2	0	1	1	0	0	0	0
CO3	3	3	2	2	1	2	0	1	2	2	1	2	0	0
CO4	2	2	2	2	3	2	1	2	1	1	2	2	0	0
CO5	3	3	2	2	2	2	1	1	2	1	2	3	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: 2015-16							
Course Code	CE307	**Title of the Course**	Structural Analysis Lab	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	**0**	**0**	**2**	**1**
Pre-Requisite	CE212	**Co-requisite**	CE-301				
Course Objectives	• To share the road influence over a structure. • To share the critical loads over structure such as beam and columns.						

Course Outcomes	
CO1	The students will aware about the influences over a beam due to load when applied (externally).
CO2	The students will aware about the critical load to secure the structural member such as beam and column.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Experiment 1	To determine flexural Rigidity (EI) of a given beam.	02	CO1
2	Experiment 2	To verify Maxwell's Reciprocal Theorem.	02	CO1
3	Experiment 3	To find horizontal thrust in a three hinged arch and to draw influence line diagrams for Horizontal Thrust and Bending Moment.	02	CO1
4	Experiment 4	To find horizontal thrust in a two hinged arch and to draw influence line diagrams for Horizontal Thrust and Bending Moment.	02	CO1
5	Experiment 5	To find carry over factor for the beam with far end fixed.	02	CO1
6	Experiment 6	To find deflection of curved members	02	CO1
7	Experiment 7	To find bar forces in a three member structural frames with pin jointed bar.	02	CO2
8	Experiment 8	To find Critical loads in Struts with different end conditions.	02	CO2
9	Experiment 9	To find forces in elastically Coupled Beam.	02	CO2
10	Experiment 10	To find deflections in beam having unsymmetrical bending.	02	CO2
11	Experiment 11	To determine the fatigue strength of mild steel specimen.	02	CO2

Reference Books:

Theory of Structures by Pundit and Gupta, Vol. I & II, McGraw Hill Publication, New Delhi, First Edition, 2000

Basic structural analysis by CS Reddy, TMH publishing Company Ltd. New Delhi, 3rd Edition, 2010

Theory of Structures by S. Ramamrutham and R. Narayan, Dhanpat Rai Publishing Company, Delhi, 2nd Edition 2015

Analysis of statically indeterminate structures P. Dayaratnam. Affiliated East-West press Pvt. Ltd.

Indeterminate structural Analysis C.K.Wang, McGraw Hill Publications, 5th Edition 2014

Structural Analysis (Matrix Approach) by Pundit and Gupta, McGraw Hill Publication, New Delhi. 2nd edition, 2008.

Theory of structures Vol. II Vazirani and Ratwani, Sixteenth edition (2017)

Fundamentals of Structural Mechanics and Analysis by M.L Gambhir, PHI Learning Private Limited, New Delhi.

	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	0	0	0	0	0	0	0	0
CO2	3	0	0	0	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	CE308	**Title of the Course**	Transportation Engineering Lab	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	**0**	**0**	**2**	**1**
Pre-Requisite	NIL	**Co-requisite**	NIL				
Course Objectives	To provide practical knowledge about tests conducted on road aggregates. To provide skills so that learner can conduct tests on bitumen and bitumen mixes.						

Course Outcomes	
CO1	Leaner will be able to determine the whether suitability of road aggregates as per Indian Codes.
CO2	Learner will be able to determine properties of Bitumen as well as bitumen mixes by performing tests on them and ascertain their suitability for varies field conditions.
CO3	Leaner will be able to perform traffic volume survey and traffic speed survey on field.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Road Aggregate Tests	To determine Crushing strength of a given Aggregate sample. To determine Aggregate Impact Vale of a given Aggregate sample. To determine Abrasion Value of a given Aggregate sample. To determine Angularity of a given Aggregate sample.	08	CO1
2	Bitumen Test	To determine Penetration Point of a given Bituminous sample. To determine Softening Point of a given Bituminous sample. To determine Flash and Fire Point of a given Bituminous sample. To determine Stripping Value of a given Bituminous sample. To determine Ductility of a given Bituminous sample.	08	CO2
3	Traffic Surveys	To Perform Traffic Volume Study at a given Stretch of Road. To Perform Traffic speed study given point of Road.	04	CO3

Reference Books:

SK Khanna & CG Justo, Highway Engineering, Nem Chand and Brothers, Roorkee, 4th Reprint 2015.

e-Learning Source:

https://www.iitk.ac.in/ce/test/IS-codes/is.1201-1220.1978.pdf

https://law.resource.org/pub/in/bis/irc/irc.gov.in.037.2019.pdf

https://law.resource.org/pub/in/bis/irc/irc.gov.in.058.2015.pdf

https://www.iitk.ac.in/ce/test/IS-codes/is.2386.1.1963.pdf

	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	2	0	0	2	0	1	0	3	1	0	3	0	1	3
CO2	2	0	0	3	0	1	0	3	1	0	3	0	1	3
CO3	2	0	0	2	0	0	0	3	1	0	3	0	1	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: 2015-16							
Course Code	CE309	**Title of the Course**	Quantity Surveying & Estimation Lab	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	**0**	**0**	**2**	**1**
Pre-Requisite	CE212	**Co-requisite**	CE-301				
Course Objectives	• To make the learner aware about the basics of Quantity Estimation and organisation. • To make the learner aware about the ways to carry out Rate analysis and Estimation of Buildings.						

Course Outcomes	
CO1	The students will be able to prepare estimates of a single and double roomed building.
CO2	The students will be able to carry out rate analysis of major civil works considering organizations such as MES, PWD &Indian Railways.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Experiment 1	Importance of estimation, different types of estimates specifications general and detailed.	02	CO1
2	Experiment 2	Methods of Estimation: General items of work for estimates units and measurement, method of accounting for the deduction of openings etc.	02	CO1
3	Experiment 3	Detailed estimates of a single roomed and a two roomed residential building.	02	CO1
4	Experiment 4	Analysis of rates: Definition of analysis of rates, Prime cost, Work charged establishment.	02	CO1
5	Experiment 5	Quantity of materials per unit of work for major civil engineering items Resource planning through analysis of rates, market rates, PW.D. Scheduled and cost indices for building material and labour. Public works Organization, M.E.S. Organization, India Railway Organization and concept of organizational set up for Public Work Execution.	02	CO1

Reference Books:

Dr. Rang Wala, Estimation, Costing & Valuation, Charator Publising House Pvt. Ltd., 17th Edition 2015.

S.V Deodhar, Estimation, Costing & Valuation, Khanna Publising, 6th Edition 2015.

	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	1	0	0	0	0	1	0	0	0	1	0	0
CO2	3	0	2	0	1	0	0	2	0	1	0	1	0	0

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

2-

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

Integral University, Lucknow

Effective from Session: 2015-16							
Course Code	CE310	**Title of the Course**	Environmental Engineering-I	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	3	1	0	4
Pre-Requisite	NIL	**Co-requisite**	NIL				
Course Objectives	To educate the students about the basic principles of water treatment processes and air pollution engineering.						

Course Outcomes	
CO1	Learners will be able to explain about importance and necessity for planned water supplies, determine variations in demand, design periods, forecast Population and assess drinking water quality parameters according to IS-10500:2012.
CO2	Learners will be able to comprehend the fundamental of water treatment, suggest design criteria for Screens, plain sedimentation tank and clariflocculators.
CO3	Learners will be able to illustrate filtration its mechanism, compare Slow Sand, Rapid Sand And Pressure Filter. They will be able to explain the process of disinfection, its methods, kinetics, and calculate doses for softening process for water treatment.
CO4	Learners will be able to have comprehensive understanding of Distribution System, Detect of Leakage in the Distribution Pipes, Analyze the Pipe Network by using Hardy-Cross Method and Equivalent Pipe Method. They will also be able to suggest various appurtenances used in the Distribution System. Plumbing System, House Water Connection.
CO5	Learners will be able to explain about air pollution its causes, consequences, control methods of Particulate & Gaseous Pollutants.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Water Quality Assessment	Importance and necessity for planned water supplies, various types of Water demands, Per capita demand, Variations in demand, Design Periods & Population Forecast, Sources of water, Intakes for collecting surface water. Guideline Specification For Drinking Water Quality- IS-10500:2012, Indicator Organism.	08	CO1
2	Sedimentation and Coagulation	Water Treatment Concept, Screening, Settling operation, Plain Sedimentation. Coagulation and its Mechanism, Coagulants, Flocculation, Mechanism of Flocculation. Sedimentation aided with coagulation.	08	CO2
3	Water Filtration and Softening	Filtration: Theory, Types Of Filter, Mechanism and Operation Of Slow Sand, Rapid Sand And Pressure Filter. Disinfection: Methods of Disinfection, Kinetics of disinfection, Chlorination and Practices of Chlorination. Softening and its Methods, Calculation of Doses.	08	CO3
4	Storage and Distribution of Water	Distribution System, Methods Of Distribution, Layouts Of Distribution Networks, Detection of Leakage in the Distribution Pipes, Pipe Network Analysis- Hardy-Cross Method, Equivalent Pipe Method. Appurtenances in The Distribution System. Plumbing System, House Water Connection, Different Cocks and Pipe Fittings.	08	CO4
5	Air Pollution Engineering	Air Pollution: Natural And Man-Made Air Pollution, Causes And Effect Of Air Pollution, Air Pollution Control Methods, Control Of Particulate Pollutants, Control Of Gaseous Pollutants.	08	CO5

Reference Books:

S. K. Garg, Water Supply Engineering: Environmental Engineering v. 1, 29th Edition, Khanna Publication, 2013

Howard S. Peavy, Donald R. Rowe, George Tchobanoglous, Environmental Engineering, 1st Edition, McGraw Hill Education; 2013.

Gilbert M. Masters, Wendell P. Ela, Introduction to Environmental Engineering and Science, 3rd Edition, Publisher: Prentice Hall, ISBN-13: 978-0-13-148193-0, ISBN-10: 0-13-148193-2

K.V.S.G. Murali Krishna, Air Pollution and Control, Laxmi Publications, 1st Edition, 2017.

Standard Methods for the Examination of water and wastewater: AWWA, APHA, WPCF 2012.

I.S. 10500: 2012, Drinking Water Standards, 2012.

e-Learning Source:

https://nptel.ac.in/courses/105105201

	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	3	0	0	0	3	0	0	0	0	0	2	1
CO2	3	2	3	0	0	0	3	0	0	0	0	0	1	2
CO3	3	2	3	0	0	0	3	0	0	0	0	0	1	1
CO4	3	2	3	0	0	0	3	0	0	0	0	0	3	2
CO5	3	2	3	0	0	0	3	0	0	0	0	0	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	CE311	**Title of the Course**	Design of Reinforced Concrete Structure-II	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	3	1	0	4
Pre-Requisite	CE302	**Co-requisite**	NIL				
Course Objectives	• To understand the general mechanical behavior of torsion on reinforced concrete beams and footing in order to design according to Indian Standard Guidelines. • To recognize the need of flat slab and circular slab according to architectural-structural demand, to familiarize with the methods used for designing flat and circular slab. • To design water tank according to Indian Standard Guidelines. • To understand the structural behavior of retaining wall in order to check stabilities and to perform design. • To introduce pre stress concrete, losses and variation of stresses.						

Course Outcomes	
CO1	In-depth understanding of torsion on beams and behavior of footing with the ability to perform design of isolated, combined footing as per Indian Standard Guidelines.
CO2	Designing of flat and circular slab with in depth knowledge of the failures and requirement.
CO3	Skill to select the type of water tank and perform designing based on demand capacity as per Indian Standard Guidelines.
CO4	Ability to conduct the stability checks, dimensioning and designing of retaining wall with or without shear keys as per Indian Standard Guidelines.
CO5	Ability to calculate the losses in pre-stress and plot the variation of stress across cross section in pre tensioned and post tensioned concrete.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Tensional Effect on Beams and Design of Footing	Effect of torsion on beam, concept of equivalent shear and moments. Design of beam under torsion. Structural behavior of footings, Design of wall, isolated and combined footing.	08	CO1
2	Flat and Circular Slabs	Nature of stresses in flat slabs. Design of flat slab with and without drops by direct method, reinforcement in flat slab. Design of Circular slab with various edges and loading condition.	08	CO2
3	Water Tanks	Design criteria, material specifications and permissible stress for tanks, design of circular and rectangular tanks situated on the ground under hoop stresses, Introduction of underground and overhead tanks.	08	CO3
4	Retaining Walls	Structural behavior of retaining wall, stability of retaining wall against overturning, sliding and pressure developed under the base design of T- shaped retaining wall, design of shear key concept of counter fort retaining wall.	08	CO4
5	Prestressed Concrete	Introduction of pre-stressed concrete, advantages of pre-stressed concrete, types of pre-stressing, methods of pre-stressing, losses in pre-stress, analysis of simple pre-stressed rectangular and T-sections.	08	CO5

Reference Books:

Ramamurtham S., "Design of Reinforced Concrete Structures", Dhanpatrai Publishing Company, 18th Edition 2015, Reprint 2016.

Bhawikatty S. S. " Advanced Concrete Design", New Age International, 3rd Edition (2016)

Sinha S.N. "Reinforced Concrete Design", Tata McGraw-Hill Education, 2nd Edition (2002)

Punmia B.C Jain A.K, "Limit State Design of Reinforced Concrete", Laxmi Publications 1st Edition (2007)

Jain A.K., "Reinforced concrete design, limit state Method", Nem Chand & Bros.; 7th Edition (2012)

IS 456-2000 Indian Standard "Plain & Reinforced Concrete-code of practice", BIS, New Delhi.

e-Learning Source:

http://nptel.ac.in/courses/105105105/
http://nptel.ac.in/courses/105105104/

	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	3	0	0	0	0	3	0	0	0	3	0	0
CO2	3	0	3	1	0	0	0	3	0	0	0	0	0	0
CO3	3	0	3	1	0	0	0	3	0	0	0	3	0	0
CO4	3	1	3	3	0	0	0	3	0	0	0	3	0	0
CO5	3	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: 2020-21							
Course Code	CE312	**Title of the Course**	Geotechnical Engineering - II	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	3	1	0	4
Pre-Requisite	CE304	**Co-requisite**	NIL				
Course Objectives	• To develop the knowledge of different boring process and sub soil exploration. • To develop the knowledge of different boring capacity of soil and ascertain the type of failure. • To develop the knowledge about pile and well foundation and their design method. • To develop the concept of slope failures. • To develop the detail knowledge of earth pressure behind retaining structures						

Course Outcomes	
CO1	Able to understand the different methods of penetration test and boring process and became well versed in sub soil exploration.
CO2	Able to determine the bearing capacity of soil using different test procedures and understand the causes of shear failure and settlements.
CO3	Able to understand concept of pile and well foundation and their design methods and their field test.
CO4	Able to explain the type of slope failures and how to stabilize the soil slopes.
CO5	Able to understand concept of theories of active and passive earth pressure for cohesive and cohessionless soil as backfill of retaining wall and able to check the stability of a retuning wall.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Soil Exploration and Site Investigation	Introduction, Planning and stages in sub-surface exploration, depth and spacing of exploration, Disturbed and undisturbed soil samples, Area ratio, External and internal clearance, Methods of exploration, Geophysical methods: Seismic refraction and Electrical resistivity method. Boring: Auger boring, Wash boring and Rotary drilling. Types of soil sample: Disturbed and undisturbed soil samples, Features of sampler affecting soil disturbance. Characterization of ground, site investigations, Standard Penetration Test, Static and Dynamic cone penetration test, ground water level etc. Preparation of Bore log report.	08	CO1
2	Shallow Foundation and Bearing Capacity	Introduction- contact pressure distributions, Bearing capacity of footing, types of shear failure, correction for size, shape, depth, compressibility, etc., ultimate and allowable stresses, Terzaghi's, Meyerhof's, Hansen, Skempton's and BIS methods, Effect of rising and lowering of water table on bearing capacity, Plate load test, Standard and Cone penetration tests for determining allowable bearing pressure, Total and Differential settlements as per IS Code, causes and methods of minimizing settlement, Introduction to Floating foundation	08	CO2
3	Deep Foundations	Pile foundations: Introduction to pile foundation, factors influencing the selection of pile, Load carrying capacity of Single Pile by static formula and dynamic formulae (Engineering News and Hileys), Feld's rule, Capacity from in-situ penetration tests, piles load test; Negative skin friction; under reamed pile foundations; Pile groups – Necessity, Efficiency, Group capacity and settlements. Well Foundation: Types of casissons and their construction; Different shapes of wells, component parts and forces, sinking of wells and remedial measures for tilts and shifts.	08	CO3
4	Stability of Slopes	Types of slopes, Types of slope failures, limit equilibrium methods of slices and simplified Bishop Method, factor of safety, friction circle method, Taylor stability number method, Stabilization of soil slopes.	08	CO4
5	Earth Pressures and Retaining Structures	Earth pressure theories, Plastic equilibrium, Coulomb's and Rankine's approaches, pressure distribution diagram for lateral earth pressures against retaining walls for different conditions in cohesion less and cohesive soils, smooth and rough walls,	08	CO5

		inclined backfills, depth of tension cracks, retaining structures, gravity cantilever, counter fort, reinforced earth, etc., design and check for stability, Rebhann's and Culmann's graphical constructions of active pressure for cohesionless soil.		

Reference Books:

Bowles .J.E, "Foundation analysis and design", McGraw Hill, 5th Edition, 2001.

Murthy .V.N.S, "Textbook of Soil Mechanics and Foundation Engineering", CBS Publishers and Distributors, New Delhi, 1st Edition, 2009.

Garg, S.K., "Soil Mechanics and Foundation Engineering", Khanna Publishers, New Delhi, India. Khanna (2003)

Khan I. H., "A Text Book of Geotechnical Engineering", Prentice –Hall of India Pvt. Ltd., Delhi, India. 2nd Revised edition edition (30 March 2005)

Arora, K. R., "Soil Mechanics and Foundation Engineering", Standard Publishers, New Delhi, India. STANDARD PUBLISHER DIST. (2009)

Punmia, B.C., "Soil Mechanics and Foundation Engineering", Laxmi Publications Pvt. Ltd., New Delhi, 1995. Prentice Hall India Learning Private Limited (2011)

Punmia, B.C., "Soil Mechanics and Foundation Engineering", Laxmi Publications Pvt. Ltd., New Delhi, 1995. Prentice Hall India Learning Private Limited (2011)

e-Learning Source:

https://nptel.ac.in/courses/105105185/

	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	2	3	1	3	2	1	1	0	2	2	0	1	0	0
CO2	3	3	2	3	2	1	0	0	2	2	0	1	0	0
CO3	3	3	3	2	2	1	0	0	2	2	0	1	0	0
CO4	2	2	2	2	2	1	0	0	2	1	0	1	0	0
CO5	3	3	3	2	2	2	1	0	2	1	0	1	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: 2015-16							
Course Code	CE313	**Title of the Course**	Traffic Engineering	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	3	1	0	4
Pre-Requisite	CE303	**Co-requisite**	NIL				
Course Objectives	• To study the fundamentals of traffic engineering. • To gain knowledge about traffic intersection and its control measures. • To study various types of traffic surveys.						

Course Outcomes	
CO1	Learner will be able to understand fundamentals of traffic engineering and hierarchy of roads in India.
CO2	Learner will be able to understand traffic flow theories & regulations related to traffic and able to evaluate a given area for compliances.
CO3	Learner will be able understand basis of traffic surveys & be able to traffic surveys and its analysis.
CO4	Learner will be able to design signalized intersections meeting Indian code requirements and they will be acquainted with traffic control measures.
CO5	Learner will learn about traffic management measures & understand road safety aspects and be able to select the desired type of control at intersection under given traffic conditions.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Traffic Engineering Principles	Traffic on road, mixed traffic, concept of PCU, Traffic Engineering- scope and objectives, road user and vehicle characteristics, Traffic characteristics, Hierarchy of Roads, Typical road cross sections, fundamental definitions, traffic flow parameters, time-space diagram, speed-flow-density relationship, capacity and level of service, factors effecting level of service.	08	CO1
2	Traffic Flow Theory and Regulation	Traffic stream and its components, stream parameters, Interrupted and un-interrupted traffic flow, trajectory diagrams, shock wave theory and it application, queuing theory and its application. Regulation of speed, regulation of vehicles, regulation concerning drivers, regulation concerning traffic, parking regulations, general rules, enforcement of regulations.	08	CO2
3	Traffic Survey and Studies	Traffic Volume study-need, methods, format preparation, analysis and presentation; Origin Destination studyneed, methods, format preparation, zoning, analysis and presentation; Speed and Delay Study- need, methods, format preparation, analysis and presentation; Parking Study- need, type of surveys, format preparation, demand estimation, type of parking facilities; Road Network Inventory Survey- need, format preparation and data collection.	08	CO3
4	Traffic Operation and Control	Traffic control devices, Traffic Signs - principles, types and design considerations; Road Markings-principles, type and design; Traffic Signals - types, optimal cycle length and signal settings, warrants, designing of traffic signals by Webster's method and IRC method, signal approach dimensions; Street Lighting; Street Furniture.	08	CO4
5	Traffic Management, Road Safety and Intersections	Traffic management measures, Intersections-at grade and grade separated intersections, rotary intersections and channelization. Accident situation in India, collection of accident data, collision and condition diagram, road and its effect on accidents, vehicles and its effect on accidents, drivers, pedestrian safety, cyclist safety, legislations, enforcement, educations and awareness, road safety audit.	08	CO5

Reference Books:

Traffic Engineering & Transport Planning by LR Kadyali, Khanna Publisher, Delhi, 2010.

Transportation Engineering and Planning, C.S.Papacostas, P.D.Prevedouros, Prentice –Hall India, Delhi, 2005

Highway Engineering-S.K.Khanna & C.EG. Justo, Nem Chand & Bros, Roorkee, 2014.

Transportation Engineering, an Introduction, C Jotin Khisty,B.Kent Lall, Prentice-Hall India, Delhi.

Transportation Planning, Principles, Practice and Policies,P.K. Sarkar, Vinay Maitri, G.J. Joshi, Prentice-Hall, India, Delhi.

e-Learning Source:
https://nptel.ac.in/courses/105101008/
https://nptel.ac.in/courses/105105107/

	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	0	0	1	0	0	0	0	0
CO2	0	0	3	0	0	0	0	0	2	1	2	0	0	0
CO3	2	1	2	1	1	0	0	0	1	0	0	0	0	0
CO4	2	0	0	0	0	0	2	0	1	0	0	0	0	0
CO5	0	2	0	0	2	2	0	0	2	2	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: 2019-20							
Course Code	CE314	**Title of the Course**	Open Channel Flow	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	3	1	0	4
Pre-Requisite	CE209	**Co-requisite**	NIL				
Course Objectives	• To learn open channel flow, to give idea on different types of flow and channels and hydraulic design principles of channels • To give the idea about gradually varied flow GVF and types of equation used in different types of flow • To introduce the basic principles and assumptions in analysis of flow profile and numerical analysis • To give the idea about rapidly varied flow RVF and condition of formation of different types of hydraulic jump. • To give the idea of design of hydraulic channel in non-linear alignment and design of culvert.						

Course Outcomes	
CO1	To understand the basic concept of open channel flow, different types of flow, channels.
CO2	To understand the basic concept of gradually varied flow and its equation.
CO3	To understand the basic concept of gradually varied flow profile and numerical analysis
CO4	To understand the basic concept of rapidly varied flow and condition of formation of different types of hydraulic jump.
CO5	To understand the basic concept of design of hydraulic channel in non-linear alignment

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Open Channel Flow	Classifications, description, types energy and momentum equation for prismatic and non-prismatic channels. Uniform flow, critical flow, critical depth, specific energy. Use of Design charts and Semi empirical relations.	08	CO1
2	Gradually Varied Flow	Gradually varied flow, dynamic equation, flow profiles, computation, analytical and graphical methods, and transitions of sub critical and supercritical flow.	08	CO2
3	Analytical and Numerical Methods of Gradually Varied Flow	Basic principles and assumptions in analysis of flow profile, methods of numerical integration. Compound channel, Equivalent Roughness.	08	CO3
4	Rapidly Varied Flow	Characteristics of the rapidly varied flow, classification of hydraulic jump, hydraulic jump in horizontal, and sloping channels, submerged hydraulic jump, jump in gradually and suddenly expanding channels, empirical solutions.	08	CO4
5	Analysis of Flow in Channels of Nonlinear Alignment	Flow in channel of non-linear alignment and non-prismatic channel sections, design considerations for sub critical and super critical flows. Hydraulic design of culvert. .	08	CO5

Reference Books:

K.Subramanya : Flow in open channels, Tata Mcgraw Hills, 2014.

V.T.Chow : Open Channel Hydraulics,Blackburn Press, 2009.

K.RangAraju:Open channel flow,Mcgrawhill Education, 2001.

Madan Mohan Das: Open Channel Flow,PHI learning private limited, 2008.

e-Learning Source:

https://nptel.ac.in/courses/105107059/

	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	1	0	2	2	1	1	2	1	1	0	2	1	0	0

CO2	2	1	2	1	0	1	1	1	1	2	2	2	0	0
CO3	1	0	2	1	2	1	1	1	1	2	0	2	0	0
CO4	1	2	0	2	1	2	2	1	0	1	2	1	0	0
CO5	2	2	2	2	2	2	1	1	2	1	3	2	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:							
Course Code	CE315	**Title of the Course**	Matrix Methods Of Structural Analysis	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	3	1	0	4
Pre-Requisite	NIL	**Co-requisite**	NIL				
Course Objectives	• To understand the Basic concept of Structural analysis. • To understand and analyses the structures using matrix methods.						

Course Outcomes	
CO1	Able to determine static & kinematic determinacy and to understand the basic methods of structural analysis.
CO2	The learner is familiarized with the basic concept of matrix methods of structural analysis and is able to analysis continuous beams using matrix methods.
CO3	Able to analyses rigid joined and pin-jointed plane frames using matrix methods.
CO4	The learner is able to analysis rigid jointed plane frames by matrix methods.
CO5	Able to analyses three-dimensional structural by displacement method.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Classification of Structures	Classification of structure, equation of static equilibrium, degree of static and kinematic determinacy. Basic methods of structure analysis.	08	1
2	Introduction of Matrix Method and Analysis of Beam	Introduction of Flexibility and stiffness method. Formulation analysis of continuous beams.	08	2
3	Analysis of Pin Joined Structure	Formulation analysis of two-dimensional pin jointed frames and space frame by matrix approach.	08	3
4	Analysis Two-Dimensional Rigid Structure	Formulation analysis of two-dimensional rigid frames by flexibility and stiffness methods.	08	4
5	Analysis Three-Dimensional Structure	Analysis of three-dimension structure by displacement method.	08	5

Reference Books:

Weaver & Gere, Matrix Analysis of Framed structures. CBS Publication & Distributors Pvt. Ltd., Edition: 2nd edition (2004).

H.C. Matrix, "Introduction to Matrix Methods of structural Analysis", McGraw Hill (2012).

Pandit, G.S & Gupta.," Structural Analysis: A Matrix Approach" McGraw Hill Education (India) Pvt. Ltd., 2nd Edition (2008).

e-Learning Source:

https://nptel.ac.in/courses/105106050/

	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	2	2	1	1	1	1	0	0	0	1	0	1	1	3
CO2	2	2	1	1	1	1	0	0	0	1	0	1	1	3
CO3	2	2	0	1	1	1	0	0	1	1	0	1	1	3
CO4	2	2	0	1	1	1	0	0	1	1	0	1	1	3
CO5	2	2	1	1	2	1	0	0	1	1	1	1	1	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: 2015-16							
Course Code	CE316	**Title of the Course**	Sustainable Construction Techniques	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	3	1	0	4
Pre-Requisite	NIL	**Co-requisite**	NIL				
Course Objectives	• To make them aware about the ways to attain sustainable construction and to overcome sustainable challenges. • To comprehend the fundamentals of energy efficiency in regards of Sustainability. • To make them understand the application of advanced material used in construction industry to prepare a sustainable architecture. • To make them understand about the modern housing scenario to impart sustainability in construction cycle. • To make them capable to perform cost analysis using latest pre-fabrication technologies.						

Course Outcomes	
CO1	Learner will be able to understand the Importance of sustainability & their challenges in construction sector.
CO2	Learner will be able to understand the need of energy efficient buildings to overcome the after effects of manmade materials.
CO3	Learner will be able to choose an innovative Building material comprised of sustainable propertiesto attain sustainable construction.
CO4	Learner will be able to understand the housing scenario as per the land usage, financial terms and strategically approaches for Urban and rural areas.
CO5	Learner will be able to impart engineering knowledge based on Precast and Prefabrication structures using latest technology.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Sustainability	Sustainability, challenges in sustainable construction, design construction and equipment, materials and systems, maintenance and conservation, waste materials, site waste management, re-use and recycling of materials.	08	CO1
2	Energy Efficient Buildings	Energy efficient buildings, concepts of green and sustainable buildings, natural lighting, rainwater harvesting.	08	CO2
3	Alternative Building Materials	Alternative Building Material for Low Cost Housing: Introduction, Substitute, for scarce materials, timber substitution, industrial waste, Agricultural waste, Strategies of Promotion of Alternative Building Materials.	08	CO3
4	Modern Housing Scenario	Housing scenario, status of urban and rural housing and construction land use and physical planning for housing, building bye laws, housing finance: approaches and strategies, housing for urban poor	08	CO4
5	Precast and Prefabricated Systems	Adoption of innovative cost effective construction technology, prefabrication, precast roofing/ flooring systems, walls.	08	CO5

Reference Books:

A.K Lal, Handbook of low cost housing, New Age Publishers, 4th Edition, 2010.

India Green Building Congress Recommendations, 3rd Revision, 2011.

Ajla Aksamija, “Sustainable Facades: Design Methods for High-Performance Building Envelopes”, Jhon Wiley & Sons Inc, 2nd Edition, 2011.

Kibert J.Charles, “Sustainable Construction: Green Building Design and Delivery”, Jhon Wiley & Sons Inc, 6th Edition, 2014.

Phillip F. Ostwald, “Construction Cost Analysis and Estimating”, Prentice Hall Press, Delhi, 3rd Reprint, 2015.

e-Learning Source:

https://www.youtube.com/watch?v=WPRgRBxfbss

https://www.youtube.com/watch?v=SJ0H6kheN_c

	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	1	0	2	2	1	1	2	1	1	0	2	1	0	0
CO2	2	1	2	1	0	1	1	1	1	2	2	2	0	0
CO3	1	0	2	1	2	1	1	1	1	2	0	2	0	0
CO4	1	2	0	2	1	2	2	1	0	1	2	1	0	0
CO5	2	2	2	2	2	2	1	1	2	1	3	2	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: 2015-16							
Course Code	CE317	**Title of the Course**	Ground Improvement Techniques	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	**3**	**1**	**0**	**4**
Pre-Requisite	CE-304	**Co-requisite**	CE312				
Course Objectives	Introduce the student to fundamentals of design of hydraulic structures in civil engineering.						

Course Outcomes	
CO1	Student will be able to understand the importance of ground improvement using dewatering method.
CO2	Student will be able to understand and explain concept of shallow and deep compaction and factors influencing compaction.
CO3	Student will be able to explain the field application of Geo-synthetics.
CO4	Student will be able to understand principles and basic of reinforced soil structure.
CO5	To learn the techniques of improving soil and its shear strength using different grouting methods.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Dewatering	Introduction - Scope and necessity of ground improvement in Geotechnical engineering- basic concepts and philosophy. Drainage - Ground Water lowering by well points deep wells- vacuum and electro-osmotic methods. Stabilization by thermal and freezing techniques.	08	1
2	Compaction and Sand Drains	Insitu compaction of granular and cohesive soils, Shallow and Deep compaction sand piles – concept, factors influencing compaction, Blasting and dynamic consolidation – Preloading with sand drains, fabric drains, wick drains – theories of sand drain – design and relative merits	08	2
3	Geo-synthetics & Applications of Geo-synthetics	Development – Types of Geosynthetics – Geotextiles – Geogrids- Geonets – Geomembranes – Geocomposites – Functions – Reinforcement – Use of geosynthetics for filtration and drainage – Use of geosynthetics in roads – Use of reinforced soil in Retaining walls – Improvement of bearing capacity – Geosynthetics in land fills	08	3
4	Stone Column, Lime Piles and Earth Reinforcement	Stone column, lime piles – Functions – Methods of installation – Earth reinforcement – Principles and basis mechanism of reinforced earth-reinforced soil retaining structures.	08	4
5	Grouting	Grouting techniques – Types of grouts – Suspension and solution grouts – Basic requirements of grout. Grouting equipment – principle of injection-injection methods – properties of treated ground-application of jet grouting-grout monitoring – Electro – chemical stabilization – Stabilization with cement, lime etc. – Stabilization of expansive clays	08	5

Reference Books:

Koerner, R.M., “Designing with Geo-synthetics”, Xlibris Publication, 6th Edition (2012).

Rowe, R.K., “Geotechnical and Geo-environmental Engineering Handbook”, Springer 1st edition (2012).

P. Purushothama Raj, “Ground Improvement Techniques Paperback” , Laxmi Publications; Second edition (2016).

e-Learning Source:

https://nptel.ac.in/courses/105108075/

https://youtu.be/OP4xTzatHzs

	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	2	1	0	1	2	2	0	0	0	0	0	1	0	2
CO2	2	1	0	2	2	1	0	0	0	0	0	1	0	1
CO3	2	0	0	1	2	1	0	0	0	0	0	1	0	2
CO4	2	1	0	1	1	1	0	0	0	0	0	1	0	1
CO5	2	1	0	1	1	1	0	0	0	0	0	1	0	1

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

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

Integral University, Lucknow

Effective from Session: 2015-16							
Course Code	CE320	**Title of the Course**	Dock Harbor and Tunnel Engineering	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	**3**	**1**	**0**	**4**
Pre-Requisite	Nil	**Co-requisite**	Nil				
Course Objectives	To provide knowledge of design Tunnels and Harbors.						

Course Outcomes	
CO1	Learner will be able to analyze and select design criteria Harbor using the knowledge of natural phenomena and their effect on Harbor of components.
CO2	Learner will be able to have basic knowledge of functioning of harbor structures.
CO3	Learner will be able to understand the working of docks and will be able to recommend type of dock structure for particular case.
CO4	Learner will be able to comprehend geotechnical considerations in tunneling and determine suitable tunneling technique.
CO5	Learner will be underfed micro tunneling techniques and suitable ventilation technique given the conditions of tunnel.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction: Harbor Planning and Natural	Harbor Planning: Harbor components, characteristics of good harbor, principles of harbor planning, site selection criteria and layout of harbors. Natural Phenomena: tides and currents phenomena, generation characteristics and effects on marine structures, silting, erosion and littoral drift.	08	CO1
2	Marine Structures	Marine Structures: General design aspects, breakwaters - function, types general design principles, wharves, quays, jetties, piers, pier heads, dolphin fenders, mooring accessories function, types, suitability, design and construction features.	08	CO2
3	Dock and Repair Facilities	Docks and Locks: Tidal basin, wet docks-purpose, design consideration, operation of lock gates and passage, repair docks - graving docks, floating docks, marine railway.	08	CO3
4	Tunnels: Introduction and Construction Methods	Site investigations, Geotechnical Considerations of tunneling, Construction & Excavation methods, soft ground tunnels, Rock tunnels.	08	CO4
5	Micro Tunneling and Tunnel Utilities	Micro tunneling techniques, Tunnel support design, Ventilation of tunnels, tunnel utilities, safety aspects.	08	CO5

Reference Books:

R. Srinivasan and S. C. Rangwala, Harbour, Dock and Tunnel Engineering, 2012, Charotar Pub. House.

S. P. Bindra, A Course in Docks and Harbour Engineering, 2015, Dhanpat Rai & Sons, New Delhi.

e-Learning Source:

https://nptel.ac.in/courses/114106025/

https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/114106025/lec3.pdf

	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	0	0	1	0	0	0	2	1
CO2	0	0	3	0	0	0	0	0	2	2	1	0	1	1
CO3	3	2	1	1	1	0	0	0	1	0	0	0	1	1
CO4	2	0	0	0	0	0	0	0	2	0	0	0	1	2
CO5	0	2	0	0	0	0	0	0	1	0	0	0	1	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: 2019-20							
Course Code	CE321	**Title of the Course**	Design of Hydraulic Structures	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	**3**	**1**	**0**	**4**
Pre-Requisite	CE201	**Co-requisite**	CE306				
Course Objectives	Introduce the Student to Fundamentals of Design of Hydraulic Structures in Civil Engineering						

Course Outcomes	
CO1	Students are able to understand about various causes of hydraulic structures failures, Bligh and Khosla theories.
CO2	Students are able to understand the concept of head works and cross drainage works.
CO3	Students are able to understand about investigation and planning of dams and reservoirs.
CO4	Students are able to understand about elementary profile of gravity dams and modes of failure of gravity dams.
CO5	Students are able to understand the concept of earth dams and spillways.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Hydraulic Structures General	Failure of hydraulic structures founded on permeable soils, Bligh's creep theory, Khosla's theory of independent variables for design of impervious floors, Types of canal falls, Design of sharda type fall.	08	1
2	Head Works and Cross Drainage Works	Function, location and layout of head works, cross drainage works: necessity and types, design of siphon aqueduct.	08	2
3	Dams and Reservoirs	Investigation and planning of dams and reservoirs, zones of storage, reservoir sedimentation and its control, classification of dams.	08	3
4	Gravity Dams	Elementary profile of a gravity dam, Low and high gravity dams, Modes of failure and factor of safety, Galleries in dams, Temperature control in mass concrete.	08	4
5	Earth Dams and Spillways	Earth Dam their component and functions, causes of failure. Types of spillways, energy dissipation below spillways, spillways gates.	08	5

Reference Books:

Subramanya K., Engineering Hydrology, Tata McGraw Hill, 2014.

Punmia B.C. &Lal P.B., Irrigation and Water Power Engineering, Laxmi Publications, 2015

Asawa, Irrigation Engineering, Wiley Eastern Edition, 2013.

S.K Garg, Irrigation Engineering and Hydraulic structures, Khanna publishers, 2016.

e-Learning Source:

https://nptel.ac.in/courses/105105040/

	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	1	2	1	1	0	0	0	0	2	2	0	0
CO2	2	2	3	2	2	1	2	0	1	2	0	0	0	0
CO3	3	2	2	3	1	2	0	1	2	3	1	2	0	0
CO4	2	3	2	2	3	2	1	2	1	2	2	2	0	0
CO5	2	3	2	3	2	2	1	2	2	1	2	3	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: 2015-16							
Course Code	CE322	**Title of the Course**	Maintenance & Rehabilitation of Structures	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	**3**	**1**	**0**	**4**
Pre-Requisite	NIL	**Co-requisite**	NIL				
Course Objectives	To provide knowledge practices adopted for maintenance of structures.						

Course Outcomes	
CO1	To make students familiar with the importance, facets and assessment of maintenance in a damaged structure.
CO2	Understand the parameters such and strength, Durability, cracks, climate effects in concrete in accordance with Quality assurance.
CO3	To make the students aware about the advanced and globally recognized material used in repair of structures.
CO4	Learner will be able to understand the problems associated with corrosion, cracks and demolition of structures.
CO5	To facilitate the need to understand the various types of repairs of structures based on weathering effects and exposure conditions.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction	Maintenance, Repair and Rehabilitation, Facets of Maintenance, importance of Maintenance, Various aspects of Inspection, Assessment procedure for evaluating a damaged structure, causes of deterioration	08	1
2	Quality Assurance for Concrete	Strength, Durability and Thermal properties, of concrete Cracks, different types, causes– Effects due to climate, temperature, Sustained elevated temperature, Corrosion -Effects of cover thickness and cracking	08	2
3	Advanced Materials	Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, Sulphur infiltrated concrete, Ferrocement, Fiber reinforced concrete	08	3
4	Rehabilitation Techniques	Rust eliminators and polymers coating for rebars during repair, foamed concrete, mortar and dry pack, vacuum concrete, Gunite and Shotcrete, Epoxy injection, Mortar repair for cracks, shoring and underpinning. Methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings and cathodic protection. Engineered demolition techniques for dilapidated structures–case studies	08	4
5	Repairing of Structures	Repairs to overcome low member strength. Deflection, Cracking, Chemical disruption, weathering corrosion, wear, fire, leakage and marine exposure.	08	5

Reference Books:

Shetty M.S., "Concrete Technology-Theory and Practice", S. Chand and Company, 2008.

Dov Kominetzky.M.S., "Design and Construction Failures", Galgotia Publications Pvt. Ltd., 2001.

Gambhir.M.L., "Concrete Technology", McGraw Hill, 2013.

e-Learning Source:

https://nptel.ac.in/courses/105/106/105106202/

https://nptel.ac.in/courses/105104030/

	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	2	0	0	2	3	0	0	0	0	0	0	3	0	2
CO2	3	3	0	0	0	0	0	0	0	0	0	0	0	1
CO3	3	0	1	0	3	0	0	0	0	0	0	0	0	2
CO4	2	3	2	0	1	0	0	0	0	0	0	2	0	1
CO5	3	0	0	0	0	0	0	2	0	0	3	2	0	1

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	CE323	**Title of the Course**	Occupational Health and Safety Engineering	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	3	1	0	4
Pre-Requisite	NIL	**Co-requisite**	NIL				
Course Objectives	To educate the students on the basic principles, development and application of occupational health and safety engineering.						

Course Outcomes	
CO1	Learner will be able to understand the importance of industrial safety and promote role of safety and health training as per the guideline of OHSAS-18001.
CO2	Learner will be able to promote safety measures in construction industry in connection with excavation work, scaffolding work, welding and cutting and during transportation of men and material.
CO3	Lerner will be able to understand the effects of electrical hazard in an industry and their control.
CO4	Learner will be able to understand effects of fire hazards in mining industry and their contract using different fire extinguisher.
CO5	Learner will be Able to prepare guidelines using different preventive technique and planning for implementation of training for safety awareness.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Occupational Health and Safety	Introduction to occupational health and safety: Occupational Health Hazards, Promoting Safety, Safety and Health training, Stress and Safety. Importance of Industrial safety, role of safety department, OHSAS 18001.	08	CO1
2	Construction Safety	Hazards in Construction Industry :Introduction of Construction industry, Scaffolding and Working plat form, Welding and Cutting, Excavation Work, Concreting and Cementing work, Transportation of men and material, Handling and Storage of compressed gas.	08	CO2
3	Electrical Safety	Electrical Hazards: Safe limits of amperages, voltages, distance from lines, etc., Joints and connections, Effects of Electrical Hazards, Effects of Current on Human Body, Control of hazards due to static electricity.	08	CO3
4	Fire Safety	Fire Hazards: Fire Types, Fire Hazard Analysis and Prevention of Fire, Fire Risk, Fire Protection and its Prevention, hazards and control in mines, Portable Fire Extinguishers, Firefighting.	08	CO4
5	Safety Guidelines and Recommendations	Construction hazards and safety guidelines; Prevention techniques for construction accidents; Site management with regard to safety recommendations; Training for safety awareness and implementation.	08	CO5

Reference Books:

B. G. Dale, Managing quality,5 th ed., Blackwell Publishing, Oxford, 2007.

D. Reese and J. V. Eidson, Handbook of OSHA construction safety and health, 2 n d ed., CRC Press, Boca aton, 2006.

F. Harris, R. McCaffer and F. Edum-Fotwe, Modern construction management, 6 t h ed., Blackwell Publishing, Oxford, 2006

K. Knutson, C. J. Schexnayder, C. M. Fiori and R. Mayo, Construction management fundamentals, 2nd ed., McGraw Hill, New York, 2008.

S. J. Holt, Principles of construction safety, Blackwell Publishing, Oxford, 2008.

R.K.Jain and Sunil S.Rao , Industrial Safety , Health and Environment Management Systems, Khanna publishers , New Delhi, 2006.

Journal of Occupational Safety and Health, ISSN 1675-5456 PP13199/12/2012 (032005)

e-Learning Source:

https://www.osha.gov/SLTC/generalshreferences/journals.html

https://www.osha.gov/

	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	1	1	2	0	0	2	1	0	2	0	0	1	0	2
CO2	2	0	0	0	0	3	2	0	2	1	0	1	0	1
CO3	1	1	3	1	0	2	1	0	2	1	0	1	0	2
CO4	1	1	3	1	0	2	1	0	2	1	0	1	0	1
CO5	1	0	3	1	0	2	1	0	2	1	0	1	0	1

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

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

Integral University, Lucknow

Effective from Session: 2015-16							
Course Code	CE324	**Title of the Course**	Principles of Town Planning and Architecture	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	3	1	0	4
Pre-Requisite	NIL	**Co-requisite**	NIL				
Course Objectives	• To impart the knowledge how planning of towns are governed • To give the knowledge of various types of town planning can be done • To give the knowledge of various material and techniques in the development of town planning • To impart the knowledge of various elements of Architectural design. • To give the knowledge and impact of Architecture effects on town planning and functioning planning of building as per Architecture.						

Course Outcomes	
CO1	To enable the student to understand the historical aspects of Architecture planning
CO2	To enable the student the various types of town planning in the past
CO3	To enable the student , the effect of materials and techniques in the development of township
CO4	To enable the student in understanding the various elements of Architectural design and its effect on town planning
CO5	To make the student to understand the function of planning of building

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction	Principles and history of town planning, Comprehensive planning of towns: Contemporary planning concepts, Problems of urban growth. Land use classification and patterns, Housing demographic arid social surveys, economic and environmental aspects. Concept of master plan, Zoning and Density	08	CO1
2	History of Town Planning	An overview of ancient human settlements, Evolution of towns: Garden city movement, Linear city and concentric city concepts, Neighborhood and Radburn, Lacite industrielle, Radiant city to present day planning, Satellite town concepts. Concept of habitat, Neighborhood planning, problems of metropolis.	08	CO2
3	Development of Town Planning	Factors influencing architectural development. Impact of development of materials and techniques through ages. Evolution of architectural forms. Brief history of architecture.	08	CO3
4	Architectural Design	Elements of Architectural Design: Line. Form, Shape, Space, texture, value and colour. Principles of Architectural Design: Balance, Rhythm, Emphasis, Proportion and Scale, Movement, Contrast, Unity, Harmony, Repetition, Hierarchy. Role of architects.	08	CO4
5	Planning of Buildings	Functional planning of buildings: Classification of buildings, General requirements of site and building. Building codes, Acts and Bye-laws, Licensing of building works. Functional planning of building such as residential, institutional, public, commercial, industrial buildings, checking for circulation, ventilation, structural, preparing sketch plan, working drawing etc.	08	CO5

Reference Books:

Sir Banister Fletcher's, A History of Architecture, CBS Publisher. 2002.

S.C. Rangwala, Town Planning, Charotar Publishing House, 2009.

G.K. Hiraskar, Fundamentals of Town Planning, Dhanpat Rai Publications, 2012.

S.C. Agarwala, Architecture and Town Planning, Dhanpat Rai & Co. 2013.

e-Learning Source:

https://nptel.ac.in/content/storage2/courses/109104047/pdf/lecture35.pdf

	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	1	2	1	2	1	3	1	2	1	0	0	0	1	2
CO2	1	3	2	2	1	2	3	2	1	0	0	0	1	3
CO3	1	1	2	2	3	1	2	2	1	0	0	0	1	1
CO4	1	2	1	2	1	2	1	2	1	0	0	0	1	2
CO5	2	1	3	1	2	1	2	1	2	0	0	0	2	1

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

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

Integral University, Lucknow

Effective from Session: 2015-16							
Course Code	CE327	**Title of the Course**	Environmental Engineering Lab-I	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	**0**	**0**	**2**	**1**
Pre-Requisite	NIL	**Co-requisite**	CE310				
Course Objectives	To impart the experimental knowledge of water quality parameters assessment to be applied in environmental engineering						

Course Outcomes	
CO1	Learners will be able to determine, explain, analyze and compare various physical water quality parameters according to the guidelines for drinking water quality code IS-10500:2012.
CO2	Learners will be able to determine, explain, analyze and compare various chemical quality parameters according to the guidelines for drinking water quality code IS-10500:2012.
CO3	Learners will be able to determine, explain, analyze and compare various and biological water quality parameters according to the guidelines for drinking water quality code IS-10500:2012.

S No.	**Experiment No.**	**Content of Experiment**	**Contact Hrs.**	**Mapped CO**
1	Experiment 1	Determination of Turbidity, colour and conductivity.	03	CO1
2	Experiment 2	Determination of pH, Alkalinity and acidity.	03	CO2
3	Experiment 3	Determination of Hardness and chlorides.	03	CO2
4	Experiment 4	Determination of Residual chlorine and chlorine demand.	03	CO2
5	Experiment 5	Determination of dissolved oxygen.	03	CO2
6	Experiment 6	Determination of most probable number of coliforms.	03	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: 2015-16							
Course Code	CE328	**Title of the Course**	Geotechnical Engineering Laboratory	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	0	0	2	1
Pre-Requisite	------	**Co-requisite**	------				
Course Objectives	• To learn the process/procedure to determine the various 'Index Properties' of soil practically. • To learn the process/procedure to calculate various 'Engineering Properties' of soil practically. • To perform various ex-situ practical do understand the behavior and nature of soil.						

Course Outcomes	
CO1	Learner should be able to determine various index and engineering properties of soil by following Indian codes.
CO2	Learner should be able to determine compaction and consolidation properties of soil by following Indian codes.
CO3	Learner should be able to determine the shear strength of the soil by following the codal provision.

Experiment No.	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Determination of water content of a given moist soil sample by (i)oven drying method, (ii) pycnometer method.	02	CO1
2	Determination of specific gravity of a given soil sample by (i) density bottle, (ii) pycnometer method.	02	CO1
3	Determination of in situ dry density of soil mass by (i) core-cutter method, (ii) sand replacement method.	02	CO1
4	Determination of relative density and grain size distribution of a given soil sample by sieve analysis and sedimentation (hydrometer) analysis.	02	CO1
5	Determination of consistency limits (liquid, plastic and shrinkage limits) of the soil sample used in experiment no. 5 (grain-size analysis).	02	CO1
6	Determination of compaction characteristics (OMC & MDD) of a given soil sample.	02	CO2
7	Determination of permeability of a remolded soil sample by constant head &/or falling head method.	02	CO1
8	Determination of consolidation characteristics of a remolded soil sample by an oedometer test.	02	CO2
9	Determination of shear strength characteristics of a given soil sample from Tri-axial Shear Test.	02	CO3
10	Determination of shear strength characteristics of a given soil sample from Direct Shear Test.	02	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	0	0	3	3	0	3	3	3
CO2	0	0	0	3	3	0	0	0	3	3	0	3	3	3
CO3	0	0	0	3	3	0	0	0	3	3	0	3	3	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	CE329	**Title of the Course**	Survey Camp	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	3	1	0	4
Pre-Requisite	NIL	**Co-requisite**	NIL				
Course Objectives	• The objective of the survey camp is to enable the students to get practical training in the Survey field work.						

Course Outcomes	
CO1	The learner will be able to relate theoretical knowledge of surveying to resolve real field problems
CO2	The learner will be able to establish horizontal control and vertical control by traversing and triangulation.
CO3	The Learner will be able to prepare field survey record and which shall include all original field observations, calculations and plots.
CO4	The learner will be able to to identify errors in field measurement and apply appropriate corrections
CO5	The learner will be able to use modern tools used in surveying

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	-	Survey camp emphasizes on field application of basis survey task include levelling, traverse survey, and curve setting. The plotting of the map of the given area along with the important features.	-	-

	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	1	0	0	2	0	0	0	0	0	0	1	3	3
CO2	1	0	0	0	3	0	0	0	3	1	0	1	3	3
CO3	1	0	0	0	1	0	0	0	2	3	0	1	3	3
CO4	2	3	0	0	1	0	0	0	2	2	0	1	3	3
CO5	2	0	0	0	3	0	0	0	0	0	0	1	3	3

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

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