MAULANA AZAD NATIONAL INSTITUTE OF TECHNOLOGY, BHOPAL

DEPARTMENT OF CIVIL ENGINEERING

SCHEME FOR B.TECH. (Civil Engineering)

(2024 admitted batch onwards)

First Year Credits (Cumulative) 41

THIRD SEMESTER:

Course Code	Course Name	Scheme of Studies Periods per week			Credits
		L	T	P	
MTH24231	Applied Numerical Methods	3	1	-	4
CE24231	Strength of Materials	3	-	-	3
CE24232	Engineering Surveying	3	-	-	3
CE24233	Water Supply Engineering	3	-	-	3
CE24234	Highway Engineering	3	-	-	3
CE24235	Fluid Mechanics	3	-	-	3
CE24236	Fluid Mechanics Lab	-	-	2	1
CE24237	Engineering Surveying Lab	-	-	2	1
CE24238	Highway Engineering Lab	-	-	2	1
CE24239	Civil Engineering Materials Lab	-	1	2	2
	Minor-1	3	-	-	3*(Extra)
Total Hours =28		**18**	**2**	**8**	**24**
Total Credits (Cumulative)					**65**
Additional Subject: - National Cadet Corps (NCC)					
NCC24251	**National Cadet Corps III**	**1**	**5**	**1**	**7**
Total Credits (Cumulative)					**11**

FOURTH SEMESTER:

Course Code	Course Name	Scheme of Studies Periods per week			Credits
		L	T	P	
CE24241	Design of RCC Structures	3	-	-	3
CE24242	Advanced Surveying	3	-	-	3
CE24243	Wastewater Engineering	3	-	-	3
CE24244	Engineering Hydrology	3	-	-	3
CE24245	Structural Analysis-I	3	-	-	3
CE24246	Soil Mechanics	3	-	-	3
CE24247	Soil Mechanics Lab	-	-	2	1
CE24248	Water and Wastewater Lab	-	-	2	1
CE24249	Planning and Design of Building Structures Lab	1	-	2	2
	Minor-2	3	-	-	3*(Extra)
Total Hours =25		**19**	**-**	**6**	**22**
Total Credits (Cumulative)					**87**
Additional Subject: - National Cadet Corps (NCC)					
NCC24252	**National Cadet Corps IV**	**2**	**-**	**1**	**3**
Total Credits (Cumulative)					**14**

FIFTH SEMESTER:

Course Code	Course Name	Scheme of Studies Periods per week			Credits
		L	T	P	
CE24351	Design of Steel Structures	3	1	-	4
CE24352	Structural Analysis-II	3	-	-	3
CE24353	Hydraulics and Hydraulic Machines	3	-	-	3
CE24354	Environmental Pollution & Management	3	-	-	3
CE24355	Geotechnical Engineering	3	-	-	3
	Departmental Elective-1(A)	3	-	-	3
CE24356	Software Applications in Civil Engineering Lab	-	-	2	1
CE24357	Geotechnical Engineering Lab	-	-	2	1
CE24358	Structural Analysis Lab	-	-	2	1
CE24359	Internship/ Industrial Training	-	-	2	1
	Minor-3	3	-	-	3* (Extra)
Total Hours =27		**18**	**1**	**8**	**23**
Total Credits (Cumulative)					**110**
Additional Subject: - National Cadet Corps (NCC)					
NCC24351	**National Cadet Corps V**	**1**	**5**	**1**	**7**
Total Credits (Cumulative)					**21**

SIXTH SEMESTER:

Course Code	Course Name	Scheme of Studies Periods per week			Credits
		L	T	P	
CS24352	Data Structures and Algorithm	3	1	-	4
CE24361	Irrigation Engineering	3	1	-	4
CE24362	Traffic Engineering & Transportation Planning	3	-	-	3
CE24363	Financing, Planning & Management of Construction Projects	3	-	-	3
	Departmental Elective-2(A)	3	-	-	3
CE24365	Remote Sensing & GIS Lab	-	-	2	1
CE24366	Concrete & Steel Testing Lab	-	-	2	1
CE24367	Traffic Engineering Lab	-	-	2	1
CE24368	Design Project			2	1
	Minor-4	3	-	-	3* (Extra)
Total Hours =25		**15**	**2**	**8**	**21**
Total Credits (Cumulative)					**131**
Additional Subject: - National Cadet Corps (NCC)					
NCC24352	**National Cadet Corps VI**	**2**	**-**	**1**	**3**
Total Credits (Cumulative)					**24**

SEVENTH SEMESTER:

Course Code	Course Name	Scheme of Studies Periods per week			Credits
		L	T	P	
HUM24451	Engineering Economics and IPR	3	-	-	3
CE24471	Detailed Project Report Preparation and Valuation of Infrastructure Projects	3	-	-	3
	Programme Elective-3 (A)	3	-	-	3
	Programme Elective-4 (A)	3	-	-	3
	Open Elective-1(C)	3	-	-	3
CE24472	Project based lab	-	-	2	1
CE24473	B Tech Project	-	-	4	2
CE24474	Industrial / Field Training	-	-	2	1
	Minor-5	3	-	-	3* (Extra)
Total Hours =23		**15**	**-**	**8**	**19**
Total Credits (Cumulative)					**150**

EIGHTH SEMESTER:

Course Code	Course Name	Scheme of Studies Periods per week			Credits
		L	T	P	
	Programme Elective-5 (A) -NPTEL	3	-	-	3
	Programme Elective-6 (A) -NPTEL	3	-	-	3
CE24481	Internship	-	-	16	8
CE24482	General Proficiency	-	-	-	1
Total Hours =22		**6**	**-**	**16**	**15**
Total Credits (Cumulative)					**165**

LIST OF DEPARTMENT/PROGRAMME ELECTIVES

For 3rd year

CE24301 Geotechnical Investigations for Civil Engineering Structures
CE24302 Modern Foundations
CE24303 Concrete Technology
CE24304 Pre-stressed Concrete
CE24305 Highway Geometric Design
CE24306 Road Safety Audit
CE24307 Noise Pollution & Its Control
CE24308 Hazardous Waste Management
CE24309 GPS Surveying and its Applications
CE24310 Remote Sensing and GIS
CE24311 Water Resources Systems, Planning and Management
CE24312 River Engineering
CE24313 Open Channel Hydraulics
CE24314 Hydropower Engineering
CE24315 Groundwater Engineering and Management

For 4th year

CE24401 Ground Improvement Techniques
CE24402 Geosynthetics and Reinforced Soil Structures
CE24403 Soil Dynamics & Machine Foundation
CE24404 Advanced RCC Design
CE24405 Bridge Design
CE24406 Earthquake Resistant Design of Structures
CE24407 Finite Element Method
CE24408 Advanced Technologies in Transport Infrastructure
CE24409 Road Safety Engineering
CE24410 Intelligent Transport Systems
CE24411 Analysis and Design of Pavement Structures
CE24412 Railway, Airport, and Harbour Engineering
CE24413 Environmental Impact Assessment
CE24414 Environmental Legislation
CE24415 Sustainable Development and Global Environmental Issues
CE24416 Industrial Waste Treatment
CE24417 Advanced Treatment Methods
CE24418 Air Pollution and Control
CE24419 Environmental Quality Monitoring
CE24420 Digital Processing of Remotely Sensed Data
CE24421 Digital Mapping and Cartography
CE24422 Mechanics of Sediment Transport
CE24423 Machine Learning and Data Analytics in Civil Engineering
CE24424 Fluid Measurement Systems
CE24425 Design of Hydraulic Structures
CE24426 Disaster Management and Mitigation
CE24427 Hydroclimatology
CE24428 Optimization Methods for Civil Engineers
CE24429 Design of Steel-Concrete Composite Structures
CE24430 Modern Construction Equipment and Construction Practices
CE24431 Mega Projects in Construction
CE24432 Recent Advances in Civil Engineering

Name of Program	B.Tech in Civil Engineering	**Semester:** 3rd	**Year:** 2nd
Name of Course	Strength of Material		
Course Code	CE24231		
Core / Elective / Other	Core		

Course Outcomes: *Students will be able to*	
1.	Analyse a body under external loading for stress and strain
2.	Evaluate and draw shear force and bending moment diagrams for beam
3.	Evaluate displacement response of determinate structures
4.	Analyse members subjected to torsional load
5.	Analyse compression members, thick and thin cylinder
Description of Contents in brief:	
1.	**Analysis of Stress** Stress at a Point, Variation of Stress, Equilibrium equations, uniaxial and biaxial stresses, stress transformation, Principal stresses, Mohr's circle of stresses, Thermal stresses and Composite bars.
2.	**Analysis of Strain** Strain at a point, Strain-Displacement relationship, uniaxial and biaxial strains, Strain transformation, Principal strain, Mohr's circle of strains, Strain measurements, Strain Rosettes, Stress-Strain relationship, Hook's law. Generalized Hook's law, Elastic constants, and Compatibility conditions.
3	**Theory of Simple Bending** Theory of flexure for initially straight beams, Distribution of bending stresses across the beam cross section, Composite beams, Shear stresses in beams and shear center, Combined direct and bending stress, Middle third rule.
4	**Torsion** Torsion of circular shafts, Power transmitted by a shaft, Stepped and composite shafts, Shaft in series and parallel, Strain energy in torsion, Combined bending and twisting, Strain energy in bending and torsion, Introduction to non-circular cross sections.
5.	**Displacement of Determinate Structures-1** Equation of elastic curve, Double integration method, Macaulay's method, Moment area method and Conjugate beam method, Strain energy in flexure, Castigliano's theorems.
5.	**Theory of Columns** Short columns subjected to axial loads, Euler's theory for long columns with different end conditions Eccentrically loaded columns, Effective length, Rankine-Gordon Formula.
6.	**Thick and Thin Cylinders** Stresses and strains in thick and thin cylinder, Hoop stresses and strain, Longitudinal Stress in Closed cylinders, Wire winding of thin cylinders, Lame's Equation, Compound Cylinders.
7.	**Theories of elastic failure.**
List of Text Books:	
1.	*Hibler, R.C., "Engineering Mechanics", Vol I and II, Pearson Press*
2.	*Hibler, R.C., "Mechanics of Materials", Pearson Education*
List of Reference Books:	
1.	*Gere and Timoshenko, "Mechanics of Materials", CBS Publisher*

2.	*Crandal, S., Dahl, N., Lardner, T., "An Introduction to the Mechanics of Solids", McGraw Hill*
3.	*Wilber, N., "Elementary Structural Analysis", McGraw Hill*
URLs:	
1.	https://nptel.ac.in/
2.	https://swayam.gov.in/

Lecture Plan:

Lecture No.	Topic
03	Stress at a Point, Variation of Stress, Equilibrium equations, uniaxial and biaxial stresses, stress transformation, Principal stresses, Mohr's circle of stresses, Thermal stresses and Composite bars.
03	Strain at a point, Strain-Displacement relationship, uniaxial and biaxial strains, Strain transformation, Principal strain, Mohr's circle of strains, Strain measurements, Strain Rosettes, Stress-Strain relationship, Hook's law. Generalized Hook's law, Elastic constants, and Compatibility conditions.
03	Theory of flexure for initially straight beams, Distribution of bending stresses across the beam cross section, Composite beams, Shear stresses in beams and shear center, Combined direct and bending stress, Middle third rule.
06	Torsion of circular shafts, Power transmitted by a shaft, Stepped and composite shafts, Shaft in series and parallel, Strain energy in torsion, Combined bending and twisting, Strain energy in bending and torsion, Introduction to non-circular cross sections.
10	Equation of elastic curve, Double integration method, Macaulay's method, Moment area method and Conjugate beam method, Strain energy in flexure, Castigliano's theorems.
06	Short columns subjected to axial loads, Euler's theory for long columns with different end conditions Eccentrically loaded columns, Effective length, Rankine-Gordon Formula.
05	Stresses and strains in thick and thin cylinder, Hoop stresses and strain, Longitudinal Stress in Closed cylinders, Wire winding of thin cylinders, Lame's Equation, Compound Cylinders.
04	Theories of elastic failure.
40	**Total no of Lectures**

Name of Program	**B. Tech. Civil Engg.**	**Semester:** 3rd	**Year:** 2nd
Name of Course	Engineering Surveying		
Course Code	CE24232		
Core / Elective / Other	Core		
Prerequisites	-Nil-		

Course Outcomes: *Students will be able to*	
1.	Basic Understanding of the fundamental concepts related to Surveying
2.	Knowledge of conventional and modern surveying instrumentation
3.	Understanding the methodology for the preparation of Map/Plan after collecting field survey data for various applications
Description of Contents in brief:	
1.	Basic concepts and terminology in Surveying: Definition, principle, and terminology such as station, ranging, chainage, baseline, tie-line, check-line, plan, map, well-shaped triangle etc. Offsets and their types and setting out approaches in the field. Classifications of surveying based on measurement approaches, applications, and other criteria. Different types of scales and basic concepts related to precision, accuracy, and errors applicable in Surveying measurements and map preparation. Different types of maps and their availability.
2.	Measurements in Surveying: Linear and angular measurements and their types such as horizontal and slope distances, bearing, azimuth, elevation, and depression angles. Basic understanding on the errors and their rectification in the linear and angular measurements of surveying data using different instruments. Tacheometry terminology, principle, and methods and Traverse Survey.
3.	Instrumentation in Surveying: Brief introduction to conventional surveying instruments like chain, tape, compass, Vernier theodolite and plane table along with their working principle such as radiation, traversing, intersection and resection solutions, local attractions in ground measurements. Understanding on the working principle, components and use of different surveying instruments such as digital theodolite, total station, auto level, digital level, laser level, levelling staff, Global Navigation Satellite System (GNSS), GPS, Smart Stations, 3D scanners, Remote Sensing satellites, terrestrial, mobile, and aerial Lidar, & UAV based mapping etc.
4.	Leveling and contouring: Basic terminology used in leveling like level plane, level surface, datum, benchmark, GTS, reduction of levels etc. concepts. Different types of leveling such as profile leveling reciprocal leveling etc. used for the engineering projects. Direct and Indirect leveling. Cross-section levelling and contour survey methods, contour characteristics, terminology. Uses of contour maps for various applications such as Highway, Railways, Route Surveying, Canal, Reservoir etc.
List of Text Books:	
1.	Surveying and Leveling-Part-I & II, T. P. Kanetkar and S. V. Kulkarni, Pune Vidhyarthi Griha Prakashan
2.	Plane Surveying, A. M. Chandra., New Age International Publishers, New Delhi
3.	Schaum's Outline of Introductory Surveying
List of Reference Books:	
1.	Engineering Surveying: Theory and Examination Problems for Students, W. Schofield. Butterworth-Heinemann
2.	Introduction to Surveying, Michael Minchin, Department of Training, Government of Western Australia
3.	Surveying Principles and Application, B.F. Kavanagh and S.J.G. Bird, Prentice Hall
URLs:	

1.	https://nptel.ac.in/courses/105/107/105107122/
2.	https://nptel.ac.in/courses/105/104/105104101/
3.	https://nptel.ac.in/courses/105/104/105104100/

Lecture Plan:

Lecture No.	Topic
1 & 2	Definition, principle, and terminology such as station, ranging, chainage, baseline tie-line, check-line, plan, map, well-shaped triangle etc.
3	Offsets and their types and setting out approaches in the field
4	Classifications of surveying based on measurement approaches, applications, and other criteria.
5	Different types of scales and basic concepts related to precision, accuracy, and errors applicable in Surveying measurements and map preparation.
6	Different types of maps and their availability.
7 & 8	Linear and angular measurements and their types such as horizontal and slope distances, bearing, azimuth, elevation, and depression angles.
9 &10	Basic understanding on the errors and their rectification in the linear and angular measurements of surveying data using different instruments.
11	Tacheometry terminology, principle
12 &13	Tacheometry methods
14	Traverse Survey
15	Brief introduction to conventional surveying instruments like chain, tape,
16	Compass
17	Vernier theodolite
18 & 19	plane table along with their working principle such as radiation, traversing, intersection, and resection solutions
20	Understanding on the working principle, components and use of different surveying instruments such as digital theodolite,
21	total station
22	auto level, digital level, laser level, leveling staff
23	terrestrial, mobile, and aerial Lidar
24 & 25	Global Navigation Satellite System (GNSS)/GPS
26	Smart Stations, 3D scanners
27 to 29	Remote Sensing Satellites
30	terrestrial, mobile, and aerial Lidar
31	UAV based mapping etc.
32	Basic terminology used in leveling like level plane, level surface, datum,
33	benchmark, GTS
34 & 35	Different types of leveling such as profile leveling reciprocal leveling etc. used for the engineering projects.
36 & 37	reduction of levels etc. concepts
38 & 39	Indirect leveling.
40	Cross-section levelling
41	contour survey methods
42	contour characteristics, terminology
43	Uses of contour maps
44 & 45	Highway, Railways, Route Surveying,
46	Canal, Reservoir etc.

Name of Program	B. Tech. in Civil Engineering	**Semester:** 3rd	**Year:** 2nd
Name of Course	Water Supply Engineering		
Course Code	CE24233		
Core / Elective / Other	Core		
Prerequisites	-Nil-		

Course Outcomes: *Students will be able to*	
1.	Estimate demand of water.
2.	Understand quality standards different sources and their conservation.
3.	Planning and design of withdrawal and conveyance of water.
4.	Process and design of water treatment units.
5.	Planning, design and maintenance of distribution network.
Description of Contents in brief:	
1.	Water Demand, Fluctuations in demand, Population forecasting, Sources of water. Water Quality parameters and standards.
2.	Intake Structures, Conveyance of Water, Rising and Gravity mains, Valves and appurtenances, Pipe materials.
3.	Conventional and advanced water treatment Processes
4.	Water distribution system and plumbing
List of Text Books and References	
1.	Environmental Engineering Vol. 1 - Water Supply Engineering: Santosh Kumar Garg.
2.	Water Supply and Sanitary Engineering: G.S Birdie and J.S. Birdie.
3.	Environmental Engineering: Howard S. Peavy, Donald R. Rowe and George Tchobanoglous.
4.	Water Works Engineering: Qasim, Motley and Zhu
5.	Water Supply and Sewage by Terence J. Mcghee.
6.	Water and Waste Water Technology by Mark T Hammer.
7.	Manual on Water Supply and Treatment: CPHEEO, MUD, GoI, New Delhi
URLs:	
1.	https://jalshakti-ddws.gov.in/sites/default/files/Manual_on_Water_Supply_and_Treatment_CPHEEO_MoUD_1999.pdf
2.	NPTEL :: Civil Engineering - NOC:Water Supply Engineering

Lecture Plan:

Lecture No.	**Topic**
1-2	Course Introduction, Water Demand, Fluctuations in Demand
3-5	Population Forecasting,
6-10	Water Quality
11-13	Withdrawal and conveyance of raw and clear water
14-15	Aeration
16-18	Sedimentation
19-20	Coagulation and Flocculation
21-24	Filtration
25-27	Disinfection
28-30	Water Softening
31-32	Removal of Fluoride
33-34	Advanced Treatment
35	Water Reservoir
36-39	Design and Maintenance of Distribution Network
40	Plumbing

Name of Program	B.Tech in Civil Engineering	**Semester:** 3rd	**Year:** 2nd
Name of Course	Highway Engineering		
Course Code	CE24234		
Core / Elective / Other	Core		

Prerequisite:	
1.	Nil
Course Outcomes:	
1.	To learn highway alignments and design geometrical elements of highways
2.	To analyze material properties, design of mixes and quality control aspects
3.	To design flexible pavement and Rigid Pavement
4.	To understand different types of Highway Construction Techniques
5.	To learn highway maintenance and evaluation methods
Description of Contents in brief:	
1.	Highway – planning, classification of roads, surveys and alignments, Geometric design
2.	Highway Materials and their characterization
3.	Design of Flexible Pavement and Rigid Pavement as per IRC guidelines
4.	Types of Highway Construction Techniques & Quality Control
5.	Maintenance of pavements, evaluation and strengthening of pavements
List of Text Books:	
1.	Principles of Transportation Engineering Chakroborti and Das, Prentice Hall India Learning Private Limited
2.	Highway Engineering S.K. Khanna & C.E.G. Justo, Nem Chand & Bros
3.	Principles & Practice of Highway Engg. L.R. Kadiyali, Khanna Publishers
4.	Principles of Pavement Design E.J. Yoder and M.W. Witczak, Wiley
5.	Pavement Design Yoder & Witczak, Wiley
List of Reference Books:	
1.	Text book of Highway Engineering – R. Shrinivas Kumar, Universities Press
2.	Highway Material Testing and Quality Control, G.Venkatappa Rao / K. Ramachandra Rao
3.	Guidelines for Design of Flexible Pavements IRC:37-2018
4.	Guidelines for Design of Rigid Pavements IRC:58-2015
URLs:	
1.	https://nptel.ac.in/courses/105105107/
2.	https://archive.nptel.ac.in/courses/105/107/105107220/

Lecture Plan :

Lecture No.	**Topics**
1	Introduction: - Scope of highway engineering, road planning and finances in India.
2	Classification of roads, planning surveys.

3-4	Highway Alignments: - Requirements, Surveys for highway location.
5-6	Highway Geometric Design:- Introduction , highway cross section elements.
7-8	Design of Camber & Sight distance
9	Design of horizontal alignment: Design of Super elevation and Widening
10	Design of Transition Curve
11	Design of vertical alignment: Design of Gradient, grade compensation
12-13	Design of Summit curve & Valley Curve
14	Highway Materials: sub grade soil.
15	Highway Materials: Types of aggregates, characteristics and Tests
16	Types of bitumens, characteristics and Tests
17	Design of highway pavements: Introduction, Types of pavement, Component of pavement, design factors of flexible pavements.
18	Design of flexible pavement pavement as per IRC:37-2018.
19	Functions of layers of pavement, Stresses in Flexible Pavement
20	Design of rigid pavements IRC:58-2015.
21-22	Types of joints in Rigid pavement, Design & Construction of Joints
23-24	Construction of bituminous pavement.
25	Sub bases
26-27	Bases (Non bituminous), and Shoulders
28-29	Bases and Surface Courses (Bituminous)
30	Construction of cement concrete pavements and their joints.
31-32	Equipment's Useful in Construction of Roads
33-34	Pavement Maintenance Methods for flexible and rigid
35	Pavement Evaluation Techniques: Introduction
36-37	Functional & Structural Evaluation
38-39	Overlay design
40	Destructive Techniques
41-42	Non-Destructive Techniques

Name of Program	B.Tech in Civil Engineering	**Semester:** 3rd	**Year:** 2nd
Name of Course	Fluid Mechanics		
Course Code	CE24235		
Core / Elective / Other	Core		
Prerequisite	Engineering Mechanics		

Course Outcomes: *Students will be able to*	
1.	Understand the fluid properties, pressure, and its measurement, and flow measuring devices
2.	Understand and analyze the kinematics and dynamics of fluid flow
3.	Understand hydraulic similitude, and forces on immersed bodies
4.	Understand and analyze the flow in pipes

Description of Contents in brief:	
1.	Fluid mechanics in the context of Indian history, fluid continuum, properties of fluids, pressure and its measurement.
2.	Hydrostatic forces on surfaces, buoyancy and floatation, fluid kinematics and dynamics.
3.	Reynolds transport theorem (RTT), dimensional analysis, hydraulic similitude, and model laws.
4.	Flow measuring devices, laminar and turbulent flow in pipes, pipe flow analysis.

List of Text Books:	
1.	"Fluid Mechanics" by Frank M. White, Tata McGraw Hill Education Pvt. Ltd.
2.	"Introduction to Fluid Mechanics and Fluid Machines" by Som, Biswas and Chakravorthy, Tata McGraw Hill, New Delhi.

List of Reference Books:	
1.	"Introduction to Fluid Mechanics" by Fox and McDonald, John Wiley and Sons Inc.
2.	"Fluid Mechanics: Fundamentals and Application" by Cengel and Cimbala, Mc. Graw Hill, New Delhi.
3.	"Fluid Mechanics" by Kundu, Cohen, and Dowling, Academic Press.

URLs:	
1.	https://archive.nptel.ac.in/courses/105/103/105103192/
2.	https://archive.nptel.ac.in/courses/112/105/112105269/

Lecture Plan:

Lecture No.	**Topic**
1-5	Concept of fluid as a continuum, properties of fluid, basic analysis of flow
6-10	Pressure distribution in a fluid, principle of equilibrium of fluids, hydrostatics, buoyancy, and stability,
11-18	Fluid kinematics, velocity field, local and convective acceleration, velocity potential, and stream function, circulation, and vorticity
19-27	Basic physical laws of fluid mechanics, the Reynolds Transport Theorem, conservation of mass, the linear momentum equation, frictionless flow: the Bernoulli equation, angular momentum theorem, energy equations, applications
28-33	The principle of dimensional homogeneity, dimensional analysis, Rayleigh method and pi theorems, modeling, and similarity.
34-40	Velocity and flow measuring devices in pipes and open channels, laminar and turbulent flow in pipes, major and minor losses - pipes in series and parallel, equivalent length, water hammer.

Name of Program	B.Tech in Civil Engineering	**Semester:** 4th	**Year:** 2nd
Name of Course	Design of R.C.C. Structures		
Course Code	CE24241		
Core / Elective / Other	Core		
Prerequisites	Strength of Materials		

Course Outcomes: *Students will be able to*	
1.	Describe properties of R.C. Materials.
2.	Illustrate concepts and methods of R.C Design.
3.	Design and detailing of flexure members and slabs.
4.	Design and detailing of compression members.
5.	Design and detailing of footings and staircases.
Description of Contents in brief:	
1.	**Properties of R.C. materials:** Compressive strength, tensile strength, stress-strain behaviour, modulus of elasticity, shrinkage, creep, characteristic strength, grades of concrete, design stress-strain curve of concrete, reinforcing steel, types and grades, stress-strain behaviour, design stress-strain curve, basic properties of concrete, constituent materials and fresh concrete, design of concrete mix.
2.	**Basic Concepts of Reinforced Concrete Design:** Introduction to Reinforced Cement Concrete, introduction to different design philosophy, Loads and Forces, Stability of the structure, Limit State Method - safety and serviceability requirements, characteristic and design values, and partial safety factors, Working Stress Method - assumptions, comparison with LSM, modular ratio, introduction to analysis of structural members using WSM.
3.	**Design and detailing of R.C. Beam in Flexure:** Singly and doubly reinforced rectangular/flanged sections.
4.	**Behaviour and Design of R.C. Beam section in Shear, Torsion, Bond, and Limit state of serviceability:** Behaviour of R.C. beam in shear, Design of beam for shear stress; Nature of bond between steel and concrete, design for bond and concept of development length and anchorage in LSM, Limit states of deflection and cracking; Design of beam subjected to torsion and detailing.
5.	**Design of Slabs:** Design, Analysis and detailing of One-way and Two slabs.
6.	**Design of Compression Members:** Classification of compression members, effective length, slenderness ratio and slenderness limit, axially loaded short column's design, increase in permissible load in helically reinforced columns, eccentrically loaded columns, minimum eccentricity, Pu and Mu interaction diagrams, design of columns using IS-456 design aids (SP-16) with Uniaxial and Biaxial bending.
7.	**Design of Footings:** Different types of footing, design and detailing of isolated footings, combined footings, and strap footings.
8.	**Design of Staircases:** Types of staircases, design staircases with waist slab, design of folded plate staircase.
List of Text Books:	

1.	Pillai, S.U., and Menon, D., "Reinforced Concrete Design", McGraw hill Publications
2.	Jain, A.K., "Reinforced concrete: Limit state design", Nem Chand and Bros.
List of Reference Books:	
1.	Krishna Raju, N., "Reinforced Concrete Design", New Age Publisher.
2.	Varghese, P.C.," Limit State Design of Reinforced Concrete", Prentice Hall India
3.	Shah, V.L. and Karve, S.R., "Limit State Theory and Design of Reinforced Concrete: Structures Publication
List of BIS Code:	
1.	IS 456: 2000: Plain and Reinforced Concrete – Code of Practice
2.	IS 875 (Part I to Part V): Code of Practice for Design Loads (Other than earthquake loads) for building and structures
3.	SP 16: 1980 - Design Aids for Reinforced Concrete to IS 456: 1978
4.	SP 24: 1983 - Explanatory Handbook on Indian Standard Code of Practice for Plain and Reinforced Concrete (IS 456:1978)
5.	SP 34: Handbook on Concrete Reinforcement and Detailing
URLs:	
1.	https://nptel.ac.in/
2.	https://swayam.gov.in/
3.	https://standardsbis.bsbedge.com/

Lecture Plan:

Lecture No.	Topic
1-4	**Properties of R.C. materials:** Compressive strength, tensile strength, stress-strain behaviour, modulus of elasticity, shrinkage, creep, characteristic strength, grades of concrete, design stress-strain curve of concrete, reinforcing steel, types and grades, stress-strain behaviour, design stress-strain curve, basic properties of concrete, constituent materials and fresh concrete, design of concrete mix.
5-10	**Basic Concepts of Reinforced Concrete Design:** Introduction to Reinforced Cement Concrete, introduction to different design philosophy, Loads and Forces, Stability of the structure, Limit State Method - safety and serviceability requirements, characteristic and design values, and partial safety factors, Working Stress Method - assumptions, comparison with LSM, modular ratio, introduction to analysis of structural members using WSM.
11-18	**Design and detailing of R.C. Beam in Flexure:** Singly and doubly reinforced rectangular/flanged sections.
19-22	**Behaviour and Design of R.C. Beam section in Shear, Torsion, Bond, and Limit state of serviceability:** Behaviour of R.C. beam in shear, Design of beam for shear stress; Nature of bond between steel and concrete, design for bond and concept of development length and anchorage in LSM, Limit states of deflection and cracking; Design of beam subjected to torsion and detailing.
23-28	**Design of Slabs:** Design, Analysis and detailing of One-way and Two slabs.
29-32	**Design of Compression Members:** Classification of compression members, effective length, slenderness ratio and slenderness limit, axially loaded short column's design, increase in permissible load in helically reinforced columns, eccentrically loaded columns, minimum eccentricity, Pu and Mu interaction diagrams, design of columns using IS-456 design aids (SP-16) with Uniaxial and Biaxial bending.

33-36	**Design of Footings:** Different types of footing, design and detailing of isolated footings, combined footings, and strap footings.
37-40	**Design of Staircases:** Types of staircases, design staircases with waist slab, design of folded plate staircase.
41-44	Case Studies and Discussions: Analysis of real-world construction projects, application of concepts learned.

Name of Program	**B. Tech. in Civil Engg.**	**Semester:** 4th	**Year:** 2nd
Name of Course	Advance Surveying		
Course Code	CE24242		
Core / Elective / Other	Core		
Prerequisites	Basics of Surveying		

Course Outcomes: *Students will be able to*	
1.	Development of computational Geodesy skills required for various type engineering project execution and DPR preparation.
2.	Knowledge on developing methodology for the use of different modern surveying techniques in the field to make maps for different applications.
3.	Competence for setting out works in the field for various type infrastructure construction works.
Description of Contents in brief:	
1.	Area and Volume computations from Surveying data.
2.	Traverse Survey computations: Traverse error adjustments using graphical and analytical methods, Bowdith rule etc. using Gales traverse table computations. Computations for latitude, departure, independent and consecutive coordinates, false origin, and omitted measurements.
3.	Horizontal and Vertical Curves setting out computations: Elements, basic terminology, types, and computations for setting out of different type curves in the field, using different methods.
4.	Global Coordinate computations and Field Astronomy: Basic concepts and terminology related to field astronomy for the computation of Terrestrial and Astronomical coordinates. Computations for different time, and shortest distances on the Earth.
5.	Computations for Global Positioning System (GPS) Survey: Basic concepts and computations for developing the mathematical model of the Earth using Ellipsoid and Geoid concepts for defining coordinates. Different types of coordinate systems and commonly used map projections used in Geodesy and GPS. Inter-conversion of ground positions in different coordinate systems.
6.	Photogrammetry & Remote Sensing based mapping computations: Basic terminology and remote sensing data capture techniques. Computations for scale, ground coordinates and distances from photogrammetric measurements, Rectification of distortions in the remote sensing data and collinearity equations.
7.	Geographical Information System (GIS) based analysis computations: Basic terminology, components, and data models in GIS. Generation of digital terrain model (DTM), digital surface model (DSM) and digital elevation model (DEM) from different sources of surveying data. Extraction of thematic map, drainage pattern and contours from DEM data using Remote Sensing & GIS software. Commonly used Geospatial Analysis tools in GIS for various applications in Civil Engineering.
8.	Commercial and open source data and computational software in Geodesy.
List of Text Books:	
1.	Surveying and Leveling-Part-I & II, T. P. Kanetkar and S. V. Kulkarni, Pune Vidhyarthi Griha Prakashan

2.	Remote Sensing and image interpretation, Lillesand T.M. and Kiefer R. W., Willey publications
3.	Advanced Surveying, A. M. Chandra., New Age International Publishers, New Delhi
4.	Engineering Surveying: Theory and Examination Problems for Students, W. Schofield. Butterworth-Heinemann
List of Reference Books:	
1.	GPS for Land Surveyors, Jan Van Sickle, CRC Press, Taylor, and Francis group
2.	Introduction to Surveying, Michael Minchin, Department of Training, Government of Western Australia
3.	Surveying Principles and Application, B.F. Kavanagh and S.J.G. Bird, Prentice Hall
4.	Elements of Photogrammetry- Paul R. Wolf, McGraw-Hill
URLs:	
1.	https://nptel.ac.in/courses/105/107/105107121
2.	https://nptel.ac.in/courses/105/107/105107158
3.	https://nptel.ac.in/courses/105/107/105107157
4.	https://nptel.ac.in/courses/105/104/105104100/

Lecture Plan:

Lecture No.	Topic
1 & 2	Area and Volume computations from Surveying data.
3 & 4	Traverse error adjustments using graphical and analytical methods Bowdith rule etc.
5 & 6	Gales traverse table computations. Computations for latitude, departure, independent and consecutive coordinates, false origin
7 & 8	omitted measurements
9	Baseline corrections
10 & 11	different type triangulation network adjustments using theory of weights and least square error adjustment method.
12	Triangulation stations visibility analysis
13 & 14	Curvature and refraction corrections
15 & 16	Horizontal and Vertical Curves setting out computations: Elements, basic terminology
17 to 19	Computations for setting out simple circular horizontal curves
20	Computations for setting out compound curves
21 & 22	Computations for setting out reverse curves
23 to 25	Computations for setting out transition curves
26	Computations for setting out composite curves
27 to 29	Computations for setting out vertical curves
30 & 31	Global Coordinate computations and Field Astronomy: Basic concepts and terminology related to field astronomy
32 & 33	Computation of Terrestrial and Astronomical coordinates. Computations for different time, and shortest distances on the Earth
34	Computations for Global Positioning System (GPS) Survey: Basic concepts
35	Developing the mathematical model of the Earth using Ellipsoid and Geoid concepts for defining coordinates.
36	Different types of coordinate systems
37	commonly used map projections used in Geodesy and GPS
38	Inter-conversion of ground positions in different coordinate systems.
39	Photogrammetry & Remote Sensing based mapping computations: Basic

	terminology and remote sensing data capture techniques.
40 & 41	Computations for scale, ground coordinates and distances from photogrammetric measurements
42	Rectification of distortions in the remote sensing data and collinearity equations.
43	Geographical Information System (GIS) based analysis computations: Basic terminology, components,
44	Data models in GIS
45	Generation of digital terrain model (DTM), digital surface model (DSM) and digital elevation model (DEM) from different sources of surveying data.
46	Extraction of thematic map, drainage pattern and contours from DEM data using Remote Sensing & GIS software.
47 & 48	Commonly used Geospatial Analysis tools in Remote Sensing & GIS for various applications in Civil Engineering.
49 & 50	Commercial and open source data and computational software in Geodesy.

Name of Program	B. Tech. Civil Engineering	**Semester: 4th**	**Year: 2nd**
Name of Course	Wastewater Engineering		
Course Code	CE24243		
Core / Elective / Other	Core		

Course Outcomes:	
1.	Estimate quantity of wastewater.
2.	To understand disposal standards and different parameters.
3.	Planning and design of sewer network.
4.	Process and design of wastewater treatment units.
5.	Planning and design of reuse options.
Description of Contents in brief:	
1.	Quantity of wastewater, Characterisation and disposal standards.
2.	Design and construction of sewer network
3.	Stream sanitation
4.	Primary and secondary treatment of wastewater
5.	Disposal and reuse of effluents
List of Text Books and References	
1.	Environmental Engineering Vol. 1 - Water Supply Engineering: Santosh Kumar Garg.
2.	Environmental Engineering: Howard S. Peavy, Donald R. Rowe and George Tchobanoglous.
3.	Water Supply and Sewage by Terence J. Mcghee.
4.	Water and Wastewater Technology by Mark T Hammer.
5.	Manual on Sewage Treatment: CPHEEO, MUD, GoI, New Delhi
URLs:	
1.	https://mohua.gov.in/cms/Latest-Manual-part-a-Engineering.php
2.	https://archive.nptel.ac.in/courses/105/105/105105178/

Lecture Plan:

Lecture No.	Topic
1-2	Course Introduction, Introduction of wastewater
3-5	Quantity of wastewater
6-11	Wastewater characteristics
11-13	Design of sewer network
14-15	Stream Sanitation
16-18	Physical and Chemical unit operations and their limitations
19-20	Aerobic suspended growth processes
21-24	Aerobic attached growth processes
25-27	Anaerobic processes
28-30	Onsite Treatment of sewage
31-32	Treatment and disposal of sludge
33-34	Advance wastewater treatment
35-37	Advanced Treatment
38-40	Effluent disposal and reuse

Name of Program	B.Tech in Civil Engineering	**Semester:** 4th	**Year:** 2nd
Name of Course	Engineering Hydrology		
Course Code	CE24244		
Core / Elective / Other	Core		
Prerequisites	-Nil-		

Course Outcomes: *Students will be able to*	
1.	Determine the importance of the hydrological cycle on the environment and analyze the rainfall and other hydrological data.
2.	Distinguish the different sources of storage in the hydrological cycle along with their residence times
3.	Estimate the amount of conversion of rainfall to runoff through unit hydrographs
4.	Develop a frequency analysis and compare the results with different distribution systems
5.	Determine the role of subsurface water resources and manage the resources of groundwater
Description of Contents in brief:	
1.	Hydrologic cycle, precipitation and its forms, rainfall measurement and analysis, mass curve, and hyetograph.
2.	Interception and depression storage, infiltration and measurement, infiltration indices, evaporation, and measurement.
3.	Streamflow measurement, flood hydrograph, direct runoff hydrograph (DRH), and unit hydrograph (UH), generation of DRH using unit hydrograph.
4.	Flood frequency Analysis, Return period, random variables, flood-frequency distributions, hydrologic routing, and hydraulic routing.
5.	Forms of subsurface water, Darcy law, hydraulic conductivity, Steady flow in radial coordinates, Dupuit's assumptions, Thiems equation, and Thies equation, the specific capacity of a well.
List of Text Books:	
1.	Chow, V.T., Maidment, D.R. and Mays, L.W., "Applied Hydrology", McGraw Hill. 1988
2.	Subramanya, K., "Engineering Hydrology", Tata McGraw Hill, 1984.
3.	Todd, D.K., Mays, L.W., "Groundwater Hydrology", John Wiley and Sons, 1959.
List of Reference Books:	
1.	Maidment, D.R., "Handbook of Hydrology", McGraw Hill, 1993.
2.	Jain, S.K., and Singh, V.P., "Engineering Hydrology: An Introduction to process, analysis, and modelling ", McGraw Hill, 2019
URL:	
1.	https://archive.nptel.ac.in/courses/105/103/105103213/

Lecture Plan:

Lecture No.	**Topic**
1	Importance of water, Indian rivers, and their courses (in brief), hydrologic cycle
2	Atmospheric water, precipitation and its forms, residence time, water budget equation
3-4	Measurement of rainfall, rain gauges, and their optimum number for rainfall measurement
5-6	Average depth of rainfall using different methods, mean annual rainfall, analysis of

	rainfall data
7-9	Consistency of rainfall record, methods to find missing rainfall data, mass curve, double mass curve, and hyetograph
10	Losses from precipitation and their types, interception, depression storage, and infiltration.
	Horton's infiltration equation,
11-12	Factors affecting infiltration, infiltration indices (w-index and ϕ-index), and related problems
13-14	Evaporation and its affecting factors, measurement of evaporation using different methods
15	Streamflow measurement, factors affecting runoff, and streamflow
16	Flood hydrograph and separation of baseflow using different methods
17-19	Effective rainfall, direct runoff hydrograph (DRH), and unit hydrograph (UH)
20-24	Runoff estimation for different rainfall durations using UH, direct method of proportioning, S-Curve method, SCS curve number method, and Synthetic unit hydrograph
25-28	Flood frequency analysis, return period, random variables, and probability distributions using binomial, Gumbell, and Poisons distributions.
29-32	Hydrologic routing and hydraulic routing using the modified Puls method and Muskingum method, respectively.
33-34	Solving flood frequency and flood routing problems
35	Forms of water in the subsurface and their storages (aquifer, aquitard, aquifuge, and aquiclude)
36	Properties of an aquifer and Concept of representative elementary volume (REV)
37	Porosity and compressibility of aquifers, Darcy law, hydraulic conductivity and transmissivity of aquifer
38-39	Steady flow into confined aquifers using radial coordinates (Theim's equation)
40	Duipit's assumptions and its applications in analyzing unconfined aquifers
41-42	Unsteady flow into a confined aquifer, Theis equation, and specific capacity of a well

Name of Program	B.Tech in Civil Engineering	**Semester:** 4th	**Year:** 2nd
Name of Course	Structural Analysis - I		
Course Code	CE24245		
Core / Elective / Other	Core		

Course Outcomes: *Students will be able to*	
1.	Analyse determinate and indeterminate structures to evaluate internal forces due to external loading.
2.	Evaluate displacement response of determinate structures using virtual forces and energy methods.
3.	Analyse two and three-hinged arch for static loads and sketch bending moment diagrams for them.
4.	Analyse structure for rolling loads and sketch Influence Line Diagrams.
5.	Analyse beams curved in plane.
6.	Analyse Cables and Suspension bridges
Description of Contents in brief:	
1.	**Analysis of planar structures** Introduction and classification of structures, Static and kinematic indeterminacy of structures, Analysis of compound and complex trusses, Analysis of determinate beams and plane frames.
2.	**Displacement of Determinate Structures – 2** Principles of Virtual forces - Unit Load Method, Dummy Load method, Reciprocal theorems (Maxwell Reciprocal theorem and Betti's Law); Deflection of trusses and plane frames.
3.	**Arches** Analysis of three hinged circular and parabolic arches, Bending moment diagrams. Two hinge parabolic & circular arch, moving load on two hinge arch, Temperature effect, Reaction, Locus for two hinged Arch.
4.	**Rolling Loads and Influence Lines Diagrams** Analysis for different types of moving loads, Influence line diagram and its uses, Muller-Breslau principle with application to determinate and indeterminate structures. Qualitative ILD for continuous beams, frames, and arches.
5.	**Unsymmetrical Bending and Curved Beams** Unsymmetrical Bending - Introduction, Location of Neutral axis, computation of stresses and deflections; Curved Beams - Bending of curved beams in plane of bending, stresses in bars with small and large initial curvature, Beams Curved in plan.
6.	**Cables and Suspension Bridges** Analysis of Cables, Suspension bridges with three and two hinged stiffening girders.
List of Text Books:	
1.	*Wang, C.K., "Intermediate Structural Analysis", McGraw Hill.*
2.	*Reddy, C, S., "Basic Structural Analysis", Tata McGraw Hill.*
List of Reference Books:	
1.	*Hibbeler, R.C., "Structural Analysis", Tata McGraw Hill.*
2.	*Norris, C.H., Wilbur, J.B., Utku, S., "Elementary Structural Analysis", McGraw Hill*
3.	*Ramamrutham, S., Narayan, R., "Theory of Structures", Dhanpat Rai Publisher*
4.	*Menon, D., "Structural Analysis", Narosa Publisher*
URLs:	
1.	https://nptel.ac.in/

2.	https://swayam.gov.in/
3.	https://standardsbis.bsbedge.com/

Lecture Plan :	
Lecture No.	**Topic**
04	Introduction and classification of structures, Static and kinematic indeterminacy of structures, Analysis of compound and complex trusses, Analysis of determinate beams and plane frames.
10	Principles of Virtual forces - Unit Load Method, Dummy Load method, Reciprocal theorems (Maxwell Reciprocal theorem and Betti's Law); Deflection of trusses and plane frames.
08	Analysis of three hinged circular and parabolic arches, bending moment diagrams. Two hinge parabolic & circular arch, moving load on two hinge arch, temperature effect, reaction, locus for two hinged Arch.
06	Analysis for different types of moving loads, Influence line diagram and its uses, Muller-Breslau principle with application to determinate and indeterminate structures. Qualitative ILD for continuous beams, frames, and arches.
06	Unsymmetrical Bending - Introduction, Location of Neutral axis, computation of stresses and deflections; Curved Beams - Bending of curved beams in plane of bending, stresses in bars with small and large initial curvature, Beams Curved in plan.
06	Analysis of Cables, Suspension bridges with three and two hinged stiffening girders.
40	**Total no of Lectures**

Name of Program	B.Tech. in Civil Engineering	**Semester:** 4th	**Year:** 2nd
Name of Course	Soil Mechanics		
Course Code	CE24246		
Core / Elective / Other	Core		
Prerequisites	Engineering mechanics, strength of materials		

Course Outcomes: *Students will be able to*	
1.	Comprehensive understanding of soil composition and their classification.
2.	Understand the principle of effective stress, permeability and seepage through soils.
3.	Understand the general principles of compaction, compressibility and consolidation.
4.	Knowledge about determining stress distribution and shear strength parameters of soils.
5.	Ability to apply various soil exploration methods.
Description of Contents in brief:	
1.	**Physical Properties of Soil:** Indic Vedic System, soil formation, soil types, composition, three phase relations, specific gravity, water content, shape and size, grain size distribution curves, relative density, consistency of soils, Texture classification system, Unified soil classification system, IS soil classification system, field identification tests.
2.	**Effective Stresses, Permeability and Seepage:** Principle of effective stress, pore pressure and total stress, Darcy's law, determination of permeability, laboratory and field methods, equivalent permeability in stratified soils, 1-D flow, Laplace's equation, flow nets, seepage, uplift pressure, confined and unconfined flows, piping, filter criteria.
3.	**Compaction and Compressibility and Consolidation:** General principles of compaction, compaction tests, factors affecting compaction, field compaction and control techniques, consolidation, normally and over-consolidated clays, void ratio-pressure relationships, compressibility characteristics, time rate of consolidation, coefficient of consolidation, curve fitting techniques, settlement, secondary consolidation, 3-D consolidation.
4.	**Stress Distribution in Soil Mass and Shear Strength of Soil:** Vertical stress distribution, Boussinesq analysis, isobar and pressure bulb, Westergaard Analysis, Newmark's Influence Chart, Shear strength of soils, Mohr-Coulomb failure criterion, determination of shear parameters, direct shear test, triaxial compression test, vane shear test, Skempton's pore pressure parameters.
5.	**Soil Exploration:** Methods of soil Exploration; Boring, Sampling, Penetration tests, Plate load test, Pressuremeter test, Geophysical methods.
List of Text/Reference Books:	
1.	Ranjan, G. and Rao, A.S.R., "Basic and Applied Soil Mechanics", New Age.
2.	Peck, R.B., Hanson, W.E. and Thornburn, T.H., "Foundation Engineering", John Wiley.
3.	Ranjan, G. and Rao, A.S.R., "Basic and Applied Soil Mechanics", New Age.
4.	Geotechnical Engineering-T.N. Ramamurthy, T.G. Sitharam
5.	Das, B.M., "Principles of Foundation Engineering", PWS
URLs:	
1.	**https://archive.nptel.ac.in/courses/105/101/105101084/**
2.	**https://www.youtube.com/watch?v=l2EgTuxfEOc**
Lecture Plan:	

Lecture No.	Topic
1	Indic Vedic System, Soil formation, Soil types, composition
2	Three phase relations, Specific gravity, water content,
3-6	Grain size distribution curves, relative density, consistency of soils
7	Texture classification system, Unified soil classification system
8-9	IS soil classification system, field identification tests
10-11	Principle of effective stress, Pore pressure and total stress, Darcy's law
12-13	Determination of permeability, Laboratory and field methods
14-16	Equivalent permeability in stratified soils
17-18	1-D flow, Laplace's equation, flow nets
19-21	Seepage, uplift pressure, confined and unconfined flows, piping, filter criteria.
22-24	General principles of compaction, compaction tests, factors affecting compaction, field compaction and control techniques, Consolidation
25-27	Normally and over-consolidated clays, void ratio-pressure relationships, compressibility characteristics
28-30	Time rate of consolidation, coefficient of consolidation, curve fitting techniques
31-33	Vertical stress distribution, Boussinesq Analysis, Isobar and pressure bulb, Westergaard Analysis,
34-35	Newmark's Influence Chart, Shear Strength of Soils, **Mohr**-Coulomb failure criterion
36-38	Determination of shear parameters, direct shear test, triaxial compression test, vane shear test, Skempton's pore pressure parameters.
39-40	Methods of soil exploration; boring, sampling, penetration tests, SPT and CPT
41-42	Correlations between penetration resistance and soil design parameters, Plate Load Test, Pressuremeter Test, Geophysical Methods

Name of Program	B.Tech in Civil Engineering	**Semester:** 5th	**Year:** 3rd
Name of Course	Design of Steel Structures		
Course Code	CE24351		
Core / Elective / Other	Core		
Prerequisites	Strength of Materials, Structural Analysis – I		

Course Outcomes: *Students will be able to*	
1.	List out properties of steel and various types of steel sections.
2.	Illustrate concepts of steel design for civil engineering structures.
3.	Design connections of steel structures.
4.	Design tension members, compression members, beams, column bases and roof trusses.
5.	Perform plastic analysis of steel sections.
Description of Contents in brief:	
1.	Introduction, properties of structural steel and structural steel sections
2.	Basic concepts of steel design - working stress and limit state method
3.	Introduction to connections - Bolted (Ordinary and HSFG) and welded connections.
4.	Tension members.
5.	Compression members: Built up columns, Beam columns and column splices.
6.	Design of Beams: Laterally supported, unsupported and built-up beams.
7.	Plate-girders including stiffeners, splices and curtailment of flange and web plates,
8.	Column bases, slab base, gusseted base, and grillage footings.
9.	Beam to column connection, Introduction to semi rigid connections.
10.	Roof truss-Design of various components for different loadings (Dead, Live and Wind loads), purlins, Gantry Girders
11	Plastic Analysis.
List of Text Books:	
1.	Subramanyam, N., "Design of Steel Structures", Oxford University Press
2.	Duggal, S.K., "Design of Steel Structures", Tata Macgraw Hill Publication
List of Reference Books:	
1.	Kazimi, S.A., "Design of Steel Structures", Prentice Hall of India, New Delhi
2.	Arya A.S., Ajmani J.L., "Design of Steel Structures" Nem Chand and Bros.
3.	Sai Ram., K.S., "Design of Steel Structures", Pearson India Education Pvt Ltd.
4.	Englekirk, R., "Steel Structures-Controlling behavior through design", John Wiley & Sons, New York
5.	Trahair, N.S., Bradford, M.A., et al., "The Behavior and Design of Steel Structures to EC3, Taylor and Francis, London, 2008
List of BIS Code:	
1.	IS 800: 2007: Code of Practice for general construction in steel
2.	IS 875 (Part I to Part V): Code of Practice for Design Loads (Other than earthquake loads)

	for building and structures
3.	IS 808: Dimensions for Hot Rolled Steel Beam, Column, Channel and Angle Sections
URLs:	
1.	https://nptel.ac.in/
2.	https://swayam.gov.in/

Lecture Plan:

Lecture No.	**Topic**
1-3	Introduction, properties of structural steel and structural steel sections
4-7	Basic concepts of steel design - working stress and limit state method
8-13	Introduction to connections - Bolted (Ordinary and HSFG) and welded connections.
13-17	Tension members.
18-23	Compression members: Built up columns, Beam columns and column splices.
24-27	Design of Beams: Laterally supported, unsupported and built-up beams.
28-30	Plate-girders including stiffeners, splices and curtailment of flange and web plates,
31-33	Column bases, slab base, gusseted base, and grillage footings.
34-35	Beam to column connection, Introduction to semi rigid connections.
36-38	Roof truss-Design of various components for different loadings (Dead, Live and Wind loads), purlins, Gantry Girders
39-40	Plastic Analysis.

Name of Program	B.Tech in Civil Engineering	**Semester:** 5th	**Year:** 3rd
Name of Course	Structural Analysis - II		
Course Code	CE24352		
Core / Elective / Other	Core		

Course Outcomes:	
1.	Analyse Indeterminate structure using force and displacement methods.
2.	Analyse structure using strain energy methods.
3.	Analyse indeterminate structures using flexibility and stiffness method.
4.	Analyse indeterminate structure using matrix method.
5.	Apply concepts of structural analysis using computer software.
Description of Contents in brief:	
1.	**Analysis of Indeterminate structures** Introduction, Force and Displacement Methods of Analysis of Indeterminate Structures.
2.	**Force Methods for analysis of Indeterminate Structures** Method of consistent deformation, Strain Energy Methods, Method of Minimum Strain Energy for indeterminate beams, Trusses, and plane frames.
3.	**Displacement Methods for analysis of Indeterminate Structures** Slope Deflection method and Moment Distribution Method for continuous beams, frames (with and without sway).
4.	**Analysis of Multi storied frames** Substitute frame method, Approximate method of analysis for multi-storied frames with lateral loads- Portal and Cantilever method.
5.	**Matrix Methods for analysis of Indeterminate structures** Introduction, Flexibility Method- Application to Beams, Trusses, Frames and Grid Structures. Stiffness Method- Application to Beams, Trusses, Frames and Grid Structures (including plane and space structures.
6.	**Computer Oriented Direct Stiffness Method** Introduction, Application to Beams, Frames and Trusses. Use of analysis software: STAAD. Pro and ETABS.
List of Text Books:	
1.	*Hibbeler, R.C., "Structural Analysis", Pearson Press*
2.	*Wang, C.K., "Intermediate Structural Analysis", McGraw Hill*
List of Reference Books:	
1.	*Weaver, W. Jr. and Gere, J.M., "Matrix Analysis of Framed Structures", CBS Publishers*
2.	*Norris, C.H., Wilbur, J.B., Utku, S., "Elementary Structural Analysis", McGraw Hill*
3.	*Ramamrutham, S., Narayan, R., "Theory of Structures", Dhanpat Rai Publisher*
4.	*Menon, D., "Advanced Structural Analysis", Narosa Publisher*
URLs:	
1.	https://nptel.ac.in/
2.	https://swayam.gov.in/
Lecture Plan (about 40-50 Lectures):	

Lecture No.	Topic
03	Introduction, Force and Displacement Methods of Analysis of Indeterminate Structures.
06	Flexibility methods- method of consistent deformation, theorem of least work, Column Analogy method and its applications to prismatic and non-prismatic beams with different end conditions and portal frames
06	Introduction, Method of Minimum Strain Energy for indeterminate beams, Trusses and plane frames.
08	Stiffness methods - Slope Deflection method and Moment Distribution Method for continuous beams, frames (with and without sway),.
04	Substitute frame method, Approximate method of analysis for multi-storied frames with lateral loads- Portal and Cantilever method.
08	Introduction, Flexibility Method- Application to Beams, Trusses, Frames and Grid Structures; Stiffness Method- Application to Beams, Trusses, Frames and Grid Structures (including plane and space structures.
05	Introduction, Application to Beams, Frames and Trusses.
40	**Total no of Lectures**

Name of Program	B.Tech in Civil Engineering	**Semester:** 5th	**Year**: 3rd
Name of Course	Hydraulics and Hydraulic Machines		
Course Code	CE24353		
Core / Elective / Other	Core		
Prerequisite	Fluid Mechanics		

Course Outcomes: *Students will be able to*	
1.	Understand the concept of boundary layer and its application
2.	Design open channel for uniform, gradually and rapidly varied flows.
3.	Computation of force exerted by water jet, types of turbines and their design features and characteristics
4.	Types of pump, their design features and characteristics, selection of pumps and turbines.
Description of Contents in brief:	
1.	Boundary layer theory: development of boundary layer over a flat plate, boundary layer thickness, application of momentum equation to boundary layer flow, local and mean drag coefficients.
2.	Open channel flow: uniform, gradually, and rapidly varied flow in open channel, characteristics of flow profiles in open channel.
3.	Impact of jets, classification of hydraulic machines, hydraulic design of turbines and pumps,
List of Text Books:	
1.	Navaratnam, S., Fluid Mechanics, Khanna Publishers, 1995.
2.	Natarajan, M.K. Principles of Fluid Mechanics, Oxford & IBH Publishing Co, 1994.
3.	Streeter V.L., Fluid mechanics, Tata McGraw Hill, 1998.
List of Reference Books:	
1.	Chaudhry, M and Hanif. Open Channel Flow. Englewood Cliffs, NJ: Prentice Hall, 1993.
2.	Chanson, H (2004b). The Hydraulics of Open Channel Flow-An Introduction, (Butterworth-Heinemann, Oxford, UK) 2ndEdition (ISBN 07506 59785)
3.	Sahu G.K., Pumps, New Age Publications Pvt. Ltd, New Delhi
URLs:	
1.	https://nptel.ac.in/courses/112/103/112103249/
2.	https://nptel.ac.in/courses/105/103/105103096/
3.	https://nptel.ac.in/courses/105/107/105107059/

Lecture Plan:

Lecture No.	**Topic**
1-10	Boundary layer theory: introduction, development of boundary layer over a flat plate, boundary layer thickness, displacement, momentum and energy thicknesses, application of momentum equation to boundary layer flow, local and mean drag coefficients
11-18	Open channel flow; critical depth, hydraulic efficient section, the concept of specific energy, sub-critical and supercritical flow, and its applications
19-25	Gradually varied flow: theory and analysis, gradually varied flow computations in prismatic channels, characteristics of flow profiles – draw down and backwater curves

26-30	Rapidly varied flow- theory of hydraulic jump, evaluation of jump elements in the rectangular and non-rectangular channels, location of jump on the horizontal floor, surges
31-40	Impact of jets, turbines, Euler's equation, classification of turbines, working proportion of turbines, efficiency of turbines, characteristics of turbines, centrifugal pump, classification of pumps, efficiency, characteristics of pumps

Name of Programme	B.Tech Civil Engineering	**Semester:** 5th	**Year:** 3rd
Name of Course	Environmental Pollution & Management		
Course Code	CE24354		
Core/Elective/Other	Core		
Prerequisites	-Nil-		

1	Sound and its transmission
2	Physical & Chemical properties of gases
3	Chemical Kinetics
4	Chemical Thermodynamics
Course Outcomes:	Students will be able to:
1	Identify & understand Air, Noise & Solid waste pollution sources and classify them
2	Understand effect of meteorology on air pollutants
3	Understand sampling , measurement and characterization of Air, Noise & Solid pollutants.
4	Understand solid waste management- generation , collection, handling, storage, processing, transportation,
5	Understand & Select Air , Noise pollution control techniques and methodologies and solid waste disposal techniques
6	Design control devices for Air, Noise & Solid pollutants as well as understand legal aspects of environmental pollution.
Description of Contents in brief:	
1	Definitions, Classification of Air pollutants. Sources, Particulates & Gaseous pollutants in Air
2	Effects of Air pollutants on human, plants, materials and animals, Economic Effects
3	Meteorological Aspects, Plume behavior, Sampling and Measurement
4	Air Pollution control- Particulate control technologies, Control of gaseous emissions
5	Sources of Noise, Effects of Noise on Human & other biotic life ,Sound Pressure, Power and Intensity, Loudness
6	Miscellaneous measures of Noise- Community noise, Airport Noise, Industrial Noise. Control of noise pollution
7	Sources, types, composition, physical, chemical and biological properties of solid wastes, sources and types of hazardous and infections wastes in municipal solid wastes,
8	Solid waste generation and collection, handling, storage, transportation.
9	Disposal of solid wastes- Materials separation and processing, thermal conversion, biological and chemical conversion, recycling of material in municipal solid wastes, Land filling, Composing, gas generation
10	Legal aspects of air, noise and solid waste management.
List of Text Books :	
1	Environmental Engineering – A Design Approach by Arcadio P. Sincero and Gregoria A. Sincero, Pearson Education ,Inc Prentice Hall of India, 2016
2	Principles and Practices of Air Pollution Control and Analysis by J.R. Mudakavi , I.K. International Publishing House Pvt. Ltd. New Delhi, Reprint 2012
3	Environmental Pollution Control Engineering- CS Rao, Wiley Eastern Ltd., New Delhi, 1996.
4	Environmental Noise Pollution – PE Cunniff, McGraw Hill, Publishing Co. Ltd
5	Air Pollution by M.N. Rao & H.V.N. Rao Tata McGraw Hill Publishing Co. Ltd
6	Environmental Engineering by Peavy, H.S., Rowe and Tchobonoglous,G., McGraw Hill
7	Solid Waste Management Frank Kreith
8	Advanced Air and Noise Pollution Control by Lawrence K.Wang, Norman C. Pereira, Yung-Tse Hung, Volume I & Volume II, Humana Press
9	Management of Solid Wastes in Developing Countries - Frank Flintoff

List of Reference Books:	
1	Introduction to Environmental Engineering by Mackenzie L Davis , David A Cornwell , Tata McGraw Hill Education Pvt. Ltd. , New Delhi, 2010
2	Environmental Engineering by Gerard Kiely , Tata McGraw Hill Education Pvt. Ltd. , New Delhi, 2007
3	Principles of Environmental Engineering & Science by Mackenzie L. Davis & Susan J. Masten , McGraw Hill Education (India) Pvt. Ltd, 2013
4	Handbook of Noise Measurement – APG Peterson & EE Gross PH, Englewood cliffs New Jersey, latest edition.
5	Air Pollution Control Equipment – H. Brauer and Y. B. G. Verma, Berlin Heidelberg, New York, latest edition.
URLs:	
1	http://www.cpcbenvis.nic.in/
2	https://iums.ac.ir/uploads/Air_Pollution_Control_Engineerin%D8%B8%E2%80%9E_95694.pdf
3	http://160592857366.free.fr/joe/ebooks/Automative%20engineering%20books/Advanced_Air_and_Noise_Pollution_Control.pdf
4	https://nptel.ac.in/courses/105/104/105104099/
5	https://swayam.gov.in/nd1_noc19_me72/preview
LECTURE PLAN	
1	Sources of Air Pollution, Processes of generation of atmospheric dust
2	Classification of Air Pollutants
3	Effects of Various Air Pollutants on human
4	Effects of Various Air Pollutants on Plants and Materials
5	Gaseous air pollutants units and measurements of concentration
6	Meteorological parameters affecting Air pollution
7	Atmospheric Stability, Stability classes, Mixing Height, Dispersion of Air Pollutants , Plume behavior - types of plumes
8	Estimation of Stack Height, Estimation of buoyant Plume Rise
9	Sampling and Measurement of Air Pollutants, High Volume Sampler, Stack Sampling & Monitoring
10	Particulate Control Technologies, Gravitational Settling Chambers Cyclone Separators,
11	Fabric Filters- Mechanism, design aspects, operational troubles, Characteristics of Fibers
12	Electrostatic Precipitators- Principle, Construction , Types, Advantages Disadvantages , Factors affecting collection efficiency of ESPs
13	Scrubbers- Mechanism, Types, Spray Tower, Venturi Scrubber
14	Air Pollution Control by Combustion, Direct combustion, Thermal Incineration, Fluidized Bed Incineration
15	Sources and Effects of Noise
16	Acoustics Principles- Sound Wave theory, Frequency, Wavelength, Amplitude
17	Sound Pressure, Power, Intensity , Unit of Measurements,
18	Loudness, Sone, Phon, Pitch, Addition and Subtraction of Decibels
19	Frequency Weighting, Octave Band Analysis
20	Sound Level Meter , Directivity , Outdoor Noise Propagation
21	Community Noise Measurement ,Airport Noise Measurement , Industrial Noise Measurement
22	Noise Attenuating Factors ,Indoor Noise Propagation, Noise Transmission through Ducts, Noise Transmission through Partitions
23	Noise Control Criteria, Noise Control Techniques
24	Noise Control – Absorption Silencer, Dissipative Muffler, Reactive Expansion Muffler
25	Noise Control- Vibration Control, Vibration isolators, Magnification Factor, Transmissibility ratio, Damping Factor
26	Noise Control in buildings , Fan Plenum
27	Sources, types, composition, physical, chemical and biological properties of solid wastes,

28	Sources and types of hazardous and infections wastes in municipal solid wastes,
29	Solid waste generation and collection,
30	Solid waste handling, storage,
31	Solid waste transportation
32	Disposal of solid wastes- Materials separation and processing,
33	Disposal of solid wastes- thermal conversion
34	Disposal of solid wastes- biological and chemical conversion
35	Disposal of solid wastes- recycling of material in municipal solid wastes
36	Disposal of solid wastes- Land filling,
37	Disposal of solid wastes - Composing,
38	Disposal of solid wastes- gas generation
39	Legal aspects of air pollution
40	Legal aspects of noise pollution
41	Legal aspects of solid waste pollution
42	Secured land fill

Name of Program	**B.Tech. in Civil Engineering**	**Semester:** 5th	**Year:** 3rd
Name of Course	Geotechnical Engineering		
Course Code	CE24355		
Core/Elective/other	Core		
Prerequisites	Soil Mechanics		

Course Outcomes: *Students will be able to*	
1.	Analyze the concept of earth pressure and stability analysis of retaining walls
2.	Understand and apply bearing capacity theories and design criteria for shallow foundations
3.	Comprehend various types and methods of construction on pile foundations and well foundations.
4.	Understand the fundamental concepts of slope stability and its importance in geotechnical engineering
5.	Understand the properties and lab tests for rocks
Description of Contents in brief:	
1.	**Introduction:** Indic Vedic system, role of civil engineer in the selection, brief review of soil mechanics principles used in foundation engineering. Earth Pressure and Retaining Walls, Earth pressure at rest, active and passive earth pressure, Rankine and Coulomb's earth pressure theories, Graphical methods, retaining walls, stability analysis of retaining walls.
2.	**Shallow Foundations:** Types of foundations, Bearing Capacity Theories: Terzaghi's, Skempton's, Meyerhof, Brinch Hansen's, Vesic's and IS Code recommendation, effect of water table, factors affecting the bearing capacity of soils, Settlement of shallow foundation in case of cohesion less soil and fine-grained soil, use of field test data in design of shallow foundations.
3.	**Deep Foundations**: Types and methods of construction, estimation of pile load capacity using static method and dynamic formulae, Group action of piles, Negative skin friction, Settlement of group of piles in sand and clay, Pile capacity from field test data, well foundations: Methods of construction, bearing capacity, tilt and shift, remedial measures, settlement and lateral stability of well foundation.
4.	**Stability of Slopes**: Introduction, Infinite slope and infinite slope, Stability analysis of infinite slopes, Stability analysis of finite slopes, Swedish circle method, Friction circle method, Taylor Stability number, Bishop's Method of stability analysis, Stability of side slopes of earth dam.
5.	**Rock mechanics**: Engineering Classification, Index properties, RQD, RMR, Laboratory Tests for determination of strength of rocks.
List of Text/ Reference Books:	
1.	Das, B.M., "Principles of Foundation Engineering", PWS
2.	Soil Mechanics and Foundation Engineering – Dr. K. R. Arora
3.	Soil Mechanics and Foundation Engineering – Dr. K. R. Arora
4.	Das, B.M., "Principles of Foundation Engineering", PWS
URLs:	
1.	https://www.youtube.com/watch?v=YEltCJUZ0hk
2.	https://www.youtube.com/watch?v=d8m-keGP6AA
Lecture Plan:	

Lecture No.	Topic
1	Indic vedic system, role of civil engineer in the selection, brief review of soil mechanics principles used in foundation engineering
2	Earth Pressure and Retaining Walls, Earth pressure at rest, active and passive earth pressure
3-4	Rankine and Coulomb's earth pressure theories
5-6	Graphical methods, retaining walls, stability analysis of retaining walls
7-8	Types of foundations, Bearing Capacity Theories: Terzaghi's, Skempton's, Meyerhof, Brinch Hansen's, Vesic's and IS Code recommendation
9-10	Effect of water table, factors affecting the bearing capacity of soils
11-12	Settlement of shallow foundation in case of cohesion less soil and fine-grained soil, use of field test data in design of shallow foundations.
13-15	Types and methods of construction, estimation of pile load capacity using static method and dynamic formula.
16-18	Group action of piles, Negative skin friction, Settlement of group of piles in sand and clay, Pile capacity from field test data
19-21	Well foundations: Methods of construction, bearing capacity, tilt and shift, remedial measures.
22-24	Settlement and lateral stability of well foundation.
25-27	Introduction, Infinite slope and finite slope, Stability analysis of infinite slopes
28-30	Stability analysis of finite slopes, Swedish circle method
31-33	Friction circle method, Taylor Stability number
34-35	Bishop's Method of stability analysis, Stability of side slopes of earth dam
36-37	Engineering Classification, Index properties, RQD, RMR
38-39	Index properties, RQD, RMR
40-42	Laboratory Tests for determination of strength of rocks.

Name of Program	B.Tech in Civil Engineering	**Semester:** 6th	**Year:** 3rd
Name of Course	Irrigation Engineering		
Course Code	CE24361		
Core / Elective / Other	Core		
Prerequisite	Mechanics of fluids, engineering hydrology		

Course Outcomes: *Students will be able to*	
1.	Differentiate the types of irrigation systems and their suitability for practice
2.	Estimate the water requirement of crops and determine the size and capacity of reservoirs to meet the requirement
3.	Analyze the forces on a gravity dam or an earth dam to carry out the requirement of storage in reservoirs
4.	Determine the different types of spillways and evaluate the suitability of an appropriate spillway for a designed hydraulic structure
5.	Design the conveyance of estimated water through a canal system
Description of Contents in brief:	
1.	Water resources in India, need for irrigation in India, definition of irrigation, types of irrigation systems, soil moisture constants, water extraction, quality of irrigation water
2.	Water requirements of crops, soil moisture irrigation relationships, Duty, Delta, and Base period and their relationship, crops and seasons, irrigation requirement, irrigation efficiencies, and intensity of irrigation.
3.	Classification of dams, gravity dams, stability criteria, modes of failure, principal and shear stress. Types and design of earth dams, criteria for safe design, phreatic line, seepage analysis.
4.	Types, location and components of diversion head works, Bligh's, Lanes and Khosla's theories, types of spillways and their working, energy dissipation, scour protection, stilling basins.
5.	Classification of irrigation canals, regime theories – Kennedy's and Lacey's theories, critical tractive force method, regulation of channel system, canal outlets, water logging, and cross drainage works.
List of Text Books:	
1.	Linsley, R.K., Franzini, J.B., Freyberg, D.L., Techobanoglous, G., "Water Resources Engineering", Tata McGraw Hill, 2013
2.	S. K. Garg, "Irrigation Engineering and Hydraulic Structures", Khanna Publishers, 1992.
List of Reference Books:	
1.	Mays, L.W, "Water Resources Engineering", John Wiley and Sons, 2019.
URLs:	
1.	https://archive.nptel.ac.in/courses/105/105/105105110/
2.	https://archive.nptel.ac.in/courses/105/104/105104103/

Lecture Plan:

Lecture No.	**Topic**
1-3	Need for irrigation in India, definition of irrigation, types of irrigation systems
4	Methods of irrigation, soil moisture constants
5-8	Depth of water held by soil in different zones, water extraction, and quality of irrigation water
9	Water requirements of crops, soil moisture irrigation relationships, estimation of

	irrigation frequency
10-11	Duty, delta, and base period and their relationship, crops, and crop seasons in India
12-13	Factors affecting duty and methods of improving duty, consumptive use of water
14-15	Irrigation requirement (gross and net irrigation requirement), irrigation efficiencies, and intensity of irrigation.
16-17	Classification of dams, factors of selecting dams, selection of site and preliminary investigation
18-20	Gravity dams, forces acting on a gravity dam, stability criteria, modes of failure, elementary and practical profiles, stability analysis, principal and shear stress
21-22	Earth dams, Types and design of earth dams, causes for failure of earth dams, criteria for safe design, phreatic line, seepage analysis
23-25	Types, location and components of diversion head works, effects of construction of weirs on permeable foundation
26-27	Bligh's, Lanes, and Khosla's theories, and related problems
28-30	Essential requirements of a spillway, spillway capacity, components, types of spillways and their working, energy dissipation below spill way, scour protection
31-32	Use of hydraulic jump as energy dissipater, stilling basins – USBR and IS standard basins
33-34	Classification of irrigation canals, canal alignment, design of unlined canals, regime theories – Kennedy's and Lacey's theories, critical tractive force method
35-36	Cross section of an irrigation channel, maintenance of irrigation channel, regulation of channel system
37-38	Canal outlets, requirements of a good outlet, types of outlets
39-40	Waterlogging- causes and control, types of cross-drainage works

Name of Program	B.Tech in Civil Engineering	**Semester:** 6th	**Year:** 4th

Name of Course	Traffic Engineering & Transportation Planning
Course Code	CE24362
Core / Elective / Other	Core

Prerequisite:	
1.	Nil

Course Outcomes:	
1.	To develop basic concept on fundamentals components of traffic engineering and its features and analyze Traffic Characteristics including vehicular and road user characteristics.
2.	To study various traffic surveys to analyze the present traffic scenarios.
3.	To develop understanding on traffic flow theory and traffic forecasting techniques.
4.	To study TOD, various traffic enforcements rules and regulations including traffic safety measures
5.	To learn transportation planning process

Description of Contents in brief:	
1.	Traffic Characteristics: Road user characteristics, vehicular characteristics- static and dynamic characteristics of vehicles affecting traffic performance etc.
2.	Traffic Studies: Spot speed studies and volume studies, Speed and delay studies, Origin and destination studies (O&D), Traffic capacity studies, Accident studies, preventive measures
3.	Traffic Stream Characteristics, Various Traffic Stream Flow Models, Analysis of LOS, Forecasting models
4.	Basic concepts of transit-oriented development, Traffic operations and Control: Traffic regulations and various means of control. Traffic control devices, Oneway streets, Traffic Signals, ITS
5.	Introduction to transportation planning process, four stages of Transportation Planning

List of Text Books:	
1.	Principles of Transportation Engineering Chakroborti and Das, Prentice Hall India Learning Private Limited
2.	Traffic Engineering & Transport Planning, L.R. Kadiyali, Khanna Publishers
3.	Principles of Traffic and Highway Engineering – Nicholas J Garber, Lester A Hoel, Cengage Learning
4.	Traffic Flow Fundamentals by Adolf D. May.

List of Reference Books:	
1.	Text Book of Highway & Traffic Engineering – Subhash C Saxena, CBS Publishers
2.	An Introduction to Traffic Flow Theory by Lily Elefteriadou.
3.	Transportation Engineering: An Introduction – C. Jotin Khisty, B. Kent Lall, Pearson Publishers

URLs:	
1.	https://nptel.ac.in/courses/105101008/
2.	https://archive.nptel.ac.in/courses/105/107/105107067/

Lecture Plan:

Lecture No.	**Topic**
1	Introduction to Traffic Engineering
2-3	Traffic characteristics: Road users and the vehicle characteristics

4-5	Traffic surveys: Classified Traffic Volume study
6-7	Spot Speed Study & Speed journey time delay survey
8	Origin & Destination surveys
9-10	Parking surveys. Use of photographic techniques in traffic engineering.
11	Modern aids in traffic surveys
12-14	Traffic controls: Traffic sign and road marking.
15-16	Traffic islands, intersections
17-19	Stream flow Characteristics: volume, density, speed
20-22	Traffic stream flow models
23-24	Level of Service (LOS) & Capacity analysis
25-26	Traffic forecasting Models using softwares
27-28	Road Safety Audit (RSA)
29	Traffic Management System
30	TOD
31-33	Intelligent Transport System, Concept of Smart City
34-35	Transportation Planning: Transport planning process, Four Stage Planning
36	Trip generation, trip distribution: Basic Concept
37	Traffic assignment, model split evaluation: Basic Concept
38-40	Types of transport models aggregate & disaggregate models, transport planning for small and medium sized cities (Case study).

Name of Program	B.Tech in Civil Engineering	**Semester: 6th**	**Year: 3rd**
Name of Course	Financing, Planning & Management of construction projects		
Course Code	CE24363		
Core / Elective / Other	Core		

Students will able to:	
1.	Understand construction projects, stakeholders, and phases.
2.	Understand Financing, cash flow, PPP in construction.
2.	Estimate project costs from client's and contractor's perspectives.
3.	Plan and schedule projects using network analysis techniques and resource scheduling.
4.	Monitor and control projects using S-curve, earned value analysis, and analyze time-cost trade-offs.
5.	Understand construction contracts, claims, disputes, quality, and safety.
Description of Contents in brief:	
1.	Introduction to construction projects, stakeholders, phases, cost estimation, and project selection using time value of money concept.
2.	Construction project financing, cash flow management, financial risk management, PPP in construction, tax consideration in projects.
3.	Construction contracts, project planning, network analysis using PERT, CPM, and Precedence Network, and resource scheduling.
4.	Time-cost trade-off analysis, monitoring and control using S-curve and earned value analysis.
5.	Construction claims, disputes, quality, and safety.
List of Text Books:	
1.	Construction Planning and Management - P.S. Gahlot and B.M. Dhir, New Age International Publishers
2.	Construction Project Management - K.K. Chitkara, Tata McGraw Hill
List of Reference Books:	
1.	Project Planning and Control with PERT and CPM - B.C. Punmia and K.K. Khandelwal, Laxmi Publications
2.	Construction Management and Planning - B. Sengupta and H. Guha, Tata McGraw Hill
3.	Construction Project Management - S. Keoki Sears, Glenn A. Sears, Richard H. Clough, Wiley India
4.	Project Finance for Construction – Anthony Higham and Peter Faarrell.
URLs:	
1.	https://archive.nptel.ac.in/courses/105/103/105103093/
2.	https://archive.nptel.ac.in/courses/105/104/105104161/

Lecture Plan (about 40-50 Lectures):

Lecture No.	**Topic**
1	Introduction to Construction Projects: Scope of construction projects, types of construction projects, project life cycle.

2	Stakeholders in Construction Projects: Identification of stakeholders, their roles and responsibilities.
3	Phases in a Construction Project: Initiation, planning, execution, monitoring and control, closure.
4-7	Construction project financing, feasibility analysis, sources, loans and credit facilities, budgeting and cost control, cash flow management, financial risk management, Insurance and bonding, PPP in construction, tax consideration in projects, documentation.
8-9	Cost Estimation from Client's Perspective: Types of estimates, factors affecting cost estimation, estimation methods.
10-11	Project Selection using Time Value of Money Concept: Present worth, future worth, annual worth, internal rate of return.
12-13	Construction Contracts: Types of contracts, key elements of a contract, bidding process.
14-15	Cost Estimation from Contractor's Perspective: Quantity takeoff, pricing, bid preparation.
16-18	Introduction to Project Planning: Work Breakdown Structure (WBS), activity definition, sequencing, and duration estimation.
19-21	Network Analysis using PERT and CPM: Network diagram, critical path, float, probabilistic duration estimates. Network Analysis using Precedence Network: Activity-on-Node (AON) diagram, lag relationships, schedule computation.
22-24	Resource Scheduling: Resource allocation, resource leveling, resource-constrained scheduling.
25-27	Time-Cost Trade-off Analysis: Direct and indirect costs, cost slope, compression and crashing of activities.
28-30	Project Monitoring and Control using S-Curve: Baseline schedule, actual progress, S-curve analysis
31-33	Project Monitoring and Control using Earned Value Analysis: Planned value, earned value, actual cost, schedule and cost variances, performance indices.
34-35	Construction Claims and Disputes: Types of claims, claim process, dispute resolution methods.
36-37	Construction Quality Management: Quality planning, quality assurance, quality control, quality standards.
38-39	Construction Safety Management: Safety hazards, safety planning, accident prevention, safety regulations.
40-42	Case Studies and Discussions: Analysis of real-world construction projects, application of concepts learned.

Name of Program	B.Tech in Civil Engineering	**Semester:** 7th	**Year:** 4th
Name of Course	Detailed Project Report Preparation and Valuation of Infrastructure Projects		
Course Code	CE24471		
Core / Elective / Other	Core		

Course Outcomes:	
1.	Understand the concept of Detailed Project Report and its importance in Infrastructure Projects.
2.	Prerequisites for preparation of Detailed Project Report for an Infrastructure Project.
3.	Tender and Contract for an Infrastructure Project.
4.	Preparation of Detailed Project Report of an Infrastructure Project.
5.	Estimating and Costing of Civil Infrastructure works.
6.	Understand specifications for civil works.
7.	Perform Rate Analysis of construction works with reference to the Schedule of Rates.
8.	Perform valuation of Civil works.
Description of Contents in brief:	
1.	Concept of Civil Infrastructure Projects and Detailed project Report of Infrastructure Projects.
2.	Need, Prerequisites, Content and Format for preparation of a Detailed Project Report.
3.	General items of work in buildings, Sub heads of various items of work, Estimate – Purpose, Types, Units and Methods of measurement of Civil works.
4.	Schedule of Rates and Specifications of works.
5.	Principles of working out quantities for detailed and abstract of estimates – Approximate method of estimating, Detailed estimates of items of building works.
6.	Estimate for road works.
7.	Rate Analysis of various items of work, over head and contingent charges.
8.	Preparation of a Detailed Project Report of an Infrastructure Project.
9.	Tender and Contracts.
10.	Valuation of Civil works.
List of Text Books:	
1.	Estimating and Costing by B. N. Dutta, UBS publishers, (2000).
2.	Estimating in Building Construction by Steven J. Peterson, Publisher: Pearson Prentice Hall
3.	Construction: Quantity Surveying by William J. Hornung
4.	Principles of Estimating by Trevor Holroyd, Publisher: Thomas Telford Ltd.
5.	Construction Cost Estimating: Process and Practices by Holm Leonard, Publisher: Pearson Education
6.	Estimating Building Costs: For Residential and Light Commercial Contractor (RS Means) by Wayne J. DelPico, Publisher: John Wiley and Sons
7.	Estimating and Costing by G. S. Birdie.

List of Reference Books:	
1.	Schedule of rates, Specifications and references published by works departments.
2.	I.S. 1200 (Parts I to XXV – 1974/method of measurement of building and Civil Engineering works – B.I.S)
3.	Estimating Building Costs: For Residential and Light Commercial Contractor (RS Means) by Wayne J. DelPico, Publisher: John Wiley and Sons
4.	Estimation, costing and specifications by M. Chakraborthi; laxmi publications.
URL	https://archive.nptel.ac.in/courses/105/104/105104161/

Lecture Plan:

Lecture No.	Topic
1-2	Concept of Civil Infrastructure Projects and Detailed project Report of Infrastructure Projects.
3-5	Tender and Contract for an Infrastructure Project
6-9	Need, Prerequisites, Content and Format for preparation of a Detailed Project Report.
10	Introduction to General items of work in buildings, Sub heads of various items of work,
11-15	Estimate – Purpose, Types, Units and Methods of measurement of Civil works.
16-20	Estimates of building, Different methods of estimation: Long wall short wall method of estimation and Centre Line method of Estimation-description
	Principles of working out quantities for detailed and abstract of estimates – Approximate method of estimating, Detailed estimates of items of building works.
21-23	Subheads of Various Items of Works, Various Methods of Taking Out Quantities, Abstracting Bill of Quantities, over head and contingent charges.
24-26	Schedule of Rates and Specifications of works.
27-28	Estimate of R.C.C. work and Structure.
30-33	Road Estimating-Introduction, cross section of typical road in Banking and Cutting, Different Methods of Road Estimating- Mid-sectional area method, Mean Sectional area method, Prismoidal formula method and numericals.
34-36	Rate analysis- Introduction to rate analysis, material required for various items of work, rates of various quantities , material , labour Rate Analysis of various items of building and road works,
37-38	Preparation of a Detailed Project Report of an Infrastructure Project.
39-40	Valuation of Buildings.

Name of Program		B.Tech. in Civil Engineering	**Semester:** 3rd	**Year:** 2nd
Name of Course		Fluid Mechanics Lab		
Course Code		CE24236		
Core / Elective / Other		Lab		
Prerequisite:				
1.	Knowledge of Basic Fluid Mechanics			
2.	Knowledge of Internal and External Flow.			
Course Outcomes: *Students will be able to*				
1.	Understand Basic practical applications of fluid mechanics			
2.	Understand basic flow properties, physics of fluid flow and various flow conditions.			
3.	Understand role of fluid mechanics in water conveyance and its relevance in engineering.			
Description of Contents in brief:				
1.	Introductions to fluid and fluid properties.			
2.	To understand the basics of hydrostatics, fluid kinematics and dynamics.			
3.	To understand the application of pipe flow and open channel flow in real life.			
List of Text Books:				
1.	White, M.F., Fluid Mechanics, Tata McGraw Hill Education Pvt. Ltd.			
2.	Som, Biswas and Chakravorthy, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill, New Delhi.			
Sl. No.	**List of Experiments**			
1	Determination of the metacentric height of a floating body and analyse its equilibrium state			
2	Differentiation of Laminar and Turbulent flows using Reynolds Apparatus.			
3	Determination of coefficient of discharge and calibration of a venturimeter and orifice meter.			
4	Determination of coefficient of discharge and calibration of an orifice and a mouthpiece.			
5	Verification of Bernoulli's theorem through Bernoulli’s apparatus			
6	Determination of friction factor of a flow through a pipe			
7	Determination of force on a flat plate and curved plate by the impact of a jet of water.			
8	Determination of losses of energy in a pipeline through the bends.			
9	Determination of flow characteristics of Sharp-Crested Weir			
10	Determination of flow characteristics at channel contraction and expansion			

Name of Program	B.Tech. in Civil Engineering	**Semester:** 3rd	**Year:** 2nd
Name of Course	Engineering Surveying Lab		
Course Code	CE24237		
Core / Elective / Other	Lab		

Prerequisite:	
1.	Knowledge of Basic Surveying Measurements
2.	Knowledge of Various Surveying Instruments
Course Outcomes: *Students will be able to*	
1.	Understand Basic practical concept of surveying measurements.
2.	Understand basic surveying operations, like chaining, Tapping, Ranging etc.
3.	Understand role of surveying in the construction field works (Example- Plotting site plan, area calculation, Angle measurements etc.).
Description of Contents in brief:	
1.	Introductions to various method of surveying used for different survey work.
2.	To understand basic concept of levelling, Reduced Level calculations and contouring.
3.	To understand the concept of Intersection method and two / three-point problems in surveying.
List of Text Books:	
1.	Surveying and Leveling-Part-I & II, T. P. Kanetkar and S. V. Kulkarni, Pune Vidhyarthi Griha Prakashan
2.	Plane Surveying, A. M. Chandra., New Age International Publishers, New Delhi
3.	Schaum's Outline of Introductory Surveying
4.	Engineering Surveying: Theory and Examination Problems for Students, W. Schofield. Butterworth-Heinemann
Sl. No.	**List of Experiments**
1	To set out a chain line of 40 to 60 meters and locate the objects near the chain line, by taking the perpendicular offsets by the method of swinging of tape.
2	Drawing of conventional symbol sheet
3	Determination of the map area using graphical/instrumental methods
4	Study of topographic maps
5	To determine the area of the given site by cross staff survey.
6	To find out the area of given site by compass/Theodolite traversing
7	To set out a regular pentagon in the field, using prismatic compass.
8	To determine the reduced level (R.L.) difference between two stations by carrying out differential levelling.
9	To carry out the profile levelling along the given line.
10	To carry out the levelling field work for the preparation of contour map of the given site.
11	To determine the given site area by the method of plane table traversing and plot the objects by the radiation method of plane table survey.
12	Horizontal and vertical angle measurements with the help of vernier theodolite.

13	Determination of Tacheometric constants
14	Tacheometric contouring
15	To determine the horizontal angle between two objects and computation of horizontal distance between two elevated inaccessible objects using digital theodolite
16	To determine the elevation angle and height of the top of an accessible object.
17	To determine the height of an inaccessible elevated visible object by One/Two plane method.

Name of Program	B.Tech. in Civil Engineering	**Semester:** 3rd	**Year:** 2nd
Name of Course	Highway Engineering lab		
Course Code	CE24238		
Core / Elective / Other	Lab		

Prerequisite:	
1.	Highway Engineering Theory
Course Outcomes: *Students will be able to*	
1.	Identify properties of aggregates
2.	Differentiate aggregate grades
3.	Evaluate the quality of pavement
4.	Distinguish the pavement construction materials
Description of Contents in brief:	
1.	Understanding various properties of aggregates, bitumen and soil subgrade and testing and analyzing according to their specified code.
List of Text Books:	
1.	Highway Materials and Pavement Testing S.K. Khanna, C.E.G. Justo and A.Veeraragavan, Nem Chand & Brothers
List of Reference Books:	
1.	L .R. Kadiyali, Principles and Practices of Highway Engineering, Khanna Publishers
2.	Related IRC codes, MoRTH Guidelines
3.	Transportation Engineering - C. JotinKhisty
Sl.No.	**List of Experiments**
1.	Aggregate Crushing Value test
2.	Los Angeles Abrasion test
3.	Aggregate Impact test
4.	Specific Gravity test of Aggregate
5.	Water Absorption test of Aggregate
6.	Shape test a) Flakiness index b) Elongation index
7.	Viscosity test of Bituminous Material
8.	Penetration test of Bitumen
9.	Softening Point test of Bitumen
10.	Flash and Fire Point test of Bitumen
11.	Ductility Test of Bitumen
12.	California Bearing Ratio test

Name of Program	B.Tech. in Civil Engineering	**Semester:** 3rd	**Year:** 2nd
Name of Course	Civil Engineering Materials Lab		
Course Code	CE24239		
Core / Elective / Other	Lab		
Prerequisite:			
	Nil		
Course Outcomes: *Students will be able to*			
1.	Enlist types of cement and performs tests on cement		
2.	Perform physical tests on aggregate for concrete		
3.	Performs tests on bricks as per latest IS code.		
4.	Perform tests on timber used as a construction material		
Description of Contents in brief:			
1.	Properties of Concrete Constituents Materials: Physical & chemical properties of cement; Testing of cements as per BIS specifications; Types of cements; Introduction to aggregates, types of aggregates, testing on aggregates; Introduction to admixtures, types of admixtures and their uses, Effects of plasticizers and superplasticizers.		
2.	Fresh Concrete & Hardened Concrete: Concrete mix design, workability and its measurements; Compaction & curing of concrete; Strength of concrete; Factors affecting strength of concrete; NDT & Conventional testing of concrete; introduction to various types of concrete.		
3.	Mortar and plasters: Preparation of cement mortar and concrete for different types of works, factors affecting strength of concrete, types of concrete and their specific use.		
4.	Brick and other Clay Products: Composition of brick-earth, manufacturing process of bricks, characteristics of good building bricks, classification and testing of bricks, special types of bricks and their uses		
5.	Timber and Wood Based Products: Classification of timber trees, cross section of exogenous tree, hard wood and soft wood, seasoning of timber, ply wood and its uses		
6.	Steel: Types of steel-mild steel, high carbon steel, high strength steel properties and uses, light Guage steel, commercial forms of steel and their uses, Steel rebars.		
List of Text Books:			
1.	Gambhir, Murari Lal, and Jamwal, Neha. Building and Construction Materials: Testing and Quality Control : Lab Manual. India, McGraw Hill Education (India).		
2.	Marotta, Theodore W., and Herubin, Charles A. Basic Construction Materials: Methods and Testing. United States, Regents/Prentice Hall.		
3.	Moondra, H. S., Laboratory Manual for Civil Engineering. India, CBS Publishers & Distributors.		
S. No.	List of Experiments		
1	Determination of normal consistency of cement with Vicat's apparatus.		
2	Determination of initial setting time of cement with Vicat's apparatus.		
3	Test for direct compressive strength of cement mortar		
4	Sieve analysis of fine and coarse aggregate.		
5	Determination of specific gravity (relative density) and water absorption capacity of fine aggregate.		

6	Determination of specific gravity and water absorption capacity of coarse aggregate.
7	Determination of unit weight and voids in aggregate.
8	Determination of resistance to degradation in small size coarse aggregate by abrasion and impact using Los Angeles Machine.
11	Sampling and testing of brick for efflorescence, compressive strength, and absorption.
12	To determine the modulus of rupture of wooden beam specimen.

Name of Program	B.Tech. in Civil Engineering	**Semester:** 4th	**Year:**2nd
Name of Course	Soil Mechanics Lab		
Course Code	CE24247		
Core / Elective / Other	Lab		

Course Outcomes: *Students will be able to*	
1.	Identify and determine the basic engineering properties of soil. They would learn the procedure for experimental investigations required for classification of the soils.
2.	Learn experimental methods of measurement of compaction, permeability and strength characteristics of soils
Description of Contents in brief:	
1.	Visual soil classification; water content; Atterberg limits; grain size analysis; specific gravity; permeability; standard proctor compaction test, unconfined compression test, direct shear test, vane shear test.
List of Text/Reference Books:	
1.	B.M. Das, "Soil Mechanics Laboratory Manual", 6th Ed., London, University Press, 2001.
2.	Soil Mechanics and Foundation Engineering – Dr. K. R. Arora
3.	Engineering Soil Testing: Alam Singh, CBS Publishers & Distributor
4.	Manual of Soil Testing: P K Jain, Nem Chand & Brother.
5.	B.M. Das, "Soil Mechanics Laboratory Manual", 6th Ed., London, University Press, 2001.
6.	J.E. Bowles, "Physical Properties of Soils", 2nd Ed., McGraw Hill International, Singapore,1990.
URLs:	
1.	**https://www.youtube.com/watch?v=WkN4LxXKKKI**
2.	**https://www.youtube.com/watch?v=bmpn5oNDvOs**

Lab Classes: about 16 lab classes schedule

S. No.	List of Experiments
1.	Introduction, Visual Classification, water content
2.	Determination of in-situ density of soil by core cutter method.
3.	Determination of in-situ density of soil by sand replacement method.
4.	Determination of specific gravity of fine-grained soil.
5.	Determination of specific gravity of coarse-grained soil.
6.	Determination of liquid limit and plastic limit of soil.
7.	Determination of shrinkage limit of soil.
8.	Grain size distribution of soil by Sieve Analysis.
9.	Grain size distribution of soil by sedimentation analysis (Hydrometer).
10.	Determination of compaction parameters of soil by Standard proctor test.
11.	Determination of compaction parameters of soil by Modified proctor test.
12.	Determination of Permeability of soil by constant head method.
13.	Determination of Permeability of soil by falling head method.
14.	Determination of shear parameters by Unconfined compression test
15.	Determination of shear parameters by Direct shear test.
16.	Determination of shear parameters by Vane shear test.

Name of Program	B.Tech. in Civil Engineering	**Semester:**4th	**Year:**2nd
Name of Course	Water and Wastewater Lab		
Course Code	CE24248		
Core / Elective / Other	Laboratory		

Prerequisite:	
1.	Theory course in Water Supply and Sewage Engineering
Course Outcomes: *Students will be able to*	
1.	Acquire capability to conduct experiments and calculate the concentration of different Water/ Wastewater Quality Parameters
2.	Compare the results with standards and discuss based on the purpose of the analysis
3	Assess the type of treatment and degree of treatment required for water and wastewater.
Description of Contents in Brief:	
1.	To enable the students to conduct different tests to find various Characteristics of water and wastewater and then decide the degree of treatment required
List of Text Books:	
1.	Water and Wastewater Testing – A Laboratory Manual by R.P. Mathur, Nem Chand & Brothers, Roorkee
2.	Chemistry for Environmental Engineering and Science by Clair N. Sawyer, Perry L. McCarty and Gene F. Parkin , Tata Mc Graw Hill Publishing Company Ltd, New Delhi
List of Reference Books:	
1.	A.P.H.A., Standard Methods for Water and Wastewater Analysis published by AWWA, American Public Health Association
2.	Guide Manual: Water and Wastewater Analysis - Central Pollution Control Board, India
3.	Quantitative Analysis by R.A. Day, Jr. and A.L. Underwood, published by Englewood Cliffs, N.J. : Prentice-Hall
Sl. No.	**List of Experiments**
1.	Determination of pH of different samples- Water, Wastewater, other solutions .
2.	Determination of Turbidity and conductivity of Water sample.
3.	Determination of Solids in Wastewater sample- (i) Total Solids (ii) Suspended Solids (iii) Dissolved Solids,
4.	Determination of Solids in Wastewater sample- (i) Total Solids (ii) Volatile Solids (iii) Fixed Solids (iii) Settleable solids
5.	Determination of Acidity of Water and Wastewater samples,
6.	Determination of Alkalinity of Water and Wastewater samples,
7.	Determination of pH of water sample and establishing its relationship with alkalinity & acidity of the same water sample
8.	Determination of Calcium, Magnesium, and Total Hardness of Water Sample.
9.	Determination of Chloride of Water and Wastewater sample by titration
10.	Determination of Optimum dosage of alum using Jar test apparatus for Raw water sample
11.	Determination of Dissolved Oxygen of water sample
12.	Determination of Biochemical Oxygen Demand of Wastewater sample
13.	Determination of Chemical Oxygen Demand of Wastewater sample
14.	Determination of MPN of the given water sample

Name of Program	B.Tech in Civil Engineering	**Semester:** 4th	**Year:** 2nd
Name of Course	Planning and design of Building Structures Lab		
Course Code	CE24249		
Core / Elective / Other	Lab		
Prerequisite	Nil		

Course Outcomes: *Students will be able to*	
1.	Understand the conventions as per IS:962-1989 for various types of lines used in engineering drawings.
2.	Understand the rules and bye-laws of local governing authorities for construction work.
3.	Create line plans for residential and public buildings.
4.	Create drawings of steel trusses and lean-to roofs. layout plans for water supply lines with accessories. layout of sanitary lines, including the positioning of inspection chambers, septic tanks, and sanitary fittings.
5.	Create two-point perspective views of small objects like pedestals, step blocks, and small single-storied buildings with flat roofs.
Description of Contents in brief:	
1.	History of Buildings, Building Planning, History of Building Drawing, building components, reading of ammonia prints of residential buildings. Types of Buildings Based on Occupancy, Types of Residential Buildings, Basic Concepts of Building Elements.
2.	Planning of building: Principles of planning of Residential and Public building, space requirements and norms for minimum dimension of Residential and Public building. Rules and bye-laws of local governing authorities for construction work, Drawing of line plans for residential and public building. Building By-Laws.
3.	Building drawing: Development of plan from line plan of a residential building, elevation, section, site plan, location plan, foundation plan, area statement and other details. submission drawing and working drawing. Detailed drawing - Drawing of staircase, drawing of steel truss& lean to roof, drawing of layout plan of water supply line with accessories, Layout plan of sanitary line, Typical Plans.
4.	Building Services: Planning of Water Distribution System, Storage Tanks, House Drainage System, Electric Supply System. Building Drawing: Introduction, Plan, Elevation, Section, Isometric, Oblique and Perspective Drawing, Shades, Shadows Rendering and Presentation Drawings, Working Drawings, Checklist for Working Drawings.
5.	Perspective drawing - Definition, Necessity, Types of perspective, Principles of Perspective Drawing, Terms used in perspective drawing, Two-point perspective view of a small object like pedestal, step block, small single storied building with flat roof etc., Drawing using AutoCAD. Computer Aided Building Drawing**.**
List of Text Books:	
1.	Shah and Kale, Principles of Building Drawing
2.	Balagopal T S, Prabhu K, Vincent P and Vijayan C, Building Drawing and Detailing, Spades Publishers (1987).
3.	Shah M G, Kale C M and Patki S Y, building drawing with an integrated approach to built environment, 4th Edition, Tata McGraw Hill (2002).

4.	Building Planning and Drawing, S.S. Bhavikatti and M.V. Chitawaagi, Techsar Publishers
List of Reference Books:	
1.	B.C. Punmia, Building construction.
2.	Sharma and Kaul, Text of building construction

Lecture Plan :

Lecture No.	Topic
1-3	Introduction to Building Design and Drawing, History of Buildings, Building Planning, History of Building Drawing, Building components, reading of ammonia prints of residential buildings, Types of Buildings Based on Occupancy, Types of Residential Buildings, Basic Concepts of Building Elements.
4-7	Planning of building: Principles of planning of Residential and Public building, Space requirements and norms for minimum dimension of Residential and Public building, Rules and bye-laws of local governing authorities for construction work, Building By-Laws
8-10	Drawing of line plans for residential and public building, Development of plan from line plan of a residential building, elevation, section, Site plan, location plan, foundation plan, area statement and other details, Submission Drawing and Working Drawing, drawing of staircase, drawing of steel truss & lean to roof, drawing of layout plan of water supply line with accessories
11-12	Layout plan of sanitary line - position of inspection chamber, septic tank, sanitary fittings. Position of wash basin, sink etc. Building Services: Planning of Water Distribution System, Storage Tanks, House Drainage System, Electric Supply System
13-14	Building Drawing: Introduction, Plan, Elevation, Section, Isometric, Oblique and Perspective Drawing, Shades, Shadows Rendering and Presentation Drawings, Working Drawings, Checklist for Working Drawings. Typical Plans.
14-15	Perspective drawing - Definition, Necessity, Types of perspective, Principles of Perspective Drawing, Terms used in perspective drawing, Two-point perspective view of a small object like pedestal, step block, small single storied building with flat roof etc.
15-17	Introduction, CAD Hardware, CAD Software, AutoCAD and Applications of AutoCAD, Operation of AutoCAD and Function Keys, Drawing with the Aid of AutoCAD.

Name of Program	B. Tech. Civil Engg.	**Semester:** 5th	**Year:** 3rd
Name of Course	Software Applications in Civil Engineering		
Course Code	CE24356		
Core / Elective / Other	Lab		

Prerequisite:	
1.	Basic understanding of civil engineering principles and concepts
2.	Familiarity with computer fundamentals and software usage.
Course Outcomes: *Students will be able to*	
1.	Understand various software applications commonly used in civil engineering practice.
2.	Gain proficiency in utilizing these software tools for design, analysis, and management tasks relevant to civil engineering projects.
Description of Contents in brief:	
Software packages for civil engineering applications; data analysis software; development of algorithms and computer codes for the solution of civil engineering problems.	
List of Text Books:	
1.	"AutoCAD 3D Modeling: Exercise Workbook" by Steve Heather
2.	"GIS Fundamentals: A First Text on Geographic Information Systems" by Paul Bolstad
3.	"Structural Analysis and Design Using Staad Pro" by S.S. Bhavikatti
4.	"Project Planning & Control Using Primavera P6" by Paul E. Harris
Sl. No.	**List of Experiments**
1	Introduction to Software Applications in Civil Engineering: Overview of software tools used in civil engineering, Importance and benefits of using software applications in civil engineering practice.
2-3	Introduction to AutoCAD: Hands on experience on 2D drafting and 3D modeling
4-6	Introduction to STAAD Pro: Practical sessions on modeling and analyzing structural elements.
7-9	Introduction to GIS software, Practical exercises using ArcGIS or QGIS for spatial analysis and mapping.
10-15	Basics of programming and numerical analysis, Applications of MATLAB in civil engineering computations and simulations.

Name of Program	B.Tech. in Civil Engineering	**Semester:**5th	**Year:**3rd
Name of Course	Geotechnical Engineering Lab		
Course Code	CE24357		
Core / Elective / Other	Lab		

Course Outcomes: *Students will be able to*	
1.	Perform laboratory tests needed to determine soil design parameters.
2.	Conduct and determine dynamic soil properties.
3.	Conduct SPT and Plate load test and interpret the test results.
Description of Contents in brief:	
1.	Triaxial test (Unconsolidated undrained test, consolidated drained test, consolidated undrained test with pore water pressure measurement), CBR test, Consolidation test, vertical and cyclic plate load test, pile load test SPT test, Vane shear test, Direct shear test, Specimen preparation, Unconfined compression test,
List of Text/ Reference Books:	
1.	Manual of Soil Testing K Jain, Nem Chand & Brother
2.	Engineering Soil Testing: Alam Singh, CBS Publishers & Distributor
3.	Manual of Soil Testing K Jain, Nem Chand & Brother
4.	Engineering Soil Testing: Alam Singh, CBS Publishers & Distributor
URLs:	
1.	**https://www.youtube.com/watch?v=QuE4tEK-5iY**
2.	**https://www.youtube.com/watch?v=uGTs5O3ds7k**

S. No.	**List of Experiments**
1.	Determination of shear parameters by Triaxial shear test.
2.	Determination of Soaked CBR of Soil compare the value in soaked and unsoaked condition.
3.	Determine compression Index of soil by consolidation test and compare with the empirical correlations.
4.	Demonstration of the Plate Load Test
5.	Demonstration of the Cyclic Plate Load Test
6.	Demonstration of the Pile Load Test
7.	Demonstration of SPT test in field
8.	Demonstration of Block Vibration Test
9.	Demonstration Liquefaction phenomenon in the laboratory
10.	Demonstration of the Electrical Resistivity Test and the Seismic Refraction Test
11.	Identification of minerals and rocks.
12.	Determination of Engineering properties of Rocks
13.	Determination of point load strength index of rocks.

Name of Program	B.Tech. in Civil Engineering	**Semester:** 5th	**Year:** 3rd
Name of Course	Structural Analysis Lab		
Course Code	CE24358		
Core / Elective / Other	Lab		

Prerequisite:	
1.	Strength of Material
2.	Structural Analysis
Course Outcomes: *Students will able to*	
1.	Understand the behavior of flexural members in shear, bending and deflection
2.	Understand experimentally behavior of axially loaded columns
3.	Understand experimentally behavior of arches, portal frames, unsymmetrical bending and curved beams.
Description of Contents in brief:	
1.	Theoretical concept of load balancing in ancient Indian construction.
2.	Ability to understand basic concept of shear force, bending moment and deflection at various sections of beams experimentally and compare with theoretical values.
3.	To understand basic concept of deflected shape of columns under various end conditions
4.	To understand the concept of horizontal thrust and influence line of arches, deflection in curved ring beam, unsymmetrical bending
List of Text Books:	
1.	Basic Structural Analysis: Wilbur and Norris
2.	Structural Analysis: R.C. Hibbeler
3.	Indeterminate Structural Analysis: C.K. Wang
4.	Structural Analysis: T.S. Thandvamoorthi
Sl.No.	**List of Experiments**
1.	To determine the shear force in simply supported beam experimentally and compare it with the theoretical value.
2.	To determine the bending moment in a simply supported beam experimentally and compare it with the theoretical value.
3.	To determine the deflection of a simply supported beam experimentally and compare it with the theoretical value.
4.	To study the behavior of different types of struts and to calculate the Euler's Buckling load for each case.
5.	To verify Clark Maxwell's theorem by means of a mild steel beam.
6.	To verify Betti's theorem by means of a mild steel beam.
7.	To determine the horizontal thrust in a three-hinged arch for a given system of loads experimentally and verify the same with calculated values.
8.	To obtain an influence line diagram for the horizontal thrust in a three hinged arch experimentally and verify the same with calculated values.
9.	To study the behaviour of a portal frame under different end conditions.
10.	To determine the deflection in curved ring beam experimentally and verify the same with calculated values using Castigaliano's Theorem.

11.	Experimental and analytical study of deflections for unsymmetrical bending of a Cantilever beam.
12.	To determine the horizontal thrust in a two-hinged arch for a given system of loads experimentally and verify the same with calculated values.
13.	To obtain an influence line diagram for the horizontal thrust in a two hinged arch experimentally and verify the same with calculated values.

Name of Program	B. Tech. in Civil Engineering	**Semester:** 6th	**Year:** 3rd
Name of Course	Remote Sensing & GIS Lab		
Course Code	CE24365		
Core / Elective / Other	Lab		

Prerequisite:	
1.	Basics of Surveying
2.	Computational Geodesy
Course Outcomes: *Students will be able to*	
1.	Acquire practical knowledge on the use of conventional and modern surveying instrumentation for making map
2.	Compete on field setting out work of engineering projects for surveying related inputs.
3.	Develop skills for the creation of GIS based digital maps using modern survey techniques such as Remote Sensing & GPS
URLs:	
1.	https://nptel.ac.in/courses/105/107/105107121
2.	https://nptel.ac.in/courses/105/107/105107158
3.	https://nptel.ac.in/courses/105/107/105107157
4,.	https://nptel.ac.in/courses/105/104/105104100/
S. No.	**List of Experiments**
1	Topographic mapping using Total Station instrument.
2	Setting out of simple circular curve using linear methods.
3	Setting out of simple circular curve using angular methods (Rankine/Two Theodolite Method).
4	Setting out of transition/compound/composite curve in the field using linear /angular methods.
5	Study on the visual interpretation of earth features by using aerial photo/ satellite images using Google Earth Pro
6	LULC mapping using open source remotely sensed satellite imagery and tools.
7	Distance and coordinate measurements using GPS (Global Positioning System) Receivers
8	Digital map database creation/storage and analysis using open source/ commercial Geographic Information System (GIS) software.
9	Calculations of area using digital planimeter instrument.
10	Learning on the use Open-source data use from various portals of NASA, ISRO, SOI and other agencies.
11	DGPS survey data collection and processing
12	DSM (Digital Surface Model) and DTM (Digital Terrain Model) generation from the remote sensing satellite based digital elevation model (DEM) based data.
13	Creation of Contour map and slope map from DEM using GIS software
14	Topographic mapping using GPS/DGPS survey methods.

Name of Program	B.Tech. in Civil Engineering	**Semester:** 6th	**Year:** 3rd
Name of Course	Concrete and Steel Testing Lab		
Course Code	CE24366		
Core / Elective / Other	Lab		

Prerequisite:	
1.	Basic of Building Materials
Course Outcomes: *Students will be able to*	
1.	Perform test on concrete and its constituent materials.
2.	Design mix for various types of concrete as per IS 10262 latest revisions.
3.	Perform tests on fresh and hardened concrete for workability and strength.
4.	Perform non-destructive testing of concrete.
5.	Perform various tests on tor-steel bars.
Description of Contents in brief:	
1.	Determination of physical properties of cement, cementitious composites, coarse and fine aggregate.
2.	Mix design of ordinary, standard, high-strength concrete as per IS 10262
3.	Determination of fresh and hardened properties of ordinary and standard concrete.
4	Determination of strength of reinforcement.
5.	Introduction to Non-destructive testing of concrete
List of Text Books:	
1.	Gambhir, Murari Lal, and Jamwal, Neha. Building and Construction Materials: Testing and Quality Control : Lab Manual. India, McGraw Hill Education (India).
2.	Marotta, Theodore W., and Herubin, Charles A. Basic Construction Materials: Methods and Testing. United States, Regents/Prentice Hall.
3.	Moondra, H. S., Laboratory Manual for Civil Engineering. India, CBS Publishers & Distributors.
S. No.	**List of Experiments**
1.	Determination of physical properties of cement, cementitious composites, coarse and fine aggregate.
2.	Design mix proportioning of ordinary grade of concrete (M20) and perform tests on fresh and hardened concrete (workability and compressive strength tests as per is codes)
3.	Design mix proportioning of standard grade of concrete (M25) and perform tests on fresh and hardened concrete (workability and compressive strength tests as per is codes)
4.	Determination of compressive strength of cylindrical concrete specimens and its relation with cube compressive strength of concrete.
5.	Determination of splitting tensile strength of cylindrical concrete specimens.
6.	Determination of compressive strength of concrete using non-destructive testing as per Indian Standard IS 516-2021.
7.	To perform tension test on tor-steel bars to find ultimate tensile strength, percentage elongation and 0.2% proof stress as per codal provisions.
8.	To determine the shear strength of tor-steel.

Name of Program	B.Tech. in Civil Engineering	**Semester:** 6th	**Year:** 3rd
Name of Course	Traffic Engineering Lab		
Course Code	CE24367		
Core / Elective / Other	Other		

Prerequisite:	
1.	B.Tech in Civil Engineering
2.	Transportation Engineering - I
Course Outcomes: *Students will be able to*	
1.	Conduct directional traffic volume count at mid block and intersection
2.	Conduct spot speed studies by using different method
3.	Evaluate the parking studies
4.	Understand Maneuver Type, Conflict Points, Intersection Geometrics, Speed analysis.
5.	Design Parking facilities.
Description of Contents in brief:	
1.	To conduct classified and directional traffic volume count at mid block section
2.	To conduct classified turning movement studies at intersection
3.	To conduct spot speed studies using distance and time method
4.	To conduct spot speed study by RADAR method
5.	To conduct parking usage survey
List of Text Books:	
1.	Traffic Engineering and Transport Planning -,L.R. kadiyali, Khanna Publishers.
2.	A Course in Traffic planning and Design- S.C Saxena, CBS, Publishers.
List of Reference Books:	
1.	Introduction to Traffic Engineering, R. Srinivasa Kumar
2.	Principles of Traffic and Highway Engineering, Garber / Hoel
4.	IRC: SP-41 “Guidelines for the Design of At-Grade Intersection in Rural & Urban Areas”
5.	The Institute of Transportation Engineers, Transportation and traffic Engineering Hand Book.
Sl. No.	**List of Experiments**
1-2	Classified traffic volume studies at mid-block section
3-4	Classified turning movements studies at intersection
5	Spot speed studies using time and distance method
6	Spot Speed Studies by radar method
7-8	Parking usage survey
9-10	Measurement of Travel Time and Delay
11	Moving Observer Method Study
12	Pedestrian Behavior Study

Name of Program	B. Tech. in Civil Engineering	**Semester:** 7th	**Year:** 4th
Name of Course	Project Based Lab		
Course Code	CE24472		
Core / Elective / Other	Lab		

Prerequisite:	
1.	All core subjects
Course Outcomes: *Students will be able to*	
1.	Understand various aspects of civil engineering projects based on case studies
2.	Gain knowledge on various codal provisions related to civil engineering
3.	Analyze civil engineering problems using various software
Description of Contents in brief:	
1.	Case study of any existing Civil Engineering Project based on area of interest (Structural Engineering, Geotechnical Engineering, /Environmental Engineering GIS, Transportation Engineering, Hydraulics, Water resource Engineering etc.)
2.	Field visits, planning and drafting of drawings using appropriate packages/software
3.	Study of associated by-laws and codal provisions
4.	Study of analysis and design using appropriate software, innovative findings
5.	Preparation and submission of project report
List of Text Books:	
1.	Building Drawing - Shah M. G. Kale C. M, Tata McGraw-Hill Education
2.	Planning & Designing of Building - Sane Y. S, Allies Book Stall
3.	Building Planning and Drawing – Chitawadagi, Bhavikatti ;
List of Reference Books:	
1.	National Building Code – SP 7; Bureau of Indian Standards
2.	Time Saver Standards for building types – Joseph De Chiara ; Mc Graw Hill
3.	Building science and planning by Dr. S. V. Deodhar, Khanna Publishers.
4.	IRC Codes
URLs:	
1.	https://www.semanticscholar.org/paper/Building-Design-and-Construction-Handbook-Merritt/d59b1806dba09cc798d6843e5357ae5b22311c7d
2.	https://kendallsquare.mit.edu/sites/default/files/documents/MIT_Vol_III_SoMa_Final_DevPlan-09-SecE.pdf
3.	https://lecturenotes.in/subject/1211/building-planning-and-drawing-bpd

Name of Program	B.Tech. in Civil Engineering	**Semester:** 5th /6th	**Year:** 3rd
Name of Course	Geotechnical Investigations for Civil Engineering Structures		
Course Code	CE24301		
Core/Elective/Other	Elective		

Course Outcomes: *Students will be able to*	
1.	Ability to understand the stages of soil exploration/boring techniques and planning for exploration.
2.	Ability to understand laboratory testing methods, its analysis and interpretations.
3.	Ability to understand in situ field testing skills of various field tests, its analysis and interpretations.
4.	Knowledge of Geophysical Methods.
5.	Preparation of soil exploration reports for civil engineering structures.
Description of Contents in brief:	
1.	**Soil Exploration:** Introduction, soil exploration program for different civil engineering projects; stages in sub surface exploration, methods of boring; number and disposition of trial pits and borings; depth of exploration, spacing of borings. Codal provisions.
2.	**Soil Samples, Soil Samplers and Sampling:** Types of soil samples, sampling methods, design features affecting sample disturbance, types of samplers for obtaining disturbed and undisturbed samplers; storage of samples and their transportation,
3.	**Laboratory Testing of Soils**: Methods and specifications-visual identification tests, laboratory tests for determining index and engineering properties of soil, analysis and interpretation of test results.
4.	**Field Testing of Soils:** Vane shear test, SPT test, CPT test, DCPT test, Plate load test, Pressure meter test**.** logging of boreholes, ground water observations; water table fluctuations and effects; analysis and interpretation of test results. preparation of soil profiles.
5.	**Geophysical Methods & Report Writing:** geophysical methods, soil exploration reports for different civil engineering structures- identification, calculations and preparation; discussion of case histories.
List of Text/ Reference Books:	
1.	Ground Improvement Techniques: Dr. P Purushothama Raj, Firewall Media
2.	Basic and Applied Soil Mechanics: Dr. Gopal Ranjan, A.S.Rao , New Age International
3.	IS 1892: Code of practice for subsurface investigation.
4.	Shahi K Gulati & Manoj Datta, "Geotechnical Engineering", McGraw Hill Education (India) Private Limited,2014.
5.	J.E. Bowles, "Physical Properties of Soils", 2nd Ed., McGraw Hill International, Singapore,1990.
URLs:	
1.	**https://nptel.ac.in/courses/105103182**
Lecture Plan	

Lecture	**Topic**
1	Introduction to Soil Exploration, Soil Exploration Program
2-3	Stages in sub surface exploration, Methods of Boring

4-5	Trial Pits and Borings, Depth and Spacing of Borings
6	Discussion of Codal Provisions
7-8	Types of Soil Samples, Design features affecting sample disturbance
9-10	Sampling Methods, Soil Samplers for disturbed and undisturbed samples
11	Sample handling and Transportation
12-13	Laboratory Testing: Visual Identification
14-17	Laboratory Testing: Index and Engineering Properties
18	Analysis and Interpretation of Test Results
19	Field Testing of Soils: Vane Shear Test
20-21	Field Testing of Soils: Standard Penetration Test
22-24	Field Testing of Soils: CPT and DCPT
25	Field Testing of Soils: Plate Load Test
26-27	Field Testing of Soils: Pressure Meter Test
28-29	Borehole Logging and Groundwater Observations
30-33	Analysis and Interpretation of Test Results, Preparation of Soil Profiles
34-36	Geophysical Methods
37-39	Soil Exploration Reports- Identification & Preparation
40-42	Discussion of Different Case Histories

Name of Program	B.Tech. in Civil Engineering	**Semester:** 5th/6th	**Year:** 4th
Name of Course	Modern Foundations		
Course Code	CE24302		
Core / Elective / Other	Elective		

Course Outcomes: Students will able to:	
1.	Understand various foundations used in modern field practices.
2.	Understand the behavior of foundations for special structures
3.	Analyze techniques of deep foundation
4.	Design pile foundations for various loading conditions
Description of Contents in brief:	
1.	**Shallow foundations:** Principles of foundation design, foundations for special structures e.g., Water tanks, Silos, Chimney, Telecommunication Towers etc, foundations for ground storage tanks for oils (Relevant Design Standards)
2.	**Deep Foundations:** Pile foundations, piled foundations, tension piles, batter piles, laterally loaded piles and design (Relevant Design Standards)
3.	**Well foundations:** Types of wells, Caissons, design aspects of the components of well foundations,
4.	**Lateral loaded pile foundations:** Lateral loading conditions on piles, analysis of laterally loaded piles, Design methodology of laterally loaded piles
5.	**Lateral loaded well foundations**
List of Text/ Reference Books:	
1.	Kurien, N. P. Design of foundation systems: principles and practices. Alpha Science International, 2005
2.	Saran, S. Analysis of Design of Substructures: Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi
URLs:	
1.	**https://www.youtube.com/watch?v=8KW_pR_fLNI**
2.	**https://www.youtube.com/watch?v=2T9s5i21yCs**

Lecture Plan:

Lecture No.	**Topic**
1	Principles of foundation design
2	Water tanks
3	Silo and Chimneys
4-6	Telecommunication Towers, foundations for ground storage tanks for oils (Relevant Design Standards)
7-8	Pile foundations
9-10	Tension piles, batter piles
11-12	laterally loaded piles
13-15	Design of laterally loaded piles (Relevant Design Standards)
16-18	Types of wells
19-21	Caissons
22-24	Design aspects of the components of well foundations
25-27	Lateral Stability of well foundations
28-30	Numerical Problems-I

31-33	Numerical Problems-II
34-35	Numerical Problems-III
36-37	IRC Method
38-39	Numerical Problems-IV
40-42	Numerical Problems-V

Name of Program	BTech in Civil Engineering	**Semester :** 5th/6th	**Year:** 3rd
Name of Course	Concrete Technology		
Course Code	CE24306		
Core / Elective / Other	Elective		

Prerequisite:	
1.	Basic Civil Engineering.
2.	Solid Mechanics.
3.	Structural Analysis -I
4.	RCC
Course Outcomes: *Students will be able to*	
1.	Understand various raw materials and ingredients to be used in the manufacturing of Cement and Concrete and the manufacturing processes used.
2.	Understand various types of cements and admixtures to be used and their applications.
3.	Understand the influence of the variation in raw materials, engineering properties of ingredients on various engineering properties of fresh and hardened concrete and durability of concrete.
4.	Understand testing methods of various ingredients.
5.	Monitor variability in concrete strength according to acceptance criteria and design mix suitable for extreme weather concreting conditions.
6.	Develop an understanding of various mix design processes and be able to design concrete mixes as per the Indian Codes.
7.	Develop an understanding of destructive and non destructive testing of concrete
8.	Decide suitability of various engineering materials for various applications.
Description of Contents in brief:	
1.	Concrete making materials : Cements, Aggregates, Water, Admixtures,
2.	Properties of Fresh and Hardened Concrete,
3.	Variability of Concrete Strength,
4.	Extreme Weather Concreting.
5.	Testing of Concrete Mixes,
6.	Modern Construction Equipments.
7.	Mix Design-Principles of Concrete Mix Design, Basic Considerations, IS Guidelines
8.	Introduction to Other Mix Deign Practices such as ACI, USBR, British mix etc.
9.	Building Materials:- Bricks, stones, glass, wood, plywood doors, shutters, plastics, tiles, aluminum, steel, properties and tests. IS code procedures.
List of Text Books:	
1.	Concrete Technology M.S.Shetty, S Chand
2.	Civil Engineering Materials and Testing Syed Danish Hasan, Alpha Science Intl Ltd
3.	Mechanics of Materials Adarsh Swaroop, New Age International Pvt. Ltd.
List of Reference Books:	
1.	Hand Book of Mix Design BIS Publication.
2.	Bureau of Indian Standards Publication IS-10262.

URLs:	
1.	https://nptel.ac.in/courses/105/102/105102012/
Lecture Plan:	
Lecture No.	**Topic**
1.	Introduction
2.	Concrete making materials
3.	Cement composition and production, its applications.
4.	Chemical composition, Structure and Hydration of cement.
5.	Properties of cement.
6-9	Types of cement and their applications.
10	Tests of cement
11	Aggregates - source, types
12	Classification, applications
13	Tests
14-15	Water
16	Chemical and Mineral Admixtures - Introduction.
17-19	Types and applications
20-21	Properties of fresh concrete
22-23	Properties of hardened concrete
24-25	Variability of concrete strength
26-27	Extreme weather concreting
28-29	Testing of concrete mixes
30	Principles of concrete mix design
31	Basic considerations, IS guidelines
32	Introduction to other concrete mix design procedures such as ACI, USBR, British Mix
33-36	Mix Design procedure
37	Engineering Materials - Bricks, stones, glass
38	Wood, plywood, doors, shutters
39	Plastics, tiles, aluminium
40	Steel, properties and tests, IS code procedures.

Name of Program	B. Tech in Civil Engineering	**Semester:** 5th/6th	**Year:** 3rd
Name of Course	Prestressed Concrete		
Course Code	CE24304		
Core / Elective / Other	Elective		

Prerequisite:	
1.	Knowledge of strength of materials.
2.	Knowledge of solid mechanics.
3.	Knowledge of structural analysis and design of reinforced concrete structures.
Course Outcomes: *Student will be able to*	
1.	Understand the structural properties of Prestressed concrete.
2.	Understand the losses of Prestressed concrete
3.	Understand the design of Prestressed concrete structures.
4.	Analyze and design of Prestressed concrete beams.
Description of Contents in brief:	
1.	Principal and general features of pre-stress concrete
2.	Materials used for prestressed concrete and their properties
3.	Methods of prestressing
4.	Analysis of prestressed concrete sections
5.	Load balancing concepts
6.	Losses in prestress
7.	Deflections of prestressed concrete sections
8.	Limit state design concepts
9.	Design for flexure
10	Design for shear
11.	Introduction to design of indeterminate structures
List of Text Books:	
1.	N. Krishna Raju, “Prestressed Concrete” McGraw Hill Education
2.	G. S. Pandit and S. P. Gupta, “Prestressed Concrete” CBS Publishersand DistributorsPvt. Ltd.
3.	Muthu, K. U., Ibrahim, Azmi, Janardhana, Maganti, Vijayanand, M., “Prestressed Concrete” PHI Learning Pvt. Ltd., Delhi
List of Reference Books:	
1.	T. Y. Lin and Ned H. Burns “Design of Prestressed Concrete Structures” Wiley India Private Ltd.
2.	Guyon, Y, “Prestressed Concrete”, John Wiley & Sons, New York
3.	Hurst, M.K., “Prestressed Concrete Design” CRC Press; 2nd edition
URLs:	
1.	https://nptel.ac.in/courses/105/106/105106117/
2.	https://nptel.ac.in/courses/105/106/105106118/

3.	https://standardsbis.bsbedge.com/

Lecture Plan:

No. of Lectures	**Topic**
1	Introduction to prestressed concrete
2	Introduction to codes for prestressed concrete
3-4	Comparison between Reinforced cement concrete structures, steel structures and prestressed concrete structures
5-6	Advantages of prestressed concrete
7-10	Materials used for prestressed concrete, concept of high strength mix design as per codes.
11-12	Methods of prestressing
13-16	Analysis of prestressed concrete sections, resultant stress at a section
17-18	Pressure line or thrust line and internal resisting couple
19-20	Load carrying mechanism of R.C.C. sections, Load carrying mechanism of prestressed concrete sections
21-22	Load balancing concept
23-26	Losses of prestress due to various factors
27-30	Deflection of prestressed concrete sections
31-33	Limit state design concept as per IS:1343
34-37	Flexural strength of prestressed concrete sections
38-41	Design for shear and torsion
42-45	Introduction to design of indeterminate structures

Name of Program	B.Tech in Civil Engineering	**Semester:** 5th/6th	**Year:**3rd
Name of Course	Highway Geometric Design		
Course Code	CE24305		
Core / Elective / Other	Elective		

Prerequisite:	
1.	Highway Engineering
Course Outcomes: *Students will be bale to*	
1.	Develop basic concept on planning and alignment of highways, road aesthetics and adaptation to the environment.
2.	Design cross sectional elements of highways.
3.	Design horizontal alignment of highways.
4.	Design vertical alignment of highways.
5.	Design hill roads, intersection and Road Furnitures.
Description of Contents in brief:	
1.	Understanding of the principles of planning and alignment highways.
2.	Understanding on the design of highway geometric elements in context of transportation planning and traffic design.
3.	To develop the capability to design highway.
List of Text Books:	
1.	Highway Engineering S.K.Khanna & C.E.G. Justo., Khanna Publishers
2.	Principles & Practice of Highway Engg. L.R. Kadiyali, Khanna Publishers
3.	Principles of Transportation Engineering Chakroborti and Das , PHI Learning Pvt. Ltd
4.	Relevant Indian Standards and Guidelines
List of Reference Books:	
1.	IRC:73-2018 Geometric design standards for rural (non- urban) highways
2.	IRC:86-2018 Geometric design standards for urban roads in plains.
3.	Highway Engineering (including airport pavements) - S.Chand
4.	Highway Engineering - S.P Bindra
5.	Highway Engineering - R Srinivasa Kumar
URLs:	
1.	https://nptel.ac.in/courses/105105107/
2.	https://en.wikipedia.org/wiki/Geometric_design_of_roads

Lecture Plan:

Lecture No.	Topics
1	Introduction
2	Importance of Highway Geom. Design
3-4	Geometric Elements
5-9	Design Factors
10-11	Design of Cross Sectional Elements

12	Camber Design
13-15	Sight Distance
16	Requirements of an ideal alignment
17	Factors & required surveys
18-19	Hill Alignments
20	Realignment
21-22	Super elevation Design
23-24	Design of Horizontal curve
25	Extra widening
26	Gradients
27	Summit Curve
28	Valley Curve
29-30	Components & Cross sectional elements of Hill Roads
31-32	Geometric design for hill roads
33-35	Geometric design of Intersections
36-40	Design of Road Furnitures

Name of Program	B.Tech in Civil Engineering	**Semester:** 5th/6th	**Year:** 3rd
Name of Course	Road Safety Audit		
Course Code	CE24306		
Core / Elective / Other	Elective		

Prerequisite:	
1.	Highway Engineering
Course Outcomes: *Students will be able to*	
1.	Acquire knowledge about Accidents & Safety Scenario in India.
2.	Learn how to analyze the main risk factors present in traffic accidents and will be able to know strategies for prevention.
3.	Acquire knowledge of Road Safety Audit & its Need.
4.	Learn Hazard identification and Risk Assessment techniques and also Technical Tips for Auditing Team.
Description of Contents in brief:	
1.	Introduction: Road Safety Scenario, History & Purpose of Road Safety.
2.	Introduction to Road Safety Audit.
3.	Various stages of Road Safety Audit.
4.	Case Studies of Road Safety Audit.
List of Text Books:	
1.	Text book of highway and traffic engineering – Subhash C Saxena, CBS Publishers
2.	Traffic Engineering & Transport Planning L.R. Kadiyali, Khanna Publishers
3.	Transportation Engineering: An Introduction – C. Jotin Khisty, B. Kent Lall, Pearson Publishers
List of Reference Books:	
1.	The way forward: Transportation planning and road safety – Geetam Tiwari, Dinesh Mohan, Nicole Muhlrad, Macmillan India Ltd
2.	IRC: SP:88:2019 Guidelines for Road Safety Audit
3.	IRC: 99-2018, Traffic Calming Devices
4.	IRC: SP:67-2022 Code of practice for road signs
5.	IRC:35-2015 Code of practice for road marking

Lecture Plan:

Lecture No.	Topic
1	Introduction: Road Safety Scenarios in India.
2-3	History of Road Safety Audit
4	What is Road Safety Audit and its Objective
5-6	Purpose and Benefits of Road Safety audit
7-8	Types of Project to be Audited
9-10	Groups involved in RSA – their role and responsibilities
11	Key Steps involved in Conducting Road Safety Audit
12-13	Safety Issues to be focused in different stages of RSA

Name of Programme	B.Tech Civil Engg	**Semester:** 5th/6th	**Year:** 3rd
Name of Course	Noise Pollution & Its Control		
Course Code	CE24307		
Core/Elective/Other	Elective		

Pre-requisites :	
1.	Sound and its transmission
2.	Physical & Chemical properties of gases
3.	Acoustics
4.	Physics of vibrations
Course Outcomes:	*Students will be able to*
1.	Understand Noise pollution and its effects
2.	Identify,group and scale Noise pollution sources.
3.	Plan sampling and monitoring of Noise pollutants .
4.	Understand & Select Noise pollution control techniques and methodologies.
Description of Contents in brief:	
1.	Sources of Noise, Effects of Noise on Human & other biotic life ,Sound Pressure, Power and Intensity, Measurement units- decibel
	Loudness, Sone, Phon, Pitch
2.	Decibel addition & subtraction, Measurement of Noise, Frequency band analysis,
3.	Legislative and regulatory aspects, standards
4.	Miscellaneous measures of Noise- Community noise, Airport Noise, Industrial Noise.
5.	Outdoor noise propagation, Directivity, Attenuating factors, Indoor Noise Propagation,
6.	Noise Transmission through ducts & partitions, Noise control Criterias,
7.	Noise Control Measures - Sound Absorption, Acoustic Barrier, Vibration Isolation, Vibration Damping, Muffling, Personal Protector, Green Belt Development--Principles and design considerations
8.	Industrial Noise Pollution Control methods, Noise control in bulidings
List of Text Books :	
1.	Noise Pollution and Control Strategy by Sagar Pal Singal , Alpha Science International Ltd
2.	Noise Pollution by Debi Prasad Tripathi, A.P.H. Publishing corporation, New Delhi
3.	Environmental Engineering – A Design Approach by Arcadio P. Sincero and Gregoria A. Sincero, Pearson Education ,Inc Prentice Hall of India, 2016

4.	Environmental Pollution Control Engineering- CS Rao, Wiley Eastern Ltd., New Delhi, 1996.
5.	Environmental Noise Pollution – PE Cunniff, McGraw Hill, Publishing Co. Ltd
6.	Environmental Engineering by Peavy, H.S., Rowe and Tchobonoglous,G., McGraw Hill
List of Reference Books:	
1.	Introduction to Environmental Engineering by Mackenzie L Davis , David A Cornwell , Tata McGraw Hill Education Pvt. Ltd. , New Delhi, 2010
2.	Environmental Engineering by Gerard Kiely , Tata McGraw Hill Education Pvt. Ltd. , New Delhi, 2007
3.	Principles of Environmental Engineering & Science by Mackenzie L. Davis & Susan J. Masten , McGraw Hill Education (India) Pvt. Ltd, 2013
4.	Handbook of Noise Measurement – APG Peterson & EE Gross PH, Englewood cliffs New Jersey, latest edition.
5.	Noise Control: Principles and Practice by Bruel & Kjaer, B & K Pub., Denmark
6.	Industrial Noise Control and Acoustics – by Randall F Barron, Marcel Dekker, Inc., New York
7.	Engineering Noise Control: Theory and Practice by David Bies et. al., Routledge Publishers
URLs:	
1.	https://udghoshna.files.wordpress.com/2014/08/noise-pollution.pdf
2.	noise pollution control policy India.pdf
3.	http://cpcbenvis.nic.in/noisepollution/noise_rules_2000.pdf
4.	http://160592857366.free.fr/joe/ebooks/Automative%20engineering%20books/Advanced_Air_and_Noise_Pollution_Control.pdf
Lecture Plan:	
1-2	Acoustics Principles: Basic properties of sound waves and spherical waves Sound Wave theory, Frequency, Wavelength, Amplitude
3	Noise sources: Machinery noise, Pumps, Compressors, Building & construction equipments, Industrial noise
4	Traffic Noise- Vehicular, train, Aircraft, Domestic appliances
5	Effects of Noise pollution on human health
6	Effects of Noise pollution on animals and other biotic life
7	Unit of Measurements: Decibel, Sound Pressure, Power, Intensity,
8	Unit of Measurements: Loudness, Sone, Phon, Pitch,

9	Addition and Subtraction of Decibels
10	Frequency Weighting,
11	Octave Band Analysis
12-13	Sound Level Meter: components Working, Types, Uses
14.	Legislative and regulatory aspects of Noise Pollution in India
15.	Noise level standard in industrial, commercial, residential and silence zones.
16.	Measurement and analysis of Noise: A weighted sound Level, Equivalent Sound Pressure Level (Leq)
17.	Directivity , Outdoor Noise Propagation
18-20	Community Noise Measurement: Noise Pollution Level, Day-Night average Level, Traffic Noise index, Community Noise equivalent Level ,Prediction of Traffic Noise
21-23	Airport Noise Measurement: Perceived Noise Level, Composite Noise rating, Noise Exposure Forecast, Effective perceived Noise Level, Noise rating curves, Calculation of these parameters
24-26	Industrial Noise Measurement: Noise Exposure Rating, Noise Dose, Noise Criteria, Preferred Noise Criteria, Speech Interference Level, Preferred Speech Interference Level
27-28	Effect of Meteorological parameters on sound propagation, Noise Attenuating Factors, A1 to A6
29.	Indoor Noise Propagation
30.	Noise Transmission through Ducts
31.	Noise Transmission through Partitions
32.	Noise Control Criteria, Noise Control Techniques,
33-34	Noise Control – Absorption Silencer , Sound absorption coefficient, sound absorbing materials
35-37	Reverberation Time, Destructive interference Mufflers: Dissipative Muffler, Reactive Expansion Muffler, Diffusers, Exhaust Mufflers
38-41	Noise Control- Vibration Control, Vibration isolators, Impact isolation Magnification Factor, Transmissibility ratio, Damping Factor Anechoic Chamber , Noise Control in buildings , Fan Plenum

Name of Programme	B.Tech Civil Engineering	Semester: 5th/6th	Year:3rd
Name of Course	Hazardous Waste Management		
Course Code	CE24308		
Core/Elective/Other	Elective		

Pre-requisites :	
1.	Engineering Chemistry
2.	Environmental Science
3.	Engineering Physics
4.	Hydraulics
Course Outcomes: *Students will be able to*	
1.	Get an insight into identification and characterization of various hazardous wastes and role of various stakeholders under legal framework
2.	Learn handling , planning , minimization and management of various hazardous wastes
3.	Acquire ability to design facilities for the storage, transport, processing/treatment and disposal of hazardous wastes
4.	Gain knowledge on identification, characterization, source reduction and management of Bio-medical and radioactive waste
Description of Contents in brief:	
1.	Hazardous waste definition, Physical and health hazard wastes, Hazardous waste management and handling rules, Characterization of Hazardous wastes,, Analytical methods, Waste inventorization , Source reduction
2.	Environmental Risk Assessment ,Parameters for toxicity quantification, Types of exposure, Biomagnifications, Effects of exposure to toxic chemicals, Calculating Risk, Hazard identification
3.	Handling & storage , Waste compatibility chart, waste transport, Manifest system, Transboudary movement, Basal Convention
4.	Hazardous waste treatment technologies, Physical, Chemical and thermal treatment, Solidification, Chemical Fixation, Encapsulation, Incineration
5.	Hazardous waste Landfills, site selection, landfill design and operation, regulatory aspects, liner system, Cover system, Leachate collection and management, Environmental Monitoring system, Landfill closure and post closure care
6.	Bio-medical waste management , sources, generation, classification, storage, Transportation, Disposal, Waste treatment, Autoclaving, disinfection, Irradiation, Incineration
7.	E-Waste management, Nuclear and Radioactive waste management
List of Text Books :	
1.	Environmental Engineering – A Design Approach by Arcadio P. Sincero and Gregoria A. Sincero, Pearson Education ,Inc Prentice Hall of India, 2016
2.	Hazardous waste management by Charles A. Wentz, McGraw Hill International
3.	Environmental Pollution Control Engineering- CS Rao, Wiley Eastern Ltd., New Delhi, 1996.
4.	Hazardous Waste Management by M LaGrega and others, McGraw Hill International
5.	Principles of Environmental Engineering & Science by Mackenzie L. Davis & Susan J. Masten , McGraw Hill Education (India) Pvt. Ltd, 2013
List of Reference Books:	
1.	Introduction to Environmental Engineering by Mackenzie L Davis , David A Cornwell , Tata McGraw Hill Education Pvt. Ltd. , New Delhi, 2010
2.	Environmental Engineering by Gerard Kiely , Tata McGraw Hill Education Pvt. Ltd. , New Delhi, 2007
3.	Solid Waste Engineering - Principles and Management IssuesTchobanoglous G., Theissen H., and EIiassen R. , McGraw Hill, New York.
4.	Hazardous Waste (Management and Transboudary Movement) Rules, MOEF, GOI, new Delhi
URLs:	
1.	htpp://nptel.iitm.ac.in
2.	htpp://www.britannica.com/EBchecked/topic/257926/hazardous-waste

3.	www.epa.gov/solidwaste/hazard/tsd/index.htm
Lecture Plan:	
1.	Sources of Hazardous wastes, Inventorization
2.	Properties of hazardous wastes
3.	Hazardous waste management - Fundamentals
4.	Characterization of waste, compatibility and flammability of chemicals,
5.	Fate and transport of contaminants, Movement across different media
6.	Effects of hazardous waste on health
7.	Relevant regulations in hazardous waste management
8.	Waste Minimization, Source reduction, waste audit
9.	Physical and Chemical Treatment Processes
10.	Waste Stabilization
11.	Waste Sorption
12.	Waste Volatilization
13.	Soil Vapour Extraction
14.	Waste Neutralization
15.	Redox reaction
16.	Advance Oxidation Processes for waste treatment
17.	Permeable Reactive Barrier
18.	Principles of biodegradation of hazardous wastes,
19.	Steps for design of biological treatment
20.	Composting
21.	Bioremediation,
22.	In-situ and ex-situ bioremediation
23.	Bioreactors
24.	Reductive dehalogenation
25.	Landfill Design
26.	Site selection criteria for a sanitary landfill:
27.	Liner systems
28.	Leachate generation and control
29.	Generation of landfill gases
30.	Closure and post-closure care
31.	Treatment, Storage and Disposal Facilities (TSDF)
32.	Incineration of hazardous wastes
33.	Types of incinerators
34.	Bioreactor Landfills, Encapsulation
35.	Bio-medical waste management , sources, generation, ,
36.	Legislative and regulatory trends of Biomedical waste management in India
37.	Classification, Categorization, storage,
38.	Segregation, Transportation, Methods of Disposal,
39.	Treatment of Biomedical wastes, Autoclaving, Shredding, Incineration
40.	Radioactive Waste Management Fundamentals
41.	Sources of radiation, Measures of radioactivity: Half-life ,
42.	Exposure pathways, Health effects of radioactivity
43.	Nuclear power plants , fuel and power production, Types of radioactive waste
44.	Waste generation from nuclear power plants, Managing radioactive waste
45.	Estimating risk from radioactive exposure
46.	Storage and disposal of High Level Waste , Disposal of other radioactive waste
47.	E-waste management – Challenges & Opportunities ,Sources, Types and Effects of E-wastes
48.	Composition, Collection, Recycling of E-waste
49.	Legislative and regulatory framework of E-waste management in India
50.	Treatment and Disposal of E-waste

Name of Program	B. Tech. in Civil Engineering	**Semester:** $5^{th}/6^{th}$	**Year:** 3^{rd}
Name of Course	GPS Surveying and Its Applications		
Course Code	CE24309		
Core / Elective / Other	Elective		

Prerequisite:	
1.	Surveying
2.	Computational Geodesy
Course Outcomes: *Students will be able to*	
1.	Gain basic understanding on the principle and instrumentation on GPS
2.	Acquire knowledge of different methods of GPS Surveying
3.	Learn on methodology of GPS use for various applications
Description of Contents in brief:	
1.	Global Positioning System (GPS): Introduction, principle, components of GPS, Space segment, control segment and user segment. Different types of GPS receivers, single and multi-frequency receivers, and their selection for specific applications.
2.	GPS Coordinate System: Definitions of astronomical terms, coordinate systems for locating heavenly bodies, geographic, geodetic, geocentric, cartesian, local and projected coordinates. Modelling the figure of earth, some important Ellipsoidal models, properties of ellipsoids and Geoid and computations of geodetic positions.
3.	Datum and Map Projection for GPS data: International and local datums, time systems, satellite orbit determination, Map projection-necessity and classification. Commonly used map projections and transformation of GPS coordinates from WGS-84 to Indian datum and vice versa.
4.	GPS Surveying methods: Basic terminology and errors in GPS observations, data acquisition, Point Positioning, Differential Positioning, Static Positioning and Kinematic positioning. GPS data formats and processing. DGPS Survey, Real Time Kinematic (RTK) Survey and mobile mapping survey planning and data analysis and their comparative accuracy of measurements.
5.	Advantages of GPS surveys over the conventional methods of surveying. Various applications of GPS technology in the management and monitoring of natural resources, engineering projects, planning, disaster mitigation etc.
List of Text Books:	
1.	Global Positioning System: Principles and Applications, Sateesh Gopi, Tata McGraw Hill
2.	GPS for Land Surveyors, Jan Van Sickle, CRC Press, Taylor, and Francis group
3.	Introduction to GPS: The Global Positioning System, Ahmed El Rabbany, Artech House Boston/London.
List of Reference Books:	
1.	Understanding GPS: Principles and Applications, Kaplan, E.D., Artech House Boston/London.
2.	Global positioning system: Theory and Practice, Hofman-Wellenhof, B. et. al, Springer-Verlag Wien GmbH
3.	GPS Satellite Surveying, Alfred Leick, Lev Rapoport, Dmitry Tatarnikov, John Wiley & Sons, Inc
URLs:	

1.	https://nptel.ac.in/courses/105/107/105107157
2.	https://nptel.ac.in/courses/105/104/105104100/
3.	https://nptel.ac.in/courses/105/107/105107121/

Lecture Plan:

Lecture No.	Topic
1	Global Positioning System (GPS): Introduction, principle
2 & 3	components of GPS, Space segment, control segment and user segment.
4 to 6	Different types of GPS receivers, single and multi-frequency receivers, and their selection for specific applications.
7 & 8	GPS Coordinate System: Definitions of astronomical terms
9	coordinate systems for locating heavenly bodies,
10 & 11	geographic, geodetic, geocentric, cartesian, local and projected coordinates.
12 &13	Modelling the figures of earth
14 & 15	some important Ellipsoidal models
16	properties of ellipsoids and Geoid and computations of geodetic positions.
17 & 18	Datum and Map Projection for GPS data: International and local datums
19	time systems
20	satellite orbit determination,
21 to 23	Map projection-necessity and classification
24 & 25	Commonly used map projections
26 & 27	transformation of GPS coordinates from WGS-84 to Indian datum and vice versa.
28 & 29	GPS Surveying methods: Basic terminology and errors in GPS observations,
30	data acquisition, Point Positioning, Differential Positioning, Static Positioning and Kinematic positioning.
31 & 32	GPS data formats and processing
33 & 34	DGPS Survey, Real Time Kinematic (RTK) Survey and mobile mapping survey planning and data analysis and their comparative accuracy of measurements.
35 & 36	Advantages of GPS surveys over the conventional methods of surveying
37 to 41	Various applications of GPS technology in the management and monitoring of natural resources, engineering projects, planning, disaster mitigation etc.

Name of Program	B. Tech. in Civil Engineering	**Semester:** 5th/6th	**Year:** 3rd
Name of Course	Remote Sensing and GIS		
Course Code	CE24310		
Core / Elective / Other	Elective		

Prerequisite:	
1.	Engineering Surveying
2.	Computational Geodesy
Course Outcomes: *Students will be able to*	
1.	Basic understanding on principle, techniques, and tools for the use of remote sensing technology in map preparation.
2.	Learning on the creation of digital maps using GIS technology
3.	Skill development for evolving methodology to use Remote Sensing and GIS techniques for various applications
Description of Contents in brief:	
1.	Remote Sensing Technology: Basic Concepts & terminology, components, and classifications of remote sensing. Passive and active remote sensors and their characteristics. Geometry, radiometry, and pre-processing of remotely sensed imagery. Characteristics of photographic images and photo-interpretation keys.
2.	Remote Sensing image analysis: Digital image classification techniques and extraction of thematic information. Georeferencing of satellite imagery and defining the coordinate system datum and map projection and ground truth collection. Raster to vector data conversion, rubber sheet transformation, rectification and registration, manual and semi-automatic digitization of image features.
3.	Geographic Information System (GIS): Definition, Basic concepts and components, GIS data formats, creation of GIS database using different map data sources such as Total Station, GPS, satellite images etc. GIS data analysis tools and visualization of map data in GIS.
4.	Commercial and open source software used in the analysis of Remote Sensing & GIS data.
5.	Applications of Remote Sensing & GIS Techniques in various fields such as natural resources development and management, disaster mitigation, environmental monitoring, and various inputs in the engineering projects.
List of Text Books:	
1.	Remote Sensing and image interpretation, Lillesand T.M. and Kiefer R. W., Willey publications
2.	Introduction to Geographic Information Systems, Kang-Tsung Chang, McGraw Hill, Indian edition
3.	Introduction to remote sensing, J. B. Campbell, Guilford Press
List of Reference Books:	
1.	Physical Principles of Remote Sensing, W. G. Rees Cambridge University Press
2.	Introductory Digital Image Processing: A Remote Sensing Perspective, John R. Jensen, Pearson Press
3.	Principles of Geographic Information, P.A. Burrough, Oxford University Press
URLs:	
1.	https://nptel.ac.in/courses/105/103/105103193/

2.	https://nptel.ac.in/courses/105/104/105104100/
3.	https://nptel.ac.in/courses/105/107/105107121/

Lecture Plan :

Lecture No.	Topic
1 & 2	Remote Sensing Technology: Basic Concepts & terminology
3 & 4	components, and classifications of remote sensing.
5 to 8	Passive and active remote sensors and their characteristics
9 & 10	Geometry, radiometry
11	pre-processing of remotely sensed imagery
12 & 13	Characteristics of photographic images and photo-interpretation keys.
14 to 16	Remote Sensing image analysis: Digital image classification techniques and extraction of thematic information.
17 & 18	Georeferencing of satellite imagery and defining the coordinate system datum and map projection and ground truth collection.
19	Raster to vector data conversion
20 & 21	rubber sheet transformation, rectification, and registration
22	manual and semi-automatic digitization of image features.
23 & 24	Geographic Information System (GIS): Definition, Basic concepts and components
25	GIS data formats
26 to 28	creation of GIS database using different map data sources such as Total Station, GPS, satellite images etc.
29 to 32	GIS data analysis tools and visualization of map data in GIS.
33 to 36	Commercial and open source software used in the analysis of Remote Sensing & GIS data.
37 to 42	Applications of Remote Sensing & GIS Techniques in various fields such as natural resources development and management, disaster mitigation, environmental monitoring, and various inputs in the engineering projects.

Name of Program	B.Tech in Civil Engineering	**Semester:** 5th /6th	**Year:** 3rd
Name of Course	Water Resources System Planning and Management		
Course Code	CE24311		
Core / Elective / Other	Elective		

Course Outcomes: *Students will be able to*	
1.	Describe the concepts of optimization.
2.	Solve water resources system problems using Linear programming.
3.	Know the concept of Dynamic programming.
4.	Solve water resources system problems Non-linear programming.
5.	Demonstrate competence in planning and management of a reservoir system.
Description of Contents in brief:	
1.	Introduction: Concept of systems, system analysis, techniques of water resources system analysis, system classification, systems approach to water resources planning and management, advantages and limitations of systems approach, modeling of water resources systems.
2.	Linear Programming: Formulation linear programming models, graphical method, simplex method, Feasible and infeasible solutions, revised simplex method, duality in linear programming, big M method, Matrix form of LPP, application of linear programming in water resources.
3.	Dynamic Programming: Belman's of principles of optimality forward and backward recursive dynamic programming, Reservoir operation, Multipurpose reservoir, operation application of dynamic programming for resource allocation.
4.	Non-linear Programming: Clerical method of optimization, objective function, maxima, minima and saddle points, convex and concave, Lagrange multipliers, functions Kuhn-Tucker condition.
5.	Water Resources Management: Need for reservoirs, classification, planning of reservoir system, estimation of water yield, hydropower generation, reservoir losses, reservoir capacity computation.
List of Text Books:	
1.	Bhave, P. R., "Water Resources Systems", Narosa Publishing House, New Delhi,2011.
2.	Water Resource System - Subhash Chander & Rajesh k Prasad
List of Reference Books:	
1.	Vedula, S., and Majumdar, P.P. "Water Resources Systems" –Modeling Techniques and Analysis Tata McGraw Hill, 5th reprint, New Delhi, 2010.
2.	Chadurvedi M.C., "Water resource Systems Planning and Management", Tata McGraw Hill inc., New Delhi,1997
URLs:	
1.	https://nptel.ac.in/courses/105/108/105108130/
2.	https://nptel.ac.in/courses/105/108/105108081/
3.	http://www.vssut.ac.in/lecture_notes/lecture1525500606.pdf

Lecture Plan (about 30-40 Lectures):

Lecture No.	Topic
1-2	Introduction to concept of systems, system classification
3-4	System analysis, techniques of water resources system analysis, systems approach to water resources planning and management
5-6	Advantages and limitations of systems approach, modeling of water resources systems
7-8	Linear Programming: Formulation linear programming models, graphical method

9-13	Simplex method, Feasible and infeasible solutions, revised simplex method
14-18	Big M method, Matrix form of LPP, application of Linear programming in water resources
19-21	Dynamic Programming: Belman's of principles of optimality forward and backward recursive dynamic programming
22-25	Reservoir operation, Multipurpose reservoir
26-27	Operation application of dynamic programming for resource allocation.
28-30	Non-linear Programming: Clerical method of optimization, Objective function
31-34	Maxima, minima and saddle points, convex and concave, Lagrange multipliers, functions Kuhn-Tucker condition.
35-37	Water Resources Management: Need for reservoirs, classification, Planning of reservoir system
38-41	Estimation of Water Yield, Hydropower Generation, Reservoir Losses, Reservoir Capacity Computation

Name of Program	B.Tech in Civil Engineering	**Semester:** 5th/6th	**Year:** 3rd
Name of Course	River Engineering		
Course Code	CE24312		
Core / Elective / Other	Elective		

Course Outcomes: *Students will be able to*	
1.	Understand the basics of river engineering
2.	Understand the behavior of river
3.	Understand the morphology of river.
4.	Demonstrate proficiency in understanding and applying the governing equations unsteady flow.
5.	Understand the diversity of river training works and their respective functionalities
Description of Contents in brief:	
1.	Introduction: Classification of Rivers, channel and flood plain features, sediment budgets, river morphology.
2.	Behaviour of Rivers: River channel patterns, causes, characteristics and prevention of meanders, cutoff characteristics, bed forms, delta form and control
3.	River Morphology: Bed level variation in alluvial streams, continuity equation for sediment, equilibrium depth of scour in long channel contractions, silting of reservoirs, local scour, Scour around bridge piers, secondary currents, flow in rigid boundary open channel bends, scour and deposition at alluvial bends.
4.	Unsteady Flow: Governing equations for one dimensional flow, hydrograph routing, kinematic routing, diffusion routing, Muskingum–Cunge routing.
5.	River Training Works: Introduction to river training, types of river training works, working of different river training structures, protection bridge, guide bund, embankment and spurs.
List of Text Books:	
1.	H. H. Chang, “Fluvial Processes in River Engineering”, Krieger Publishing Company, 1st Edition, 2008.
List of Reference Books:	
1.	W. Wu, “Computational River Dynamics”, Taylor & Francis, 1stEdition, 2007.
2.	P Y Julien River Mechanics, Cambridge university press, 2nd edition, 2018
3.	M. B. N. Al-BaghdadiK, “Progress in River Engineering & Hydraulic Structures”, CreateSpace Independent Publishing Platform, 1st Edition, 2018.
URLs:	
1.	https://archive.nptel.ac.in/courses/105/103/105103204/

Lecture Plan (about 30-40 Lectures):

Lecture No.	Topic
1-3	Introduction: Classification of Rivers, channel and flood plain features, sediment budgets, river morphology.
4-6	Behaviour of Rivers: River channel patterns, causes, characteristics and prevention of meanders,
7-9	Cutoff characteristics, bed forms, delta form and control
10-11	River Morphology: Bed level variation in alluvial streams, continuity equation for sediment
12-16	Equilibrium depth of scour in long channel contractions, silting of reservoirs, local scour, Scour around bridge piers,
17-20	Secondary currents, flow in rigid boundary open channel bends, scour and deposition at alluvial bends

21-22	Unsteady Flow: Governing equations for one dimensional flow
23-27	Hydrograph routing, kinematic routing, diffusion routing, Muskingum–Cunge routing
28-30	River Training Works: Introduction to river training, types of river training works
31-34	Working of different river training structures, protection bridge, guide bund, embankment and spurs.

Name of Program	B.Tech in Civil Engineering	**Semester:** 5th/6th	**Year**: 3rd
Name of Course	Open Channel Hydraulics		
Course Code	CE24313		
Core / Elective / Other	Elective		

Course Outcomes: *Students will be able to*	
1.	Develop a basic knowledge of open channel flow relationships by applying fluid properties, hydrostatics, and the conservation equations for mass, momentum, and energy
2.	Understand the concepts of free surface flow and its applications in flood control, design of drainage and water ways.
3.	Develop the skills needed for systematic decomposition and solution of real-world problems
4.	Understand the environmental, economic, and societal risks involved in Hydraulic engineering works affecting open channels
Description of Contents in brief:	
1.	Concept of Free Surface Flow, Open Channel Conveyance History in Indian Subcontinent, Uniform flow, Velocity and pressure distribution, Froude number, Alternate depths, Critical flow, Hydraulic radius, Hydraulic mean depth, Energy and momentum principle, Subcritical and supercritical channel transitions.
2.	Gradually varied flow, Differential equation of GVF, Flow profiles, and their features, Direct integration of GVF differential equation, Simple numerical solutions of GVF equation, Spatially varied flow.
3.	Rapidly varied flow, Hydraulic jump in a horizontal rectangular and non-rectangular channel, Types of Hydraulic Jump, Sharp and broad crested weir, Flow over a spillway.
4.	Gradually and rapidly varied unsteady flows, St. Venant's equation, Analysis of positive and Negative Surges moving upstream and downstream.
5.	Hydraulics of Mobile Bed in Open Channels, Incipient motion, Bed shear stress, Bedforms, Sediment load – bed load, suspended load, and total load, Scour around bridge and abutment piers.
List of Text Books:	
1.	Chow, V.T., "Open Channel Hydraulics", McGraw Hill, 1959.
2.	Subramanya, K. "Flow in Open Channels", Tata McGraw-Hill, 1982.
List of Reference Books:	
1.	Chanson, H. "The Hydraulics of Open Channel Flow: An Introduction", Elsevier, 2004.
2.	Henderson, H., "Open Channel Flow", Macmillan, 1966

Lecture Plan (about 40-50 Lectures):

Lecture No.	Topic
1	Concept of Free Surface Flow, Classifications of flow and applications
2-4	Uniform flow, velocity distribution, Energy and Momentum Coefficient, Pressure Distribution: Horizontal, Parallel and Curvilinear Flow
5-8	Froude number, Critical Flow, Subcritical and Supercritical Channel Transitions, Computation of Critical Depth, Critical Depths in Compound Channels
9-10	Flow Resistance, Flow Resistance Equations: Chezy and Manning, Normal Depth and its computation
11-14	Gradually Varied Flow, Governing Equation, Classification of Water-Surface Profiles
14-15	Discharge From a Reservoir, Profiles in Compound Channels
16-18	Computation of Gradually Varied Flow, Direct-Step Method, Integration of Differential Equation, Single-step Methods
19-21	Spatially Varied Flow, SVF with Increasing and Decreasing Discharge, Side Weir, Bottom Racks
22-24	Rapidly Varied Flow, The Momentum Equation Formulation for the Jump, Hydraulic Jump

	in Channels: Rectangular, Use of the Jump as an Energy Dissipator, Location of Jump
25-26	Sharp-Crested Weir, Ogee Spillway, Broad-Crested Weir, Critical-Depth Flumes, Sluice Gates
27-29	Unsteady Flow: Gradually Varied Unsteady Flow, St. Venant's Equation, Numerical Methods
30-33	Rapidly Varied Unsteady Flow–Positive and Negative Surges
34-35	Hydraulics of Mobile Bed Channels, Initiation of Motion of Sediment
35-37	Bed Forms, Sediment Load
38-40	Design of Stable Channels Carrying Clear Water [Critical Tractive Force Approach], Regime Channels, Scour

Name of Program	B.Tech in Civil Engineering	**Semester:** 5th/6th	**Year:** 3rd
Name of Course	Hydropower Engineering		
Course Code	CE24314		
Core / Elective / Other	Elective		

Course Outcomes: *Students will be able to*	
1.	Knowledgeful about the fundamentals of hydropower, transient analysis and various components of a hydropower plant.
2.	Able to understand the components of hydropower system and its design aspects
3.	Better understanding on the importance of hydropower as a renewable source of energy.
4.	Knowledgeful about the environmental impact assessment on hydropower development
Description of Contents in brief:	
1.	Estimation of Water Power Potential. Demand and Supply, Firm and Secondary Power, Prediction of Load, Environmental Impact Assessment of Hydropower Project
2.	Types of Hydro-Power Plants: Run of River Plants, Valley Dam Plants, Diversion Canal Plants, High Head Diversion Plants, Pumped Storage Power Plants, Small Scale Hydropower
3.	Hydropower Plant Components: Dams, Types of Dams, Penstocks: Design and Analysis, Gated and Non-gated Spillways
4.	Intakes, Critical Submergence and Swirling Flow, Power Channels, Desiltation Cambers, Trash Rack Designs, Turbines, Cavitation, Turbine Model Testing
5.	Water Hammer and Surges, Resonance in Penstocks, Transient Analysis, Governing Equations
List of Text Books:	
1.	Barrows, H.K., "Water Power Engineering", Tata McGraw Hill Publishing Company Ltd
2.	Dandekar, M.M., and Sharma, K.H., "Water Power Engineering", Vikas Publishing House Pvt. Ltd.
List of Reference Books:	
1.	Norwegian Institute of Technology: Hydropower Development: Vols. 3, 4, 5 & 6, Division of Hydraulic Engineering.
2.	Streeter, V.L., and Wylie, B., "Fluid Transients", McGraw-Hill Book Company

Lecture Plan (about 40-50 Lectures):

Lecture No.	Topic
1	Introduction to Hydropower Engineering, Types of Renewable Energy sources, Basics of Hydropower Projects, Hydropower Potential and Development in India
2-4	Types of Hydropower Plants and Various Classifications, Introduction to Various Components of Hydropower Project, Examples of various Hydropower Projects
5-8	Hydropower Assessments, Stream flow data for hydropower studies, Flow duration curve, Extrapolation of Flow Duration Data to Ungaged Sites, Development of Flow Duration Curve for Un-gauged Site using Physiographic Catchment Parameters, Estimation of available water power
9-11	Classes of Water Power- Firm and Secondary, Efficiency, Economic analysis of hydropower, Discounting Factors, methodology for analysis, Present-worth comparison, Rate-of-return comparison, Benefit-cost ratio comparison, Annual-worth comparison
12-14	Electrical Loads, Storage and Pondage, Load curve, Load Factor, Capacity and Utilization Factors, Prediction of load, Pondage capacity analysis.
15-18	Hydraulics of Hydropower Intakes, Types of intakes, Design of intake structures, Hydraulic design of bellmouths, Intake transitions, Centerline locating, Air-entrainment, Critical submergence and swirling flow, Sump design

19-21	Penstocks and quality of approach flow towards turbines, Classification of penstocks, Layout of penstocks, Economical diameter of penstocks, Design Criteria for Penstocks, Hydraulic losses in penstock,
22	Power Channel, Design of lined power channel, Most economical section,
23	Trash Racks, Hydraulic Design of trash racks, Head loss through racks, Vibration of racks, Resonance
24-25	Settling Basins, Flushing discharge, Velocity at Basin, Sediment Removal Efficiency,
26-28	Spiral Case of Turbines, Hydraulic Design, Stay Vanes, Rectangular scroll case, Meridonial and Tangential velocity, Design procedure for circular scroll case,
29-31	Hydraulic turbines, Classifications, Theory of turbomachinery, Performance of turbines, Turbine characteristics, Hydraulic design of draft tube,
32-37	Hydraulic transients, Causes of Water Hammer, Wave velocity, Basic equations for transient flow, solution by characteristics method, Method of specified time intervals, Equivalent pipe
38-40	Methods for control of transients, Surge tanks, Types of Surge Tanks, Design consideration, Simple surge tank -governing equation, Jaeger's Equation, Stability criteria

Name of Program	B. Tech. Civil Engg.	**Semester:** 5th/ 6th	**Year:** 3rd
Name of Course	Groundwater Engineering and Management		
Course Code	CE24315		
Core / Elective / Other	Elective		
Prerequisites	Mechanics of Fluids, Engineering Hydrology		

Course Outcomes: *Students will be able to*	
1.	Understand the importance of Groundwater for the domestic as well as industrial purposes.
2.	Classify different kinds of aquifers and identify the aquifer parameters such as permeability and storativity by interpreting the experimental datasets.
3.	Determine the role of unsaturated water with soil water characteristics for the root development of plants.
4.	Modelling the fate and transport of contaminants in groundwater and manage the aquifer through remediation.
Description of Contents in brief:	
1.	Aquifers, concept of continuum in porous media, hydraulic conductivity tensor and principal coordinate system according to hydraulic conductivity tensor
2.	Continuity equation in cartesian and polar coordinates, solution to simple case using analytical solutions, image well theory and applications to varying pumping rates
3.	Flow though unsaturated zone, continuity equation, Richards equation, and soil water characteristic curves
4.	Groundwater contamination, equation of contaminant transport, source identification, management of contaminant sources
List of Text Books:	
1.	Todd, D.K., "Groundwater Hydrology", Wiley.
2.	Bear J., "Hydraulics of Groundwater", McGraw-Hill.
List of Reference Books:	
1.	Bouwer, H., "Groundwater Hydrology", McGraw-Hill.

Lecture Plan:

Lecture No.	Topic
1	Groundwater occurrence and its role in the hydrologic cycle, moisture distribution in a vertical profile
2-3	Classification of aquifers, continuum approach to flow through porous media
4-5	Darcy's law, hydraulic conductivity, eigenvalues of the hydraulic conductivity tensor
6-7	Flow in anisotropic aquifers, assumptions for a phreatic aquifer
8	Aquifer storativity, Dupuit-Forchimer equation
9-10	Basic equation of continuity in cartesian coordinates, initial and boundary conditions
11-13	Simplified case of the continuity equation with isotropic hydraulic conductivity and steady state, laplace equation
14	Differential equations governing ground water flow in polar coordinates
15-18	well hydraulics, analytical solutions for confined, leaky confined and unconfined aquifers

19-22	Image well theory, time-variant pumping rates
23-26	well interference, analysis of pumping test data with real examples
27-28	Concept of interfacial tension, principles of flow in the unsaturated zone
29-30	Capillary pressure and retention curves, soil water characteristic curves (SWCC),
31-32	Continuity equation in unsaturated zone, one dimensional Richard's equation
33-34	Reasons for the depletion of groundwater, artificial recharge, managed aquifer recharge
35-36	Contamination of groundwater, different sources of contamination
37	Contaminant transport equation (Advective Diffusive Equation – ADE)
38-39	Solution procedure of the source identification problem
40	Management of the aquifer using aquifer remediation techniques

Name of Program	B. Tech. in Civil Engineering	**Semester:** 7th	**Year:** 4th
Name of Course	Ground Improvement Techniques		
Course Code	CE24401		
Core / Elective / Other	Elective		

Course Outcomes: *Students will be able to*	
1.	Identify various types of problems and need for ground improvement.
2.	Gain knowledge about laboratory and field compaction methods.
3.	Design ground improvement methods for deep deposits of cohesionless soils.
4.	Design sand drains/prefabricated vertical drains, stone columns and soil stabilization techniques for cohesive and cohesionless soils.
5.	Design dewatering and grouting techniques.
Description of Contents in brief:	
1.	Need for ground improvement, factors affecting ground improvement techniques. principles of compaction, laboratory compaction, comparison of properties of soil compacted to wet and dry-of optimum moisture content, compaction control. field methods for shallow surface compaction, available equipment and their suitability
2.	Deep compaction methods for cohesionless soils: Vibro-flotation, Vibro compaction, Terra Probe, compaction by explosives, dynamic compaction, compaction piles etc. evaluation of ground improvement through various field tests.
3.	Deep compaction method for cohesive soils: Design of preconsolidation using preloading, construction and installation of sand drains and PVDs, Design of vertical drains with and without smear effect.
4.	Design of stone column, failure mechanism, load carrying capacity of stone column, settlement analysis by stress concentration factor, installation techniques, geosynthetic encased stone column etc. Soil Stabilization: Mechanical stabilization, role of fine and coarse fractions, method of mixing soil to get designed plasticity index. stabilization with additives: lime, fly ash, cement, bitumen, chemicals, non-traditional stabilizers etc…
5.	Dewatering Methods for cohesive and cohesionless soils; grouting of soil, grout materials, mechanical stability of grout, permeating grouting, displacement grouting, jet grouting; case studies of ground improvement techniques.
List of Text/ Reference Books:	
1.	Ground Improvement Techniques: Dr. P Purushothama Raj. Firewall Media.
2.	Basic and Applied Soil Mechanics: Dr. Gopal Ranjan, A.S.Rao , New Age.
3.	Engineering Principles of Ground Modification: Manfred R. Hausmann, McGraw-Hill publication.
URLs:	
https://nptel.ac.in/courses/105/108/105108075/	
https:/ /nptel.ac.in/courses/105/105/105105210/	
Lecture Plan:	

Sl.No.	**Topics**
1	Requirements of ground improvement technique, Factors affecting ground improvement techniques.
2,3,4	Compaction, Laboratory compaction,
5	Comparison of properties of soil compacted to wet of o.m.c. and dry of o.m.c.
6,7,8	Field compaction- Available equipment and their suitability Methods for shallow surface compaction. Compaction control in field
9	Methods for Deep compaction Vibrofloation, Terra Probe Method
10	Dynamic & Pounding Methods.
11-13	Sand Drains, Design of Sand Drain with preloading

14	Design of sand drains considering smear effect.
15	Design of Preload.
16 -17	Numerical
18-20	Design of stone column
21-22	Design problems
23	Soil Stabilization- Mechanical Stabilization.
24-25	Numerical on Mechanical Stabilization
26	Role of fine and coarse fraction, method of mixing soils to get designed plasticity index.
27-29	Stabilization using cement, lime, fly ash etc.
30-31	Stabilization using non-conventional additives.
32-33	Dewatering Methods.
34-37	Electro-osmosis dewatering Method, case studies
38	Grouting, Grout Materials, Mechanical Stability of grout
39-40	Grouting Techniques
40-42	Case studies of Ground improvement Techniques

Name of Program	B.Tech. in Civil Engineering	**Semester:** 7th	**Year:** 4th
Name of Course	Geosynthetics and Reinforced Soil Structures		
Course Code	CE24402		
Core/Elective/Other	Elective		

Course Outcomes: *Students will be able to*	
1.	Understand about geosynthetics and their applications.
2.	Gain knowledge about manufacturing and tests on geosynthetics.
3.	Design reinforced soil structures such as retaining walls and embankments.
4.	Gain knowledge about accelerated consolidation process using geosynthetics.
5.	Design municipal and hazardous waste landfills.
Description of Contents in brief:	
1.	Introduction, types and testing of geosynthetics.
2.	Soil retaining structures
3.	Design of reinforced soil retaining walls.
4.	Stability analysis of soil slopes.
5.	Applications of geosynthetics.
List of Text/ Reference Books:	
1.	Koerner, R. M. (2012). Designing with Geosynthetics, 6th Edition, Vol. 1 and 2, Xlibris corp., 914 p.
2.	Giroud, J.P. (1984)."Geotextiles and Geomembranes. Definitions, Properties and Design," Selected Papers, Revisions and Comments, 4th ed., IFAI Publishers, 325 p.
3.	J.N. Mandal and D. Choudhury (Editors), International Conference on Geosynthetics and Geoenvironmental Engineering, Quest Publications, Mumbai, 2004.
4.	Hausmann, M. R. (1990). Engineering Principles of Ground Modification, McGraw-Hill Publishing Company, New York, 632 p.
5.	Other relevant Design manuals.
URLs:	
1.	**https://archive.nptel.ac.in/courses/105/106/105106052/**
2.	**www.internationalgeosynthetics.org**
Lecture Plan:	

Lecture No.	**Topic**
1-2	Introduction to Geosynthetics, types, manufacture and their applications
3	Strength of reinforced soils, Testing of Geosynthetics
4	Different types of soil retaining structures.
5	construction aspects of geosynthetic reinforced soil retaining walls.
6	Design codes for reinforced soil retaining walls.
7-8	External stability analysis of reinforced soil retaining walls, seismic loads and internal stability analysis of reinforced soil walls, testing requirements for reinforced soil retaining walls
9-10	Design of reinforced soil retaining walls- simple geometry, Design of reinforced soil retaining walls- sloped backfill soil, Design of reinforced soil retaining walls supporting a bridge abutment

11-15	Stability analysis of soil slopes- Infinite slopes, Stability analysis of reinforced soil slopes resting on soft foundation soils and strong foundation soil.
16-20	Stability analysis of reinforced soil slopes – bilinear wedge analysis, Design of embankments supported on load transfer platforms
19-24	Reinforced soil for supporting shallow foundations
25-27	Accelerated consolidation of soft clays using geosynthetics, Geosynthetic encased stone columns for load support
28-30	Drainage application of geosynthetics, Filtration applications of Geosynthetics
31-35	Erosion control using geosynthetics, Natural geosynthetics and their applications
36-40	Geosynthetics for construction of municipal and hazardous waste landfills

Name of Program	B. Tech in Civil Engineering	**Semester:** /7th	**Year:** 4th
Name of Course	Soil Dynamics and Machine Foundation		
Course Code	CE24403		
Core / Elective / Other	Elective		

Prerequisite:	
1.	Soil Mechanics/ Geotechnical Engineering
2.	Foundation Engineering
Course Outcomes: *Students will be able to*	
1.	Understand dynamic behavior of soils
2.	Design Improved machine foundation
3.	Analysse soil stability
Description of Contents in brief:	
1.	Soil dynamics importance, applications, wave Propagation through soils.
2.	Theory of Vibration: Free and forced vibrations – un-damped and damped for single degree of freedom system. Harmonic and transient conditions. Mass Spring-Dashpot model and calculation of response magnification. Transmissibility vibration isolation.
3.	Dynamic soil parameters, factor affecting, Determination of dynamic Soils constants $C_u, C_\tau, C_\emptyset, C_\epsilon$, G and D etc. and approximate values.
4.	Machine Foundations, types, nature of dynamic forces produced by common machines, design criteria and permissible amplitudes, design approaches. Design of machine foundation for impact and reciprocating machine.
5.	Effects of dynamic loads on bearing capacity, earth pressure and liquefaction
List of Text Books:	
1.	Soil Dynamics and Machine Foundation Swami Saran, Galgotia Publications Pvt Ltd
2.	Soil Dynamics Shamsher Prakash. McGraw Hill Publications Pvt Ltd.
3.	Principles of Soil Dynamics B.M.Das. Thomsons Engineering
List of Reference Books:	
1.	Handbook of M/c Foundation Srinivasan & Vaidanathaln, McGraw Hill Education
URLs:	
1.	https://www.youtube.com/watch?v=rJyG2L-_nmk Soil dynamics lectures by Prof. D. Chaudhaury, IIT, Mumbai
2.	DOI: 10.1680/geot.1993.43.1.181Seismic bearing capacity of soils

Lecture Plan :	
Lecture No.	Topic to be Covered
1-6	Soil mechanics v/s Soil dynamics , dynamic loads, vibration terminology seismic coefficient evaluation, Equivalent Dynamic Load to an Actual Earthquake Load,
7-15	Theory of Vibration: Free and forced vibrations – un-damped and damped single degree of freedom system. Harmonic and transient conditions. Mass Spring-Dashpot model and calculation of response magnification. Transmissibility, vibration isolation.
16-22	Wave propagation through soils, Dynamic soil properties and their determination-empirical, laboratory and field methods
23-27	Factors Affecting Shear Modulus, and damping ratio
28-32	Dynamic Bearing Capacity of Shallow foundations, Earth Pressure under EQ loading
33-36	Soil Liquefaction
37-42	Design of foundation for impact and reciprocating machine

Name of Program	B.Tech in Civil Engineering	**Semester:** 7th	**Year:** 4th
Name of Course	Advanced RCC Design		
Course Code	CE24404		
Core / Elective / Other	Elective		

Course Outcomes: *Student will be able to*	
1.	Design and detailing of Continuous beam, flat and circular slab.
2.	Design and detailing of water tanks.
3.	Design and detailing of Retaining wall.
4.	Design and detailing of deep foundation.
5.	Illustrate concepts of prestress concrete and its losses.
Description of Contents in brief:	
1.	**Design and Detailing of Continuous beam:** Loading arrangement for maximum response, redistribution of moments, design and detailing of continuous beam.
2.	**Design and Detailing of Flat and Circular Slabs:** Design of flat slabs with and without drops; Circular slabs with various edge and loading conditions, and their usages.
3.	**Design and Detailing of Water Tanks:** Design criteria, material specifications and permissible stresses for water retaining structures, design of water tanks with fixed and flexible bases, situated on ground/underground - Square, Rectangular, and circular tanks; Overhead tanks - square, rectangular, circular & Intze water tanks with design of staging.
4.	**Design and detailing of Retaining Wall:** Types of Retaining wall, Structural behaviour of retaining wall, Stability of Retaining wall against overturning, sliding & pressure developed under the base, Cantilever retaining wall; Concept of counterfort retaining wall.
5.	**Design of Deep Foundation:** Types of deep foundations - pile foundation; under-reamed pile foundation, well foundation, structural Design consideration, Method of analysis, Construction methods
6.	**Introduction to Prestress concrete and Seismic Design:** Advantages of prestressing, methods of prestressing, analysis of simple prestress members, losses in prestress concrete. Introduction to earthquake analysis for structures and ductile detailing of structures.
List of Text Books:	
1.	Verghese, P.C., "Advanced Reinforced Concrete Design", PHI
2.	Krishna Raju, N., "Advanced Reinforced Concrete Design", CBS
List of Reference Books:	
1.	Pillai, S.U., and Menon, D., "Reinforced Concrete Design", McGraw hill Publications
2.	Shah, V.L. and Karve, S.R., "Limit State Theory and Design of Reinforced Concrete", Structures Publication
3.	Krishna Raju, N., "Prestressed Concrete", CBS.
List of BIS Code:	
1.	IS 456: 2000: Plain and Reinforced Concrete – Code of Practice
2.	IS 875 (Part I to Part V): Code of Practice for Design Loads (Other than earthquake loads) for building and structures

3.	IS 3370 (Part I to Part IV): Code of Practice for Concrete Structures for storage of Liquids
4.	IS 2911: Code of practice for design and construction of pile foundations
5.	IS 1893: Criteria For Earthquake Resistant Design of Structures
6.	IS 13920: Ductile Design and Detailing of Reinforced Concrete Structures Subjected to Seismic Forces - Code of Practice (First Revision)
URLs:	
1.	https://nptel.ac.in/
2.	https://swayam.gov.in/
3.	https://standardsbis.bsbedge.com/
4.	https://www.nicee.org/IITK-GSDMA_Codes.php

Lecture Plan:

Lecture No.	Topic
5	**Design and Detailing of Continuous beam:** Loading arrangement for maximum response, redistribution of moments, design and detailing of continuous beam.
6-11	**Design and Detailing of Flat and Circular Slabs:** Design of flat slabs with and without drops; Circular slabs with various edge and loading conditions, and their usages.
12-21	**Design and Detailing of Water Tanks:** Design criteria, material specifications and permissible stresses for water retaining structures, design of water tanks with fixed and flexible bases, situated on ground/underground - Square, Rectangular and circular tanks; Overhead tanks - square, rectangular, circular & Intze water tanks with design of staging.
22-27	**Design and detailing of Retaining Wall:** Types of Retaining wall, Structural behaviour of retaining wall, Stability of Retaining wall against overturning, sliding & pressure developed under the base, Cantilever retaining wall; Concept of counterfort retaining wall.
28-32	**Design of Deep Foundation:** Types of deep foundations - pile foundation; under-reamed pile foundation, well foundation, structural Design consideration, Method of analysis, Construction methods
33-40	**Introduction to Prestress concrete and Seismic Design:** Advantages of prestressing, methods of prestressing, analysis of simple prestress members, losses in prestress concrete. Introduction to earthquake analysis for structures and ductile detailing of structures.

Name of Program	B.Tech in Civil Engineering	**Semester:** 7th	**Year:** 4th
Name of Course	Bridge Design		
Course Code	CE24405		
Core / Elective / Other	Elective		

Prerequisite:	
1.	Knowledge of analysis of structures
2.	Knowledge of strength of materials
3.	Knowledge of design of R.C.C. structures
Course Outcomes: Student will be able to	
1.	Learn the dispersion of wheel load over a bridge deck
2.	Analyze and design slab culvert and box culvert
3.	Analyze and design T-beam girder bridges
4.	Analyze and design abutments and piers
Description of Contents in brief:	
1.	Introduction to IRC Bridge Design Course
2.	Bridge system and planning
3.	Economic considerations
4.	Aesthetics and selection of type of bridge
5.	Loading standards
6.	Super structure analysis
7.	Effective width method of analysis
8.	Pigeaud's theory, Courbon's method of analysis of girder bridges
9.	Design of solid slab bridges
10.	T-beam, girder bridge
11.	Design of box culverts
List of Text Books:	
1.	Krishna Raju, "Design of Bridges" Oxford & IBH Publishing Co. Pvt. Ltd.
2.	Victor, D.J., "Essentials of Bridge Engineering" Oxford & IBH Publishing Co. Pvt.Ltd.
3.	Raina, V.K., "Concrete Bridge Practice, Analysis, Design and Economics" Tata McGraw Hill New Delhi
List of Reference Books:	
1.	Raina, V. K., "Concrete Bridge Practice" Shroff Publishers and Distributors Pvt. Ltd
2.	Demetrios E. Tonias, "Bridge Engineering" McGraw Hill Publications
3.	IRC:6 and IRC:21
URLs:	
1.	https://nptel.ac.in/courses/105/105/105105165/
2.	http://www.irc.nic.in/WriteReadData/LINKS/SOP%20December%202019%20(1)87692446-7c93-4005-9a54-75871f23fe31.pdf
Lecture Plan (about 40-50 Lectures):	

No. of Lectures	Topic
1-3	Introduction to bridge systems
4	Different type of bridge systems
5	Components of bridge
6	Importance & identification of bridges
7	Selection of bridge site
8-10	Alignment, planning
11	Economic considerations in selection of bridges
12-14	Study of IRC-6 and IRC-21
15-16	Various IRC loadings on bridges
17-19	Effective width method for load distribution
20-22	M.Piegeud's method of load distribution
23-25	Courbon's method of load distribution for girders
26-27	Design of pipe culverts
28-29	Design of arch culverts
30-32	Design of slab culverts, Numerical problem
33-36	Design of box culverts, Numerical problem
37-42	Design of girder bridges, Numerical problem
43-44	Construction and maintenance of bridges

Name of Program	B.Tech in Civil Engineering	**Semester:** 7th	**Year:**4th
Name of Course	Earthquake Resistance Design of Structures		
Course Code	CE24406		
Core / Elective / Other	Elective		

Prerequisite:	
1.	Structural Analysis
2.	Geology
Course Outcomes:	
1.	Able to understand the theory of Earthquake Engineering.
2.	The effect of site characteristics on seismic behavior of structures.
3.	Design and construction of Seismic resistant Structures is well understood.
Description of Contents in brief:	
1.	Introduction to Seismology and plate tectonics.
2.	Definitions : Focus, Epicenter, Magnitude, Intensity, etc.
3.	Geotechnical aspects of Earthquake Engineering.
4.	Codal provisions for Earthquake resistant design and construction of R.C.C. Structures,
5.	Codal provisions for Earthquake resistant design and construction of Masonry Structures,
List of Text Books:	
1.	Earthquake Resistant Design of Structures - Agarwal P & M. Shrikhande ; Printice Hall
2.	Earthquake Resistant Design of Structures – S.K. Duggal ; Oxford Univ. Press
3.	Dynamics of Structures- Anil K. Chopra, Prentice Hall
List of Reference Books:	
1.	Geotechnical Earthquake Engg. – Kramar S.L.; Prentice Hall
2.	IS: 1893 Part 1 to 5 – Latest Edition
3.	IS: 13920 – Latest Edition
URLs:	
1.	https://www.nicee.org/EQTips.php
2.	https://nptel.ac.in/content/storage2/courses/105108076/module1/lecture1.pdf
3.	https://nptel.ac.in/content/storage2/courses/105101005/downloads/Lec22.pdf

Lecture Plan:	
Lecture No.	
1.	Introduction of the subject , Definitions and terminology
2.	The Interior of the Earth
3	Causes of Earthquake
4	Elastic Rebound Theory
5	Plate Tectonic Theory
6	Nature and Occurance of Earthquake
7	Seismic Waves
8	Seismic Waves

9	Seismograph
10	Graphical Method of locating Earthquake
11	Effects of Earthquake
12	Consequences of Earthquake Damage
13	Intensity
14	Intensity
15	Magnitude
16	Magnitude
17	Strong Ground Motion
18	Strong Ground Motion
19	Behavior of Structures under Seismic Condition
20	Lumped Mass Approach
21	System with Single Degree of Freedom
22	Dynamic Response of single degree of freedom structure
23	Response Spectrum
24	Response Spectrum
25	Design Spectrum
26	Systems with multiple degree of freedom
27	Dynamic Behaviour of Soil
28	Liquefaction
29	Liquefaction
30	Soil Structure Interaction
31	Soil Structure Interaction
32	Seismic Considerations for Shallow & Deep Foundations
33	Structural Configurations
34	Simplicity, Uniformity, Symmetry
35	Stiffness and Strength
36	Stiffness and Strength
37	Choice of Construction Material
38	Seismic Design Requirements , IS: 1893, 13920
39	Codal Provisions IS:1893, 13920
40	Design Earthquake Loads
41	Horizontal and Vertical Earthquake
42	Basic Load combinations
43	Seismic Methods of Analysis
44	Seismic Methods of analysis
45	Seismic Weights , Torsion , Soft and Weak Storey
46	IS 1893 Design Procedure (Z, I, R, T_n)
47	IS 1893 Design Procedure (R, T_n)
48	IS 1893 Design Procedure (V_B), Example Problem
49	Example Problem
50	Example Problem

Name of Program	B.Tech. in Civil Engineering	**Semester:** 7th	**Year:** 4th
Name of Course	Finite Element Method		
Course Code	CE24407		
Core/ Elective/Other	Elective		

Prerequisite:	
1.	Matrix algebra, differentiation & integration, Numerical methods, Computer Programming in high level language/MATLAB
2.	Mechanics of materials, Theory of Elasticity
3.	Matrix method of structural analysis
Course Outcomes:	
1.	The students will be able to apply knowledge of FEM for structural analysis of any kind of civil Engineering structure to evaluate internal forces and deformation.
2.	The forces and deformations thus evaluated will help the students to design any type of RCC determinate/indeterminate structure and to apply design checks for stresses and deformation produced due to external loading for safe and economical design.
3.	The structural analysis and design of any type of steel determinate and indeterminate and to apply design checks for stresses and deformation produced due to external loading for safe and economical design.
Description of Contents in brief:	
1.	Concept of structural analysis, 2D and 3-D elasticity, Generalized Hooke's law
2.	Strain energy and virtual work, principle of minimum potential energy, stiffness
3.	Stiffness matrix evaluation of bar and truss elements for analysis of bar problems and truss analysis and their application
4.	Stiffness evaluation of beam and frame elements and problem solving
5.	Stiffness evaluation of 2D elements and their application for plane stress and plane strain analysis
List of Text Books:	
1.	Introduction to Finite Element Method by P.N. Godbole
2.	Finite Element Method by S.S. Bhavikatti
3.	First course in finite element method by Daryl L. Logan
List of Reference Books:	
1.	Introduction to Finite Element, boundary element and meshless methods Darrell W Pepper
2.	Introduction to Finite Element Method: Theory, Programming & Applications Erik.G. Thompson
3.	Fundamentals of Finite Element Analysis David V. Hutton
URLs:	
1.	www.nptel.ac.in
2.	www.nptelvideos.in
3.	www.ocw.mit.edu

Lecture Plan	
Lect. No.	**Topic**
	Topic 1: Introduction
1-2	Introduction to FEM, General Description of the method, steps in FEM, Overview of matrix algebra, Matrix method Vs FEM
3	Terminology used in FEM such as element, node, degree of freedom, element stiffness matrix, load vector, finite element mesh, convergence
4 - 5	Various types of finite elements and their choice for analysis, Applications of FEM in Civil Engineering
	Topic 2: Element Characteristics
6-8	Concept of strain energy and work done by external forces, concept of element, stiffness matrix and load vector

9-10	Principle of minimum potential energy, Derivation of general expression for stiffness matrix and load vector of an element using principle of minimum potential energy
11	Principle of virtual work, general expression for stiffness matrix and load vector of an element using principle of virtual work
12-13	Initial stresses and strains and numerical problems
	Topic 3: Bar and Truss Problems
14-15	Stiffness matrix for two node bar element, Equivalent nodal force vector due to surface and body forces for two node bar element
16-18	Numerical Problems for bar analysis
19-21	Analysis of plane trusses, stiffness matrix for truss members in local and global coordinate system, Concept of transformation, evaluation of forces in the members
22-24	Numerical Problems for plane truss analysis
25	Space truss analysis using 2 node bar element (3 d.o.f. per node)
	Topic 4: Beam and Frame Analysis
26	Evaluation of stiffness matrix and nodal force vector for two node beam element using generalized coordinate system
27-29	Numerical problems for beam analysis
30	Evaluation of stiffness matrix of a plane frame member
31-33	Numerical problems for plane frame analysis
	Topic 5: CST Element: Two dimensional Analysis
34-36	Basic concepts of 2D and 3D elasticity and Generalized Hooke's law
37	Plane stress and plain strain problems, elasticity matrix
38	Stiffness matrix for constant strain triangle (CST) element
39	Equivalent nodal force vector for CST element due to body force, surface force and initial stresses/strains
40-42	Numerical problems

Name of Program	B.Tech. in Civil Engineering	**Semester:** 7th	**Year:** 4th
Name of Course	Advance Technologies in Transport Infrastructures		
Course Code	CE24408		
Core / Elective / Other	Elective		

Prerequisite:	
1.	Highway Engineering
Course Outcomes: *Students will be able to*	
1.	Gain knowledge of Advance Equipments for Functional & Structural Evaluation of Pavements.
2.	Gain knowledge of Advance Materials used in Different layers of Pavement.
3.	Gain knowledge of Advance Transit Technologies, Construction & Maintenance Techniques.
4.	Learn about Intelligent Transit Systems, TOD & Traffic Management Techniques.
Description of Contents in brief:	
1.	Workings, Benefits of Advance Equipments : FWD, LWD, Dynamic Cone Penetrometer, Etc.
2.	Advance Highway Materials : Aggregates, Bitumen, Composites Plastics & Geosynthetics, Reclaimed Waste Products.
3.	ITS, ToD, & Other Traffic Management Techniques.
List of Text Books:	
1.	Highway Engineering S.K.Khanna & C.E.G. Justo., Khanna Publishers
2.	Traffic Engg. & Transport Planning L.R. Kadiyali, Khanna Publishers
3.	Principles of Transportation Engineering Chakroborti and Das , PHI Learning Pvt. Ltd
List of Reference Books:	
1.	Principles of Highway Engineering and F.L.Mannering & W.P.Kilareski, John Wiley Traffic Analysis Publishers.
2.	Fundamentals of intelligent transportation Mashrur A. Chowdhury, Adel Wadid Sadek systems planning.
3.	Pavement Management System' Haas and Hudson McGraw Hill Book Co.
4.	Indian Roads Congress and MoRT&H specifications.
5.	IRC-SP41: guidelines for the design of at-grade intersections in rural and urban areas
URLs:	
1.	https://nptel.ac.in/courses/105106115/
2.	https://onlinemasters.ohio.edu/blog/5-advancements-in-transportation-technology/

Lecture Plan:

Lecture No.	Topic
1	Introduction: Advance Technologies & Scope in India.
2	Types of Advance Equipments
3-4	Benkelmen Beam Deflection Technique.
5-6	Dynamic Cone Penetrometer : Working & Benefits.
7-8	Light Weight Deflectometer: Working & Benefits.
9-10	Falling Weight Deflectometer: Working & Benefits.
11-12	Other various Advance Equipments.

13	Advance Highway Materials: Introduction
14-17	Aggregate: Nature and properties – types and processing, aggregates for pavement base – aggregate for bituminous mixture, aggregate for Portland. Tests on aggregates, specification
18-22	Bituminous Materials: conventional and modified binders – types and grade , physical and chemical properties and uses, types of asphalt pavement construction, principles of bituminous pavement construction – tests on bituminous materials. Bituminous Mix design –modified mixtures, etc.
23-24	Composites, Plastics and Geosynthetics
25-26	Reclaimed/Recycled Waste Products: Reclaimed Materials – waste products in transport engineering applications.
27-28	Fundamentals of ITS
29-30	Types of ITS
31-33	Sensor technologies and Data requirements of ITS
34-37	ITS Data collection techniques
38	ToD
39-40	Other Various Advance Techniques.

Name of Program	B.Tech in Civil Engineering	**Semester:** 7th	**Year:** 4th
Name of Course	Road Safety Engineering		
Course Code	CE24409		
Core / Elective / Other	Elective		

Prerequisite:	
1.	Highway Engineering
Course Outcomes:	
1.	To analyze black spot and assess the present safety scenarios on roads.
2.	To develop basic concept on Road Safety Audit and its necessity.
3.	To analyze the Design Stage Audit on Urban and Rural roads.
4.	To analyze the Construction Stage audit as recommended by IRC.
5.	To analyze Existing Stage Audit and Night Stage Audit in Indian context.
Description of Contents in brief:	
1.	Introduction: Road Safety Scenario.
2.	History & Purpose of Road Safety.
3.	Road Safety Audit Overview as per IRC: SP: 88-2019.
4.	Students will learn Technical Tips for Auditing Team through case studies.
List of Text Books:	
1.	Traffic Engg. & Transport Planning L.R. Kadiyali, Khanna Publishers
List of Reference Books:	
1.	5th Indian Roads Congress, "Road Safety Audit Manual", IRC:SP-88-2019
2.	Indian Roads Congress, "Highway Safety Code", IRC: SP-44:1996
3.	Highway and Traffic Engineering –Subhash Saxena ,CBS publisher& distributors
URLs:	
1.	https://www.civil.iitb.ac.in/tvm/nptel/582_Accident/web/web.html
2.	https://youtu.be/QGPGLlXwaHs

Lecture Plan:

Lecture No.	Topics
1	Introduction: Road Safety Scenarios in India.
2	Assessment of Black spot
3	History of Road Safety Audit
4	What is Road Safety Audit and its Objective
5	Purpose & Benefits of Road Safety audit
6	Five Stages of Road Safety Audit- An overview
7	Design stage Audit
8	Construction stage Audit
9	Existing stage Audit
10	Pre-opening stage Audit
11	Night Time Safety Audit

12-13	Case Studies
14	Types of Project to be Audited
15	Groups involved in RSA – their role and responsibilities
16-17	Key Steps involved in Conducting Road Safety Audit
18-19	Safety Issues to be focused in different stages of RSA
20-21	Planning of Road Safety Audit
22-24	Management of Road safety Audit
25-26	Practices for Safer Roads & Road Safety Audit Policy
27-28	Principles for Safer Design
29-30	Road safety audit checklists purposes and uses
31-32	"5Es" of Safe Road Operation
33-36	Responsibilities of Road accidents and safety measures
37-39	Road Safety Education: "5Ps" of road Safety education
40	Various Safety Principles

Name of Program	B.Tech in Civil Engineering	**Semester:** 7th	**Year:** 4th
Name of Course	Intelligent Transport Systems		
Course Code	CE24410		
Core / Elective / Other	Elective		

Prerequisite:	
1.	Highway Engineering
Course Outcomes:	
1.	Acquire in-depth knowledge of Intelligent Transport System, including wider and global perspective, with an ability to evaluate, analyze and synthesize existing and new knowledge.
2.	To acquire knowledge for data collection and analyse for ITS.
3.	To understand about the development of ITS models.
4.	Ability to apply ITS for sustainable mobility.
5.	To have an overview of ITS implementation in developing countries
Description of Contents in brief:	
1.	Fundamentals of ITS: Definition of ITS, the historical context of ITS from both public policy and market economic perspectives. Types of ITS
2.	Sensor technologies and Data requirements of ITS: Importance of telecommunications in the ITS. Information Management, Traffic Management Centers (TMC), ITS Data collection techniques, ITS User Needs and Services and Functional areas – Introduction
3.	Advanced Traffic Management systems (ATMS), Advanced Traveller Information Systems, Commercial Vehicle Operations, ITS Models, and evaluation, ITS and safety, ITS and security, ITS as a technology deployment program
4.	Advanced Transportation Systems : Public, Rural, Vehicle Control, Automated Highway Systems
5.	ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries, ITS and regional strategic transportation planning, including regional architecture, Future of ITS
List of Text Books:	
1.	Transportation Engineering and Planning - C.S Papacostas / P.D Prevedouros
2.	Traffic Engineering & Transport Planning L.R. Kadiyali, Khanna Publishers
List of Reference Books:	
1.	Fundamentals of Intelligent Transportation Systems Planning, Artech House Chowdhury, M. A. and Sadek A.
2.	Perspectives on Intelligent Transportation Systems, Sussman J.M., Springer
URLs:	
1.	https://nptel.ac.in/courses/105101008/

2.	https://nptel.ac.in/content/storage2/courses/105101008/downloads/cete_48.pdf

Lecture Plan	
Lecture No.	**Topic**
1-3	Fundamentals of ITS: Definition of ITS, the historical context of ITS from both public policy and market economic perspectives.
4	Types of ITS
5-7	Sensor technologies and Data requirements of ITS: Importance of telecommunications in the ITS. Information Management, Traffic Management Centers (TMC)
8-10	ITS Data collection techniques
11-14	ITS User Needs and Services and Functional areas – Introduction
15-16	Advanced Traffic Management systems (ATMS)
17-18	Advanced Traveller Information Systems
19	Commercial Vehicle Operations
20-22	ITS Models and Evaluation Methods
23-26	ITS and safety, ITS and security, ITS as a technology deployment program
27-29	ITS applications
30-33	Advanced Transportation Systems : Public, Rural, Vehicle Control
34-36	Automated Highway Systems
36-39	ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries
40-41	ITS and regional strategic transportation planning, including regional architecture
42	Future of ITS

Name of Program	B.Tech in Civil Engineering	**Semester:** 7th	**Year:** 4th
Name of Course	Analysis & Design of Pavement Structures		
Course Code	CE24411		
Core / Elective / Other	Elective		

Prerequisite:	
1.	Highway Engineering - I
Course Outcomes: *Students will be able to*	
1.	Analyze the material characterization soil, aggregates and bitumen for road construction and quality control aspects.
2.	Understand the layered concept of pavements.
3.	Analyze and design the flexible pavement for low and high volume of roads.
4.	Analyze and design the rigid pavement for low and high volume of roads.
5.	Design overlay and understand the concept of pavement evaluation.
Description of Contents in brief:	
1.	Introduction: Important types of pavement, Component parts of the pavement structures and their functions, design factors etc.
2.	Design of Flexible Pavements: stresses in flexible pavements, various design methods, design as per latest Indian standards guidelines.
3.	Design of Rigid Pavements: stresses in rigid pavements, various design methods, design as per latest Indian standards guidelines : Design parameters and their estimation, design procedure etc.
4.	Design of Joints etc. Rigid and flexible overlays and their design Procedures etc.
List of Text Books:	
1.	Principles of Transportation Engineering Chakroborti and Das, Prentice Hall India Learning Private Limited
2.	Highway Engineering S.K. Khanna & C.E.G. Justo, Nem Chand & Bros
3.	Pavement Design Yoder & Witczak, Wiley
4.	Principles of Pavement Design E.J. Yoder and M.W. Witczak, Wiley
5.	Concrete Road Design, HMSO
List of Reference Books:	
1.	Guidelines for Design of Flexible Pavements IRC:37-2018
2.	Guidelines for Design of Rigid Pavements IRC:58-2015
3.	Guidelines for Strengthening of Flexible Road Pavements Using Benkelman Beam Deflection Technique, IRC:81-1997.
4.	Principles of Transportation Engineering - Partha Chakraborty / Animesh Das
5.	MoRTH, Specifications for road and bridge works, fifth revision, IRC, New Delhi, 2013.
6.	IRC:15-2017 Fifth revision code of practice for construction of jointed plain concrete roads.
URLs:	
1.	https://nptel.ac.in/courses/105105107/
2.	https://www.slideshare.net/pjainrahul/rigid-pavement-68226826
Lecture Plan:	

Lecture No.	**Topics**
1-2	Introduction to Pavement Materials & Testing
4-6	Highway material characterization
7-8	Types of pavement, Component of pavement

9-11	Functions of layers of pavement
12-14	Stresses in Flexible Pavement
15-16	Methods of Flexible pavement design
17-19	Stresses in Rigid Pavement
20-21	Methods of Rigid pavement design
22-25	Types of joints in Rigid pavement, Design & Construction of Joints
26-29	Design of flexible pavement for low volume roads
30-32	Design of flexible pavement for high volume roads
33-35	Design of rigid pavement for low volume roads
36-38	Design of rigid pavement for high volume roads
39	Overlay design of flexible pavement
40	Overlay design of rigid pavement
41	Evaluation of pavements

Name of Program	B.Tech in Civil Engineering	**Semester:** 7th	**Year:** 4th
Name of Course	Railway, Airport and Harbour Engineering		
Course Code	CE24412		
Core / Elective / Other	Elective		
Prerequisites	Highway engineering		

Course Outcomes: *Students will be able to*	
1.	Understand the Basics of the Railway Engineering, Alignment, Gauges & Components of Permanent Ways.
2.	Design and conduct surveys to collect data. Design of railway geometrics, Signaling & Interlocking system, Implementing Modern Safety Techniques in Railways.
3.	Plan Airport Site including navigational aids.
4.	Design Airport including runway length, Width etc. & Taxiway Geometrics.
5.	Understand basic concepts of Dock & Harbour Engineering, their types, Break waters-Functions and types, Navigational Aids
Description of Contents in brief:	
1.	Railway engineering: General Introduction to Transportation Engg. - Characteristics and comparison of important modes of Transportation in India, Indian Railway history
2.	Permanent Way: surveys and alignment, gauges, coning of wheels etc. Components of permanent way, Geometric design, Various tractive resistance, hauling capacity & tractive efforts, Stations & yards, Signaling &interlocking, Modern techniques for safety in railways.
3.	Airport Planning, Lightning and Marking System.
4.	Airport Engineering: Airport site selection, wind rose diagram, basic runway length & corrections, runway and taxi way geometrics.
5.	Docks & Harbours Engineering: History of water transportation in India, Introduction to docks & harbour & their types, ~~design & construction of~~ break waters function & types, and navigational aids.
List of Text Books:	
1.	A Text Book of Railway Engg S.C. Saxena & S.P. Arora, Dhanpat Rai Publications (p) Ltd
2.	Airport planning and design K Khanna, Arora and Jain, Nem Chand
3.	A Course in Docks and Harbour Engineering S.P Bindra, Dhanpat Rai Publications
4.	Railway Track Engineering I.S. Mundry
List of Reference Books:	
1.	Railway Engineering - S.C Saxena / S.P Arora
2.	Elements of Bridge Tunnel & Railway Engineering - S.P. Bindra
3.	Transportaion Engineering - C. JotinKhisty
4.	Transportation Engineering - S.P. Chandola
5.	Airport Engineering – S.S. Rangwala
URLs:	
1.	https://nptel.ac.in/courses/105107123/
2.	https://nptel.ac.in/courses/105105165/

Lecture Plan:	
Lecture No.	**Topic**
1-2	Introduction: - Scope of Railway Engineering, History of railway
3	Comparison of Important Modes of Transportation in India.
4	Characteristics of Railways
5	Components of Permanent ways
6-8	Railway Alignments: - Requirements, Surveys for railway location.
9-10	Traction
10-12	Tractive Resistance, Hauling Capacity
13	Railway Planning: planning process, survey.
14	Railway Geometric Design:- Introduction , cross section elements.
15-16	Design of horizontal alignment.
17-19	Design of vertical alignment.
20-21	Railway Materials.
22	Design of railway: Introduction, design factors.
23	Railway Signalling
24	Interlocking System
25-26	Station & Yard
27-28	Airport Engineering- Introduction, Classification, Organizations etc.
29-30	Components of Aircraft, Movements, Characteristics
31-33	Airport Characteristics & Comparison with other modes of transportation in India.
34-35	Airport Planning: Site Selection, Cross Wind Components.
36-38	Airport Geometric Design: Runway Geometrics, Runway Length estimation & Corrections, Orientation-Wind Rose Diagrams etc.
39	Airport Navigational Aids- Lightning, Marking.
40	Taxiway Geometric Design.
41	Introduction & history of water transportations: Harbors, ports, classification, components of harbors and its functions
42	Docks & Harbours: Their types, components & Functions
43	Break Waters & Navigational Aids

Name of Program	B.Tech. in Civil Engineering	**Semester:** 7th	**Year:** 4th
Name of Course	Environmental Impact Assessment		
Course Code	CE24413		
Core / Elective / Other	Elective		

Prerequisite: None	
Course Outcomes: *Students will be able to*	
1.	To make the students familiar about the impacts of development activity
2.	To learn to prepare an EIA Report
3.	To learn the process of Environmental Clearance as specified by GoI
Description of Contents in brief:	
1.	Environmental Impacts of Infrastructure projects
2.	Various Steps in EIA Process
3.	Methodologies for estimation of Impacts
4.	Preparation of an EIA report
5.	GoI Procedure for Seeking Environmental Clearances
List of Text Books:	
1.	**Environmental Impact Assessment (EIA) Simplified @ CRC** by George Alex, Blue Rose Publishers, 2020
2.	Environmental Impact Assessment By Dr. S. Ramachandran, Airwalk Publications, 2019
3.	Introduction to Environmental Impact Assessment: Guide to Principles and Practice by Bram Noble, OUP Canada; 2006
List of Reference Books:	
1.	**Handbook of Environmental Decision Making in India: An EIA Model (Handbooks Series)** by O.V. Nandimath, Oxford University Press, 2008
2.	**Introduction To Environmental Impact Assessment (Natural and Built Environment Series) by John Glasson, Riki Therivel, Routledge2019**
3.	Cumulative Effects Assessment and Management: Principles, Processes and Practices by Larry Canter, EIA PRESS, 2015
URLs:	
1.	https://era.org.mt/en/Pages/EIAprocess.aspx
2.	http://environmentclearance.nic.in/
3.	https://www.cseindia.org/understanding-eia-383

Lecture Plan

Lecture No.	Topic
1-5	Introduction to EIA in the context of Sustainable Development
5-10	Learning about types of Impacts through Case Studies
10-15	Socio-Economic-Environmental-Cultural Issues to be considered
15-20	Scoping and Baseline Studies- the issues pertaining to data
20-25	Various Steps involved in the EIA process
25-30	Forecasting Impacts, EIA Methodologies
30-35	EIA Methodologies, Environmental Impact Statement
35-40	The GoI Procedures related to Environmental Clearances
40-50	Role and importance of Public Hearing, Post Project Monitoring and Environmental

	Management Plan

Name of Program	B.Tech in Civil Engineering	**Semester:** 7th	**Year:** 4th
Name of Course	Environmental Legislation		
Course Code	CE24414		
Core / Elective / Other	Elective		

Prerequisite: None	
Course Outcomes: *Students will be able to*	
1.	To make the student aware of the Evolution of Environmental Legislation in India and elsewhere.
2.	To convey the information on various Acts of the GoI that pertain to Environmental Legislation in India, and to generate awareness on procedural aspects of Environmental legislation
3.	To make the student understand the importance of legislation in the context of Environmental protection. To make one understand what statutory bodies originate from the legislation, what their powers are and how do they help in conserving and protecting Environment in the Indian context
Description of Contents in brief:	
1.	Environmental Acts in India
2.	Procedural aspects, setting up of Statutory bodies related to Environment and the powers conferred to them
3.	Environmental clearances and related laws , R&R Policies
4.	International Treaties and conventions related to Global Environmental Issues
5.	Judicial activism , National Green Tribunal, and the role of NGOs and Ciil Society in Environmental protection
List of Text Books:	
1.	Environmental Law in India by Prof. P.Leelakrishnan, Lexis Nexis Butterworth India, 2018
2.	Environmental Law–An Introduction by Nawneet Vibhaw, Lexis Nexis, 2016
3.	Environmental Legislation in India (Encyclopaedia of Environment), by K.R. Gupta (Editor), Atlantic, 2006
List of Reference Books:	
1.	Global Environmentalism and Local Politics: Transnational Advocacy Networks in Brazil, Ecuador, and India (SUNY series in Global Environmental Policy) by Maria Guadalupe Moog. Rodrigues , State University of New York Press, 2003
2.	Climate Law in EU Member States: Towards National Legislation for Climate Protection (New Horizons in Environmental and Energy Law series) by Marjan Peeters , Mark Stallworthy, and Javier de Cendra de Larragan (Editors), Edward Elgar Publishing Ltd, 2012
3.	The WTO and International Environmental Law: Towards Conciliation by Anupam Goyal, Oxford University Press, 2006
URLs:	
1.	https://greentribunal.gov.in/
2.	https://www.mondaq.com/india/
3.	https://www.wwfindia.org/about_wwf/enablers/cel/

Lecture Plan (about 40-50 Lectures):

Lecture No.	**Topic**
1-5	Historical background of Environmental movements National and international Acts and Agreements, their need and significance in the context of protection of Environment
5-10	Salient features of the Indian Constitution in the context of Environmental conservation and protection. Role of Legislators, executive and Judiciary in Indian context.

	Introduction to concept of Bill, Policy, Act, Litigation etc
10-15	Procedural aspects of formulation of a Bill and the passing of Acts. Procedural aspects of translation of an Act to actual implementation in the field. Statutory Bodies and their Powers. Concept of Judicial preview, review and Litigation.
15-30	Major Acts in Indian Environmental Context - Water Act. Air Act, The Environment (protection) Act, Municipal Solid Waste Rules, Batteries (Management and Handling) Rules, Hazardous waste Rules, Biomedical Waste (Management and Handling) Rules, Prevention of Cruelty to Animals (Slaughter House) Rules, Slaughter Act., e-waste (management and handling) Rules, Forest Conservation Act etc.
30-40	Role and Functions of the Statutory bodies such as Central and State Pollution Control Boards- Their Powers. Environmental clearances, EIA and related legislation Role of Municipalities and Panchayats and the powers vested in them. Factory Act, Occupational hazards and compensation, Industrial Acts in reference to Environmental conservation Land reforms, Land Use and Ownership, The R&R related legislation pertaining to infrastructure projects Inter-state Issues and the role of Tribunals National Green Tribunals-NGTs and their role
40-45	International Treaties and conventions related to Global Environmental Issues particularly about ozone depletion, climate change and Acid rains Trade and Environment Patents and quality assurance. ISO: 14000 National Certifications related to environment. Star rating of equipment, Green products. Extra judicial certifications such as the Halal Certifications - their legality and consequences
45-50	The NGOs and their role, Role of Civil Society. Judicial activism in India, PILs and Environmental protection. Balancing of human rights and the right of other species. Need for future legislation in view of Global warming and climate change, water rights, ban on Meat consumption and community ownership of resources. Environmental Rights in the time of crisis and disasters.

Name of Program	B.Tech. in Civil Engineering	**Semester:** 7th	**Year:** 4th
Name of Course	Sustainable Development and Global Environmental Issues		
Course Code	CE24415		
Core / Elective / Other	Elective		

Prerequisite: None	
Course Outcomes: *Students will be able to*	
1.	To understand the meaning of Sustainable Development and its significance
2.	To make the students aware of the various Global Environmental Issues
3.	An exploration into the reasons behind Global Environmental Issues and lack of sustainability in the present Development model
Description of Contents in brief:	
1.	Sustainable Development – background, history and dimensions
2.	Global Environmental Issues confronting Humanity, Possible Causes, Their Threat and Potential to cause damage
3.	Possible mitigation and solutions
4.	Historical Reasons behind global environmental issues
5.	Semitic and Non-Semitic philosophies behind environmental Issues, and the Indigenous concept of Sustainability
List of Text Books:	
1.	**Global Environmental Issues by Frances Harris,** Wiley-Blackwell**, 2004**
2.	The Global Casino: An Introduction to Environmental Issues by Nick Middleton, Routledge, 2018
3.	Introduction to Sustainable Development by Martin J. Ossewaarde, SAGE Publications Pvt. Ltd, 2018
List of Reference Books:	
1.	**The Gaia Hypothesis: Science on a Pagan Planet by Michael Ruse**. University of Chicago Press, 2013
2.	The Age of Sustainable Development by Jeffrey D. Sachs, Columbia University Press, 2015
3.	**Environmental Solutions: Environmental Problems and the All-inclusive global, scientific, political, legal, economic, medical, and engineering bases to solve them by Franklin J. Agardy and Nelson Leonard Nemerow, Academic Press, 2005**
URLs:	
1.	https://www.millenniumassessment.org/en/index.html
2.	https://sustainabledevelopment.un.org
3.	https://www.youtube.com/watch?v=w-VO_zZBBt8&t=356s

Lecture Plan (about 40-50 Lectures):	
Lecture No.	**Topic**
1-5	Global Environmental Problems – History and causes
5-10	Sustainable Development- Historical aspects and Importance, Role of UN
10-15	Ozone Depletion, Good and Bad Ozone- History and Present Scenario
15-20	Acid Rain – Causes and Consequences
20-25	Deforestation and Biodiversity crisis
25-30	The Sixth Extinction and Millennium Ecosystem Assessment
30-35	Plastics –Problems and possible solutions
35-40	Climate Change - Causes, Threats and Mitigation, Adaptation

40-45	Global Warming –Meat eating , Role of Livestock, Zoonotics
45-50	Semitic and non-Semitic Philosophies and their role in destruction/conservation of Nature

Name of Programme	B.Tech in Civil Engineering	**Semester:** 7th	**Year:** 4th
Name of course	Industrial Waste Treatment		
Course code	CE24416		
Core/ Elective/Other	Elective		
Prerequisite:			
1.	Water Supply Engineering		
2.	Wastewater Engineering		
Course outcome:	*Student will be able to*		
1.	Understand process steps in different industries e.g. Pulp & paper Industry, electroplating Industry, Distillery, Tannery, Dairy industry, cement Industry etc.		
2.	Design waste management strategies (recycling , reuse, process modifications, segregation schemes) for different industries, to minimize waste , besides designing treatment plants		
Description of course content			
1.	Introduction to environmental waste management and its tools. Importance and modes of waste minimization.		
2.	Introduction to environmental audits and ISO 14000. Detailed process in pulp and paper industry, with complete auditing of input and output materials. Different in plant control strategies and treatment layout for the industry		
3.	Design of equalization tank, primary & secondary tanks, aeration units, anaerobic digesters for the industry. Detailed process in Cement industry and thermal power plants. Dispersion model for air pollution for these industries. Ground level concentration of pollutants.		
4.	Design of stacks for different industries.		
5.	Design of neutralization units and flotation tanks and coagulation units for the industries. Effluent standards for industries, in India. Introduction to electronic waste management.		
List of Text books	1. C. S. Rao, Environmental Pollution Control Engineering, New Age International Publication. 2. Industrial Water Pollution Control by W. W.Eckenfelder		
List of Reference Books	1. Environmental Industrial Pollution control by P.R.Trivedi and Gurdeep Raj. 2. Pollution Control in process industries by S.P.Mahajan. 3. Waste Water Treatment for Pollution Control by Soli J.Arcieivala.		
URLs	1. https://nptel.ac.in/courses/105/105/105105178/ 2. https://nptel.ac.in/courses/105/105/105105048/ 3. https://nptel.ac.in/courses/105/105/105105169/		
Lecture Plan:			
Lecture No.	**Topic**		
1.	Introduction to waste management, with special focus on industries		
2 to 3	Waste management strategies: recycling & reuse, process modification, by-product recovery and segregation of waste for waste reduction.		
4 to 10	Introduction to production processes in Pulp and paper Industry, with input materials and output materials.		
11 to 13	In plant control strategies in pulp and paper industry.		
14 to 20	Design of treatment plants for pulp & paper industry.		
21 to 24	Introduction to processes of cement industry. And identification of points of pollution. Waste reduction strategies in cement industry and thermal power plants		
25 to 26	Design of stack, ground level concentration calculations by dispersion model in cement industry and thermal power plants.		
26 to 30	Design concepts for cyclones, bag house filters and scrubbers.		
33 to 35	Introduction to different EMSs, ISO 14000.		
36	Different industrial effluent standards		

38 to 40	Some case studies practising waste management.
40 to 43	Waste management of electronic waste
42 to 45	Waste management of plastic waste.

Name of Programme	B.Tech in Civil Engineering	**Semester:** 7th	**Year:** 4th
Name of Course	Advance Treatment Methods		
Course Code	CE24417		
Core/Elective/Other	Elective		

Pre-requisites:	
1.	Wastewater Engineering
Course Outcomes: *Students will be able to*	
1.	Understand the purpose, working principles, operations and limitations of different advance water & wastewater treatment technologies
2.	Learn the design principles & functional design of various advance treatment technologies
3.	Master various unit operations and unit processes for assessment and use & can apply to specific needs
4.	Understand how to select appropriate technology with enhanced capability for trouble shooting
5.	Have in-depth knowledge to perform research at higher level
6.	Contribute in development of new and improvement in existing advance treatment technologies for wastewater reuse as well as achieving zero liquid discharge conditions
Description of Contents in brief:	
1.	Membrane Separation: Membrane process terminology & classification, Materials, membrane configuration, membrane operation, ultrafiltration, reverse osmosis, microfiltration, Nanofiltration: Applicability, limitations, advantages and disadvantages, membrane fouling, electrodialysis, membrane bioreactors.
2.	Ion exchange and adsorption, principles, mechanism, types, applications, design, adsorption isotherms
3.	Biological nutrient removal: Nitrogen removal: nitrification, denitrification, processes for biological nitrogen removal, phosphorous removal mechanism; application of phostrip, bardenpho and phoredox process. Combined N and P removal by A2/O, bardenpho.
4.	Upflow anaerobic sludge blanket process, Sequential Batch Reactor process, rotating biological contactor, Moving Bed Bio Reactor technology,
5.	Gas transfer, Mass transfer, two film theory, aeration, types of aerators, design of aerators, ammonia stripping , Floatation
6.	Advanced Oxidation processes- types , mechanisms, Disinfection by chlorine, ozone , ultraviolet radiation & other chemicals, formation & control of disinfection byproducts, removal of refractory organics and specific inorganics.
7.	Evaporators: Multiple effect evaporators-falling film, raising film, forced circulation, agitated thin film driers, distillation
8.	Fluoride and arsenic removal, Electro coagulation, Electrochemical wastewater treatment processes, Taste & odor removal, oil separation
9.	Sludge treatment and disposal, land treatment methods, residuals management
10.	Low cost treatment methods, constructed wetlands, aquatic treatment technologies
List of Text Books :	
1.	Wastewater Engineering- Treatment and Reuse by Metcalf & Eddy , Tata McGraw -Hill, New Delhi
2.	Wastewater Treatment for Pollution Control by Soli J. Arceivala
3.	Environmental Pollution Control Engineering- CS Rao, Wiley Eastern Ltd., New Delhi, 1996.
4.	Environmental Engineering – A Design Approach by Arcadio P. Sincero and Gregoria A. Sincero, Pearson Education ,Inc Prentice Hall of India,
5.	Theory and Practice of Water & wastewater Treatment by Droste R.L. , John Wiley
6.	Wastewater Treatment by Rao M.N., Dutta A.K., Oxford & Ibh Publishing
7.	Wastewater Treatment – Concepts and Design Approach by G.L. Karia, R.A. Christian, PHI Learning Pvt Ltd, Delhi
8.	Wastewater Engineering by Parker R, CBS Publication
List of Reference Books:	
1.	Introduction to Environmental Engineering by Mackenzie L Davis , David A Cornwell , Tata McGraw Hill Education Pvt. Ltd. , New Delhi, 2010
2.	Environmental Engineering by Gerard Kiely , Tata McGraw Hill Education Pvt. Ltd. , New Delhi, 2007

3.	Principles of Environmental Engineering & Science by Mackenzie L. Davis & Susan J. Masten, McGraw Hill Education (India) Pvt. Ltd, 2013
4.	Handbook of Water and Wastewater treatment Plant Operations by Frank R Spellman, Taylor & Francis
URLs:	
1.	https://pdfs.semanticscholar.org/bf7c/a2b1d236fca009173de8136f897afc5f66a1.pdf?_ga=2.127889742.219243355.1590438224-376393648.1590438224
2.	https://www.epa.gov/sites/production/files/2019-02/documents/emerging-tech-wastewater-treatment-management.pdf
3.	http://www.jpf.org/LRV/septic.htm.
Lecture Plan:	
1.	Overview of Advanced Waste Water Treatment
2.	Introduction, Need of Advanced Waste Water Treatment, Purpose of Advanced Waste Water Treatment
3.	Typical residual constituents in treated wastewater effluents and their effects
4.	Unit operations and processes for removal of residual constituents found in treated wastewater effluents
5.	Membrane Filtration Process, Terminology, Membrane Process Classification and operation: Microfiltration, Ultrafiltration, Nano filtration, Reverse Osmosis,
6.	Membrane Configurations: Plate-and-frame module, Spiral-wound module, Tubular module, Hollow-fiber module
7.	Membrane materials, suitability, Application of membrane processes
8.	Membrane Fouling: Modes of membrane fouling, Control of membrane fouling, Silt density index
9.	Advantages & Disadvantages of Membrane Filtration, Design of membrane
10.	Electrodialysis- Mechanism, Advantages, disadvantages, applications, Design
11.	Ion Exchange Fundamentals of Ion Exchange, Types of Ion Exchange Resins Theory of Ion Exchange
12.	Characterization of ion exchange resins, Exchange capacity
13.	Applications: Removal and recovery of heavy metals, Removal of nitrogen, Removal of phosphorus, Organic chemical removal
14.	Application of Ion Exchange: Softening, Demineralization
15.	Adsorption Introduction, Fundamentals of adsorption, Mechanism, Type of adsorbents
16.	Factors affecting adsorption
17.	Development of adsorption isotherms: Freundlich, Langmuir, BET Activated carbon adsorption, Granular carbon adsorption
18.	Estimation of breakthrough time and adsorption capacity
19.	Nutrient Removal – Nitrogen & Phosphorus, Necessity
20.	Nitrogen Removal: Nitrification, Reaction kinetics, Factors affecting Nitrification
21.	Denitrification, Reaction kinetics, factors affecting denitrification, Simultaneous nitrification and denitrification
22.	Types of Denitrification processes, Process configuration
23.	Phosphorus Removal : Introduction, Phosphorus removal by Chemical Precipitation: Principles of process, Chemicals applied, Chemistry of phosphorus precipitation
24.	Phosphorus removal by Biological Precipitation: Principles of the process, Microorganisms involved in the process, Process configurations
25.	Upflow anaerobic sludge blanket process (UASB), Theory, Construction, Mechanism, Basis of Design , Design considerations, Advantages , Disadvantages, Operation & Control
26.	
27.	Sequential Batch reactor- Theory, construction, Mechanism, Design , advantages , Disadvantages
28.	
29.	Rotating biological contactors, Theory, construction, Mechanism, Design , advantages , Disadvantages
30.	
29.	Moving Bed Bio Reactor, Membrane bio reactor, Principle, construction, working, Advantages , disadvantages
30.	
31.	Gas Transfer, aeration, types of aerators, Oxygen transfer, design of aeration process, Flotation, oil removal
32.	Ammonia stripping, Gas strippers, design of stripping tower, VOCs removal
33.	Advance Oxidation processes: Theory, Technologies used to produce hydroxyl radicals, Applications,

34.	Types of oxidizing agents, ozone based and non ozone based processes, Fenton and photo-Fenton Oxidation, Solar Photo Catalytic Treatment Systems
35.	
36.	Oxidation of refractory organic compounds, removal of toxic compounds
37.	Disinfection: theory, disinfectants used, mechanism, factors affecting disinfection, disinfection by chlorine, Ozone and UV radiation, Dechlorination, Design of facilities, Formation of disinfection by products and its control
38.	
39.	Evaporators: Multiple effect evaporators-falling film, raising film, forced circulation, agitated thin film driers, distillation
40.	Fluoride and arsenic removal for drinking water
41.	Electrochemical wastewater treatment processes, Electrocoagulation, Factors affecting Electro coagulation, Electrode materials, Reactor configurations
42.	Electro-oxidation: Electro oxidation process, Reactor configurations
43.	Electro-floatation: Factors affecting electro floatation, Comparison with other technology, Reactor configurations
44.	Low-cost treatment technologies, Aquatic treatment, Constructed wetlands, Reed bed technology, root zone treatment
45.	

Name of Programme	B.Tech Civil Engg	**Semester:** 7th	**Year:** 4th
Name of Course	Air Pollution & Control		
Course Code	CE24418		
Core/Elective/Other	Elective		

Pre-requisites:	
1.	Physical & Chemical properties of gases
2.	Chemical Kinetics
3.	Chemical Thermodynamics
Course Outcomes: *Students will be able to*	
1.	Identify, classify and understand Air pollution sources, plume behavior, able to calculate pollutant concentration in ambient air.
2.	Understand effects of air pollutants on human being, plants, materials
3.	Understand effect of meteorology , able to calculate stack height, Solve plume dispersion problems using Box and Gaussian models
4.	Plan air pollutants sampling and able to understand monitoring methods.
5.	Understand & Select Air pollution control techniques and methodologies.
6.	Design particulate and gaseous control devices
Description of Contents in brief:	
1.	Definitions, Classification of Air pollutants. Sources, Particulates & Gaseous pollutants in Air
2.	Effects of Air pollutants on human, plants, materials and animals, Economic Effects
3.	Meteorological Aspects, Plume behavior, Sampling and Measurement
4.	Air Pollution control- Particulate control technologies, Control of gaseous emissions
5.	Automobile Emission control, Indoor Air Pollution
6.	Sources of Noise, Effects of Noise on Human & other biotic life ,Sound Pressure, Power and Intensity, Loudness
7.	Decibel addition & subtraction, Measurement of Noise, Frequency band analysis,
8.	Miscellaneous measures of Noise- Community noise, Airport Noise, Industrial Noise.
9.	Outdoor noise propagation, Directivity, Attenuating factors, Indoor Noise Propagation,
10.	Noise Transmission through ducts & partitions, Noise control Criterias, Noise control
List of Text Books :	
1.	Environmental Engineering – A Design Approach by Arcadio P. Sincero and Gregoria A. Sincero, Pearson Education ,Inc Prentice Hall of India, 2016
2.	Principles and Practices of Air Pollution Control and Analysis by J.R. Mudakavi , I.K. International Publishing House Pvt. Ltd. New Delhi, Reprint 2012
3.	Environmental Pollution Control Engineering- CS Rao, Wiley Eastern Ltd., New Delhi, 1996.
5.	Air Pollution by M.N. Rao & H.V.N. Rao Tata McGraw Hill Publishing Co. Ltd
6.	Environmental Engineering by Peavy, H.S., Rowe and Tchobonoglous,G., McGraw Hill
7.	Advanced Air and Noise Pollution Control by Lawrence K.Wang, Norman C. Pereira, Yung-Tse Hung, Volume I & Volume II, Humana Press
List of Reference Books:	
1.	Introduction to Environmental Engineering by Mackenzie L Davis , David A Cornwell , Tata McGraw Hill Education Pvt. Ltd. , New Delhi, 2010
2.	Environmental Engineering by Gerard Kiely , Tata McGraw Hill Education Pvt. Ltd. , New Delhi, 2007
3.	Principles of Environmental Engineering & Science by Mackenzie L. Davis & Susan J. Masten , McGraw Hill Education (India) Pvt. Ltd, 2013
4.	Handbook of Noise Measurement – APG Peterson & EE Gross PH, Englewood cliffs New Jersey, latest edition.
5.	Air Pollution Control Equipment – H. Brauer and Y. B. G. Verma, Berlin Heidelberg, New York, latest edition.
URLs:	

1.	http://www.cpcbenvis.nic.in/
2.	https://iums.ac.ir/uploads/Air_Pollution_Control_Engineerin%D8%B8%E2%80%9E_95694.pdf
3.	http://160592857366.free.fr/joe/ebooks/Automative%20engineering%20books/Advanced_Air_and_Noise_Pollution_Control.pdf
4.	https://nptel.ac.in/courses/105/104/105104099/
5.	https://swayam.gov.in/nd1_noc19_me72/preview
Lecture Plan:	
1.	Sources of Air Pollution,
2.	Processes of generation of atmospheric dust
3.	Classification of Air Pollutants
4.	Effects of Various Air Pollutants on human
5.	Effects of Various Air Pollutants on Plants and Materials
6.	Gaseous air pollutants units and measurements of concentration
7.	Meteorological parameters affecting Air pollution
8.	Atmospheric Stability, Stability classes, Mixing Height
9.	Dispersion of Air Pollutants, Plume behavior - types of plumes
10.	Estimation of Stack Height,
11.	Estimation of buoyant Plume Rise
12.	Sampling and Measurement of Air Pollutants
13.	High Volume Sampler
14.	Iso kinetic sampling
15.	Stack Sampling & Monitoring
16.	Particulate Control Technologies,
17.	Gravitational Settling Chambers: Principle, construction
18.	Gravitational Settling Chambers: Advantages, disadvantages
19.	Gravitational Settling Chambers: Howard chamber, Design aspects
20.	Cyclone Separators: Principle, construction, mechanism
21.	Cyclone Separators: advantages, disadvantages
22.	Cyclone Separators: advantages, disadvantages, operating troubles
23.	Cyclone Separators: Design aspects
24.	Fabric Filters- Mechanism, operational troubles,
25.	Fabric Filters- design aspects, Characteristics of Fibers
26.	Electrostatic Precipitators- Principle, Construction, Types, Advantages, Disadvantages
27.	Factors affecting collection efficiency of ESPs
28.	ESP Design aspects
29.	Scrubbers- Mechanism, Types, Spray Tower, Venturi Scrubber
30.	Scrubber: advantages, disadvantages, applications
31.	Absorption of Gaseous Emissions, Design Considerations, Tower Diameter, Tower Height
32.	Adsorption of Gaseous Pollutants
33.	Air Pollution Control by Combustion, Direct combustion, Thermal Incineration,
34.	Air Pollution Control by Fluidized Bed Incineration
35.	Liquid Injection Incinerators, Rotary Kilns, Catalytic Combustion
36.	Flue Gas Desulphurization, Emission control of Nitrogen Oxides
37.	Odour Control, Control of Organic Emissions- VOCs and VSCs
38.	Air pollutants from Petrol and Diesel Engines, Control Technologies for Automobile Emissions
39.	Indoor Air Quality and its model
40.	Control of Sulphur Dioxide Emissions, Coal Gasification, Fluidized bed combustion

Name of Program	B.Tech. in Civil Engineering	**Semester:** 7th	**Year:** 4th
Name of Course	Environmental Quality Monitoring		
Course Code	CE24419		
Core / Elective / Other	Elective		

Prerequisite:	
1.	Theory course in Water Supply and Sewage Engineering
Course Outcomes: *Students will be able to*	
1.	Plan monitoring schemes for different environmental systems
2.	Conduct testing & analysis of different parameters, with precision and accuracy checks, removal of errors, and with other statistical checks
3.	Perform proper analysis and data management (accuracy of data, collection & storage)
Description of Contents in brief:	
	Environmental monitoring – landforms, soil, vegetation, land use, and wetland, monitoring of air quality parameters: methods, equipment, water standards, air and soil quality parameters: methods, equipment, units and standards, environmental quality modeling, environmental quality indices. Principals of instrumentation: advantages, applications, and limitations of the analytical techniques-spectrophotometry, atomic absorption and emission spectrophotometry, flame photometry, nephelometry, inductively coupled plasma spectrometry, mass spectrometry, FTIR, NMR, electrochemical methods: polarography, ion-selective electrodes, chromatography.
List of Text Books:	
1.	Instrumental Methods of Analysis HH Willard & LL Dean, John Wiley,
2.	Environmental Chemistry by Syer Mecarty, Mc Graw Hill
List of Reference Books:	
1.	Instrumental Methods of Chemical Analysis by GW Ewing
2.	Modern Methods of Chemical Analysis by RL .Recsok & LD Shields
3.	Fundamentals of Molecular Spectroscopy byCN. Banwell

Lecture Plan

Lecture No.	**Topic**
1 to 3	Introduction to monitoring, sampling, and planning for monitoring schemes
4	Details about monitoring plans in India by CPCB
5	Different types of environmental monitoring schemes
6 to 10	Error, Detection limits, accuracy, and precision
10 to 12	Statistics involved with data collection mean, mode, median, standard deviation, coefficient of correlation
13	Significance of statistics in data analysis
14	Numerical related to statistics
15 to 17	Monitoring planning for water bodies and introduction to parameter which may need special care
18 to 20	Special emphasis to parameter , their safe transportation and preservation and sampling techniques
21 to 22	Special reference to DO, BOD and COD testing , and with particular intricacies to bacterial

	count sampling and Preservation and computation of results.
23 to 24	Need of equalization of flow and strength and design of equalization tank for flow
25	Design of equalization tank for strength with special emphasis on monitoring of ETP
26	Introduction to instrumentation techniques with its advantages and limitations of analytical techniques
27-28	Theory of spectrophotometry, atomic absorption spectrophotometry
29 to 31	Details of AAS and emission spectrophotometry and flame photometry
32	Inductive coupled plasma spectrophotometry principle and working
33 to 35	Introduction to ion chromatography and details of polarography
36	Ion chromatography and the principle of ion chromatographer
27 to 40	Gas chromatography, principle, and working and partitioning of column
41 to 42	Remote sensing in environmental monitoring
43 to 45	Introduction to Air pollution monitoring

Name of Program	B. Tech. in Civil Engineering	**Semester:** 7th	**Year:** 4th
Name of Course	Digital Processing of Remotely Sensed Data		
Course Code	CE24420		
Core / Elective / Other	Elective		

Prerequisite:	
1.	Engineering Surveying
2.	Advanced Surveying
Course Outcomes: *Students will be able to*	
1.	Understand on principle, techniques, and tools for the computer-based analysis of remote sensing data
2.	Learn on the creation of digital maps from remotely sensed digital data
3.	Develop skill for evolving methodology to use Remote Sensing techniques for various applications
Description of Contents in brief:	
1.	Basic Concepts of Digital Images: Basic terminology related to remotely sensed digital images. Image rectification and restoration: Geometric and radiometric correction, establishing, spatial transformation, model using GCP's, intensity interpolation techniques (nearest neighbor, bilinear and cubic convolution.
2.	Image Enhancements: Contrast manipulation: Grey Level threshold, level slicing and contrast stretching. Spatial feature manipulation: spatial filter, edge enhancement and Fourier analysis. Point, local and regional operation –Fourier transform, scale- space transform, wavelet transform, multi-image manipulation: Multi-band rationing and differencing, principal components, vegetation indexes, color composition and Intensity Hue Saturation (IHS).
3.	Initial statistics extraction from digital images: Image histogram, mean, standard deviation, variance, covariance. Image display alternatives: mono and color, composites of MSS, Band Combination, and optimum index factor (OIF), Variance-Covariance and correlation matrices. Pattern recognition, boundary detection and representation, textural and contextual analysis, Image Classification and thematic information extraction, General steps for land cover information extraction, classification levels and supervised and unsupervised classification techniques, selection of appropriate algorithms for classification: Parallelepiped, Minimum distance, Maximum likelihood, Isodata, fuzzy classification, classification accuracy assessment. Hybrid training, Non- parametric, and sub-pixel classification, Hyper – spectral image analysis.
4.	Introduction to commercial and open source image processing software.
List of Text Books:	
1.	Remote Sensing and image interpretation, Lillesand T.M. and Kiefer R. W., Willey publications
2.	Introductory Digital Image Processing: A Remote Sensing Perspective, John R. Jensen, Pearson Press
3.	Digital Image Processing, Rafael C. Gonzalez, Richard E. Woods, Pearson
List of Reference Books:	
1.	Physical Principles of Remote Sensing, W. G. Rees Cambridge University Press
2.	Remote sensing models & methods for image processing, Robert Shcowebgerdt, Academic Press
3.	Remote Sensing Digital Image Analysis, John A. Richards, Springer
URLs:	
1.	https://nptel.ac.in/courses/105/103/105103176
2.	https://nptel.ac.in/courses/105/104/105104100/

3.	https://nptel.ac.in/courses/105/107/105107121/

Lecture Plan:

Lecture No.	Topic
1 & 2	Basic Concepts of Digital Images: Basic terminology related to remotely sensed digital images
3	Image rectification and restoration:
4 to 6	Geometric and radiometric correction
7 & 8	establishing, spatial transformation model using GCP's,
9 to 11	intensity interpolation techniques (nearest neighbor, bilinear and cubic convolution.
12 & 13	Image Enhancements: Contrast manipulation: Grey Level threshold, level slicing and contrast stretching
14 &15	Spatial feature manipulation: spatial filter, edge enhancement
16	Fourier analysis. Point, local and regional operation –Fourier transform,
17 & 18	scale- space transform, wavelet transform
19 & 20	multi-image manipulation: Multi-band rationing and differencing, principal components,
21 & 22	vegetation indexes, color composition and Intensity Hue Saturation (IHS).
23 & 24	Initial statistics extraction from digital images: Image histogram, mean, standard deviation, variance, covariance.
25	Image display alternatives: mono and color, composites of MSS, Band Combination, and optimum index factor (OIF)
26 & 27	Variance-Covariance and correlation matrices
28	Pattern recognition, boundary detection and representation, textural and contextual analysis,
29 & 30	Image Classification and thematic information extraction,
31	General steps for land cover information extraction,
32	classification levels and supervised and unsupervised classification techniques,
33 & 34	selection of appropriate algorithms for classification: Parallelepiped, Minimum distance, Maximum likelihood, Isodata, fuzzy classification,
35	Isodata, fuzzy classification
36	classification accuracy assessment.
37 & 38	Hybrid training, Non- parametric, and sub-pixel classification
39	Hyper – spectral image analysis.
40 to 43	Introduction to commercial and open source image processing software.

Name of Program	B. Tech. Civil Engineering	**Semester:** 7th	**Year:** 4th
Name of Course	Digital Mapping and Cartography		
Course Code	CE24421		
Core / Elective / Other	Elective		

Prerequisite:	
1.	No Prerequisite
Course Outcomes: *Students will be able to*	
1.	Gain knowledge on principle, techniques, and tools for the Digital Mapping and Cartography.
2.	Understand the methodology for the creation of GIS based digital cartographic map.
3.	Develop skill for Geospatial analysis of the digital cartographic map.
Description of Contents in brief:	
1.	Introduction to Cartography: Nature and scope, significance of Computer Mapping, mapping in a digital age. Categories & characteristics of maps, study of different types of maps, basics of map scales, component of map, conventional mapping verses digital mapping. Survey of India national series maps, interpretation of topographic maps, indexing and numbering of topographical maps.
2.	Fundamentals of Cartographic Design: Colour, pattern, lettering, compilation, border information, aesthetics, Generalization: Semantic & Geometric, Symbolization, dot, isopleth and choropleth mapping, Multivariate and dynamic mapping, Map production, methods of map printing.
3.	Creation and analysis of Digital maps: Basic Terminology related to Geographical Information System (GIS) and creation of GIS database for Cartographic maps. Spatial and attribute data. Spatial models: Semantics, spatial information, temporal information, conceptual models of spatial information, representation of geographic information: point, line and area futures, topology, raster and vector data, raster to vector data conversion, map projection, analytical transformation, rubber sheet transformation, manual digitization, and semi-automatic line following digitizer.
4.	Remote sensing data as an input to GIS data; Attribute database: scale and source of inaccuracy; GIS functionality; data storage and data retrieval through query, generalization, classification, containment search within a spatial region; Overlay: arithmetical, logical and conditional overlay, buffers, inter visibility, aggregation; Network analysis; Applications of GIS in planning and management of utility lines and in the field of environmental engineering, geotechnical engineering, transportation engineering and water resources engineering,
5.	Introductory concepts of Web based GIS and its applications.
List of Text Books:	
1.	Elements of Cartography, Arthur H. Robinson et.al., John Wiley and Sons, INC
2.	Geographical Information Systems and Computer Cartography, Jones Christopher B. Routledge, Taylor, and Francis Group.
3.	GIS Cartography: A Guide to Effective Map Design, Peterson, Gretchen N., CRC Press, Taylor & Francis Group, New York.
List of Reference Books:	
1.	Introduction to Geographic Information Systems, Kang-Tsung Chang, McGraw Hill, Indian edition
2.	Remote Sensing and image interpretation, Lillesand T.M. and Kiefer R. W., Willey publications
3.	Principles of Geographic Information, P.A. Burrough, Oxford University Press
URLs:	
1.	https://nptel.ac.in/courses/105/107/105107158

2.	https://nptel.ac.in/courses/105/104/105104100/
3.	https://nptel.ac.in/courses/105/107/105107121/

Lecture Plan:

Lecture No.	Topic
1 & 2	Introduction to Cartography: Nature and scope, significance of Computer Mapping, mapping in a digital age.
3	Categories & characteristics of maps, study of different types of maps
4	basics of map scales
5	component of map
6	conventional mapping verses digital mapping
7 & 8	Survey of India national series maps,
9	interpretation of topographic maps
10 & 11	indexing and numbering of topographical maps.
12 & 13	Fundamentals of Cartographic Design: Colour, pattern, lettering, compilation, border information, aesthetics
14	Generalization: Semantic & Geometric
15 & 16	Symbolization, dot, isopleth and choropleth mapping,
17	Multivariate and dynamic mapping,
18	Map production, methods of map printing.
19 to 21	Creation and analysis of Digital maps: Basic Terminology related to Geographical Information System (GIS)
22 & 23	Creation of GIS database for Cartographic maps
24	Spatial and attribute data.
25 & 26	Spatial models: Semantics, spatial information, temporal information, conceptual models of spatial information
27	representation of geographic information: point, line and area futures, topology
28	raster and vector data, raster to vector data conversion
29	map projection
30	analytical transformation, rubber sheet transformation,
31	manual digitization, and semi-automatic line following digitizer
32 & 33	Remote sensing data as an input to GIS data; Attribute database: scale and source of inaccuracy;
34	GIS functionality; data storage
35 & 36	data retrieval through query, generalization, classification, containment search within a spatial region; Overlay: arithmetical, logical and conditional overlay, buffers, inter visibility, aggregation
37	Network analysis;
38 to 40	Applications of GIS in planning and management of utility lines and in the field of environmental engineering, geotechnical engineering, transportation engineering and water resources engineering,
41 & 42	Introductory concepts of Web based GIS and its applications.

Name of Program	B.Tech in Civil Engineering	**Semester:** 7th	**Year:** 4th
Name of Course	Mechanics of Sediment Transport		
Course Code	CE24422		
Core / Elective / Other	Elective		

Course Outcomes: *Students will be able to*

1.	Understand the mechanism of sediment transport
2.	Understand the dynamics of natural streams.
3.	Know the behaviour and maintenance of open channels.
4.	Understand the dynamics of turbulent fluvial flows
5.	Understand the diversity of river training works and their respective functionalities

Description of Contents in brief:

1.	Introduction to sediment: Physical properties of fluid and sediment, origin and properties of sediments, nature of problems
2.	Fluvial hydraulics: Scour criteria and problems: regimes of flow, Shields curve, incipient motion of sediment particles, terminal fall velocity of sediment in fluid, alluvial bed forms and Resistance to flow
3.	Sediment transport: Bed load, suspended load and total load transport, Meyer-Peter approach, du Boys' approach, Einstein's approach, Engelund and Fredsoe's approach, sediment samplers, design of stable channels, alluvial stream and their hydraulic geometry
4.	Turbulent Fluvial Flows: Decomposition and averaging procedure, equation of motion (Reynolds equations), Prandtl's mixing length theory, hypothesis of von Kármán, velocity distribution, the linear law in viscous sub-layer, the logarithmic law in turbulent wall shear layer, law in buffer layer, log-wake law and velocity defect law, turbulence intensity, calculation of bed shear stress using bed slope, velocity distribution, average velocity, Reynolds shear stress distribution, turbulent kinetic energy distribution
5.	River Training Works: Objectives, classification of river training works, design of guide banks, groynes or spurs their design and classification ISI Recommendations of approach embankments and afflux embankments, pitched islands, artificial cut-offs, objects and design considerations, river control-objectives and methods.

List of Text Books:

1.	Yang, C.T., "Sediment Transport: Theory and Practice." 1996, McGraw-Hill, USA.

List of Reference Books:

1.	Dey, Subhasish, "Fluvial Hydrodynamics" 2014, Springer, India
2.	Garde, R.J., Raju, K.G.R, "Mechanics of Sediment Transportation and Alluvial Stream Problems" 1985, Wiley Eastern Ltd.
3.	Yalin, M.S., "Mechanics of Sediment Transport" 1977, Pergamon Press, Oxford.

URLs:

1.	http://marineman.ir/wp-content/uploads/2015/03/Basic-Concept-of-Sediment-Transport.pdf
2.	https://archive.nptel.ac.in/courses/105/103/105103204/

Lecture Plan (about 30-40 Lectures):

Lecture No.	**Topic**
1-3	Introduction to sediment: Physical properties of fluid and sediment, origin and properties of sediments, nature of problems
4-6	Fluvial hydraulics: Scour criteria and problems, Shields curve, incipient motion of sediment particles
7-9	Terminal fall velocity of sediment in fluid, regimes of flow, alluvial bed forms and Resistance

	to flow
10-11	Sediment transport: Bed load, suspended load and total load transport
12-15	Meyer-Peter approach, du Boys' approach, Einstein's approach, Engelund and Fredsoe's approach
16-18	Sediment samplers, design of stable channels, alluvial stream and their hydraulic geometry
19-21	Turbulent Fluvial Flows: Decomposition and averaging procedure, equation of motion (Reynolds equations),
22-26	Prandtl's mixing length theory, hypothesis of von Kármán, velocity distribution, the linear law in viscous sub-layer, the logarithmic law in turbulent wall shear layer, law in buffer layer, log-wake law and velocity defect law
27-30	Turbulence intensity, calculation of bed shear stress using bed slope, velocity distribution, average velocity, Reynolds shear stress distribution, turbulent kinetic energy distribution
31	River Training Works: Objectives, classification of river training works
32-34	design of guide banks, groynes or spurs their design and classification ISI Recommendations of approach embankments and afflux embankments
35-38	Pitched islands, artificial cut-offs, objects and design considerations, river control-objectives and methods.

Name of Program	BTech in Civil Engineering	**Semester:** 7th	**Year:** 4th
Name of Course	Machine Learning and Data Analytics in Civil Engineering		
Course Code	CE24423		
Core / Elective / Other	Departmental Elective		

Prerequisite:	
1.	Basic Probability and Statistics, Linear Algebra, Data Structures
2.	Basic Programming Skills
3.	Fundamentals of Civil Engineering
Course Outcomes: *Students will be able to*	
1.	Apply of supervised and unsupervised machine learning algorithms in Civil engineering
2.	Learn about the tools used to handle large-scale data and its analysis
3.	Apply different tools and their applications in different real-world problems related to civil engineering
Description of Contents in brief:	
1.	Introduction to machine learning and data analytics in civil engineering: fundamentals, tools, history necessities in Bhartiya (Indian) Context,
2.	Machine learning in modern civil engineering; recapitulation of linear regression, logistic regression; supervised algorithms such as k-nearest neighbor, support vector machines, neural networks fundamentals and backpropagation,
3.	Applications to structural damage detection, soil classification, Geotechnical Investigations etc.; unsupervised clustering algorithms such as hierarchical clustering, k-means and DBSCAN,
4.	Application on transportation, Structural health monitoring, Rainfall runoff modelling, Soil strength prediction etc
5.	ML and Data analytics in Error analysis, Uncertainty; Propagation of Uncertainty
6.	Relevant tools; large-scale data visualization using Power BI; deep learning tools such as keras, pytorch.
List of Text Books:	
1.	Data science for civil engineering: a beginner's guide by Rakesh K. Jain, Prashant Shantaram Dhotre, Deepak Tatyasaheb Mane, Parikshit Narendra Mahalle, 2022, CRC Press
2.	Big Data Analytics by Rajkamal and Preeti Saxena, McGraw hill Publication
3.	Big Data Science Analytics & Mchine lerning by V.K. Jain, Khanna Publishers
List of Reference Books:	
1.	Fundamental of Machine learning for Predictive Data Analytics by John D Kelleher, Brian Mac Namee ans Aoife D' Arcy
2.	The Elements of Statistical Learning: Data Mining, Inference and Prediction, Trevor Hastie, Robert Tibshirani, Jerome Friedman, Springer
URLs:	
1.	https://nptel.ac.in/courses/106106198
2.	http://digimat.in/nptel/courses/video/106106198/L01.html

Lecture Plan	
No. of Lectures	**Topic**
1-5	Introduction to machine learning(ML) and data analytics(DA) in civil engineering: fundamentals, tools, history necessities in Bhartiya Context,

6-11	Machine learning in modern civil engineering; recapitulation of linear regression, logistic regression; supervised algorithms
12-16	unsupervised machine learning algorithms such as k-means clustering, deep learning algorithms such as convolution neural networks
17-21	Applications of ML and DA to structural damage detection, structural health monitoring
22-26	Application of ML and DA in Soil Classification and other geotechnical Investigations
27-31	DA in Transportation and traffic engineering, water management and hydrological investigations
32-36	Introduction to relevant tools; large-scale data visualization using Power BI; deep learning tools such as keras, pytorch.
37-40	Hands-On-Training sessions on ML and AL techniques

Name of Program	B.Tech. in Civil Engineering	**Semester:** 7th	**Year:** 4th
Name of Course	Fluid Measurement Systems		
Course Code	CE24424		
Core / Elective / Other	Elective		

Course Objectives: *Students will be able*	
1.	To introduce the need and objectives of fluid measurement systems.
2.	To understand the working principles of instruments used for the measurement of fluid properties.
3.	To learn the techniques of flow measurement in pipe and open channel flows.
4.	To understand the systems used for wall shear stress measurement.
5.	To introduce the techniques used for flow visualization.
6.	To learn the concepts of error and uncertainty estimation for measurement systems.
Description of Contents in brief:	
1.	Measurement system in ancient India; need and objectives of fluid measurement systems.
2.	Fundamentals of measurement of viscosity, specific gravity, surface tension, pressure, etc; viscometer; hydrometer; barometer; manometer; dial-type pressure gauges; pressure transducers.
3.	Flow measurement in pipes: Venturi meter; orifice meter; nozzle meter; pitot tube; rotameter; water meter.
4.	Flow measurement in open channel flows: Pitot tube; current meter; dilution technique; moving boat method; area velocity method.
5.	Wall shear stress in uniform flows; wall shear stress from depth-averaged velocity; measurement of wall shear stress using floating element method, fence technique and Preston tube.
6.	Reynolds experiment; flow visualization using hydrogen bubble method; schlieren system; shadowgraph.
7.	Error and uncertainty in measurement; estimation of measurement errors; external and internal estimates of errors; dependence and independence of errors; general procedure of uncertainty analysis.
List of Text Books:	
1.	Rathakrishnan, E. 2007. *Instrumentation, Measurements, and Experiments in Fluids*. CRC Press, Boca Raton, Florida, United States.
2.	Nakra, B. C., and K. K. Chaudhry. 2009. *Instrumentation Measurement and Analysis*. Third Edition, McGraw-Hill, New Delhi, India.
List of Reference Books:	
1.	Çengel, Y. A., and J. M. Cimbala. 2014. *Fluid mechanics: Fundamentals and applications.* Third Edition, McGraw-Hill, New York, United States.
2.	Crowe, C. T., D. F. Elger, B. C. Williams, and J. A. Roberson. 2009. *Engineering Fluid Mechanics*. Ninth Edition, John Wiley & Sons, Inc., Jefferson City, United States.
3.	Subramanya, K. 2008. *Engineering Hydrology*. Third Edition, McGraw-Hill, New Delhi, India.

Lecture Plan:

Lecture No.	Topic
1	Measurement system in ancient India
2	Need and objectives of fluid measurement systems
3–4	Fundamentals of measurement of viscosity, specific gravity, surface tension, pressure, etc
5–10	Viscometer; hydrometer; barometer; manometer; dial-type pressure gauges; pressure transducers
11–16	Venturi meter; orifice meter; nozzle meter; pitot tube; rotameter; water meter; current meter
17–22	Dilution technique; moving boat method; area velocity method.

23–28	Wall shear stress in uniform flows; wall shear stress from depth-averaged velocity; measurement of wall shear stress using floating element method, fence technique and Preston tube.
29–34	Reynolds experiment; flow visualization using hydrogen bubble method; schlieren system; shadowgraph.
35–40	Error and uncertainty in measurement; estimation of measurement errors; external and internal estimates of errors; dependence and independence of errors; general procedure of uncertainty analysis.

Name of Program	B.Tech. in Civil Engineering	**Semester:** 7th	**Year:** 4th
Name of Course	Design of Hydraulic Structures		
Course Code	CE24425		
Core / Elective / Other	Elective		

Course Objectives: *Students will be able to*	
1.	To offer an understanding on the hydraulic design aspects of flow diversion structures.
2.	To learn the hydraulic design principles of different components of gravity and embankment dams.
3.	To deliver the basic concepts of reservoir planning and maintenance.
4.	To learn the hydraulic design aspects of lined and unlined canals.
Description of Contents in brief:	
1.	**Structures for flow diversion**: Barrages in different river regimes; site investigation and data collection; location and alignment selection; planning and layout; finalization of layout through model studies; hydraulic design for surface and subsurface flows; protection works; diversion of river; design of canal head regulator, sediment exclusion arrangements; guidelines for barrage operation.
2.	**Structures for water storage**: Types of dam; site selection; selection of the type of dam; appurtenant structures and ancillary works; layout of dams; stability and design of concrete gravity dams; types and layout of embankment dams; design of embankment dams; causes of failure of embankment dams; seepage control measures in embankment dams.
3.	**Spillways and energy dissipators**: Selection of spillways; hydraulic aspects of different types of spillways, such as free overfall, overflow, chute, side channel, shaft, tunnel and syphon spillways; protection of downstream of spillways from scour; design of stilling basin and bucket type energy dissipators.
4.	**Planning of storage reservoirs**: Geological study of reservoir site; reservoir storage zones; effect and control of sedimentation in reservoirs; reservoir losses and their minimization.
5.	**Reservoir outlet works**: Classification of outlet works; functions of outlet works; estimation of design discharge capacities; components and layout of outlet works; different types of gates and valves for flow control.
6.	**Structures for water conveyance**: Layout of canals; maintenance of canals; design of lined and unlined canals; cross drainage works.
List of Text Books:	
1.	Garg, S. K. 1976. *Irrigation Engineering and Hydraulic Structures*. Khanna Publishers, Delhi, India.
2.	Novak, P., A. I. B. Moffat, C. Nalluri, and R. Narayanan. 2007. *Hydraulic Structures*. CRC Press, Boca Raton, Florida, United States.
List of Reference Books:	
1.	Varshney, R. S., S. C. Gupta, and R. L. Gupta. 1993. *Theory and Design of Irrigation Structures*. Volume II, Sixth Edition, Nem Chand & Bros., Roorkee, India.
2.	James, C. S. 2019. *Hydraulic Structures*. Springer Nature, Switzerland.

Lecture Plan:

Lecture No.	**Topic**
1	History of hydraulic structures in ancient India.
2–4	Barrages in different river regimes; site investigation and data collection; location and alignment selection; planning and layout; finalization of layout through model studies

5–7	Hydraulic design for surface and subsurface flows
8–10	Protection works; diversion of river; design of canal head regulator, sediment exclusion arrangements; guidelines for barrage operation
11–14	Types of dam; site selection; selection of the type of dam; appurtenant structures and ancillary works; layout of dams
15–17	Stability and design of concrete gravity dams
18–21	Types and layout of embankment dams; design of embankment dams; causes of failure of embankment dams; seepage control measures in embankment dams
22–25	Selection of spillways; hydraulic aspects of different types of spillways, such as free overfall, overflow, chute, side channel, shaft, tunnel and syphon spillways; protection of downstream of spillways from scour
26–28	Design of stilling basin and bucket type energy dissipators
29–32	Geological study of reservoir site; reservoir storage zones; effect and control of sedimentation in reservoirs; reservoir losses and their minimization
33–36	Classification of outlet works; functions of outlet works; estimation of design discharge capacities; components and layout of outlet works; different types of gates and valves for flow control
37–40	Layout of canals; maintenance of canals; design of lined and unlined canals; cross drainage works

Name of Program	B. Tech. Civil Engg.	**Semester:** 7th	**Year:** 4th
Name of Course	Disaster Management & Mitigation		
Course Code	CE24426		
Core / Elective / Other	Elective		
Prerequisites	-Nil-		

Course Outcomes: *Students will be able to*	
1.	Understand the basic principles of disaster management
2.	Understand different types of disasters and issues associated with each of these disasters.
3.	Learn about the national initiatives and framework related to disaster management
4.	Understand the role of ICT and geoinformatics in disaster management and learn about disaster mitigation strategies
Description of Contents in brief:	
1.	Disaster, Hazard, Vulnerability, Resilience, Risks. Natural disasters, geological disasters, Man made disasters, Environmental hazards, Disasters and national losses, Historical perspective of disasters in India and the Indian sub-continent, Recent major disasters, Disaster management cycle and its components, Earthquake, Landslide, Flood, Drought, Fire etc - classification, causes, impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts - in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Global warming and climate change. Adaptation. Dos and don'ts during various types of disasters.
2.	Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness, community based DRR, structural and non-structural measures, roles and responsibilities of the community, Panchayati Raj institutions/ Urban Local Bodies, States, Centre, and other stakeholders including NGOs. Institutional processes and framework at State and Central Level – National and State Disaster Management Authorities. Prediction and early warning systems. Role of information, education, communication, and training, geoinformatics and IT in disaster preparedness, risk assessment, response, recovery, and management. Role of engineers on disaster management.
3.	Components of disaster relief - water, food, sanitation, shelter, health, waste management, Institutional arrangements for mitigation, response and preparedness, Legislation in India on Disaster Management. National disaster management policy. Other related policies, plans, programmes and legislation relevant to/ pertaining to disaster management. Disaster damage assessment. Disaster mitigation. Existing organization structure for managing disasters in India. Case studies.
List of Text Books:	
1.	Sulphey, M. M.,Disaster Management, PHI Learning, 2016.
2.	Parag Diwan,A Manual on Disaster Management, Pentagon Press, 2010
3.	Damon P. Coppola, Introduction to International Disaster Management, Butterworth-Heinemann, 2016.
4.	S. R. Sharma, Disaster Management, A P H Publishers, 2011.
5.	Sreeja. S. Nair, Training Manual on Geoinformatics Applications in Disaster Management, NIDM, 2012.

Lecture Plan:

Lecture No.	Topic
1	Basic terminology related to Disaster, Hazard, Vulnerability, Resilience, Risks
2 & 3	Natural disasters - hydro-meteorological disasters such as flood, flash flood, cloud burst,

	drought, cyclone, forest fires etc;
4 to 5	Geological disasters like earthquake, tsunami, landslides, volcanic eruption
6 & 7	Man made disasters - chemical industrial hazards, major power break downs, traffic accidents, fire hazards, biological hazards, nuclear accidents.
8 to 9	Disasters and its impact over globally and specifically over India
10 & 12	Discuss recent disaster, Disaster management cycle and its components.
13 to 15	Global trends in disaster and Global Warming and climate change.
16 & 17	Disaster cycle - Phases, Culture of safety
18 to 20	Disaster prevention, mitigation and preparedness, community based DRR
21 & 22	Structural and non-structural measures
23 to 25	Roles and responsibilities of the community, Panchayati Raj institutions/ Urban Local Bodies, States, Centre, and other stakeholders including NGOs
26 & 27	Institutional processes and framework at State and Central Level – National and State Disaster Management Authorities.
28	Prediction and early warning systems
29 & 30	Role of information, education, communication, and training, geoinformatics and IT in disaster preparedness, risk assessment, response, recovery, and management.
31	Role of engineers on disaster management.
32 to 34	Components of disaster relief - water, food, sanitation, shelter, health, waste management, Institutional arrangements for mitigation, response and preparedness
35	Legislation in India on Disaster Management
36	National disaster management policy
37 & 38	Other related policies, plans, programmes and legislation relevant to/ pertaining to disaster management.
39	Disaster damage assessment
40	Disaster mitigation
41	Existing organization structure for managing disasters in India.
42 & 43	Case Studies

Name of Program	B. Tech. Civil Engineering	**Semester:** 7th	**Year:** 4th
Name of Course	Hydroclimatology		
Course Code	CE24427		
Core / Elective / Other	Elective		
Prerequisites	-Nil-		

Course Outcomes: *Students will be able to*	
1.	Select climate variables affecting precipitation at a location.
2.	Perform risk assessment and mapping with respect to extreme events.
3.	Extract GCM projections and downscale these for a river basin.
4.	Perform hydrological impact assessment of projected climate change.
Description of Contents in brief:	
1.	Introduction to hydro-climatology: climate system; climate, weather and climate; overview of earth's atmosphere; vertical structure of atmosphere; radiation and temperature; laws of radiation; heat- balance of earth atmosphere system; random temperature variation; modelling vertical variation in air temperature; temporal variation of air temperature; temperature change in soil; thermal time and temperature extremes.
2.	Hydrologic cycle: introduction; global water balance; cycling of water on land, a simple water balance model; climate variables affecting precipitation, precipitation and weather, humidity, vapor pressure, forms of precipitation, types of precipitation; cloud; atmospheric stability; monsoon; wind pattern in India; global wind circulation; Indian summer monsoon rainfall.
3.	Climate variability: floods, droughts, drought indicators, heat waves, climate extremes. steps of risk characterization - hazard identification, exposure assessment, vulnerability analysis, risk mapping, risk characterization to natural hazards, risk assessment as a distributed process.
4.	Climate change: introduction; causes of climate change; modelling of climate change, global climate models, general circulation models, downscaling; IPCC scenarios; commonly used statistical methods in hydro-climatology: trend analysis; empirical orthogonal functions, principal component analysis; canonical correlation; statistical downscaling with regression.
List of Text Books:	
1.	G. S. Campbell, and J. M. Norman, An Introduction to Environmental Biophysics, Springer, 2000.
2.	W. M. Washington, and C. L. Parkinson, An Introduction to Three-Dimensional Climate Modeling, Oxford University Press, 2005.
3.	M. L. Shelton, Hydroclimatology: Perspectives and Applications, Cambridge University Press, 2009.
4.	K. McGuffie, and A. Henderson-Sellers, The Climate Modelling Primer 4th edition, Wiley Blackwell, 2014.
5.	IPCC, Fourth and Fifth Assessment Reports, 2016.

Lecture Plan:

Lecture No.	Topic
1 & 2	Introduction to hydro-climatology: climate system; climate, weather and climate
3	Overview of earth's atmosphere;
4 to 6	Vertical structure of atmosphere; radiation and temperature; laws of radiation
7 & 8	Heat- balance of earth atmosphere system; random temperature variation
9	Modelling vertical variation in air temperature

10 & 12	Temporal variation of air temperature; temperature change in soil; thermal time and temperature extremes
13 to 15	Hydrologic cycle: introduction
16 & 17	Global water balance; cycling of water on land, a simple water balance model
18 to 20	Climate variables affecting precipitation, precipitation and weather, humidity, vapor pressure
21	Forms of precipitation, types of precipitation
22 to 24	Cloud; atmospheric stability; monsoon; wind pattern in India
25	Global wind circulation
26 & 27	Indian summer monsoon rainfall
28 to 30	Climate variability: floods, droughts, drought indicators, heat waves, climate extremes
31 & 32	Steps of risk characterization - hazard identification, exposure assessment, vulnerability analysis
33 & 34	Risk mapping, risk characterization to natural hazards, risk assessment as a distributed process.
35 & 36	Climate change: introduction; causes of climate change, modelling of climate change
37 & 38	Global climate models, general circulation models,
39 & 40	Downscaling; IPCC scenarios
41	Commonly used statistical methods in hydro-climatology: trend analysis
42 & 43	Empirical orthogonal functions, principal component analysis; canonical correlation; statistical downscaling with regression.

Name of Program	B. Tech. Civil Engineering	**Semester:** 7th	**Year:** 4th
Name of Course	Optimization Methods for Civil Engineers		
Course Code	CE24428		
Core / Elective / Other	Elective		
Prerequisites	Engineering Mathematics		

Course Outcomes: *Students will be able to*	
1.	Determine the need for optimal design in engineering, necessary and sufficient conditions of optimality
2.	Determine the optimality of constrained and unconstrained problems using classical search techniques
3.	Determine the optimality of non-linear problems and linear problems using classical optimization methods
4.	Apply evolutionary algorithms for fundamental problems as well as advanced engineering design problems
Description of Contents in brief:	
1.	Introduction to optimization, need for optimal design, necessary and sufficient conditions for optimality
2.	Constrained and unconstrained optimization problems, global and local optima, single and multivariable problems
3.	Classical optimization methods for single and multivariable problems, linear and dynamic programming.
4.	Metaheuristic optimization algorithms, principles of biomimicry and related civil engineering applications
List of Text Books:	
1.	Deb. K., Optimization for engineering design: Algorithms and examples, PHI Pvt Ltd., 1998.
2.	Bennis. F., and Bhattacharjya. R.K., Nature-inspired methods for metaheuristics optimization, Modeling and optimization in science and technologies, Springer, 2020.
List of Reference Books:	
1.	Arora., J.S., Introduction to optimum design, McGraw Hill International edition, 1989.

Lecture Plan:

Lecture No.	Topic
1	History of optimization and its application in the context of Bharat
2-3	Basics of engineering analysis and design, need for optimal design
4-5	Difficulties associated with optimization problems, problems of global and local optima
6-8	Single and multivariable problems, necessary and sufficient conditions for optimality
9-11	Basics of constrained and unconstrained problems, stationary points, points of maxima, points of minima and inflection points
12-18	Exhaustive search method, bounding phase method, region elimination method, interval halving method, golden section search method, Newton-Raphson method, and bisection method.
19-22	Definition of descent direction, steepest descent direction method, Newton method
23-27	Quadratic approximation of a function, convex and concave functions, convex optimization problem
28-35	Linear Programming, Dynamic Programming, Transportation Model, Assignment Model, Decision Theory.

36-37	Evolutionary algorithms, introduction to genetic algorithm (GA), differential evolution (DE)
38-40	Cultural and memetic evolutionary algorithms, Particle swarm optimization (PSO), shuffled frog leaping algorithm (SFLA), simulated annealing (SA), invasive weed growth optimization (IWO) and other metaheuristic principles of biomimicry

Name of Program	B.Tech in Civil Engineering	**Semester:** 7th	**Year:** 4th
Name of Course	Design of Steel-Concrete Composite Structures		
Course Code	CE24429		
Core / Elective / Other	Elective		

Prerequisite:	
1.	Understanding of Structural Analysis
2.	Understanding of RCC Design
3.	Understanding of Steel Design
Course Outcomes: *Students will be able to*	
1.	Ascertain, decide and recommend the suitability of Steel Concrete Composite
2.	Structure for various situations with significant advantage.
3.	Do the Analysis Design and Drawing of Steel Concrete Composite Beams of various types.
4.	Do the Analysis Design and Drawing of Steel Concrete Composite Slabs of various types.
5.	Do the Analysis Design and Drawing of Steel Concrete Composite Columns of various types.
Description of Contents in brief:	
1.	Introduction to Steel Concrete Composite Structures.
2.	Advantages and Applications of Steel Concrete Composite Structures.
3.	Various types of Steel Concrete Composite Beams and their Design
4.	Various types of Steel Concrete Composite Floors & their Design
5.	Various types of Steel Concrete Composite Columns and their Design
6.	Study of Indian and European codes
List of Text Books:	
1.	R.P.Johnson: Composite Structure of Steel and Concrete (Volume 1), Blackwell Scientific Publication (Second Edition), U.K.
2.	G. W. Owens and P. Knowles: Steel Designer's Manual (Fifth edition), The steel construction Institute (U.K), Oxford Blackwell Scientific Publication.
3.	IS: 11384-1985, Code of Practice for Composite Construction in Structural Steel and Concrete.
List of Reference Books:	
1.	Lawson, R.M., " Design of composite slabs and beams with steel decking", SCI Publications, P050, 1993.
2.	Owens, G. W., " Design of fabricated composite beams in buildings", SCI Publications P059, 1989.
3.	Lawson, R.M. and Rackham, J. W., " Design of haunched composite beams in buildings", SCI Publications, P060, 1989.
4.	Brett, P., and Rushton, J., " Parallel beam approach- a design guide", SCI Publications, P074, 1990.

5.	Knowles, P.R., "Design of castellated beams", SCI Publication P005, 1985.
6.	Lawson, R. M. and McConnel, R., " Design of stub girders", SCI Publications, P118, 1993.
7.	Merrill, S. K.," Design of composite trusses", SCI Publications, P083, 1992.
8.	ENV 1994-1-1: EC4: Design of composite steel and concrete structures, Part 1.1: General rules and rules for buildings.
9.	R. Narayanan "Composite Steel Structures" Advances, Design and Construction, Elsevier, Applied science, UK, 1987.
10.	R.M. Lawson, D.L Mullett and FPD Ward "Good practice in Composite floor Construction". The Steel Construction Institute, 1990.
11	Mark Lawson and Peter Wickens "Composite Deck Slab", Steel Designers Manual (Fifth edition), The Steel Construction Institute, UK, 1992.
12.	Bryan E.R. and Leach. P "Design of Profiled sheeting as Permanent Formwok", Construction Industry Research and Information Association (CIRIA), Technical Note 116, 1984.
13.	Data Sheet: Fire resistance of Composite Slabs with Steel Decking, Construction Industry Research and Information Association (CIRIA), Special Publication 42

URLs:

Lecture Plan:

Lecture No.	**Topic**
1.	Introduction
2.	Elastic behaviour of composite beams
3	Shear Connectors
4	Ultimate load behaviour of composite beams
5	Serviceability Limit States
6	References and Concluding Discussions
7	Types and orientation of profiled deck slab in composite beam
8	Provisions for service openings in composite beams
9	Basic Design Considerations
10	Design of Composite beams
11	Effect of continuity
12	Serviceability
13	References and Concluding Discussions
14-15	Numerical on simply supported beam
15-16	Numerical on continuous beam
17	Introduction to composite floors
18	Structural elements
19	Bending resistance of composite slab
20	Shear resistance of composite slab
21	Serviceability
22	References and concluding discussions
23	Design Situations
24	Analysis for internal forces and moments
25	Design Tables

26	Serviceability limit States
27	Diaphragm action of deck slab
28	Design of Profiled Decking
29	Concluding Discussions and References
30-31	Numericals
32	Introduction to Columns - Materials and partial safety factors
33-34	Column Design
35-36	Design Problems
37	Columns subjected to compression and bending.
38-40	Design Problems

Name of Program	B. Tech. in Civil Engineering	**Semester:** 7th	**Year:** 4th
Name of Course	Modern Construction Equipment and Construction Practices		
Course Code	CE24430		
Core / Elective / Other	Elective		

Prerequisites: Nil

Course Outcomes: *Students will be able to*

1.	Select construction equipment appropriate to tasks
2.	Evaluate equipment ownership and operating costs
3.	Estimate and schedule activities using equipment productivity and cost data
4.	Apply contemporary techniques pertaining to construction methods, equipment usage and management

Description of Contents in brief:

1.	Introduction and planning process of equipment utilization
2.	Cost of owning and operating construction equipment
3.	Equipment life and replacement analysis
4.	Engineering Fundamentals of moving earth
5.	Earthmoving and excavating equipment
6.	Piles and Pile Driving Equipment
7.	Concreting Equipment
8.	Methods and Tools for estimating equipment productivity
9.	Modern Construction Methods in Construction Projects

List of Text Books:

1.	Gransberg, D. D., & Rueda Benavides, "Construction equipment management for engineers, estimators, and owners" J. A., CRC Press, 2020, 2nd Edition
2.	Peurifoy, R. L., Schexnayder, C. J., Schmitt, R. L., "Construction planning, equipment, and methods", McGraw-Hill Education, 2018, 9th Edition
3.	F. Harris, "Modern construction equipment and methods", Longman Scientific & Technical, 1989

List of Reference Books:

1.	Sharma S.C., "Construction Equipment and Management", Khanna Publishers New Delhi, 2019, 1st Edition
2.	Schaufelberger, J.E. and Migliaccio, Routledge, "Construction equipment management", 2019, 1st Edition

Lecture Plan:

Lecture No.	Topic
1-2	Introduction to Modern Construction Equipment and Construction Practices
3-4	Factors affecting equipment selection, Planning equipment utilization, Equipment utilization chart
5-7	Equipment Life and Replacement Procedures - Physical, profit and economic life, Replacement analysis
8-9	Equipment Financing Decision - Financing methods, Rental, and lease contract considerations
10-12	Engineering Fundamentals of Moving Earth - Rolling resistance, Effect of grade

	on tractive effort, Effect of altitude on performance of IC engines, Performance chart, ways to define payload of equipment
13-16	Planning for Earthwork Construction: Planning, Graphical Presentation of Earthwork, Earthwork Quantities, Mass Diagram, Pricing Earthwork Operations.
17-20	Compaction and Stabilization Equipment: Compaction of Soil and rock, Types of Compacting Equipment, Dynamic Compaction, Stabilizing soils with Lime, Cement Soil Stabilization
21-23	Bull Dozers, Scrapers, Front Loaders and Excavators – Types, Operation, Performance Charts
24-25	Trucks and Hauling Equipment, Finishing Equipment - Trucks, productivity, Performance Calculations, Graders, Trimmers
26-28	Piles and Pile Driving Equipments – Types of piles and pile hammers
29-30	Concreting Equipment – Types of Concrete mixers machines, Methods of handling and transporting concrete
31-32	Estimating and Optimizing Construction Equipment System Productivity - Peurifoy's method of optimizing productivity, Phelps' Method
33-34	Estimation of Equipment Productivity - Mathematical models, Simulations
35-37	Scheduling Equipment-Intensive Horizontal Construction Projects - Linear scheduling method, Precedence diagramming method, Developing equipment resource packages
38-40	Introduction to Modern Construction Methods in Construction Projects: Choice of choosing MCM, Segmental, Insitu construction of Bridges, Elaborate Case studies (Mechanical Fabrication, Typical Method statements)

Name of Program	B.Tech. in Civil Engineering	**Semester:** 7th	**Year:** 4th
Name of Course	Mega Construction Projects		
Course Code	CE24431		
Core / Elective / Other	Elective		
Prerequisite	Knowledge of Civil Engineering Basic Subjects		

Course Outcomes: students will be able to	
1.	Apply knowledge and skills of modern construction practices and techniques in planning and execution of mega construction projects.
2.	Include innovative ideas in project
3.	Apply theoretical and practical aspects of project management techniques to achieve project goals
4.	Understand and apply safety in construction
5.	Handle mega construction projects at national and international level

Description of Contents in brief:	
1.	Mega Construction Projects: Introduction, meaning, types, need of Mega Construction Projects. Mega Construction Projects in the World and in India. Concepts, Strategies, and Practices for Success of mega projects. Importance of planning
2.	Characteristics of Megaprojects (difficulty, variability, interdependency, complex and novel or easy, routine or special, independent or dependent etc.). Social, cultural, cognitive, and operational complexities of mega projects. The structure, dynamics, and management of megaprojects
3.	Project Estimates and Techno-Economic Feasibility Report, Detailed Project Report (DPR). Mmanagement of construction companies, management of construction projects, and management of construction activities. International Contracting and International Construction Management. Phases and Activity Groups in projects. Engineering Management of mega construction projects. Innovation in Construction of mega projects.
4.	Project clearance procedures and necessary documentation for mega construction projects. Web based project management. Private sector participation in Infrastructure Development Projects. Technology Transfer and Foreign Collaboration.
5.	Safety in construction at various stages of work, legal requirements, safety awareness programs, safety policies, methods, equipment, and training. Safety in various types of projects
6.	Case studies of important mega construction projects in India and abroad

List of Text Books:

1.	Construction Management – Roy, Pilcher
2.	Project Management-Planning and Control---Rory Burkey 4th ed.—Wiley,India.
3.	Construction Management – O'Brien.

4.	Construction Management Fundamentals by Knutson, Schexnayder, Fiori, Mayo, Tata McGraw Hill

List of Reference Books

1.	Christian Brockmann, Advanced Construction Management: The Complexity of Megaprojects, John Wiley & Sons, Ltd. (2021), ISBN:9781119554769
2.	Barrie, D. and Paulson, B. (1992). Professional Construction Management. New York:McGraw-Hill.
3.	Bennett, J. (1991). International Construction Project Management: General Theory and Practice.Oxford: Butterworth-Heinemann
4.	Construction Project Management Theory & practice --- Kumar Neeraj Jha, Pearson,2012

Lecture Plan:

1-2	Mega Construction Projects: Introduction, meaning, types, need of Mega Construction Projects.
3	**Mega Construction Projects from around the World and from India**
4-5	**Mega Construction Projects: Concepts, Strategies, and Practices for Success.**
6-7	Mega Construction Project planning, importance of planning the projects, Work Breakdown Structure (WBS) for a mega project.
8-10	**Characteristics of Megaprojects**
11-12	Social, cultural, cognitive, and operational complexities
13-14	The structure, dynamics, and management of megaprojects
15-17	Project Estimates and Techno-Economic Feasibility Report, Detailed Project Report
18-19	Mega construction project management: management of construction companies, management of construction projects, and management of construction activities.
20	International Contracting and International Construction Management,
21-23	Mega project Phases and Activity Groups: project idea, project development, project design, market contacts, bidding period, contract negotiations, construction, maintenance period, and operation.
24-25	Engineering Management of mega construction projects: design and design management, project management, production planning, site installation, and construction.
26-27	Innovation in Construction of mega projects, time saving and cost reduction, improvement in quality
28-30	Project clearance procedures and necessary documentation for major works like dams, water supply and sanitation schemes, multistoried structures, ports, tunnels. Web based project management.
31-33	Private sector participation in Infrastructure Development Projects - BOT, BOLT, BOOT - Technology Transfer and Foreign Collaboration - Scope of Technology Transfer
34-35	Safety in construction operations – Safety of accidents on various construction sites such as buildings, dams, tunnels, bridges, roads, etc. safety at various stages of construction. Prevention of accidents. Safety measures.
36-37	Safety awareness program. Labor laws, legal requirement, and cost aspects of accidents on site, Incentive for safety practices.
38-39	Safety policies, methods, equipment, and training. Safety in office, on sites of high-rise construction, in deep excavations and in tunneling.
40-42	Case studies of important mega construction projects in India and abroad

Name of Program	BTech in Civil Engineering	**Semester:** 7th	**Year:** 4th
Name of Course	Recent Advances in Civil Engineering		
Course Code	CE24432		
Core / Elective / Other	Elective		
Prerequisites	-Nil-		

Course Outcomes: *Students will be able to*	
1.	Understand the latest development in Construction Engineering
2.	Acquire knowledge on emerging trends of Geotechnical Engineering
3.	Understand the current trends in Hydraulic and Water Resources Engineering
4.	Learn latest practices in Transportation Engineering
5.	Understand recent advances in Environmental Engineering
Description of Contents in brief:	
1.	Introduction to fiber reinforced concrete, self-compacting concrete, concreting in hot and cold weather, self-healing concrete, translucent concrete, and concrete 3D printing; building information modeling; concept of performance based design considering seismic, wind, and fire environments; and use of new materials in construction industry.
2.	Concept of digital soil mapping; introduction to bio-geotechnical engineering; smart and sustainable geosynthetics; and risk management in challenging geological conditions.
3.	Smart and sustainable hydraulics; urban water conservancy and water safety; introduction to ecological and environmental hydraulics; morphodynamics of fluvial and coastal systems; overview of hydro-informatics; water harvesting and groundwater recharge practices; management of coastal aquifers; and monitoring and forecasting of extreme drought and flood.
4.	Artificial intelligence in transportation management systems; introduction to multi-domain and multi-layer traffic engineering; recycling of pavement materials; alternative pavement materials; and innovative technologies for construction, monitoring, and maintenance of pavements.
5.	Water saving technology; ecological sanitation systems; agroforestry; green infrastructure; circular economy; environmental biotechnology; zero energy buildings; and sky water technology.
List of Text/Reference Books:	
1.	Recent advances in Civil Engineering, proceedings of the 2nd international conference on sustainable construction technologies and advancements in Civil Engineering, 2021, edited by P. G. Kumar, K. V. L. Subramaniya, S. M. Santhakumar, and N. Satyam D.
2.	Recent advances in Civil Engineering, proceedings of the international conference on recent advances in Civil Engineering, 2024, edited by J. Thomas and S. Vishnudas.
3.	Recent advances in Civil Engineering, proceedings of international conference on

	Civil Engineering: innovative development in engineering advances, 2024, edited by K. R. Reddy, P. T. Ravichandran, R. Ayothiraman, and A. Joseph.

Lecture Plan:

Lecture No.	Topic
1-4	Introduction to fiber reinforced concrete, self-compacting concrete, concreting in hot and cold weather, self-healing concrete, translucent concrete, and concrete 3D printing
5	Building information modeling
6-7	Concept of performance based design considering seismic, wind, and fire environments
8	Use of new materials in construction industry
9	Concept of digital soil mapping
10-12	Smart and sustainable geosynthetics and introduction to bio-geotechnical engineering
13-14	Risk management in challenging geological conditions
15-16	Smart and sustainable hydraulics, and urban water conservancy and water safety
17-18	Introduction to ecological and environmental hydraulics
19-20	Morphodynamics of fluvial and coastal systems
21	Overview of hydro-informatics
22-23	Water harvesting and groundwater recharge practices, and management of coastal aquifers
24-25	Monitoring and forecasting of extreme drought and flood
26-27	Artificial intelligence in transportation management systems
28-29	Introduction to multi-domain and multi-layer traffic engineering
30-32	Recycling of pavement materials; alternative pavement materials; and innovative technologies for construction, monitoring, and maintenance of pavements
33-34	Water saving technology and ecological sanitation systems
35-36	Agroforestry and green infrastructure
37	Circular economy
38	Environmental biotechnology
39	Zero energy buildings
40	Sky water technology