INSTITUTE OF ENGINEERING AND TECHNOLOGY

Dr. RMLAU, Ayodhya

U.P. 224001

EVALUATION SCHEME & SYLLABUS

FOR

B.TECH (CIVIL ENGINEERING)

SECOND YEAR (2nd Year)

ON

CHOICE BASED CREDIT SYSTEM (CBCS)

Effective from the Session: ~~2022-23~~ 2025-26 onwards

B.Tech (Civil Engineering)
Semester – III

S.No	Course Code	Course Title	Periods			Evaluation Scheme				End Semester	Total	Credit
			L	T	P	CT	TA	Total	PS	ESE		
1	ESE305	Mechanics of Solid	3	1	0	30	20	50		100	150	4
2	HSMS301	Effective Technical Communication	3	0	0	30	20	50		100	150	3
3	CEC301	Building-Materials & Construction	3	0	0	30	20	50		100	150	3
4	CEC302	Surveying	3	1	0	30	20	50		100	150	4
5	CEC303	Fluid Mechanics	3	1	0	30	20	50		100	150	4
6	CEC3L1	Building Material Lab	0	0	2				25	25	50	1
7	CEC3L2	Surveying Lab	0	0	2				25	25	50	1
8	CEC3L3	Fluid Mechanics lab	0	0	2				25	25	50	1
9	DCE-101	Departmental Elective-I	2	0	2	15	10	25		25	NC*	0
		Total									900	21

B.Tech (Civil Engineering)
Semester - IV

Sl. No.	Subjects	Subjects	Periods			Evaluation Scheme				End Semester	Total	Credit
	Code		L	T	P	CT	TA	Total	PS	ESE		
1	BSC401	Mathematics-IV	3	1	0	30	20	50		100	150	4
2	CEC401	Structural Analysis I	3	1	0	30	20	50		100	150	4
3	CEC402	Engineering Geology	3	1	0	30	20	50		100	150	4
4	CEC403	Concrete Technology	3	1	0	30	20	50		100	150	4
5	CEC404	Environmental Engineering - I	3	1	0	30	20	50		100	150	4
7	CEC4L4	Structural Analysis Lab	0	0	2				25	25	50	1
8	CEC4L5	Engineering Geology Lab	0	0	2				25	25	50	1
9	CEC4L6	Concrete Technology Lab	0	0	2				25	25	50	1
10	DCE-101	Departmental Elective-I	2	0	0	15	10	25		25	NC*	
		Total									**900**	**23**

B.Tech (Civil Engineering- II Year)

MECHANICS OF SOLID		
Course Objective: 1. To understand the basic knowledge of structures. 2. Understand the two dimensional static force analyses. 3. To analyze the Pin jointed framed structure. 4. Understand the knowledge of Newton's law and basics of friction.		
Course Outcomes: 1. Use scalar and vector analytical techniques for analyzing forces in statically determinate structures 2. Apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems. 3. Apply basic knowledge of mathematics and physics to solve real-world problems. 4. Understand basic dynamics concepts--force, momentum, work and energy; 5. Understand and be able to apply Newton's laws of motion;		
Unit	**Topics**	**No. of Lectures**
I	**Two-Dimensional Static Force Analysis:** Two-dimensional force systems: Basic concepts, Laws of motion, Principle of transmissibility of forces, transfer of aforce to parallel position, resultant of a force system, simplest resultant of two dimensional concurrent and non-concurrent force systems, distribution of force systems, free body diagrams, equilibrium and equations of equilibrium.	8
II	Beam: Introduction, shear force and bending moment, different equations of equilibrium, shear force and bending moment diagram for statically determined beams. Trusses: Introduction, simple truss and solution of simple truss, methods of F-joint and methods of sections.	8
III	Centroid and moment of inertia: Centroid of plane, curve, area, composite bodies, moment of inertia of plane area, parallel axis theorem, perpendicular axis theorem. Mass moment of inertia of circular ring, disc, cylinder, sphere, and cone about their axis of symmetry.	8
IV	Simple stress and strain: Introduction, normal and shear stresses, stress-strain diagrams for ductile and brittle material, elastic constants, one-dimensional loading of members of varying cross sections, strain energy. Columns and struts: Classification of columns, slenderness ratio. Short columns, combined bending and direct stress, middle third and middle quarter rule.	8

V	Pure bending of beams: Introduction, simple bending theory, stress in beams of different cross sections. Torsion: Introduction, torsion of shafts of circular cross sections, torque and twist, shear stress due to torque	8

Books and References

1. IrvingH.Shames(2006),EngineeringMechanics,4thEdition,PrenticeHall
2. F.P.Beer and E. R. Johnston (2011),Vector Mechanicsfor Engineers, Vol I - Statics,VolII,- Dynamics, 9th Ed, TMH
3. R.C. Hibbler (2006), Engineering Mechanics: Principles ofStatics andDynamics, Pearson Press.
4. Andy Ruinaand Rudra Pratap (2011),Introduction to Statics and Dynamics, Oxford University Press
5. Shanesand Rao(2006),EngineeringMechanics,PearsonEducation,
6. Hibler and Gupta(2010),EngineeringMechanics(Statics,Dynamics)byPearsonEducation
7. ReddyVijaykumar K.andK.SureshKumar(2010),Singer'sEngineering Mechanics
8. BansalR.K.(2010),ATextBookofEngineeringMechanics,LaxmiPublications
9. KhurmiR.S.(2010), Engineering Mechanics,S.Chand&Co.
10. TayalA.K.(2010),EngineeringMechanics, UmeshPublications
11. Strength ofMaterialsbyTimoshenkoandYoungs,East West Press.
12. TextbookofAppliedMechanics-DynamicsandStatics byPrasadI.B,Khanna Publications.

BUILDING MATERIAL & CONSTRUCTION

Course Objectives:

1. To understand the physical and mechanical properties of construction materials and their respective testing procedure.
2. To know the building materials available in market for construction purpose and Modern materials.
3. To learn the principles and methods to be followed in construction of various civil engineering structures.
4. To gain knowledge about doors, windows, plastering, painting, damp proofing, scaffolding, shoring, underpinning and to take suitable engineering measures.

Course Outcomes:

After completion of this course, the student will be able to:

1. Identify the relevant physical and mechanical properties of construction materials.
2. Choose the modern construction material appropriate to the climate and functional aspects of the buildings.
3. Select the construction technique to be followed in brick, stone, masonry, concreting, flooring, roofing, plastering and painting etc.

Unit	Topics	No. of Lectures
I	**Study of common building Materials: Bricks**: Manufacturing process of clay bricks, classification of clay bricks. Properties of clay bricks, testing methods for clay bricks. Problems of efflorescence & lime bursting in bricks. Brick Masonry. **Cement**: Raw materials used, Process of Manufacturing, Chemical composition, compounds formed and their effect on strength, Types of cement, Uses of cement. **Aggregate:** Mineralogy, properties test and standard **Stones:** Requirement of good building stone, characteristics of building stone sand their testing. Common building stones. Methods of preservation of stones.	8
II	**Supplementary Cementing Materials: Pozzolona**: Chemical composition and requirements for uses, Natural and Artificial fly ash, Surkhi, Meta kaolin, Rice husk and ash Pozzolona, properties and specifications for use in construction. **Lime**: Manufacture of lime, classifications of limes, properties of lime. **Gypsum**: properties of gypsum plaster, building products made of gypsum and their uses. **Timber**: Classification and identification of timber, Fundamental Engineering Properties of timber, Defects in timber, Factor affecting strength of timber,	8

	Methods of seasoning and preservation of timber.Wood based products.	
III	**Modern Materials**: Glass, Tiles & Ceramics, Sealants for joints; Sheets for pitched roof coverings; Fiber glass reinforced plastic; Clay products –Refractories; Composite materials –Types, application of laminar composites; Fiber textiles-Mats and pads for earth reinforcement; Polymers and resins for building repair. Glass: Ingredients, properties types and use in construction. Insulating Materials: Thermal and sound insulating material, desirable properties and types.	8
IV	**Buildings:** Components of building, area considerations, Construction Principle and Methods for layout, damp proofing, anitermite treatment in buildings,Vertical circulation means: stair cases and their types, design and construction. Different types of floors, and flooring materials (Ground floor and upper floors). Bricks and stone masonry construction. **Doorsand Windows:** Construction details, types of doors and windows and their relative advantages & disadvantages. Types of roof and roof treatments, Lintel sand Chhajja, Principles of building Planning.	8
V	Natural Ventilation, Water Supply and Sanitary fittings (Plumbing), Electric Fittings. Heating Ventilation & Air conditioning (HVAC), Mechanical Lifts and Escalators, Fire Fighting and Fire Protection of Buildings. Acoustics. Plastering and its types, pointing, Distempering, Color washing, Painting etc. Principles & Methods of building maintenance.	8

Text and References Books:

1. BuildingMaterialsandconstruction–Arora&Bindra, Dhanpat Roy Publications.
2. B. C. Punmia, AshokKumarJain, Arun KumarJain(2005),BuildingConstruction, Laxmi Publications (P) ltd., New Delhi, India.
3. Buildingmaterials,constructionandplanningbyS.MAHABOOBBASHA
4. Buildingmaterialsby Duggal,Newage Internations.
5. BuildingconstructionbyPCverghesePHI.
6. Constructiontechnology–vol-1&2 byR.chuddy, LongmanUK.
7. BasicsofcivilEnggbySubhashchander;Jainbrothers.

NPTEL Lectures Links:

- https://nptel.ac.in/courses/105102088/
- http://www.nptelvideos.in/2012/11/building-materials-and-construction.html

B.Tech (Civil Engineering- II Year)

SURVEYING

Course Objectives-

1. To underst and the basic principles of surveying and different methods of Surveying
2. To learn about Tacheometry, geodetic surveying and GPS surveying.
3. To know the types of errors encountered in different types of surveying.
4. Analyze the obtained spatial data to compute areas and volumes and draw contours to represent 3D data on plane figures

Course Outcome-After completion of this course,the student will be able to:

1. Describe the function of surveying and work with survey instruments, take observations, and prepareplan, profile, and cross-section and performcalculations. Calculate, design and layout horizontal and vertical curves.
2. Operate a total station and GPS to measure distance, angles, and to calculate differences in elevation. Reduce data for application in a geographic information system.
3. Relate and apply principles of photogrammetry and GPS GIS for surveying

Unit	Topics	No. of Lectures
I	**Surveying:** definition, divisions, classification and principles of surveying.**Scales:** plain, vernier, diagonal, planandmap. Linearmeasurement: chainand tape surveying, types of chain and tape, ranging, obstacles and tape correction. **Accuracyanderrors:** definitions, sourcesandkinds of errors,application of probability for computation of errors, laws of weights.	8
II	**Compass surveying**: Measurement of directions, Reference meridians, bearing and azimuths, local attraction. **Leveling:** Methods of determining elevations, Direct leveling- basic terms and definitions, principle, booking and reduction of field notes, curvature andrefraction correction, use of Automatic level, Digital Level, Vertical Control. **Trigonometric leveling:** Accessible and inaccessible objects.	8
III	**Theodolitesurvey:** Vernier theodolite, Measurementsof horizontal and vertical angles, Horizontal Control, working of Electronic Theodolites. **Traversing and triangulation:** Principles of traversing bycompass and theodolite, computations of traverse coordinates, omitted measurements **Contouring:** Contours, contour interval, horizontalequivalent, characteristics, Methods and interpolation, use to prepare profiles.	8
IV	Tachometry: Principles of stadia systems, subtense bar and tangential methods. Elements of simple circular curves, theory and methods of setting out simple circularcurves, transitioncurves-type sand their characteristics,ideal transition curve, equations of various transition curves, Introduction to vertical curves. Principles and classification of triangulation systems, strength of figures, satellite stations, and triangulation field work. Introduction to modern surveying Instruments /Techniques like total station.	8

V	Photogrammetric Survey: basic principles, aerial camera, scale of a vertical photograph, relief displacement of a vertical photograph, height of object from relief displacement, flight planning for aerial photography, selection of altitude, interval between exposures, crab and drift, stereoscope and stereoscopic views, parallax equations.	8

References:

1. Schofield,"EngineeringSurveying"6/e,CRCPressTaylor &FrancisGroup.
2. BCPunamia et al:SurveyingVol.I,II,LaxmiPublication
3. Bannister,"Surveying"7/e,Pearson Education,Noida.
4. AMChandra:Plane Surveying,HigherSurveying,NarosaPub.
5. AKDeyPlainSurvey,SChand
6. SKDuggal: SurveyingVol.I,II.
7. Chandra, A.M., Higher Surveying, Third Edition, New Age International (P) Limited,2002.

NPTEL Lecture Link:

- https://nptel.ac.in/courses/105107121/
- https://nptel.ac.in/courses/105107121/2
- https://nptel.ac.in/courses/105107157/

FLUID MECHANICS

Course Objective

1. To familiarize with the properties of fluids and the applications of fluid mechanics.
2. To formulate and analyze problemsrelated to calculation of forces in fluid structure interaction.
3. To understand the concept of fluid measurement.
4. Types of flows and dimensional analysis.
5. To develop the idea what will happen when fluid and solid body interact with each other.

Course Outcomes:

Attheend of this course the student will be able to-

1. Underst and the broad principles of fluid statics,kinematics and dynamics
2. Understand definitions of the basic terms used in fluid mechanics
3. Understand classifications of fluid flow
4. Apply the continuity,momentum and energy principles
5. Apply dimensional analysis

Unit	Topics	No. of Lectures
I	Fluid and continuum, Physical properties of fluids, Rheology of fluids. Pressure-density height relationship, manometers, pressure on plane and curved surfaces, centre of pressure, buoyancy, stability of immersed and floating bodies, fluid masses subjected to linear acceleration and uniform rotation about an axis.	8
II	Types of fluid flows: Continuum & free molecular flows. Steady and unsteady, uniform and non-uniform, laminar and turbulent flows, rotational and irrotational flows, compressible and incompressible flows, subsonic, sonic and supersonic flows, sub- critical, critical and supercritical flows, one, twoandthreedimensional flows, streamlines, path lines, streak lines, stream tube, continuity equation for 1-D, 2-D and 3-D flows, circulation, stream function, velocity potential function, potential flow: source, sink, doublet and half-body.	8
III	Equation of motion along a streamline and its integration,Bernoulli'sequation and its applications- Pitot tube, orifice meter, venturimeter and bendmeter, notches and weirs, momentum equation and its application to pipe bends. resistance to flow, Minor losses in pipe in series and parallel, power transmission through a pipe, siphon, water hammer, three reservoir problems andpipenetworks.	8
IV	Equation of motion for laminar flow through pipes, Stokes' law, mixing length concept and velocity distribution in turbulent flow over smooth andrough surfaces,Boundary layer thickness,boundary layer overaflatplate, displacement, momentum and energy thickness. Application of momentum equation.Laminar boundary layer,turbulent boundarylayer,laminarsub-layer,	8

	separationanditscontrol.VortexFlow: Free & Forced.	
V	Drag and lift, drag on a sphere, aerofoil, Magnus effect, Similarity Laws; geometric, kinematics and dynamic similarity, undistorted and distorted model studies, Dimensional analysis, Buckingham's Pitheorem,important dimensionless numbers and their significance.	8

References:

Books and References

1. Hibbler,"FluidMechanicsinSIUnits"1/ePearsonEducation,Noida.
2. Fox&Donald,"Introduction toFluidMechanics"JohnWiley&SonsPvtLtd,
3. Cengel&Cimbala,"FluidMechanics"TMH,NewDelhi.
4. Katz,"Introductory FluidMechanics"CambridgeUniversityPress
5. Pnueli&Gutfinger,"FluidMechanics"CambridgeUniversity Press
6. Modi&Seth"Hydraulics&FluidMechanics"StandardPublications.
7. Gupta,"Fluid Mechanics& HydraulicMachines"PearsonEducation,Noida
8. Graebel,"EngineeringFluid Mechanics",CRCPressTaylor&FrancisGroup.
9. Janna,"IntroductiontoFluidMechanics"4/e, CRCPressTaylor&FrancisGroup

B.Tech (Civil Engineering- II Year)

BUILDING MATERIAL & CONSTRUCTION LAB

List of Experiments

1. Tension test on mild steel and HYSD bars
2. Compressiontest onmildsteel, cast iron and wood.
3. Torsion test on mildsteel circular sections.
4. Bending Test onWood Under two point loading
5. Shear Test on Mild steel-singleand double shear
6. Tests on Fine aggregates – Moisture content, Specific gravity, Bulk density, Sieve analysis and Bulking
7. Tests on Coarse aggregates – Absorption, Moisture content, specific gravity, Bulk density and Sieve analysis.
8. Hardness tests on ferrous and non-ferrous metals–Brinell's, Rockwell and Vicker's

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SURVEYING LAB
Experiments
1. To prepare conventional symbol chart based on the study of different types of to pographical maps. 2. To measure bearings of a closed traverse by prismatic compass and to adjust the traverse by graphical method. 3. To find out reduced levels of given points using Auto/dumpylevel. 4. To perform fly leveling with Auto/tilting level. 5. To study parts of aVernier theodolite and measurement of horizontal and vertical angle. 6. To measure horizontal angle between two objects by repetition/reiteration method. 7. To determine the height of a vertical structure (e.g.chimney/ watertank etc.) using trigonometrical leveling by taking observations in single vertical plane. 8. To study various parts of Total Station and practice for measurement of distance, horizontal and vertical angles. 9. To set out a simple circular curve by Rankine'smethod. 10. To plot contour map of given area.

FLUID MECHANICS LAB

Note: Ensureto conductatleast 08 experiments from the list:

Experiments

1. To verify themomentumequation usingtheexperimentalset-uponimpactofjet.
2. Todeterminethecoefficientof dischargeof anorificeof agivenshape.Alsoto determine the coefficient of velocity and the coefficient of contractionoftheorifice mouth piece.
3. To calibrate an orifice meter and study the variation of the co-efficient of discharge with the Reynolds number.
4. To calibrate a Venturimeter and study the variation of the co-efficient ofdischargewith the Reynolds number.
5. To calibrate a bend meter and study the variation of the co-efficient of discharge with the Reynolds number.
6. To draw aflow-netusingElectricalAnalogyMethod.
7. To study the transition from laminar to turbulent flow and to determine the lower critical Reynolds number.
8. To study the velocity distribution in a pipe and also to compute the discharge by integrating the velocity profile.
9. Tostudythe variationoffriction factor,'f'forturbulentflowincommercial pipes.
10. To studythe boundary layer velocityprofile over a flat plate and to determine the boundary layer thickness.
11. TodetermineMeta-centric heightofagivenshipmodel.
12. To determinctheheadlossforasuddenenlargement
13. Todeterminetheheadlossforasuddencontraction

B.Tech (Civil Engineering- II Year)

MATHEMATICS IV		
Unit	**Topics**	**No. of Lectures**
I	**Partial Differential Equations** Origin of Partial Differential Equations, Linear and Non Linear Partial Equations of first order, Lagrange's Equations, Charpi t's method, Cauchy's method of Characteristics, Solution of Linear Partial Differential Equation of Higher order with constant coefficients, Equations reducible to linear partial differential equations with constant coefficients.	8
II	**Applications of Partial Differential Equations:** Classification of linear partial differential equation of second order, Method of separation of variables, Solution of wave and heat conduction equation up to two dimension, Laplace equation in two dimensions, Equations of Transmission lines.	8
III	**Statistical TechniquesI:** Introduction: Measures of central tendency, Moments, Moment generating function (MGF) , Skewness, Kurtosis, Curve Fitting , Method of least squares, Fitting of straight lines, Fitting of second degree parabola, Exponential curves ,Correlation and Rank correlation,Regression Analysis: Regressionlinesof y onx and x on y,regression coefficients,properties of regressionscoefficients and non linear regression.	8
IV	**Statistical TechniquesII:** Durability of concrete: Permeability of concrete - Shrinkage-plastic shrinkage - drying shrinkage - Chemical attack - Sulphate attack of concrete structures - chlorideattack,Alkaliaggregatereaction.,carbonation,freezingandthawing. Corrosion Curing and Methods of curing. Testing of hardened concrete, Creep– factors affecting creep.	8
V	**StatisticalTechniques III:** Sampling,Testing of Hypothesis and Statistical Quality Control:Introduction, Sampling Theory (SmallandLarge),Hypothesis, Null hypothesis, Alternative hypothesis,TestingaHypothesis,Level of significance,Confidencelimits,Test of significance of difference of means,T-test, F-test and Chi-square test,One way Analysis of Variance (ANOVA).Statistical Quality Control (SQC) , Control Charts , Control Charts for variables (Xand R Charts), Control Charts for Variables (p, np and C charts).	8

TextBooks:

1. ErwinKreyszig,Advanced Engineering Mathematics,9th Edition,John Wiley& Sons,2006.
2. P.G.Hoel, S.C.PortandC.J.Stone,Introduction to Probability Theory,UniversalBook Stall, 2003(Reprint).
3. S.Ross:A First Coursein Probability,6th Ed.,PearsonEducationIndia,2002.
4. W. Feller, An Introduction to ProbabilityTheoryand its Applications, Vol. 1, 3rd Ed., Wiley, 1968.

ReferenceBooks

1. B.S.Grewal,Higher Engineering Mathematics,Khanna Publishers,35th Edition,2000.
2. T.Veerarajan:Engineering Mathematics (forsemesterIII),Tata McGraw-Hill,New

STRUCTURAL ANALYSIS - I

Course Objective

1. To know the development of internal forces and resistance mechanism for one dimensional and two dimensional structural elements.
2. To analyze and understand different internal forces and stresses induced due to representative loads on structural elements.
3. To analyze and understand principal stresses due to the combination of two dimensional stresses on an element and failure mechanisms in materials.
4. To evaluate the behavior of torsion members,columns and struts

Course Outcomes:

1. To evaluate the strength of various structural elements internal forces such as compression, tension, shear, bending and torsion.
2. To suggest suitable material from among the available in the field of construction and manufacturing.
3. To evaluate the behavior and strength of structural elements under the action of compound stresses and thus understand failure concepts.
4. To understand the basic concept of analysis and design of members subjected to torsion and bending, shear stress.

Unit	Topics	No. of Lectures
I	Introduction, Classification of Structures, Forms of structure, Loads & Forces Equation of static equilibrium, Internal Forces, Idealization of structure, Supports & connections, Free Body Diagram, Principle of superposition, Degree of static indeterminacy, Degree of Kinematic Indeterminacy, Stability, Settlement of supports.	8
II	**Displacements:** Slope and deflection of determinate beam by- Moment area method, Conjugate beam method, Slope and deflection of beams & frames by- strain Energy Method, Unit Load Method.	8
III	**Arch Structure:** Analysis of three hinged parabolic, segmental and Semi circular, Arches. Three hinged parabolic arches with supports at the same and different levels. Determination of normal thrust, radial shear and bending moment. ,Moving load &influence lines for three hinged parabolic Arch .	8
IV	**Influence Line Diagrams:** Rolling loads and influence line diagrams for determinate beams, Absolute maximum bending moment and shear force. Muller-Breslau's principal & its applications for determinate structures.	8
V	**Analysis of cables:** Introduction, Analysis of cables Structures with concentrated and continuous loadings, Effect of Temperature upon length of cable. **Stiffening girders:** Analysis of three hinged stiffening girders.	8

ENGINEERING GEOLOGY

Course Objectives: The course aim to develop the learner's abilityto understand application of the geological sciences to engineering projects i.e., geological factors regarding the location, design, construction, operation and maintenance of engineering works

Course Outcomes:

Aftercompletingthecourse,student:

1. Will learn origin of solar system and understand internal structure of Earth
2. Will understand interpretation stress-strain imprinted in earth, Interpretation of deformed structure and its application in civil engineering
3. Will learn the minerals, Rocks and it types,the crystal formation, formand occurrences and its application in civil engineering
4. Will learn the engineering propertiesof the rocks and soils
5. Will understand the construction of dam,tunnel and safety of roads in hilly regions

Unit	Topics	No.of Lectures
I	Origin of Earth, Age of Earth, Internal Structureand composition of Earth, Geological work of natural agencies and engineering considerations.	06
II	Introduction to structural geology; Primary and secondary structures; Fold and folding, Fault and faulting; Joint and jointing; Engineering considerations.	18
III	Studyof minerals and rocks;Its engineering importance. Laws of crystallography; Crystal morphology; Crystallographic axes; Elements of symmetry; Crystallographic notations; Crystal system Definition of mineral;Physical properties of minerals Brief introduction to rocks belonging to igneous, sedimentary and metamorphic	12
IV	Engineering properties of the rocks and soils; Soil and Soil groups of India	12
V	Geological consideration for geo-engineered structures;Damsand reservoir; Tunnels and Road cuts;Improvement of sites	12

Suggested Readings:

1. L.D. Leet, S. Judson and M.E. Kauffman, (1982): Physical Geology. Prentice-Hall Inc. 629p.
2. Ghosh,S.K., 1993.StructuralGeology:Fundamentals,andmodernDevelopments, PergamonPress.
3. Berry, L.G., Mason, B. and Dietrich, R.V. (1985): Mineralogy: Concepts, Descriptions, and determinations. C.B.S. publishers.
4. Nesse, William D. (2012): Introduction to mineralogy (2nd Edition). Oxford University Press.
5. Phillips,F.C(1971):Introductionto Crystallography.LongmanGroupPublication.
6. Sands, Donald E. (1975): Introduction to crystallography.Dover Publications, Inc. New York.
7. Krynine D.P. and Judd W.R., 1957. Principles ofEngineering Geology & Geotechnics. McGraw-Hill.
8. Winter,J.D.2001. Igneous and MetamorphicPetrology.PrenticeHall.
9. Pettijohn,F.J.(1975):SedimentaryRocks(3rdEdition).Harper andRowPublisher.

Text & Reference Books:

1. Basic Structural Analysis by C.S Reddy,McGraw Hill Publication.
2. Indeterminate structural Analysis,C.K.Wang,McGraw Hill Publication.
3. StructuralAnalysis-I,S S Bhavikatti, Vikas Publishing House Pvt Ltd.
4. Structural Analysis: A Matrix Approach,McGraw Hill Publication

E LearningLink:

1.https://nptel.ac.in/courses/105/105/105105166/

CONCRETE TECHNOLOGY

Course Objective

To get the knowledge on quality of concrete, Proportion ingredients of Concrete to arrive at most desirable mechanical properties of Concrete durability aspects, causes of deterioration, and repairing of concrete structures.

Course Outcomes:

1. Relate material characteristics and their influence on microstructure of concrete.
2. Distinguish concrete behavior based on its fresh and hardened properties.
3. Illustrate proportioning of different types of concrete mixes for required fresh and hardened properties using professional codes

Unit	Topics	No. of Lectures
I	**Cement:** Manufacture, basic properties of cement compounds, types and cement chemistry ,Hydration of cement Aggregates: mineralogy, properties, test and standards. Workability :Factors affecting workability and its Measurement.	8
II	**Study of SCM's :** like fly ash, silica fume , ground granulated blast furnace slag, metakaoline and Pozzolana . Admixtures - process of various stages of concrete, study of accelerators, retarders, water reducers, air entrainers , water proofers, super plasticizers. Factors influencing strength, W/C ratio, gel/space ratio,Maturity concept.	8
III	**Mixdesign:**Principleof mix proportioning,propertiesrelatedtomix design, Mix design method (IS method and ACI method). Mix designofconcrete: packing density, Rheology, mix design examples.	8
IV	**Durability of concrete:** Permeability of concrete - Shrinkage-plastic shrinkage - drying shrinkage - Chemical attack - Sulphate attack of concrete structures - chloride attack, Alkali aggregate reaction., carbonation, freezing and thawing. Corrosion Curing and Methods of curing. Testing of hardened concrete, Creep– factors affecting creep	8
V	**Special concrete properties and their application :** Studyand uses of high strength concrete, High performance concrete - high strength concrete, high density concrete - light weight concrete - Fibre reinforced concrete - self-compacting concrete - Polymer concrete	8

Text Books:

1. NevilleA.M."Properties of Concrete"-4thEd.,Long man.
2. M.S. Shetty, Concrete Technology - Theory and Practice Published by S. Chand and Company, New Delhi.
3. Kumar Mehta.Pand Paulo J.M. Monteiro"Concrete-Microstructure,Property and

Materials",4th Edition,Mc Graw Hill Education,2014
4. A.R. Santha Kumar,"Concrete Technology", Oxford University Press,New Delhi (New Edition)

Reference Books:

1. MLGambir, "Concrete Technology",Mc Graw HillEducation,2014.
2. N. V.Nayak,A.K. Jain Hand book on Advanced Concrete Technology,
3. JobThomas, "Concrete Technology",CENGAGE Learning, 2015
4. IS4926 (2003):Code of Practice Ready-Mixed Concrete.
5. IS10262 (2002):code of Practice Concrete Mix Design.
6. Criteria for RMC Production Control, Basic Level Certification for Production Control of Ready Mixed Concrete-BMTPC
7. Specification and Guidelines for Self-Compacting Concrete,EFNARC,Association House

NPTEL Lecture Links:

- https://nptel.ac.in/courses/105102012/
- https://nptel.ac.in/courses/105106176/

B.Tech (Civil Engineering- II Year)

ENVIRONMENTAL ENGINEERING -I

Course Objective

1. To understand the physical, chemical & biological properties ofwater
2. To understand the population forecasting techniques.
3. To understand the layout of treatment plant and methods involved to treat the rawwater.
4. To understand the distribution system, pipe joints & valves.

Course Outcomes:

1. Students are able to identify the basic properties of rawwater.
2. Students are able to treat raw water.
3. Students are able to design filteration tank.
4. Studentsare able to understand the layout of treatment plant & basic functioning of units.

Unit	Topics	No. of Lectures
I	Importance and necessity of water supply engineering, Sources of water,Suitability of water, Choice of source, Types of demand, Population forecast, Computation of quantity of water, Fluctuation in demand, Factors affecting demand, Impurities in water, Collection of water sample.	8
II	Types of pipes used for conveyance, Pipe joints, Laying of pipes, Distribution system, Types of valves, Types of meters, Pipe fittings and fixtures, Necessity, Methods to prevent leaks, Measures for conservation of water	8
III	Characteristics of water: Physical, chemical and biological standards. Theory, Operation and design of aeration system, sedimentation, coagulation, and flocculation. Design of each units. Characteristics of water: Physical, chemical and biological standards.	8
IV	Objectives of water treatment, Location of water treatment plant, Layout of water treatment plant, Basic principles of working of treatment plant, Various stages of treatment of influent water; Sedimentation, Functioning of Coagulation treatment plant, Filtration, Disinfection	8
V	Filtration: Slow and rapid gravity filter, multi-media filters and pressure filters. Design of slow sand filter and rapid sand filter. Disinfection: theory and application of chlorine. Miscellaneous methods of water treatment-removal of iron and manganese, hardness, fluorides, colour, taste and odour, dissolved metals and gases	8

Text and Refrence Books:

Peavy, Howard S., Rowe, DonaldR and Tchobanoglous, George, "Environmental Engineering" McGraw Hill Education (India) Pvt. Ltd., New Delhi. Garg,SK: Water SupplyEngineering (Environmental Engineering Vol.–I).

Garg, SK: Water Supply Engineering (EnvironmentalEngineering Vol.–I).

Metcalf & Eddy,"WastewaterEngineering:Treatment&Reuse",Tata Mc-GrawHill.

E-Learning Links:

- https://nptel.ac.in/courses/105/105/105105201/

B.Tech (Civil Engineering- II Year)

Structural Analysis Lab
Experiments
1. To determine Flexural Rigidity (EI) of a given beam 2. To verify Maxwell'sReciprocal theorem. 3. To find horizontal thrust in a three-hinged arch and to draw influence line diagrams for Horizontal Thrust end Bending moment. 4. To find horizontal thrust in a two hinged arch and to draw influence line diagrams for horizontal Thrust and bending moment. 5. To find deflection of curved members. 6. To find bar forces in a three members structural frames with pin jointed bar 7. To find Critical load in Struts with different end conditions. 8. To find deflections in Beam having unsymmetrical bending

B.Tech (Civil Engineering- II Year)

Engineering Geology Lab
Experiments
1. Study of physical properties and identification of minerals referred under theory 2. Megascopic and microscopic description and identification of rocks referred under theory 3. Megascopic and microscopic identification of rocks and minerals 4. Interpretation and drawing of sections for geological maps showing tilted beds, faults, uniformities etc., 5. Simple structural geology problems

B.Tech (Civil Engineering- II Year)

CONCRETE TECHNOLOGY LAB

Experiments

1. Testing of cement: Consistency, fineness, setting time, Specific Gravity, Soundness and strength.
2. Testingof fine aggregate: Specific Gravity, sieve analysis and zoning, bulkingof fine aggregate, bulk density, silt content.
3. Testing of coarse aggregate: Specific Gravity, sieve analysis, bulk density, flakiness index, elongation index, water absorption & moisture content, soundness of aggregate.
4. Concrete Mix design by ACI211.1-91 method, IS code method as per 10262-2007 & 456-2000, DOE method
5. Tests on Concrete- Workability tests – Slump cone test, compaction factor test, Vee-bee consistometer test, flow table test, strength tests- compressive strength, flexural strength, split tensile strength.
6. Effects ofAdmixture- Accelerator, Retarder, Super Plasticizer.
7. Non destructive Testing-Rebound Hammer test, Ultrasonic Pulse Velocity test.

INSTITUTE OF ENGINEERING AND TECHNOLOGY

Dr. RMLAU, Ayodhya

U.P. 224001

EVALUATION SCHEME & SYLLABUS

FOR

B.TECH (CIVIL ENGINEERING)

THIRD YEAR (3rd Year)

ON

CHOICE BASED CREDIT SYSTEM (CBCS)

Effective from the Session: 2026-27 onwards

B.Tech. (Civil Engineering)- III Year

Semester V

S.No	Course Code	Course Title	Periods			Evaluation Scheme				Subject Total	Credit
			L	T	P	Sessional Exam			ESE		
						CT	TA	Total			
1	HSMC501	Engineering Managerial Economics	3	0	0	30	20	50	100	150	3
2	CEC501	Geotechnical Engineering	3	1	0	30	20	50	100	150	4
3	CEC502	Design of Concrete Structures-I	3	1	0	30	20	50	100	150	4
4	CEC503	Structural Analysis-II	3	1	0	30	20	50	100	150	4
5	CEC504	Environmental Engineering - II	3	1	0	30	20	50	100	150	4
Practical/Design/Drawing											
7	CEC5L1	Geotechnical Engineering Lab	0	0	2			25	25	50	1
8	CEC5L2	Environmental Engineering Lab	0	0	2			25	25	50	1
9	CEC5L3	Computer Aided Design Lab-I	0	0	2			25	25	50	1
		Total								**900**	**22**

B.Tech. (Civil Engineering)- III Year

Semester VI

S.No	Course Code	Course Title	Periods			Evaluation Scheme				Subject Total	Credit
			L	T	P	Sessional Exam			ESE		
						CT	TA	Total			
1	CEC601	Design of Steel Structures	3	1	0	20	30	50	100	150	4
3	CEC602	Design of Concrete Structures-II	3	1	0	20	30	50	100	150	4
4	CEC-603	Transportation Engineering	3	1	0	20	30	50	100	150	4
6	CEC-604	Geotechnical Engineering -II	3	1	0	20	30	50	100	150	4
7	CEC-605	Open Channel Flow	3	1	0	20	30	50	100	150	4
Practical/Design/Drawing											
9	CEC6L1	Transportation Engineering Lab	0	0	2			25	25	50	1
10	CEC6L2	Computer Aided Design Lab-II	0	0	2			25	25	50	1
11	CEC6L3	Desing and Thinking Lab	0	0	2			50		50	1
		Total								**900**	**23**

GEOTECHNICAL ENGINEERING

Course Objectives:

The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course.

1. Analyze the soil for engineering parameters.
2. Calculate andanalyze the stressonsoilandbeabletodrawthestresspath.
3. Analyze the effect off low of fluids through soil.
4. Understand various bearing capacity determination techniques.

Course Outcomes:

1. To learn the basic engineering properties of soil.
2. To know the application of soil hydraulics.
3. To understand the stresses induced in soil.
4. To learn the effect tof long term loading in soil.
5. Design the footing rest on soi lmedium.

Module	Topics	No. of Lectures
I	Origin and classification: Preview of Geotechnical field problems in Civil Engineering, Soil formation, transport and deposit, Soil composition; Basic definitions,Weight volume relationships, Clay minerals, Soil structure, Index properties, sensitivity and thixotropy, Particle size analysis, Unified and Indian standard soil classification system.	[8]
II	Soil Hydraulics: Stress conditions in soil- total, effective and neutral stresses and relationships. Permeability - Darcy's Law, hydraulic conductivity, equivalent hydraulic conductivity in stratified soil. Seepage, flow nets, seepage calculation from a flow net, flow nets in anisotropicsoils, seepage through earth dam, capillarity, critical hydraulic gradient and quick sand condition,uplift pressure, piping;	[6]
III	Soil compaction, water content-dry unit weight relationships. Factors controlling compaction. Field compaction equipment; field compaction control; Proctor needle method. Consolidation: Primary and secondary consolidation, Terzaghi's one dimensional theory of consolidation, Consolidation test, Normal and Over Consolidated soils, determination of coefficient of consolidation	[8]
IV	Shear Strength: Mohr-Coulomb failure criterion, shear strength parameters and determination;direct and tri-axial shear test; unconfined compressiontest;porepressure, Skempton's pore pressure coefficients.	[6]
V	Earth pressure: Classical theories, Coulomb and Rankine'sapproachesforfrictionaland c-φ soils, inclined backfill, Graphicalmethodsof earth pressure determination, Stability of slopes, Culman method & Method of slices, Stability number & chart.	[5]

SuggestedReadings:

Text&ReferenceBooks:

1. V.N.S.Murthy–SoilMechanicsandFoundationEngineering(FifthEdition)
2. K.R.Arora– SoilMechanicsandFoundationEngineering
3. NarasingaRao,B.N.D,"SoilMechanics&FoundationEngineering",JohnWiley&Sons.
4. AlamSingh–ModernGeotechnicalEngineering
5. B.C.Punmia–SoilMechanicsandFoundation,LaxmiPublication

E Learning links:

1. E-LearningLinkhttps://nptel.ac.in/courses/105/105/105105168/

DESIGN OF CONCRETE STRUCTURES-I

Course Objectives:

The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course.

1. Understand the stress Strain behavior of concrete and reinforced concrete.
2. Design various structural members as per LSM theory.
3. To understand flexural/shear behaviour of beam,column and slab
4. To analyze the behavior of axial loaded structure.
5. To analyze the members for serviceability.

CourseOutcomes:

1. To calculate the basic material properties.
2. To learn the theories of design philosophies
3. To know the beam and slab design.
4. To design the axially loaded members.
5. To apply the serviceability check in various structure.

Module	Topics	No. of Lectures
I	Introduction to various Design Philosophies and assumptions in Limit State Design, Partial Safety factors, Characteristic load and strength. Stress block parameters, concept of balanced section, under reinforced and over reinforced section. Method of Rectangular Singly and Doubly ReinforcedSections. Design of Rectangular Singly And Doubly Reinforced beams,T-beams,Lbeams byLimit State Design Method.	[8]
II	Behaviour of RC beam in Shear, Shear Strength of beams with and without shear reinforcement, minimum and maximum shear reinforcement, design of beamin shear. Introduction to development length Anchorage bond, flexural bond. Failure of beam under shear, Concept of Equivalent Shear and Moments.	[8]
III	Design of one way,One way continuous and cantilever solid slabs by Limit State Design Method, Design of RCC staircases.Design of two way slabs by limitstate method, Serviceability Limit States, Control of deflection, cracking and vibrations.	[10]
IV	Design of Columns by Limit State Design Method- Effective height of columns, Assumptions, Minimum eccentricity, Short column under axial compression, requirements for reinforcement, Column with helical reinforcement, Short column under axial loadanduni-axial bending, Design of columns under bi-axial loading by Design Charts.	[8]
V	Structural behavior of footings, Design of isolated footings,combined rectangular and trapezoidal footings by Limit State Method, Design of strap footings.	[8]

Text&ReferenceBooks:

1. Reinforced Concrete Design by S.U. Pillai & D.Menon,T.M.H.,Publication
2. Reinforced Concrete-Limit State Design by A.K.Jain,Nem Chand &Bros.,Roorkee.
3. Reinforced Concrete Vol. –II by H.J Shah,Charotar Publisher,Gujarat.
4. RCC Designs (Reinforced Concrete Structures) by B.C .Punmia, Ashoka Kumar Jain and Arun Kumar Jain, Laxmi Publishers, New Delhi.
5. Reinforced Concrete Structures by R. Parkand Pauley.
6. Bureau of Indian Standard IS 456-2000

E Learning links:

1.https://nptel.ac.in/courses/105/105/105105105/

STRUCTURAL ANALYSIS-II

Course Objectives:

The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course.

1. To understand the concept of static and kinematic indeterminacy
2. To learn various method of analyzing in determinate structures
3. To draw influence lines for indeterminate structure
4. To understand the concept of Plastic Analysis
5. To apply the concept of FEM.

Course Outcomes:

1. To learn the degree of freedom in structures.
2. To know the analysis of indeterminate structure
3. To draw the ILD of various structure
4. To learn plastic hinge application
5. Analyze the structure using FEM techniques.

Module	Topics	No. of Lectures
I	Analysis of fixed beams, Continuous beams and simple frames with and without Translation of joint, method of Consistent Deformation, Slope Deflection method, Moment Distribution method.	[8]
II	Analysis of two hinged arches; parabolic, semicircular and segmental arches. Analysis of two hinged arches supported at same & different level	[8]
III	Muller-Breslau's Principle and its applications for drawing influence lines for indeterminate beams, Influence line diagrams for arches; horizontal thrust, Bending Moment, radial shear and normal thrust	[8]
IV	Analysis of Indeterminate beam & Frames By of Force and Displacement Matrix methods.	[8]
V	Basics of Plastic Analysis; Introduction, Applications of Static and Kinematic theorem for Plastic Analysis of Beams and Frames.	[8]

Suggested Readings:

Text & Reference Books:

1. Jain,A.K.,Advanced Structural Analysis,NemChand &Bros.,Roorkee.
2. Hibbeler,R.C.Structural Analysis",PearsonPrenticeHall,Sector62,Noida-201309
3. C.S.Reddy"StructuralAnalysis",TataMcGrawHillPublishingCompany Limited,
4. Wang,C.K."IntermediateStructural Analysis",TMHBookPublishingCompany
5. ThandavaMoorthy,T.S.,"StructuralAnalysis"OxfordUniversityPress,NewDelhi

ELearninglinks:

1. https://nptel.ac.in/courses/105/105/105105109/
2. https://nptel.ac.in/courses/105/106/105106050/

ENVIRONMENTAL ENGINEERING - II

Course Objectives:

The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course.

1. Understand various type of waste water
2. Design of wastewater treatment plants
3. Various technique of designing treatment plant

Course Outcomes:

1. To learn the types and parameters of waste water.
2. To know the physiochemical properties of waste.
3. To lean the treatment process of various units.
4. To learn the secondary treatment process.

Module	Topics	No. of Lectures
I	Introduction: Wastewater flow and its characteristics, Wastewater collection systems, Estimation and variation of wastewater flows. Problems of industrial wastewaters,	[8]
II	Sampling, Preliminary, primary, secondary and tertiary wastewatertreatmentprocesses. Theory and design of screens, grit chambers, sedimentation, coagulation, flocculation.	[8]
III	Physico-chemical and biological treatment strategies and their evaluation, Theory of activated sludge process(ASP), extended aeration systems, trickling filters (TF), Aerated lagoons, stabilization ponds, oxidation ditches, sequential batch reactor, rotating biological contactor, etc., Mass balancing in ASP and TF and their design.	[8]
IV	Anaerobic treatment process, Effects of pH, temperature and other parameters on anaerobic treatment, Concept of anaerobic contact process, anaerobic filter, anaerobic fixed film reactor, fluidized bed and expanded bed reactors and upflow anaerobic sludge blanket (UASB) reactor.	[8]
V	Indian standards for disposal of treated wastewaters on land and in natural streams, Agricultural irrigation, Ground water recharge, Treated wastewater reclamationand reuse. Recent technologies of treatment.	[8]

Suggested Readings:

Text & Reference Books:

1. Peavy, Howard S., Rowe, Donald R, George, "Environmental Engineering"McGraw Hill Education.
2. Nathanson, Schneider,"BasicEnvironmentalTechnologyPollutionPearsonEducation.
3. Metcalf & Eddy,"Wastewater Engineering: Treatment & Reuse",TataMc-Graw Hill
4. Garg, S.K"Environmental EngineeringVol.II (Sewage Disposal and Air Pollution Engineering)"
5. Rao, M.N. & Dutta, A.K."Wastewater Treatment", Oxford & IBH Publishing.

ELearninglinks:

1. https://nptel.ac.in/courses/105/105/105105178/
2. https://nptel.ac.in/courses/105/106/105106119/

GEOTECHNICAL ENGINEERING LAB

NOTE: Student will have to perform many 8 out of the listed experiments below:

List of Experiments

1. Determinationof watercontent ofagivenmoistsoilsampleby (i)oven drying method,(ii)pycnometer method.
2. Determination of specific gravity of a given soil sample by (i) density bottle (ii) pycnometer method.
3. Determination of in situ dry density of soil mass by (i)core-cuttermethod,(ii)sandreplacementmethod.
4. Determinationofrelativedensityof agivensoilsample.
5. Determinationofcompletegrainsizedistributionofagivensoilsamplebysieveanalysisand sedimentation (hydrometer) analysis.
6. Determination of consistency limits (liquid, plastic and shrinkage limits) of the soil sample used inexperiment no. 5 (grain-size analysis).
7. Determinationofshearstrengthof soilbyDirectsheartest.
8. Determinationofcompactioncharacteristics (OMC&MDD) of a given soil sample.
9. Determinationofpermeability of aremoulded soilsamplebycon stanthead&/orfallinghead method.
10. Determinationofconsolidationcharacteristicsofaremouldedsoilsamplebyanodometertest.
11. Determination of shear strength characteristics of a givensoilsamplebyU/UtestfromTri-axial Compression Machine.
12. Retrievingsoilsamplesandconducting SPTtestsbyadvancingboreholesthroughhand-held auger.

ENVIRONMENTAL ENGINEERING LAB
NOTE: Student will have to perform any 8 out of the listed experiments below:
List of Experiments
1. Determination of turbidity and conductivity. 2. Determination of pH, alkalinity and acidity. 3. Determination of hardness and chlorides. 4. Determination of MPN (MostProbableNumber) of coliforms. 5. Measurement of SPM and PM10 with high volume sampler. 6. Determination of total, suspended and dissolved solids. 7. Determination of BOD. 8. Determination of COD. 9. Determination of optimum dose of coagulants by Jar TestApparatus.

COMPUTER ADDED DESIGN LAB - I
NOTE: Student will have to perform the listed experiments below:
List of Experiments
1. Introduction to Auto CAD 2. Different Softwares for CAD 3. Practice Exercises on Auto CAD Software 4. Drawing Plan of a building in Auto CAD a) Plan of a Single Storeyed building in Auto CAD b) Plan of a Multi Storeyed building in Auto CAD 5. Drawing Section and Elevation of a building in Auto CAD 6. a) Section and Elevation of a Single Storeyed building in Auto CAD b) Section and Elevation of a Multi Storeyed building in Auto CAD 7. Detailing of building components like Doors, Windows, Roof Trusses 8. Exercises on development of working drawings of buildings in Auto CAD

DESIGN OF STEEL STRUCTURES

Course Objectives:

The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course.

1. Analysis and design of stee lstructure.
2. Design of bolted and welded connections.
3. Analysis and design of axially loaded tension member,axiallyloadedcolumn,
4. Design of lacing and batten system, design of slab base foundation.

CourseOutcomes:

1. To know the basic properties of steel and to understand the behaviour
2. To know the different steel structure analysis and design.
3. To know the design and analysis of angle sections,bolted & welded connection.
4. To understand concepts of strength and stiffness considerations.
5. Analyze,and design the riveted and bolted connections.

Module	Topics	No. of Lectures
I	Introduction, Advantages of Steel as a Structural. Material, Disadvantages of Steel as a Structural Material, Structural Steel, Stress-Strain Curve for Mild Steel, Rolled Steel Sections, Local Buckling of Plate Elements. Introduction, Limit States for Steel Design, Limit States of Strength, Limit States of Serviceability.	[8]
II	Bolted Connections. Types of Bolts, Failure of Bolted Joints, Specification for Bolted Joints, Bearing-Type Connections, Prying Action, Tensile Strength of Plate, Efficiency of the Joint, Design of eccentric bolted connections. Simple Welded Connections: Introduction, Symbols, Welding Process, Weld Defects, Inspection of Welds, Assumptions in the Analysis of Welded Joints, Welds, Design of Fillet Welds, Design of eccentric welded connections.	[8]
III	Introduction, Types of Tension Members, Net Sectional Area, Effective Net Area, Types of Failure, Design Strength of Tension Members, Slenderness Ratio (λ), Displacement, Design of Tension Member, Lug Angles, Splices, Gusset Plate.	[8]
IV	Introduction, Effective Length, Slenderness Ratio(λ), Types of Sections, Types of Buckling, Classification of Cross Sections, Column Formula, Design Strength, Design of Axially Loaded Compression Members, Built-Up Columns (Latticed Columns), Lacing, Batten, Compression Member Composed of Two Components Back-to-Back, Splices, Design of Column Bases.	[8]
V	Behavior of Beam in Flexure, Section Classification, Lateral Stability of Beams, Lateral-Torsional Buckling, Bending Strength of Beams, Laterally Supported Beams, Laterally Unsupported Beams, Web Buckling, Bearing Strength, Web Crippling, Deflection, Design Procedure of Rolled Beams. BearingPlates,EffectofHolesinBeam,IntroductiontoPlateGirder,IntroductiontoGantryGirder	[8]

Suggested Readings:

Text& Reference Books:

1. Design of Steel Structures by N.Subramanian, Oxford University Press
2. Limit State Design Design of Steel Structures by KS Sairam,Pearson Education
3. Design of Steel Structures by S Ramamurtham,Dhanpat Rai Publishing Company
4. Design of Steel Structures by S.K. Duggal,Tata Mcgraw Hill.
5. Steel Structures by Robert Englekirk. HohnWiley&sonsinc.
7. Design of steel structures by Willam T Segui,CENGAGE Learning
8. Structural Steel Design By D Mac Laughlin, CENGAGELearning

E Learning links:

1.https://nptel.ac.in/courses/105105162/

DESIGN OF CONCRETE STRUCTURES-II

Course Objectives:

The students are expected to be able to demonstrate the following knowledge,skills,and attitudees after completing this course.

1. Understand and design Flats lab
2. Understand various components of retaining wall and design
3. Learn the design of liquid sretaining structure
4. Understand the concept of prestress

Course outcomes:

1. To learn the design of flat slab.
2. To know the forces acting onretainingwall.
3. To lean the design of various liquid retaining structure.
4. To learn the process of pre-stressing.

Module	Topics	No. of Lectures
I	Flat slab:nature of stresses in flat slab with or without drop,coefficients fo rdesign of flat slab, Reinforcement in flat slab (IS Code Method).	[8]
II	Structural behaviourof retaining wall,stabilityof retaining wall against overturning and sliding, Design of cantilever retaining wall by Limit State Method, Concept of counterfort Retaining wall	[8]
III	Introduction,Design Philosophy,Type of Tanks,Components of Tank,Design & detailing of Underground Rectangular and Circular Water Tank	[8]
IV	Design & Detailing of Elevated circular & rectangular RC water tanks., Design & Detailing Intz Tank	[8]
V	Prestressing: Advantage of pre-stressing. Methods of pre-stressing, Losses in pre-stress, Analysis of simple prestressed rectangular section.	[8]

Text & ReferenceBooks:

1. Reinforced Concrete Design by S.U .Pillai & D.Menon,T.M.H.,Publication
2. Reinforced Concrete-Limit StateDesignby A.K.Jain,Nem Chand &Bros.,Roorkee.
3. Reinforced ConcreteVol. –II byH.J.Shah,Charotar Publisher,Gujarat.
4. RCC Designs (Reinforced Concrete Structures)by B.C. Punmia,Ashoka Kumar Jain andArun KumarJain, Laxmi Publishers, New Delhi.
5. Reinforced Concrete Structures by R. ParkandPauley.
6. Bureau of Indian Standard IS456-2000
7. Reinforced Concrete Structures by R. ParkandPauley.

ELearninglinks:

1.https://nptel.ac.in/courses/105/105/105105105/

GEOTECHNICAL ENGINEERING -II

Course Objectives:

1. Understand various methods of Soil Exploration and its importance.
2. Analyze bearing capacity and settlement of soil for shallow foundation.
3. Design the various types of shallow foundation and understand the basics of deep foundation.
4. Understand the characteristics of well foundations and retaining wall.
5. Understand the concept of soil reinforcement.

Course Outcome:

1. To learn different methods of soil exploration
2. To understand the concept of bearing capacity and its calculation
3. To know the design of shallow foundation and settlement calculation
4. To apply the concept of geotextile and geogrid in foundation

Module	Topics	No. of Lectures
I	Introduction to soil exploration, methods of boring and drilling, soil sampling and sampler, insitu tests, SPT, CPT, DCPT, geophysical methods; soil resistivity methods seismic refraction methods.	[6]
II	Bearing capacity of shallow foundation, design criteria, factors affecting bearing capacity, factors influencing selection of depth of foundation, modes of shear failures, types of shallow foundations, contact pressure under rigid and flexible footings, Terzaghi's, Meyerhof, Hansen's bearing capacity theories, IS code method	[8]
III	Settlement of shallow foundations: components of settlement & its estimation, immediate, consolidation, & differential settlements Design of shallow foundation; principles of design of footing, design of isolated footings and strip footing.	[6]
IV	Deep foundation; introduction, necessity of deep foundations, pile installation, pile groups, group action of piles in sand and clay, group efficiency of piles, settlement of piles, negative skin friction, single and double under reamed piles	[6]
V	Geotechnical properties of reinforced soil, use of soil reinforcement, shallow foundation on soil with reinforcement, design considerations, idealized soil, foundation and interface behaviour, elastic models of soil behaviour.	[6]

Suggested Readings:

Text & ReferenceBooks:

1) Alamsingh; Soil Mechanics & Foundation Engineering; CBS Publishers & Distributors, Delhi
2) Taylor D.W.; Fundamentals of Soil Mechanics; Asia Publishing House, Mumbai
3) Das Braja M; Principles of Geotechnical Engineering; Thomson Asia Pvt. Ltd.
4) Joseph E. Bowles: Foundation analysis and design.McGraw-Hill Higher Education
5) Gopal Ranjan, Rao A.S.R.; Basic and applied soil mechanics; New age int. (p) ltd.
6) Arora K.R.; Soil Mechanics & Foundation Engineering; Standard Pub., Delhi
7) B.C. Punamia; Soil Mechanics & Foundation Engineering; Laxmi Pub. Pvt. Ltd., Delhi.
8) V. N. S. Murthy; Soil Mechanics & Foundation Engineering; Sai Kripa Technical Consultants, Banglore
9) P. Purushothama Raj; Soil Mechanics and Foundation Engineering; Pearson Education.
10) I.H. Khan – Text Book of Geotechnical Engineering
11) C. Venkataramaiah – Geotechnical Engineering
12) Shenbaga R Kaniraj- Design Aids in Soil Mechanics and Foundation Engineering
13) Gulati, S.K., "Geotechnical Engineering" McGraw Hill Education (India), Pvt. Ltd., Noida.

TRANSPORTATION ENGINEERING

Course Objectives:

The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course.

1. Understand the principles and practices in transportation Engineering
2. To learn transportation planning and land use planning, economics, and master plan.
3. Identifyand solve transportation problems.
4. To learn the design process of curves and signals
5. To learn the design of flexible and rigid pavements

Course Outcomes:

1. To learn types of roads.
2. To analyze the problems of SSD and OSD.
3. To learn the design of signals.
4. To learn the application of road design.

Module	Topics	No. of Lectures
I	Introduction: Role of Transportation, Modes of Transportation History of road development,Road types and pattern, Nagpur roadplan, Bombay road plan & 3rd 20 Year Road Plan, Factors Controlling the alignment, Survey for route location.	[6]
II	Geometric Design (IRC:73-Latest revision): Cross sectional elements, camber,shoulder, sight distance, horizontal curves, super elevation, extra widening, transition curves and gradient,vertical curves, summit and valley curves.	[8]
III	Traffic Engineering: Traffic Characteristics, Traffic studies on flow, speed, travel time - delay and O-D study, PCU, peak hour factor, parking study, accident study and analysis, traffic capacity, density, traffic control devices: signs, Island, signal design by Webster's andIRC method. Intersection at grade and grade separated intersections,	[6]
IV	Highway Materials: Properties of Subgrade, Aggregates & Binding materials, Various tests and specifications, Design of Highway Pavement : Types of Pavements, Design factors, Design of bituminous paving mixes; Design of Flexible Pavementby CBR method (IRC:37-Latestrevision),Design of rigid pavement, Westergaard theory, load and temperature stresses, joints, IRC method of rigid pavement design (IRC:58-2015)	[6]
V	Highway Construction: Construction of Subgrade, Water Bound Macadam (WBM), Wet mix macadam (WMM), Granular Sub Base (GSB),Tack Coat, Prime Coat, Seal Coat, SurfaceDressing,Bituminous Macadam (BM), Semi dense bituminous concrete (SDBC) and Bituminous concrete, Dry lean concrete (DLC), Cement Concrete (CC) road construction, Roller Compacted Concrete Roads	[6]

SuggestedReadings:

Text&ReferenceBooks:

1. KhannaS.K.,Justo C.E.G,&Veeraragavan,A."HighwayEngineering",Nem Chandand Bros., Roorkee.
2. Khanna S. K., JustoC.E.G, &Veeraragavan A.,"Highway Materials andPavement Testing",Nem Chand and Bros., Roorkee
3. LRKadiyali,TransportationEngineering,KhannaPublication

E Learning links:

1. https://nptel.ac.in/courses/105/101/105101087/
2. https://nptel.ac.in/courses/105/105/105105107/

TRANSPORTATION ENGINEERING LAB
NOTE: Studentwillhave toperformany8out ofthe listedexperimentsbelow:
List of Experiments
1. To Determine the Crushing Value of Coarse Aggregates. 2. To Determine the Impact Value o fCoarse Aggregates. 3. To determine the Flakiness Index and Elongation Index of Coarse Aggregates. 4. To determine the LosAngeles Abrasion Value of Coarse Aggregates. 5. To determine the Stripping Value of Coarse Aggregates. 6. To determine the penetration Value of Bitumen. 7. To determine the Softening Poin to Bituminous material. 8. To determine the Ductility Value of Bituminous material. 9. To determine the Flash and Fire Point of Bituminous material

COMPUTER ADDED DESIGN LAB - II
NOTE: Student will have to perform the listed experiments below:
List of Experiments
1. Working on Latest Version of ANALYSIS SOFTWARE LIKE ANSYS , ADINA, NISA, MATLAB/AUTO CAD-3D 2. Working on LatestVersionofDESIGNSOFTWARELIKESTAADPRO/STRUDS /SAP/ETAB /STRAP 3. WorkingonLatestVersionof GEOTECHNICALSOFTWARESlikeGEO-5 / PLAXIS

Desing and Thinking Lab
NOTE: Student will have to perform the listed experiments below:
List of Experiments
1. Practice brainstorming and problem definition on a civil engineering design challenge. 2. Visit a construction site to observe site conditions, structural and safety provisions. 3. Evaluate creative problem-solving techniques applied to real civil engineering scenarios 4. Define the problem statement: Based on the empathy mapping exercise, have participants synthesize their findings and define a problem statement. 5. Ideation session: Have participants generate as many ideas as possible to solve the problem statement. Encourage wild, unconventional, and innovative ideas. 6. Prototyping session: Have participants select one or more ideas and create a low-fidelity prototype to test their assumptions and validate their ideas 7. Prototype a small civil engineering product or structure using design thinking stages 8. Design an eco-friendly civil structure (green building, water harvesting system, or low-cost housing). 9. Apply IoT or smart materials concept in civil design (optional advanced activity). 10. Present complete design thinking process with prototype, testing results, and learnings.

INSTITUTE OF ENGINEERING AND TECHNOLOGY

Dr. RMLAU, Ayodhya

U.P. 224001

EVALUATION SCHEME & SYLLABUS

FOR

B.TECH (CIVIL ENGINEERING)

FINAL YEAR (4th Year)

ON

CHOICE BASED CREDIT SYSTEM (CBCS)

Effective from the Session: ~~2024-2028~~

2027-28

Semester-VII

S No	Course Code	Course Title	PERIODS			Evaluation Scheme				Total	Credit
			L	T	P	Sessional Exam			ESE		
						CT	TA	Total			
1	CEC-701	Bridge Engineering	3	1	0	30	20	50	100	150	4
2	CEC-702	Water Resource Engineering	3	1	0	30	20	50	100	150	4
3	CEC-703	Transportation Engineering - II	3	1	0	30	20	50	100	150	4
4	CEC -704	Application of AI –ML in Civil Engineering	3		0	15	10	25	50	75	3
5	DCE-102	Departmental Elective - II	3		0	15	10	25	50	75	3
PRACTICAL/DESIGN/DRAWING											
6	CLC-751	Non distructive Testing Lab	0	0	2		-	25	25	50	1
7	PR-01	Mini Project#	0	0	6		-	200	-	200	4
		Total								900	24

**4 weeks Industrial Training to be done during the summer break of third year and report to be submitted in VII semester.

#Project should be initiated inVII semester beginning and should be completed by the end of VIII semester.

Semester-VIII

S No	Course Code	CourseTitle	PERIODS			EvaluationScheme				Subject Total	Credit
			L	T	P	Sessional Exam			ESE		
						CT	TA	Total			
1	CEC-801	Construction Technology and Management	3	1	0	30	20	50	100	150	4
2	DCE-103	Departmental Elective-III	3	1	0	30	20	50	100	150	4
3	DCE-104	Department Elective-IV	3	1	0	30	20	50	100	150	4
PRACTICAL/DESIGN/DRAWING											
4	PR-02	Project	0	0	12			100	350	450	12
		Total								**900**	**24**

B.Tech (Civil Engineering)-IV Year

BRIDGE ENGINEERING

Course Outcomes (COs)	At the end of the course, students will be able to:
CO1	Discuss the IRC standard live loads and design the deck slab bridge.
CO2	Analyse and design box and pipe culverts for given loading and prepare detailing.
CO3	Design and detail reinforced concrete T-Beam bridges.
CO4	Design and check the stability of piers and abutments.
CO5	Discuss construction techniques for precast bridge members.

Course Details

Unit	Topics / Subtopics	No. of Lectures
I	**General Considerations for Road Bridges** Introduction – Site selection – Soil exploration – Bridge type selection – Economical span – Number of spans – Determination of HFL – General arrangement drawing	8
II	**Standard Specifications:** Width of carriageway, Clearances, Loads (Dead, IRC Live, Impact), Wind load, Longitudinal/Centrifugal/Horizontal forces	8
III	**Culverts** Introduction, Analysis and Design of Box Culverts, Slab Culverts, Pipe Culverts	8
IV	**General Provision for Design of Reinforced Concrete T-Beam Bridges** Introduction , design provision as per IRC	8
V	**General Provision for Design of Substructure and Bearings** Introduction to substructures, design provision for substructures as per IRC. Bearings: Forces, Types, Applications and design provision as per IRC	8

Text &Reference Books

1. Johnson Victor D., *Essentials of Bridge Engineering*, 7th Edition, Oxford, IBH Publishing Co., Ltd., 2006.
2. Ponnuswamy, *Bridge Engineering*, 4th Edition, McGraw-Hill, 2008.
3. Krishnam Raju N., *Design of Bridges*, 4th Edition, Oxford and IBH Publishing Co., Ltd., 2008.
4. Vazirani, Ratvani & Aswani, *Design of Concrete Bridges*, 5th Edition, Khanna Publishers, 2006.
5. Jagadish T.R. & M.A. Jayaram, *Design of Bridge Structures*, 2nd Edition, 2009.
6. Swami Saran, *Analysis and Design of Sub-Structures*, 2nd Edition, Oxford IBH Publishing Co. Ltd., 2006.

WATER RESOURCE ENGINEERING

Course Objectives:

The students are expected to be able to demonstrate the followingknowledge, skills, and attitudes after completing this course

1. Understand the concept of hydrological cycle,mechanism of precipitation,evapotranspiration
2. Estimate water requirements of crops and storage capacity of reservoir.
3. Design of unlined channel of silt theories.
4. Different methods to determine suspended loads and bed load.
5. To know different River training methods.

Course Outcomes:

1. Understand the interaction among various processes in the hydrologic cycle.
2. Design of water management systems utilizing the basic principles of the hydrologic cycle.
3. Apply knowledge for efficient design methods for rapid conveyance of water with lesser loss in irrigation canals.
4. To demonstrate a knowledge of the multi-disciplinary nature of water resources engineering.

Unit	Topics	No. of Lectures
I	Irrigation: Necessity and types, Advantages & disadvantages of irrigation; water resources of India, need of irrigation in India, development of irrigation in India, impact of irrigation on human environment, Methods of Irrigation, Hydrology: Hydrological Cycle and its components; Water Budget Equation,	8
II	Water requirement of crops: Crops and crop seasons in India, cropping pattern; Quality of irrigation water, Soil-water relationships- soil characteristics significant from irrigation considerations, root-zone soil water, infiltration, consumptive use, irrigation requirement, frequency of irrigation; duty and delta. Methods of applying water to the fields: surface, sub-surface, sprinkler and drip irrigation types and its design and drawing.	8
III	Canals:Distributionsystemsforcanalirrigation,canalcapacity,canal losses, alignment of main and distributary canals, Design of canal by Kennedy'sandLacey'stheory,Waterloggingandits prevention.Liningof Irrigation Canals:Advantages and types; factors for selection ofa particular type, design of lined channels, cross-section of lined channels, Economics of canal lining.	8

B.Tech (Civil Engineering)-IV Year

TRANSPORTATION ENGINEEERING - II

Course Objectives:

The course content should be taught and curriculum should be implemented with the aim to develop required skills in the students so that they are able to acquire following competencies:

1. Comprehend different parts of the rail track, their functions and its operation system with respect to construction and engineering applications
2. Explain essential features and requirements of different types of crossings and signal system, maintenance of tracks and required procedures.

Course Outcomes:

The theory should be taught and practical should be carried out in such a manner that students are able to acquire required learning out comes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

1. Explain Components of Railway Track, different Railway Gauges
2. Design track Gradients as per given requirements
3. Discuss various Types of Track Turnouts
4. Describe purposes and facilities at Railway Stations
5. Explain Interlocking and modern signal system
6. Describe Surface Defects on Railway Track and Their Remedial Measures

Unit	Topics	No. of Lectures
I	History of Indian Railways, Importance of Railways For Environment Recent Developments. Role of Civil Engineers In Construction And Maintenance, Components of Railway Track Definition of Railway Gauges, Types, Uniformity of Gauge. Different Gauges on Indian Railways, Cross- Section of Permanent Way as Per IRS Problems Caused By Change of Gauge. Basic Requirements and selection of An Ideal Alignment Functions and Types Of Rails Standard Rail Sections, 1.13 Causes and Effects Of Creep, Measures To Reduce Creep. Fittings and Fastening and their requirements . Forces Acting On Track, Coning Of Wheels	8
II	Functions & Requirements of sleepers Types and Spacing of Sleepers, Method Of Fixing Rails With Pre-stressed Concrete And Wooden Sleepers, Function and Specifications of Track Ballast Necessity and Details of geometric design of track Design of track Gradients, Grade compensation on curves. Curves and Super elevation.	8
III	Resistance to-friction, wave action, speed, track irregularity, wind, Resistance to gradient, curvature, starting and accelerating Stress in rails, sleepers, ballast and formation Necessity of Points & Crossing Track Layouts And Sketches of Turn Out, Types Of Crossing Types of Track Turnouts	8
IV	Purposes Facilities Required at Railway Stations. Requirements of Station Yard, Classification Of Railway Stations, Types Of Yards	

IV	Regulation Works: Falls, Classification; Introductiontodesign principle of falls, Design of Sarda type and straight glacis tall. Cross drainageworks: Necessity and types; Aqueduct, SiphonAqueduct, super passage, canal siphon, level crossing.	8
V	Types of dams, design principles of gravity and earth dams, stability analysis. Spillways: Spillway types energy dissipation. Principle and design of distributary head regulator and cross regulator, canal escape, Bed bars plants, important terms, types of turbines and their suitability; Power House layout and important structures of a powerhouse.	8

Suggested Readings:

TextBooks:

1. Water Resources Engg. By Larry W Mays,John WileyIndia
2. Water resources Engg.ByWurbsand James,John Wiley India
3. Water Resources Engg. By R.K. Linsley, McGrawHill

ReferencesBooks:

1. Fundamental of Hydraulic Engineering System by Houghalen,Pearson Publication.
2. Irrigation and water Power engineering by B.C. Punmia, Laxmi Publications.
3. Engineering Hydrology by K.Subramanya,TMH.

E-LearningLink:

1. https://nptel.ac.in/courses/105105110/

	Objectives of signaling Classification of signals Types and working of Interlocking Modern signal system	
V	Introduction of Maintenance Programme. Monsoon, Pre-Monsoon & Post-Monsoon Maintenance. Causes For Maintenance, Routine Maintenance Tools For Railway Track Maintenance &Their Functions. Surface Defects And Their Remedial Measures	

B.Tech (Civil Engineering)-IV Year

Application of AI-ML in Civil Engineering

Course Objectives

1. To introduce fundamentals of Artificial Intelligence (AI) and Machine Learning (ML) relevant to civil engineering problems.
2. To understand data-driven approaches for solving real-world civil engineering challenges.
3. To apply AI/ML tools for modeling, prediction, and optimization in civil infrastructure systems.
4. To familiarize students with case studies and applications in construction, transportation, water, and geotechnical engineering.

Course Outcomes (COs)

After successful completion of the course, students will be able to:

CO No.	Course Outcomes
CO1	Explain basic principles and algorithms of AI and ML used in engineering analysis.
CO2	Prepare and preprocess civil engineering datasets for ML model training.
CO3	Apply supervised and unsupervised learning techniques to solve civil engineering problems.
CO4	Analyze and interpret model performance for decision making in structural, geotechnical, and environmental systems.
CO5	Evaluate AI/ML applications in smart cities, sustainability, and infrastructure management.

Course Content

Unit	Topics / Subtopics	No. of Lectures
I	**Introduction to AI & ML** Basics of Artificial Intelligence, Machine Learning, and Data Science – AI vs ML vs Deep Learning – Civil Engineering Data Sources – Role of AI in Planning, Design, and Management.	6
II	**Data Processing & Modeling** Data collection, cleaning, normalization – Feature extraction – Regression, Classification, and Clustering Techniques – Model evaluation and validation.	6
III	**AI/ML in Structural Engineering** Prediction of concrete strength, crack detection, material optimization – Structural health monitoring using AI – Neural networks and image-based defect detection.	6
IV	**AI/ML in Transportation & Geotechnical Engineering** Traffic flow prediction, pavement condition monitoring, road safety analysis – Soil property prediction, slope stability assessment, foundation design optimization.	6
V	**AI/ML in Water Resources & Environmental Engineering** Flood forecasting, water quality prediction, groundwater modeling – Wastewater treatment optimization – Smart city and sustainability applications.	6

NON DESTRUCTIVE TESTING LAB
NOTE: Student will have to perform minimum 3 test on concrete & two test on structural steel
Experiments
1. Non Destructive testing of reinforced cement concrete (a) Strength assessment using rebound hammer (b) Quality assessment using ultrasonic pulse velocity test (c) Strength assessment using pull out method (d) Assessment of corrosion of reinforcing bars using half cell potentiometer (e) To determine thickness of concrete cover, diameter & spacing of reinforcing bars using rebar scanner.
2. Testing of structural steel (a) Testing for corrosion of structural steel (b) Assessment of thickness of pipes/tubes/structural steel (c) Test for welding performance with Di-penetration test, ultrasonic test & magnetic particle test

CONSTRUCTION TECHNOLOGY & MANAGEMENT

Course Objectives:

To plan Bar Chart, CPM and PERT Network

To prepare CPM chart, PERT chart material requirement schedule, Manpower schedule, Machinery Schedule,

Construction Management, to analyze, evaluate and design construction contract documents.

Course Outcomes:

1. Understand the use of advanced materials in construction projects
2. Plan and develop management solutions to construction projects.
3. Evaluate construction projecte conomics,cost-benefit analysis and break even analysis.
4. Understand the principles of project management, resource management and inventory

Unit	Topics	No. of Lectures
I	Elements of Management: Project cycle, Organisation, planning, scheduling monitoring updating and management system in construction.	8
II	Network Techniques: Bar charts, milestone charts, work break down structure and preparation of networks. Application of network techniques like PERT, GERT, CPM AON and AOA in construction management. Project monitoring, cost planning, resource allocation through network techniques. Line of balance technique.	8
III	Engineering Economics: Time value of money, Present economy studies, Equivalence concept, financing of projects, economic comparison present worth method Equivalent annual cost method, discounted cash flow method, analytical criteria for postponing of investment retirement and replacement of asset. Depreciation and breakeven cost analysis.	8
IV	Contract Management: Legal aspects of contraction, laws related to contracts, land acquisition, labour safety and welfare. Different types of contracts, their relative advantages and disadvantages. Elements of tender preparation, process of tendering pre-qualification of contracts, Evaluation of tenders, contract negotiation and award of work, monitoring of contract extra items, settlements of disputes, arbitration and commissioning of project.	8
V	Equipment Management: Productivity, operational cost, owning and hiring cost and the work motion study. Simulation techniques for resource scheduling. Construction equipment for earth moving Hauling equipment, Hoisting equipment, Conveying equipment, Concrete Productionequipment	8

Suggested Readings:

Text and Reference Books:

1. Construction Planning, Equipment and Methods: R.L. Peurify .T.M.H.,International Book Company.
2. PERT& CPM Principles and Applications L.S.Srinath,E.W.P.Ltd.,NewDelhi.
3. Network AnalysisTechniquesS.K.Bhatnagar,Willey Eastern Ltd.
4. Construction Technology by Sarkar,Oxford
5. Construction Project Managementby KK Chitkara,McGraw Hill Publication.
6. Construction Management and Planning by Sengupta and Guha, McGraw HillPublication

E Learning Link:

1.https://nptel.ac.in/courses/105103093/

DEPARTMENTAL ELECTIVES I

S.No	SUBJECT
1	Cyber Security
2	Environmental Science
3	Indian Knowledge System
4	Internet of Things

DEPARTMENTAL ELECTIVES II

S.No	SUBJECT
1	Global Disaster Scenario and Type of Natural Disaster
2	Automation in Construction Industry
3	Remote Sensing and GIS

DEPARTMENTAL ELECTIVES III

S.No	SUBJECT
1	Ground Improvement Techniques
2	Energy generation from Waste
3	Water Resources Systems, Aanlysis, Planning, & Management

DEPARTMENTAL ELECTIVES IV

S.No	SUBJECT
1	Industrial Pollution Control and EIA
2	Disaster Resilient Structures and Retrofitting
	Aanalyis of Transportation System

INTERNET OF THINGS & 5G		
Unit	**Topics**	**No.of Lectures**
I	Introduction to the IoT: What is the Internet of Things, Technology drives, Business drivers, TypicalsIoT applications, Trends and implications.	8
II	IoTArchitecture: Architecture for IoT, Elements of an IoT Architecture, Architectural design considerations.	8
III	IoT Networks Protocols (MACLayer):Wireless sensor networks (WSN) and power consumption, CSMA/CA and slotting, Centralized vs. distributed, state of the art MAC layer protocols for WSNs.	8
IV	Wireless technologies for IoT (Layer1&3): Bluetooth/Bluetoothsmart, Zigbee/Zigbee smart, UMB (IEEE 802.15.4), Proprietary systems.	8
V	IoT applications & 5G: Introduction to IoT device programming, IoT application development, overview of 5G, key parameters of 5G, Massive MIMO for 5G.	8

Suggested Readings:

1. McKinseyglobalinstitute report:"Unlockingthepotentialoftheinternet ofthings".
2. Karl,Holger, and Andreas Willig, Protocols and architectures for wireless sensor networks. John Wiley & Sons.
3. E.G. LarsonandP.stoica,"5GMassive MIMOwirelesscoomunication",Cambridge university press 2008

GLOBAL DISASTER SCENARIO AND TYPE OF NATURAL DISASTER

Course Content Unit 1:

Introduction - Disaster Management Cycle, Public administration/policy and emergency management – incident command center – training need analysis and human resource development plan– corporate/public agency coordination and the human element in preparedness planning. Institutional framework in India for disaster preparedness and mitigation

Unit 2:

Earthquake: Introduction–generalcharacteristics–mechanism–causesandeffects–prediction - seismic zones and waves – vulnerability – damage potential – magnitude and intensity – geological and geographical analysis – epicenter – characteristics of general motion and attenuation.Landslideand land degradation: Causes – tectonic conditions – erosion – avalanches– rock fall – damage assessment.

Unit 3:

Floods: General characteristics – causes – geomorphology and floods – flood forecasting – river andcoastalflood–flashflood–lakeoutburst–risks,environmental planning–floodcontrol and management. Cyclone and Tsunami: Structure and nature of cyclones and Tsunamis – characteristics hazard donation – factors-hazard potential – impact assessment.

Unit4:

Manmade hazards: Toxic chemicals – noise pollution – environment ground water pollution and management – solid waste management. Terrorist disaster/War: Hazardous wastes – reactivity – toxicity– nuclear war – biological weapons – armed conflicts – land mines etc.

Unit5:

National & World Wide Scenario: History of disasters - various disasters in various countries - DisastersinIndiaReliefandrehabilitationindisastersatlocal,nationalandgloballevels,Gaps in disaster management identified on analysis, Worldwide Aid and Agencies, Study of different case studies on natural disaster & man-made disaster.

TextBooks and Reference Books

1. DonaldHyndman,DavidHyndman"NaturalHazards and Disasters"ThirdEdition

2. Coppola PDamon, 2007.IntroductiontoInternationalDisasterManagement, Carter,Nick 1991.

3. DisasterManagement:ADisasterManager'sHandbook.AsianDevelopmentBank,Manila

4. GovernmentofIndia,MinistryofHomeAffairs,NationalDisasterManagementDivision, 2004, Disaster Management in India – A Status Report

5. NationalPolicyonDisasterManagement2009,NDMA, GovernmentofIndia.

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AUTOMATION IN CONSTRUCTION INDUSTRY

CourseObjective:

1. To get knowledge about application of automation and use of robotsin construction.

2. Tolearn the basic concept of Sensors and inspection

3. To study the existing and prototype equipment for construction.

4. To study on Data networking, robotic technologies for pre-fabrication elements.

Module 1: Concept and application of Building Management System (BMS) and Automation, requirements and design considerations and its effect on functional efficiency of building automation system,architectureandcomponentsofBMS- Reviewand analysisof state- of –art in construction automation .Field sensors actuators, controllers, non-destructive evaluation, data acquisition , examples of sensors in existing automated equipment

Module 2: Off- site automation in construction Information processing (computer applications), materials processing, case study (concrete batch plant) - Existing and prototype equipment for construction – case study (concrete placement and finishing), final product design session

Module 3: Introduction to building automation systems – components– Heating, ventilation, and air conditioning (HVAC)– Lighting – Electrical systems water supply and sanitary systems– Fire safety – security -Communication and office automation system -Water pump monitoring & control - Control of Computerized HVAC Systems

Module4:Datanetworking–IBMS system and its components–Centralized control equipment's – substation and field controllers – Gamma building control – energy-efficient building and room automation.

Module 5: Automation and robotic technologies for customized component, module and building prefabrication- Elementary technologies and single – Task construction robots - Site automation- robotic on site factories.

Selecting robot-Activated concrete cutting robot, concrete floor finishing robot- Ceiling panel positioning robot- Exterior wall painting robot-safety and training- case studies.

References:

1. Javad MajrouhiSardroud,(2011),"AutomatedManagementofConstructionProjects"LAP Lambert Academic Publishing.

2. WangShengwei,(2010),"IntelligentBuildingsandBuildingAutomation"Taylor&Francis Group.

3. Majrouhi SardroudJavad,(2014), "AutomationinConstructionManagement"Scholars' Press.

4. HongleiXu and Xiangyu Wang, (2014), "Optimization and Control Methods in Industrial Engineering and Construction (Intelligent Systems, Control and Automation: Science and Engineering)" Springer.

Remote Sensing and G.I.S.

Course Objectives:
The objective of this course is to understand thefundamentals of remote sensing and G.I.S.

Course Outcomes:
After completing the course,student will:
Learn the state ofart technology, being effectively used to monitor and assess the earth's resources Able to develop skills of interpretation of the visual and digital satellite data
Understand theinteractionofhumanswiththegeologicalenvironment.

Unit	Topics	No.ofLectures
I	Remote Sensing: Electromagnetic Radiation –Characteristicsand Remote Sensing Regions and bands, Scattering, Reflection, Atmospheric Window; Spectra of common natural objects – soil, rock, water and vegetation; Toposheet, Aerial photos– types, scale, resolution; properties of aerial photos.	12
II	Stereoscopy, Parallax, Relief displacement, Elements of photo and imagery pattern and interpretation, General Orbital characteristics of remote sensing satellites, G.P.S.	12
III	Data Processing and Interpretation (Digital Image Processing – D.I.P.), Characteristics of remote sensing data, Pixel, Digital number; Preprocessing; Enhancements, Classification.	12
IV	Types of Indian and Foreign Remote Sensing Satellites, Application in Geology: Remote sensing applications in Structure, Mineral Exploration, Groundwater potentials, Environmental monitoring.	12
V	Introduction to Geographic Information System (G.I.S.); components of G.I.S.;productgenerationinG.I.S.;toolsformapanalysis;integration of G.I.S. with remote sensing. Applications ofG.I.S.inLandslides, Route location and pipelinealignments; Neo tectonism, seismic hazard and damage assessment.	12

Suggested Readings:

1. Drury,S.A.(1987):Image Interpretation in Geology.Allen and Unwin.
2. Gupta,R.P.(1991):RemoteSensing Geology.Springer, Berlin.
3. Halis,J.R.(1983):Applied Geomorphology.
4. Holmes, A. (1992): Holmes Principles of Physical GeologyEdited by P. McL. D. Duff. Chapman and Hall, London.
5. Lillesand, T.M. and Kiefer, R.W. (1987): Remote Sensing and Image Interpretation. John Wiley, New York.

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GROUND IMPROVEMENT TECHNIQUES

Course Contents:

Module 1: Introduction: Need of Ground Improvement: Different methods of Ground improvement, General Principal of Compaction: Mechanics, field procedure, quality control in field.

Module2: Ground Improvement in Granular Soil:In place densification by(i)Vibrofloatation (ii)Compaction pile(iii)Vibro Compaction Piles(iv) Dynamic Compaction (v) Blasting

Module 3: Ground Improvement in Cohesive Soil: Compressibility, vertical and radial consolidation, preloading methods. Types of Drains, Design of vertical Drains, construction techniques. Stone Column: Function Design principles, load carrying capacity, construction techniques, settlement of stone column foundation.

Module 4: Ground Improvement by Grouting and Soil Reinforcement: Grouting in soil, types of grout,desirable characteristics, grouting pressure, grouting methods. Soil Reinforcement: Mechanism, Types of reinforcing elements, reinforcement-soil interaction, Reinforcement of soil beneath the roads, foundation. Geosynthetics and their application.

Module5: Soil Stabilization:Lime stabilization-Base exchange mechanism, Pozzolanic reaction, lime-soil interaction, line columns, Design of Foundation on lime columns. Cement stabilization: Mechanism, amount, age and curing. Fly-ash - Lime Stabilization, Soil Bitumen Stabilization.

TextBooks:

1. R.M.Korner, *DesignwithGeosynthetics*,PrenticeHall,NewJersy, 3rdEdn.2002
2. P.Purushothama Raj,*Ground ImprovementTechniques*,TataMcGrawHill,NewDelhi,1995.
3. Dr. B.C.Chattopadhyay and J.Maity, *Ground Control and ImprovementTechniques*, PEEDOT, Howrah, 2011.
4. G.V.Rao and G.V.S.Rao,*TextBook On Engineering with Geotextiles*, Tata McGraw Hill
5. T.S.Ingold and K.S.Miller,*Geotextile HandBook*, Thomas Telfrod, London
6. N.V.Nayak, *Foundation Design Manual*, Dhanpat Rai and Sons, Delhi.
7. M.P.Moasley,*Ground Improvement Techniques*

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ENERGY GENERATION FROM WASTE

CourseContent Unit 1:

Introduction: The Principles of Waste Management and Waste Utilization. Waste Management Hierarchy and 3R Principle of Reduce, Reuse and Recycle. Waste as a Resource and Alternate Energy source.

Unit 2:

Waste Sources & Characterization; Waste production in different sectors such as domestic, industrial, agriculture, postconsumer, waste etc. Classification of waste – agro based, forest residues, domestic waste, industrial waste (hazardous and non-hazardous). Characterization of waste for energy utilization. Waste Selection criteria.

Unit 3:

Technologies for Waste to Energy; Biochemical Conversion – Energy production from organic waste through anaerobic digestion and fermentation. Thermo-chemicalConversion– Combustion, Incineration and heat recovery, Pyrolysis, Gasification; Plasma Arc Technology and other newer technologies.

Unit 4:

Waste to Energy Options; Landfill gas, collection and recovery. Refuse Derived Fuel (RDF) – fluff, briquettes, pellets. Alternate Fuel Resource (AFR) – production and use in Cement plants, Thermal power plants and Industrial boilers. Conversion of wastes to fuel resources for other useful energyapplications.Energy from PlasticWastes– Non-recyclableplastic wastesfor energy recovery. Energy Recovery from wastes and optimization of its use, benchmarking and standardization. Energy Analysis.

Unit5:

Waste To Energy & Environmental Implications; Environmental standards for Waste to Energy Plant operations and gas clean-up. Savings on non-renewable fuel resources. Carbon Credits: Carbon foot calculations and carbon credits transfer mechanisms.

TextandReference books:

1. John Pichtel, Waste Management Practices:Municipal, Hazardous, and Industrial, Second Edition, CRC Press.

2. Banwari Lal and Patwardhan, Wealth from Waste:Trends and Technologies by, TERI Press.

3. S.N Mukhopadhyay, Fundamentals of waste and Environmental Engineering, TERI Press.

4. GeorgeTchobanoglous, Frank Kreith, Hand book of Solid WasteManagement, Second Edition,The McGraw-Hill.

CourseOutcomes:

To provide the students

1. Theknowledge about the operations of Waste to Energy Plants.

2. The various aspects of Waste toEnergyManagement Systems.

3. With knowledge to carryout Techno-economic feasibility for Waste to Energy Plants.

4. With the knowledge in planning and operations of Waste to Energy plants

WATER RESOURCES SYSTEM ANALYSIS, PLANNING & MANAGEMENT

Course Objectives:

1. To impart knowledge about the planning and management of water resources.
2. To introduce the concepts of watershed management, integrated water resources management, environmental interaction of water resources and policies/framework related to water resources.
3. To enable the students to understand the different components of water resources and their management.

CourseContent:

Unit-1

Basic concepts of systems need for systems approach in water resources, system design techniques, problem formulation, modeling of water resource system

Unit-2

Optimization techniques, LP, NLP, dynamic programming, multi-objective optimization, stochastic optimization

Unit-3

Simulation, reservoir operation problems, case studies; planning, role of a planner, sensitivity analysis, performance measures

Unit-4

National water policies, public involvement, social impact, economic analysis.

Unit-5

Water resources system modelling, river basin planning and management, water distribution system, ground water system, water quality modelling, floodplain management, urbanstorm water management; Fuzzy optimization, genetic algorithm, multi criteria decisionmaking, decision support system, expert systems.

References:

1. Loucks, D.P., Stedinger,P.J.R., Haith,D.A., "Water ResourcesSystemsPlanning and Management", Prentice Hall, New Jersy, 1987.

2. Hall, K., A and Draoup,J.A.,WaterResources Systems Engineering,Tata McGrawHill, 1970.

3. Neil, G.S.,Water Resources Planning,McGrawHill,1985.

4. NationalWaterPolicy, Ministry of Water Resources, Government of India,1987.

Course Outcomes (Cos):

1. The students will be able to understand the basic concepts of systems, need for systems approach in water resources, system design techniques, problem formulation.

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INDUSTRIAL POLLUTION CONTROL & EIA

Course objectives:

1. To have sufficient knowledge on Engineering ethics, environment and Ecological.
2. To have sufficient knowledge on fundamentals of EIA and ESA.
3. To have better understanding of Industrial Air pollution management.
4. To have adequate knowledge on Wastewater treatment processes.
5. To have understanding of advanced wastewater treatment processes.
6. To have sufficient knowledge on Hazardous Waste Management.

Course content:

Unit 1

Engineering ethics and environment, Ecological systems and pollution, Fundamental definitions of pollution parameters, Standards and legislation, EIA and ESA

Unit2

Air and water pollution management through waste minimization

Unit3

Industrial Air pollution management - air pollution meteorology (Generation, transportation and dispersion of air pollutants), Outlines of industrial air pollution control Selection, design and performance analysis of air pollution control equipment.

Unit4

Industrial Water pollution management - Wastewater treatment processes and advanced wastewater treatment processes.

Unit5

Hazardous Waste Management - Sources, Classification, Regulations for Hazardous Waste Management, Waste Minimization and Resource Recovery – Approaches, Development ofa Waste Tracking, Treatment of hazardous waste, Thermal treatment, Soil contamination and site remediation, monitoring of disposal sites.

Text Books

1. C.S. Rao, *Environmental Pollution Control Engineering*, Wiley Eastern Ltd., 2003.
2. S.P. Mahajan, *Industrial Pollution and Control*, Dhanpat Rai & Co., 2004.
3. B.K. Sharma, *Environmental Chemistry*, Goel Publishing House, 2015.
4. K. V. Smith, *Introduction to Environmental Engineering and Science*, 5th Edition, McGraw-Hill, 2013.
5. Canter, L. W., *Environmental Impact Assessment*, 2nd Edition, McGraw-Hill, 1996.

Reference Books

1. Howard S. Peavy, Donald R. Rowe, George Tchobanoglous, *Environmental Engineering*, McGraw-Hill, 2013.
2. S. K. Garg, *Environmental Engineering*, Vol. II, Khanna Publishers, 2010.

3. M. Anji Reddy, *Environmental Impact Assessment – Theory and Practice*, BS Publications, 2010.
4. P. K. Goel, *Water Pollution – Causes, Effects and Control*, New Age International, 2011.
5. C. S. Rao, *Environmental Impact Assessment*, Wiley Eastern Ltd., 2002.

E-Learning / Online Resources

- NPTEL Course: Environmental Pollution Control and EIA
- UNEP & World Bank Guidelines on Industrial Pollution Control and EIA

B.TechCivil EngineeringOpenElective

DISASTER RESILIENT STRUCTURES AND RETROFITTING

Unit-1:

Earthquake effects on the structures, Classification of loads, Seismic methods of analysis, Seismic design methods, Seismic damages during past earthquakes and effect of irregularities and building architecture on the performance of structures.

Unit-2:

Basic design considerations for multistoried RC and steel structure with foundation as per latest IS:1893, Capacity based design of building,Types of ductility, Factors affecting ductility, Ductile detailing as per latest IS:13920, Seismic design considerations for masonry buildings.

Unit-3:

Firesafetyofbuildings, Effect of high temperatures on different types of steel and concrete structural members, Fire resistance by structural detailing.

Unit-4:

Analytical determination of the ultimate bending moment, Design of RC members for fire resistance,Introduction of IS:1642.General characteristicsof blastandeffectson structures, Blast load on above and below ground structures, Response of structural elements to blast force, Dynamic strength of materials and design stresses, Load combinations for design, Introduction of IS:4991. Sources of weakness in RC and Steel framed buildings.

Unit-5:

Classification of retrofitting techniques,Conventional and non-conventional methods, IS code provisions for retrofitting of masonry structures.

Books:

1. Thomas Paulay and Priestley M. J. N., "Seismic Design of Reinforced Concrete and Masonry Buildings", Wiley India Pvt Ltd.

2. Agarwal Pankaj and Shrikhande Manish, "Earthquake Resistant Design of Structures", PHI. 3. Datta T. K., "Seismic Analysis of Structures" Wiley.

4. Duggal Shashikant K., "Earthquake Resistant Design of Structures", 2nd Edition, Oxford. 5. Priestley M. J. N., Calvi G. M. and Kowalsky M. J., "Displacement-Based Seismic Design of Structures", 2nd Edition, EUCENTRE.

6.Varghese P. C.,"AdvancedReinforced Concrete Design",2ndEdition,PHILearning Pvt.Ltd.

7. CormieDavid,MaysGeoff andSmith Peter, "BlastEffectson Buildings",3rdEdition, Thomas Telford Publishing.

ANALYSIS OF TRANSPORT SYSTEM

Module1

Introduction: Evaluation issues, Evaluation process, values, goals, objectives, criteriaand standards frame work – Estimation of cost, impacts and performance levels – evaluation of alternatives, economic environmental and safety evaluations; multi criteria evaluation methods, techniques – scoring techniques – group consensuous.

Module–2

Economic Evaluation: Review of Engineering Economics-Welfare Theories and Equilibrium- Theoretical Basis-Discounted Cash Flow Methods-Cost, Benefit Cost Effectiveness and Shadow Pricing Techniques-Criteria for Pricing Services-Average Cost Vs Marginal Cost - Allocation of Resources within Transportation Section-Financing of Transport Sections in India

Module–3

Environmental Evaluation: Introduction, air pollutants, pollutant effects, air quality standards, factors influencing air pollution, air pollution dispersion & pollution models, air pollution reduction measures - Noise pollution: noise measurement, noisepropagation, noise modeling, noise control and abatement techniques, Energy related issues, energy consumption of different modes, energy related transportation actions

Module–4

Safety Evaluation: Highway safety problem, accident categories, highway safety improvement program – planning, implementation & evaluation stages, steps in HSIP, counter measures for accidents and probable causes, road safety audit.

References

1) Hutchinson B.G., Principle of Transportation Systems Planning, Mc Graw-Hill.

2) DickeyJ.W.,et.al., MetropolitanTransportationPlanning,TataMcGraw-Hill.

3) ITE (1982), Transportation and Traffic Engineering Hand Book, Chapters 21 and 22',Prentice-Hall, New Jersy.

4) Heggei, I.G.,Transportation Engineering Economics, Mc-GrawHillBookCompany, New York.

5) CANTER, L.W., Environmental impact assessment, McGraw-Hill,1997

6) CRRI, Road user Cost Study in India, Central Road Research Institute, New Delhi,1982

7) Robley Winfrey, Economic analysis for highways, International Textbook Co.

8) M.Wohl, B.J .Martin, Traffic System Analysis for Engineers and Planners, McGrawHill Text, 1967.

9) Babkov,V.F., Road Conditions and Traffic Safety, MIR Publishers, Moscow