

KURUKSHETRA UNIVERSITY, KURUKSHETRA**SCHEME OF STUDIES/EXAMINATIONS**

SEMESTER-V (w.e.f. 2026-27 onwards)

B.Tech. Civil Engineering

S. No.	Course No./ Code	Subject	L: T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of exam (Hours)
						End Semester Exam	Internal Assessment	Practical Exam	Total	
1	B24-CE-301	Structural Analysis-II	3:0:0	3	3	70	30	--	100	3
2	B24-CE-303	Surveying & Geomatic Engineering-II	3:0:0	3	3	70	30	--	100	3
3	B24-CE-305	Fluid Mechanics-II	3:0:0	3	3	70	30	--	100	3
4	B24-CE-307	Geotechnical Engineering	3:0:0	3	3	70	30	--	100	3
5	B24-CE-309	Transportation Engineering-II	3:0:0	3	3	70	30	--	100	3
6	B24-CE-371	Geotechnical Engineering Lab	0:0:2	2	1	--	40	60	100	2
7	B24-CE-373	Fluid Mechanics Lab-II	0:0:2	2	1	--	40	60	100	2
8	B24-CE-375	Structure Analysis-II Lab	0:0:2	2	1	--	40	60	100	2
9	B24-CE-379	Industrial Training	0:0:2	2	1	--	100		100	
10	B24-MAC-301	Constitution of India	2:0:0	2	1	--	100		100	3
11		Professional Elective Course (PEC-01)	4:0:0	4	4	70	30	--	100	3
TOTAL				29	24	420	500	180	1100	

Note:- All students have to undertake the survey camp for 10 days after 5th semester which will be evaluated in 6th semester.

LIST OF PROFESSIONAL ELECTIVE COURSES (PEC-01)

B24-CEP-320	HYDROLOGY
B24-CEP-322	ROCK MECHANICS
B24-CEP-324	PAVEMENT MATERIALS

KURUKSHETRA UNIVERSITY, KURUKSHETRA
COMMON SCHEME OF STUDIES/EXAMINATIONS

SEMESTER-VI (w.e.f. 2026-27 onwards)

B.Tech. Civil Engineering

S. No.	Course No./ Code	Subject	L: T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hours)
						End Semester Exam	Internal Assessment	Practical Exam	Total	
1	B24-CE-302	Design of Steel Structure-I	3:0:0	3	3	70	30	--	100	3
2	B24-CE-304	Design of Concrete Structure-I	3:0:0	3	3	70	30	--	100	3
3	B24-CE-306	Environmental Engineering-II	2:0:0	2	2	70	30	--	100	3
4	B24-CE-308	Irrigation Engineering -II	3:0:0	3	3	70	30	--	100	3
5	B24-CE-310	Concrete Technology	3:0:0	3	3	70	30	--	100	3
6	B24-CE-370	Irrigation Engineering Design & Drawing	0:0:2	2	1	--	40	60	100	2
7	B24-CE-372	Concrete Technology Lab	0:0:2	2	1	--	40	60	100	2
8	B24-CE-374	Environmental Engineering-II Lab	0:0:2	2	1	--	40	60	100	2
9	B24-CE-378	Survey Camp - Viva	0:0:2	2	1	--	40	60	100	2
10	B23-VAC-302/ B23-VAC-304/ B23-VAC-306/ B23-VAC-308/ B23-VAC-310	Hindi Language Skills / Sanskrit Language Skills/ German Language Skills/ Japanese Language Skills/ French Language Skills	2:0:0	2	1	-	100	-	100	3
11		Professional Elective Course (PEC-02)	4:0:0	4	4	70	30	--	100	3
12		Open Elective Course (OEC-1)	3:0:0	3	3	70	30	--	100	3
TOTAL				31	26	490	470	240	1200	

LIST OF PROFESSIONAL ELECTIVE COURSES (PEC-02)

B24-CEP-326	ENGINEERING GEOLOGY
B24-CEP-328	AIRPORT PLANNING AND DESIGN
B24-CEP-330	OPEN CHANNEL FLOW

LIST OF OPEN ELECTIVE COURSES (OEC-01)

B24-CEO-332	INTRODUCTION TO AI
B24-CEO-334	HUMAN RESOURCE DEVELOPMENT
B24-CEO-336	SOFT SKILL & INTERPERSONAL COMMUNICATION

SEMESTER-V
(W.E.F. 2026-27 ONWARDS)

B. TECH CIVIL
ENGINEERING

B24-CE-301		Structural Analysis -II					
Lecture	Tutorial	Practical	Credit	End-of-Semester Exam	Internal Assessment	Total	Duration of Exam
3	0	0	3	70	30	100	3
Course Outcomes (CO)							
CO1	Students will be able to understand behavior of statically determinate structures.						
CO2	Students will be able to analyze the behavior of rolling load on structures.						
CO3	Students will be able to analyze the frames structures.						
CO4	Students will be able to drive methods for stiffness and flexibility.						

UNIT I

Deflection of statically determinate structures: Deflection of determinate beams by moment area and conjugate beam methods, Deflection of determinate pin-jointed trusses and rigid-jointed frames by the principle of virtual work (unit load method), Strain Energy and Castigliano theorems. Application of Castigliano's theorem of least work to propped cantilevers, fixed beams, and continuous beams.

UNIT II

Rolling Loads: Introduction, Single concentrated load, uniformly distributed load longer than span, shorter than span, two-point loads, several point loads, Max. B.M. and S.F. Absolute, Max.

UNIT III

Kani's Method: Analysis of continuous beams and simple frames, analysis of frames with different column lengths and end conditions of the bottom story.

UNIT IV

Approximate Analysis of frames: (i) For vertical loads, (ii) for lateral loads by the Portal method & the Cantilever method.

Matrix Methods: Introduction, Stiffness Coefficients, Flexibility Coefficients, development of flexibility & stiffness matrices for plane frame, Global axis and local axis, analysis of plane frame, pin jointed and rigid jointed.

Text/Reference Books:

1. Theory of Structures-Vol. I&II-S. P. Gupta & G. S. Pandit, Tata McGraw-Hill, N. Delhi
2. Structural Analysis-A unified classical & Matrix Approach, A. Ghali & A. M. Neville, Chapman & Hall, London
3. Advanced Structural Analysis-A. K. Jain, Nem Chand & Bros., Roorkee.
4. Structural Analysis-A Unified Approach, D. S. Prakash Rao, University Press, Hyderabad.
5. Indeterminate structures, R. L. Jindal S. Chand & Co., N. Delhi.

B24-CE-303		Surveying & Geomatic Engineering -II					
Lecture	Tutorial	Practical	Credit	End-of-Semester Exam	Internal Assessment	Total	Duration of Exam
3	0	0	3	70	30	100	3
Course Outcomes (CO)							
CO1	Students will be able to understand the basics of advanced surveying techniques used in various fields of civil engineering.						
CO2	Students will be able to know the fundamental interaction principles of electromagnetic radiation						
CO3	Students will be able to effectively process and analyze remote sensing data.						
CO4	Students will be able to figure out the applications of photogrammetry in surveying						

UNIT I

Introduction to Geomatic Engineering: Introduction to GIS, GPS, and DEM, Components of GIS, Application of GIS in civil engineering.

Remote Sensing: Fundamentals, EMS, RS System, Active and Passive radiation, Electromagnetic Radiation, Thermal Emission – Planck’s formula, Stefan–Boltzmann Law, Wein’s Displacement Law; Emissivity – Kirchhoff’s Law.

UNIT II

Interaction of EMR with Atmosphere: Characteristics of Solar Radiant Energy, Application of remote sensing to various engineering fields, Scattering, Refraction, Absorption, Transmission.

Interaction of EMR with Earth Surface: Spectral Reflectance Curves. Interaction of the Earth's surface with EM radiation in visible, NIR, TIR, and Microwave regions.

UNIT III

Sensors and Platforms: Platforms, IRS satellite systems – Introduction, Stages of development, Sensors, Types of scanning systems.

Data Processing: Initial data statistics. Pre-processing – Atmospheric, Radiometric, and Geometric corrections, Image Histogram.

UNIT IV

Data analysis: Image Interpretation Elements, Keys, and Aids. Basic Instrumentation. Visual analysis of data.

Photogrammetry: Aerial and terrestrial, applications, types, and geometry of aerial photographs, flight planning, relief displacement, stereoscopic vision, and stereoscopies.

Text/Reference Books:

1. Geomatic Engineering, Manoj K Arora, RC Badjatiya, Nem Chand & Bros
2. Remote Sensing and Image Interpretation, Lillisand, T.M. & Kiefer R.W., John Wiley and Sons
3. Introduction to Remote Sensing, Campbell, J.B. Taylor and Francis.
4. Principles of Geographic information systems, Burrough, P.A and MacDonnel
5. Concepts and Techniques of GIS, C.P.Lo, Albert K.W.Yeung.

B24-CE-305		Fluid Mechanics-II					
Lecture	Tutorial	Practical	Credit	End-of-Semester Exam	Internal Assessment	Total	Duration of Exam
3	0	0	3	70	30	100	3
Course Outcomes (CO)							
CO1	Students will understand the Laminar flow, Stokes law.						
CO2	Students will learn to calculate fluid pressure, forces on surfaces, and Open channel flow.						
CO3	Students will apply equations of motion and use flow measurement techniques to solve problems related to compressible flow.						
CO4	Students will study the working and principles of the pump & Turbine.						

UNIT I

Laminar Flow: Navier-Stokes equation, Laminar flow between parallel plates, laminar flow through pipes-Hagen-Poiseuille law, laminar flow around a sphere- Stokes ' law.

Flow through pipes: Types of flows- Reynolds' experiment, shear stress on turbulent flow, boundary layer in pipes-Establishment of flow, velocity distribution for turbulent flow in smooth and rough pipes, resistance to flow of fluid in smooth and rough pipes, Stanton and Moody's diagram. Darcy's Weisbach equation, other energy losses in pipes, loss due to sudden expansion, hydraulic gradient and total energy lines, pipes in series and in parallel, equivalent pipe, branched pipe, pipe networks, Hardy-Cross method, water hammer.

UNIT II

Drag and Lift: Types of drag, drag on a sphere, flat plate, cylinder, and airfoil, development of lift on immersed bodies like circular cylinder and airfoil.

Open Channel Flow: Type of flow in open channels, geometric parameters of channel section, uniform flow, most economical section (rectangular and trapezoidal), specific energy and critical depth, momentum in open channel, specific force, critical flow in rectangular channel, applications of specific energy and discharge diagrams to channel transition, metering flumes, hydraulic jump in rectangular channel, surges in open channels, positive and negative surges, gradually varied flow equation and its integration, surface profiles.

UNIT III

Compressible flow: Basic relationship of thermodynamics, continuity, momentum, and energy equations, propagation of elastic waves due to compression of fluid, Mach number and its significance, subsonic and supersonic flows, propagation of elastic waves due to disturbance in fluid Mach cone, stagnation pressure.

UNIT IV

Pumps and Turbines: Reciprocating pumps, their types, and work done by single-and double-acting pumps. Centrifugal pumps, components and parts, and working, types, heads of a pump, statics, and manometric heads. Force executed by fluid jet on stationary and moving flat vanes, Turbines-classifications of turbines based on head and specific speed, component and working of Pelton wheel and Francis turbines, cavitation and setting of turbines.

Text/Reference Books:

1. Fluid Mechanics and Hydraulic Machines, Dr. R.K. Bansal, Luxmi Publication
2. Hydraulic and Fluid Mechanics by P. N. Modi & S. M. Seth
3. Introduction to Fluid Mechanics by Robert N. Fox & Alan T. Macnold
4. Flow in Open Channels by S. Subraminayam

B24-CE-307		Geotechnical Engineering					
Lecture	Tutorial	Practical	Credit	End-of-Semester Exam	Internal Assessment	Total	Duration of Exam
3	0	0	3	70	30	100	3
Course Outcomes (CO)							
CO1	Demonstrate knowledge of sub-surface exploration techniques, soil sampling, sounding methods (SPT, SCPT, DCPT), and geophysical approaches for site investigation.						
CO2	Apply suitable drainage and dewatering methods to manage groundwater conditions and improve soil stability for construction projects.						
CO3	Analyze and design shallow foundations considering bearing capacity, settlement behavior, IS Code recommendations, and methods of improvement.						
CO4	Evaluate and design deep foundation systems, including piles, drilled piers, caissons, and well foundations, with emphasis on load capacity, group behavior, settlement, and construction practices.						

UNIT I

Sub-Surface Exploration: Purpose, Stages in Soil Exploration, Depth and Lateral Extent of Exploration, Guidelines for Various Types of Structures, Groundwater Observations, Excavation and Boring Methods, Soil Sampling and Disturbance, Major Types of Samplers. Sounding methods – SCPT, DCPT, SPT & interpretation, and geo-physical methods.

Drainage & Dewatering: Introduction, ditches and sumps, well point systems, shallow well system, deep well drainage, vacuum method, electro-osmosis, consolidation by sand piles, eductor method.

UNIT II

Shallow Foundations – I: Location of footing, shear failure criterion, settlement criterion, ultimate bearing capacity, modes of shear failure, Rankine's analysis, Terzaghi's theory, Skempton's formula, effect of fluctuation of G.W.T., effect of eccentricity on bearing capacity, IS Code recommendations, factors affecting bearing capacity, methods of improving bearing capacity.

Shallow Foundations – II: Causes of settlement of foundation, allowable bearing pressure based on settlement, settlement calculation, elastic and consolidation settlement, allowable settlement according to IS Code, plate load test and its interpretation, bearing capacity from penetration tests, design bearing capacity. Situation suitable for shallow foundations, types of shallow foundations, and their relative merits,

UNIT III

Pile Foundations I: Introduction, necessity of pile foundations, classification of piles, load capacity, static analysis, analysis of pile capacity in sands and clays, dynamic analysis, pile load tests, negative skin friction, batter piles, lateral load capacity, uplift capacity of single pile, under-reamed pile.

Pile Foundations II: Group action in piles, pile spacing, pile group capacity, stress on lower strata, settlement analysis, design of pile caps, negative skin friction of pile group, uplift resistance of pile group, lateral resistance, batter pile group.

UNIT IV

Drilled Piers: Drilled piers – types, uses, bearing capacity, settlement, construction procedure, caissons – types, bearing capacity and settlement, construction procedure.

Well foundation: shapes, depth, components, factors affecting well foundation design, lateral stability, construction procedure, sinking of wells, rectification of tilts and shifts, and recommended values of tilts & shifts as per IS 3955.

Text/Reference Books:

1. Soil Mechanics by Craig R.F., Chapman & Hall
2. Fundamentals of Soil Engineering by Taylor, John Wiley & Sons
3. An Introduction to Geotechnical Engineering, by Holtz R.D. and Kovacs, W.D., Prentice Hall, NJ
4. Principles of Geotechnical Engineering, by Braja M. Das, Cengage Learning
5. Principles of Foundation Engineering, by Braja M. Das, Cengage Learning
6. Essentials of Soil Mechanics and Foundations: Basic Geotechnics by David F. McCarthy
7. Soil Mechanics in Engineering Practice by Karl Terzaghi, Ralph B. Peck, and Gholamreza Mesri.
8. Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering by V.N.S. Murthy

B24-CE-309		Transportation Engineering-II					
Lecture	Tutorial	Practical	Credit	End-of-Semester Exam	Internal Assessment	Total	Duration of Exam
3	0	0	3	70	30	100	3
Course Outcomes (CO)							
CO1	Students will be able to study different types of pavements and their design						
CO2	Students will study highway construction using bituminous and non-bituminous pavement						
CO3	Students will study highway maintenance and hill road design						
CO4	Students will study highway economics and tunnels						

UNIT-I

Design of Flexible Pavements: Types of pavements. Flexible and rigid pavements. Components of a pavement and their functions. Factors affecting the design of pavements. Design of thickness of a flexible pavement using the CBR method (including the latest IRC guidelines) and the Triaxial method.

Design of Rigid Pavements: Critical combination of stresses. IRC guidelines for the determination of the thickness of a rigid pavement. Joints: requirements, types, patterns. Spacing of expansion and contraction joints. Functions of dowel and tie bars.

UNIT-II

Highway Construction: Non-Bituminous Pavements: Brief introduction to earthwork machinery: shovel, hoe, clamshell, dragline, bulldozers. Principles of field compaction of subgrade. Various Compacting equipment. Construction steps of WBM. WMM. Construction of cement concrete pavements.

Construction of Bituminous Pavements: Various types of bituminous constructions. Prime coat, tack coat, seal coat, and surface dressing. Construction of BM, DBM. Brief coverage of machinery for the construction of bituminous roads: bitumen boiler, sprayer, pressure distributor, hot-mix plant, cold-mix plant.

UNIT-III

Highway Maintenance: Pavement failures. Maintenance of WBM, bituminous surfaces, and cement concrete pavements. Pavement evaluation. Benkelman beam method

Highway Drainage and Hill Roads: Surface drainage: types, brief design. Types of sub-surface drainage. Special characteristics of hill roads: construction of hill roads, drainage of hill roads, and maintenance problems of hill roads

UNIT-IV

Highway Economics and Finance: Need for economic evaluation. Highway user benefits and costs. Methods of economic evaluation: benefit-cost ratio method, net present value method, and internal rate of return method.

Tunnels: Sections of tunnels: advantages, limitations. Shaft & Pilot tunnel. Driving tunnel in rocks: sequence of construction operations, full face method, heading and bench method, drift method.

Books:

1. Highway Engineering by S. K. Khanna & C.E.G. Justo, Nem Chand Bros., Roorkee.
2. Principles and Practice of Highway Engineering. By L. R. Kadiyali, Khanna Publishers, Delhi.
3. Principles of Pavement Design by Yoder, E.J., E.J., & Witczak, M. W, John Wiley and Sons, USA.
4. Tunnel Engineering by S. C. Saxena, Dhanpat Rai Publications, N. Delhi.
5. A textbook of Tunnel, Bridges and Railway Engineering by S.P. by S. P. Bindra, Dhanpat Rai, Delhi.

B24-CE-371		Geotechnical Engineering Lab					
Lecture	Tutorial	Practical	Credit	Internal Assessment	Practical Exam	Total	Duration of Exam
0	0	2	1	40	60	100	2
Course Outcomes (CO)							
CO1	Perform grain size analysis, shrinkage limit determination, and relative density tests to classify and evaluate soil properties.						
CO2	Conduct triaxial and consolidation tests to analyze soil strength, compressibility, and pore water pressure behavior.						
CO3	Apply field testing methods such as undisturbed sampling, standard penetration test, and dynamic cone penetration test for site investigation.						
CO4	Demonstrate the ability to carry out model plate load tests and interpret results for assessing bearing capacity and settlement of foundations.						

List of Experiments:

1. Grain Size Analysis-Hydrometer method.
2. Shrinkage Limit Determination.
3. Relative Density of Granular Soils.
4. Consolidated Drained (CD) Triaxial Test.
5. Consolidated Undrained (CU) Triaxial Test with Pore Water Pressure measurement.
6. Consolidation Test.
7. Undisturbed Sampling.
8. Standard Penetration Test.
9. Dynamic Cone Penetration Test.
10. Model Plate Load Test.

Text/Reference Books:

1. Soil Testing for Engineers by S. Prakash & P. K. Jain, Nem Chand & Bros. Roorkee.
2. Engineering Soil Testing by Lambi, Wiley-Eastern.
3. Engineering Properties of Soils & Their Measurement by JE Bowles, McGraw-Hill.
4. Soil Engineering in Theory & Practice by Alam Singh, Vol. II, Geotechnical Testing & Instrumentation, CBS Pub.

B24-CE-373		Fluid Mechanics Lab -II					
Lecture	Tutorial	Practical	Credit	Internal Assessment	Practical Exam	Total	Duration of Exam
0	0	2	1	40	60	100	2
Course Outcomes (CO)							
CO1	Identify and characterize flow patterns and regimes.						
CO2	Demonstrate practical understanding of principles, equations, and instruments of fluid flow-related phenomena.						
CO3	Discuss the differences among measurement techniques, their relevance, and applications.						
CO4	Demonstrate the ability to write clear lab reports and understand ethical issues associated with decision making.						

LIST OF EXPERIMENTS

1. To determine the coefficient of drag by Stokes' law for spherical bodies.
2. To determine head loss due to various pipe fittings.
3. To study the phenomenon of cavitation in pipe flow.
4. To determine the characteristics of a centrifugal pump.
5. To determine the critical Reynolds number for flow through commercial pipes.
6. To determine the coefficient of discharge for flow over a broad crested weir.
7. To study the characteristics of a hydraulic jump on a horizontal floor and a sloping glacis, including friction blocks.
8. To study the scouring phenomenon around a bridge pier model.
9. To study the scouring phenomenon for flow past a spur.
10. To study the momentum characteristics of a given jet.

Note: Students are required to complete at least 8 experiments from the above list.

B24-CE-375		Structure Analysis- II Lab					
Lecture	Tutorial	Practical	Credit	Internal Assessment	Practical Exam	Total	Duration of Exam
0	0	2	1	40	60	100	2
Course Outcomes (CO)							
CO1	Verify fundamental theorems like reciprocal, moment area, and influence line through experiments on beams, arches, Muller Breslau principle and trusses.						
CO2	Analyze structural behavior, including deflections and stresses, in curved members, beams, trusses, and struts under various conditions						
CO3	Experimentally determine the material properties of construction materials like steel, concrete, and bricks for use in structural analysis.						
CO4	Experimentally understand the forces in the compression and tension members.						

LIST OF EXPERIMENTS

1. Experiment on a two-hinged arch for horizontal thrust & influence line for Horizontal thrust
2. Experimental and analytical study of a 3-bar pin-jointed Truss.
3. Experimental and analytical study of deflections for unsymmetrical bending of a Cantilever beam.
4. Begg's deformeter- verification of Muller Breslau principle.
5. Experimental and analytical study of an elastically coupled beam.
6. Determine the Forces in members of redundant frames.
7. Sway in portal frames -demonstration.

B24-MAC-301		Constitution of India					
Lecture	Tutorial	Practical	Credit	Internal Assessment	Practical Exam	Total	Duration of Exam
2	0	0	1	100	0	100	3
Course Outcomes (CO)							
CO1	The students will be able to know about the salient features of the Constitution of India.						
CO2	To know about the fundamental duties and the federal structure of the Constitution of India.						
CO3	To know about the emergency provisions in the Constitution of India.						
CO4	To know about fundamental rights under the Constitution of India.						

UNIT-I

Meaning of the constitution law and constitutionalism, Historical perspective of the Constitution of India. Salient features and characteristics of the Constitution of India. Scheme of the fundamental rights

UNIT -II

The scheme of the Fundamental Duties and its legal status. The Directive Principles of State Policy – Its importance and implementation. Federal structure and distribution of legislative and financial powers between the Union and the States.

Parliamentary Form of Government in India – The Constitution, Powers, and Status of the President of India

UNIT - III

Amendment of the Constitutional Powers and Procedure. Historical Perspectives on Constitutional Amendments in India.

Emergency Provisions: National Emergency, President Rule, Financial Emergency. Local Self-Government – Constitutional Scheme in India.

UNIT-IV

Scheme of the Fundamental Right to Equality. Scheme of the Fundamental Right to certain Freedom under Article 19. Scope of the Right to Life and Personal Liberty under Article 21.

Books

1. Constitution of India. Prof. Narender Kumar (2008) 8th edition. Allahabad Law Agency.
2. The Constitution of India. P.M. Bakshi (2016) 15th Edition. Universal law Publishing

Professional Elective Course -01

B24-CEP-320		Hydrology					
Lecture	Tutorial	Practical	Credit	End-of-Semester Exam	Internal Assessment	Total	Duration of Exam
4	0	0	4	70	30	100	3
Course Outcomes (CO)							
CO1	Students will be able to get better knowledge about the total precipitation in the particular area using different rain gauges						
CO2	Students will be able to measure the evaporation, transpiration and infiltration and can analyze the measured data.						
CO3	Students will be able to calculate the total runoff and able to draw hydrographs for the different durations of rainfall and can predict the future runoff.						
CO4	Students will be able to get the knowledge of ground water, its quality and efficiency of the ground storage.						

UNIT I

Introduction: Hydrologic cycle, scope and application of hydrology to engineering problems, drainage basins and its characteristics, stream geometry, hypsometric curves.

Precipitation: Forms and types of precipitation, characteristics of precipitation in India, measurement of Precipitation, recording and non-recording rain gauges, rain gauge station, rain gauge network, estimation of missing data, presentation of rainfall data, mean precipitation, depth -area –duration relationship, frequency of point rainfall, intensity-duration- frequency curves, probable max. precipitation.

UNIT II

Evaporation & Transpiration: Process, evaporimeters and empirical relationships, analytical method, reservoir evaporation and methods of its control, transpiration, evapotranspiration and its measurement, Penman's equation and potential evapotranspiration.

Infiltration: Infiltration process, initial loss, infiltration capacity and measurement of infiltration, infiltration indices.

UNIT III

Runoff: Factor affecting run-off, estimation of runoff, rainfall-runoff relationships, measurement of stage-staff gauge, wire gauge, automatic stage recorder and stage hydrograph, measurement of velocity-current meters, floats, area velocity method, moving boat and slope area method, electromagnetic, ultra-sonic and dilution methods of stream flow measurement, stage discharge relationship

Hydrograph: Discharge hydrograph, components and factors affecting shape of hydrograph, effective rainfall, unit hydrograph and its derivation, unit hydrograph of different durations, use and limitations of UH, triangular UH, Snyder's synthetic UH, floods, rational methods, empirical formulae.

UNIT IV

Floods and Flood Routing: Flood frequency studies, recurrence interval, Gumbel's Method, flood routing, reservoir flood routing, channel flood routing and flood plain mapping.

Ground Water: Occurrence, types of aquifers, compressibility of aquifers, water table and its effects on fluctuations, wells and springs, movement of ground water, Darcy's law, permeability and its determination, porosity, specific yield and specific retention, storage coefficient, transmissibility.

Text/Reference Books:

1. Engineering Hydrology by K. Subramanya, TMH, New Delhi
2. Hydrology by HM Ragoonath
3. Hydrology for Engineers by Linsely, Kohler, Paulhus.
4. Elementary Hydrology by V.P.Singh

B24-CEP-322		Rock Mechanics					
Lecture	Tutorial	Practical	Credit	End-of-Semester Exam	Internal Assessment	Total	Duration of Exam
4	0	0	4	70	30	100	3
Course Outcomes (CO)							
CO1	Demonstrate understanding of rock mass and material properties, effects of discontinuities, engineering classification, hardness, rock pressure, and subsidence.						
CO2	Apply methods of rock exploration including direct penetration, core boring, core recovery, rock quality designation, fracture frequency, calyx hole drilling, and core logging.						
CO3	Conduct sampling and laboratory tests such as uniaxial compressive strength, Protodykanov index, tensile, flexural, shear, punch shear, and in-situ strength tests.						
CO4	Analyze rock behavior under pressure arch theory, evaluate creep, convergence, rock burst, coal bumps, rock mass rating, and assess subsidence with protective measures.						

UNIT I

Rock mass & material form; Effects of discontinuities on rock mass. Physical properties of rocks, Mechanical properties of rocks. Engineering Classification of rock Masses (by deer & miller). Moh's scale of Hardness, Rock Pressure & Subsidence.

Unit II

Object and Methods of rock exploration, Rock exploration by direct penetration, Core boring Core recovery, Rock quality designation, Fracture frequency by indirect penetration, large diameter calyx hole Logging of core

Unit III

Sampling and Sample preparation, Specimen Uniaxial compressive strength Test; Protodykanov strength index. Tests for measuring rock strengths: Tensile strength tests, Flexural strength test, Shear strength test, Punch shear test, and In situ tests.

Unit IV

Rectangular opening, circular shaft & long wall working. Creep, Convergence, Rock burst & Coal bumps, Rock Mass Rating. Subsidence: Definition & factors governing subsidence. Angle of draw, line of break; Critical area, Subcritical area, supercritical area. Protective measures against Subsidence.

Books:

1. Fundamentals of Rock Mechanics” by J C Jaeger and N G W Cook
2. Rock Mechanics and Design Structures of Rock” by Obert and W I Duvall

B24-CEP-324		Pavement Materials					
Lecture	Tutorial	Practical	Credit	End-of-Semester Exam	Internal Assessment	Total	Duration of Exam
4	0	0	4	70	30	100	3
Course Outcomes (CO)							
CO1	Demonstrate understanding of soil classification, compaction, strength evaluation, stabilized pavement materials, and properties of road aggregates for flexible and rigid pavements.						
CO2	Explain the origin, preparation, properties, and tests of bitumen, and apply criteria for selecting suitable binders.						
CO3	Analyze bituminous cutbacks and emulsions, perform relevant tests, and evaluate polymer-modified and rubber-modified bitumen for pavement applications.						
CO4	Assess the mechanical properties of bituminous mixes, apply mix design methods and specifications, and design concrete mixes, including polymer composites and fibre reinforced concrete, as per IRC standards.						

Unit I

Soil - Classification, characteristics, compaction, evaluation of soil strength; stabilized pavement materials;

Aggregates: requirements, properties, and tests on road aggregates for flexible and rigid pavements.

Unit II

Bitumen: Origin, preparation, properties and tests, constitution of bituminous road binders, Tests on Bituminous materials. Criterion for selection of different binders.

Unit III

Bituminous Cutbacks and Emulsions: Different types of cutbacks, various tests of cutback, Preparation of bituminous emulsion, uses of bitumen emulsion, Various tests for Bitumen emulsion. Polymer-modified bitumen and rubber-modified bitumen.

Unit IV

Bituminous Mixes: Mechanical properties: Resilient modulus, dynamic modulus, and fatigue characteristics of bituminous mixes. bituminous mix design methods and specifications.

Concrete Mixes: Concrete Mix Design, Polymer Concrete Composites, Fibre-Reinforced Concrete. Relevant IRC standard for concrete mix design.

Recommended Books

1. Principles of Transportation Engineering by Chakroborty & Das, Prentice Hall, India
2. Highway Engineering by S.K. Khanna & C.E.G. Justo, Nem Chand Bros., Roorkee
3. Principles and Practice of Highway Engineering by L.R. Kadiyali, Khanna Publishers, Delhi
4. Principles of Transportation and Highway Engineering by G.V. Rao, Tata McGraw-Hill Publishing Co. Ltd., New Delhi
5. Alternative Materials in Road Construction by P.T. Sherwood, Thomas Telford Publication, London
6. Civil Engineering Materials, Second Edition by Shan Somayaji, Prentice Hall Inc.
7. MORTH Specifications for Road and Bridge Works, IRC Publication
8. Relevant IRC / IS Codes

*****End of semester V*****

SEMESTER-VI
(W.E.F. 2026-27 ONWARDS)

B. TECH CIVIL
ENGINEERING

B24-CE-302		Design of Steel Structure -I					
Lecture	Tutorial	Practical	Credit	End-of-Semester Exam	Internal Assessment	Total	Duration of Exam
3	0	0	3	70	30	100	3
Course Outcomes (CO)							
CO1	To provide students a fundamental understanding of steel as a structural material, IS:800 design principles, and the ability to design safe and efficient steel members and their connections such as riveted/bolted joints and tension members in real structures.						
CO2	To understand and design steel compression members including columns, built-up sections, and their connections for safe load carrying.						
CO3	To understand the behavior and design of different steel beams considering bending and buckling for safe load-carrying capacity.						
CO4	To understand the loads, behavior and design of gantry girders, plate girders and beam-column connections for efficient and safe industrial steel structures.						

UNIT I

Introduction: Loads, structural steels and their specifications, structural elements, steel vs. concrete and timber, design specifications as per IS: 800, structural layout, strength and stiffness considerations, efficiency of cross-section, safety and serviceability considerations.

Riveted/Bolted Connections: Riveting and bolting, their types, Types of welded joints (theory), failure of riveted joint, efficiency of a joint, design of riveted joint, concentric riveted joints, advantages and disadvantages of bolted connections, stresses in bolts.

UNIT II

Design of Tension Members: Introduction, types of tension members, net sectional areas, design of tension members, lug angles, and splices.

Design of Compression Members: Introduction, effective length and slenderness ratio, various types of sections used for columns, built-up columns, necessity, design of built-up columns, laced and battened columns, including the design of lacing and battens, design of eccentrically loaded compression members.

UNIT III

Design of Beams: Introduction, types of sections, general design criteria for beams, design of laterally supported and unsupported beams, design of built-up beams, web buckling, web crippling and diagonal buckling.

UNIT IV

Gantry Girders: Introduction, various loads, specifications, design of gantry girder.

Plate Girder: Introduction, elements of plate girder, design steps of a plate girder, necessity of stiffeners in plate girder, various types of stiffeners, web and flange splices (brief introduction), Curtailment of flange plates, design beam to column connections: Introduction, design of framed and seat connection.

Text/Reference Books:

1. Design of steel structures, S.K.Duggal, TMH Pub., New Delhi
2. Design of steel structures, Dr.B.C.Punmia, Luxmi Publication
3. Design of steel structures-I, Dr. Ram Chandra, Scientific Publisher, Jodhpur
4. Design of steel structures, A.S.Arya & J.L.Ajmani, Nem chand & Bros., Roorkee.Design of steel structures-I, Dr. Ram Chandra, Scientific Publisher, Jodhpur
5. Design of steel structures, A.S.Arya & J.L.Ajmani, Nem chand & Bros., Roorkee.
6. Design of steel structures, M.Raghupati, TMH Pub., New Delhi.

B24-CE-304		Design of Concrete Structure -I					
Lecture	Tutorial	Practical	Credit	End-of-Semester Exam	Internal Assessment	Total	Duration of Exam
3	0	0	3	70	30	100	3
Course Outcomes (CO)							
CO1	Students will able to understand the properties of concrete materials and the design principles of RCC, and apply IS code provisions to design safe and durable reinforced concrete structures.						
CO2	Students will able to analyze and design singly and doubly reinforced beams using Working Stress Method and Limit State Method, ensuring proper reinforcement requirements for safe and efficient structural performance.						
CO3	Students will able to design RCC beams for shear, bond and torsion, and also analyze and design various types of columns and footings as per IS code to ensure safety and stability of structures.						
CO4	Students will able to provide proper reinforcement detailing and check serviceability requirements like deflection and cracking, along with designing one-way and two-way slabs as per IS code for safe and durable construction.						

UNIT I

Elementary treatment of concrete technology: Cement, Physical requirements of cement, aggregate, admixture and reinforcement, Strength and durability, shrinkage and creep. Design of concrete mixes, Acceptability criterion, I.S. Specifications.

Design Philosophies in Reinforced Concrete: Basic assumptions of Working stress method and limit state methods, Types of section of beam, Normal distribution curve, characteristic strength and characteristic loads, design values, Partial safety factors and factored loads, stress-strain relationship for concrete and steel.

UNIT II

Working Stress Method: Permissible stresses in concrete and steel, Moment of resistance in singly and doubly reinforced beams, design of singly and doubly reinforced rectangular and flanged beams in flexure, design examples.

Limit State Method: Analysis and design of singly and doubly reinforced rectangular and flanged beams, minimum and maximum reinforcement requirements, and design examples.

UNIT III

Analysis and Design of Sections in shear bond and torsion: Diagonal tension, shear reinforcement, development length, Anchorage and flexural bond, Torsional stiffness, equivalent shear, Torsional reinforcement, Design examples.

Columns and Footings: Effective length, Minimum eccentricity, short columns under axial compression, Uniaxial and biaxial bending, slender columns, Isolated and wall footing, and design example.

UNIT IV

One-Way and Two-Way Slabs: General Considerations, Design of One-Way and Two-Way Rectangular Slabs for Distributed and Concentrated Loads, Design Examples.

Serviceability Limit State: Control of deflection, cracking, slenderness and vibrations, deflection and moment relationship for limiting values of span to depth, limit state of crack width, Design examples.

Text/Reference Books:

1. Reinforced Concrete Design, S.N. Sinha, TMH Pub, N. Delhi
2. Reinforced Concrete, I.C. Syal & A, K, Goel, A.H, Wheeler & Co. Delhi.
3. SP-34(S&T)-1987 'Handbook on Concrete Reinforcement and Detailing', BIS, N. Delhi.
4. SP-16(S&T)-1980, 'Design Aids for Reinforced Concrete to IS:456, BIS, N. Delhi.

B24-CE-306		Environmental Engineering – II					
Lecture	Tutorial	Practical	Credit	End-of-Semester Exam	Internal Assessment	Total	Duration of Exam
2	0	0	2	70	30	100	3
Course Outcomes (CO)							
CO1	Students will study the effect of waste water on streams.						
CO2	Students will study the working process of treatment plant.						
CO3	Students will study the Determine the characteristics of sewage, its variation in flow due to weather, and the design of the sewer.						
CO4	Students will study about the standard for disposal.						

UNIT I

Collection of sewage: Importance of sanitation, Systems of sewerage – separate, combined and partially separate. Quantity of sanitary sewage and variations. Shapes of sewer – circular and egg shaped. Design of sewers, self-cleansing velocity and slopes, Construction and testing of sewer lines. Sewer materials. joints and appurtenances.

UNIT II

Sewage Characterization: Quality parameters- BOD, COD, Solids, D.O., Oil & Grease. Indian Standards for the Disposal of Effluents into Inland Surface Sources and on Land.

UNIT III

Sewage Treatment: Objectives, sequence and efficiencies of conventional treatment units. Preliminary treatment, screening and grit removal units. Theory and design aspects of primary treatment, secondary treatment- activated sludge process & its modifications, Trickling filter, sludge digestion and drying beds. Stabilization pond, aerated lagoon, UASB process, septic tank and Imhoff tank

UNIT IV

Disposal of Sewage: Disposal of sewage by dilution – self-purification of streams. Sewage disposal by irrigation (sewage treatment).

Text/Reference Books:

1. Environmental Engineering, Vol. II, S.K. Garg, Khanna Publishers, New Delhi
2. Waste Water Treatment by M.N. Rao & A.K. Dutta.
3. Water Supply Engineering, P.N. Modi, Standard Book House, New Delhi.
4. Ministry of Environment, Forest and Climate Change (MoEFCC). (1986). Environment (Protection) Rules, 1986 - Schedule VI.
5. Industrial and Hazardous Waste Treatment by N.L. Nemerow & A. Dasgupta.

B24-CE-308		Irrigation Engineering -II					
Lecture	Tutorial	Practical	Credit	End-of-Semester Exam	Internal Assessment	Total	Duration of Exam
3	0	0	3	70	30	100	3
Course Outcomes (CO)							
CO1	Understand the fundamental concepts of Canal Falls, cross regulator, or head regulator						
CO2	Understand the fundamental concepts of Aqueducts, level crossings, and diversion canal headwork.						
CO3	Understand the fundamental concepts of Dams, control of seepage, and filter design.						
CO4	Understand the fundamental concepts of Spillway and energy dissipaters.						

UNIT I

Regulation works: Canal falls-necessity and location, development of falls, design of cistern element, roughening devices, design of Sarda type fall, and design of straight Glacis fall. Off-take alignment, cross-regulators, and distributaries, head regulators, devices to control silt entry into the off-taking channel, silt ejectors, canal escapes, and types of escapes.

UNIT II

Cross drainage works: Classification and their selection, hydraulic design aspects of aqueducts, syphon aqueducts, super passage, canal syphon, and level crossing, design of transitions.

Diversion canal headworks: Various components and their functions, layout plan, site selection for diversion headworks, Bligh's creep theory, Khosla's method of independent variables, use of Khosla's curves, various corrections, and silt excluders.

UNIT III

Storage Headworks: Types of dams, selection of a site, gravity dam-two-dimensional design, forces acting, stability criterion, elementary profile of a dam, cutoffs and drainage galleries, arch dams-constant angle and constant radius arch dam, simple design and sketches, most economical angle, Earth dam, design principles, seepage through earth dams, seepage line, control of seepage, design of filters.

UNIT IV

Spillways and Energy Dissipaters: Essential requirements of spillway and spillway's capacity, types of spillways and their suitability, Ogee spillways, chute, side channel, shaft and syphon spillways, energy dissipation below spillways, stilling basins, USBR and I.S. Stilling Basins.

Text/Reference Books:

1. Garg S. K., "Irrigation Engineering and Hydraulic Structures", Khanna Publishers, 23rd Revised Edition, New Delhi, 2009
2. Dilip Kumar Majumdar, "Irrigation Water Management", Prentice-Hall of India, New Delhi, 2008
3. Punmia B.C., et. al; Irrigation and water power Engineering, Laxmi Publications, 16th Edition, New Delhi, 2009
4. Duggal, K.N. and Soni, J.P., "Elements of Water Resources Engineering", New Age International Publishers, 2005
5. Linsley R.K. and Franzini J.B, "Water Resources Engineering", McGraw-Hill Inc, 2000

B24-CE-310		Concrete Technology					
Lecture	Tutorial	Practical	Credit	End-of-Semester Exam	Internal Assessment	Total	Duration of Exam
3	0	0	3	70	30	100	3
Course Outcomes (CO)							
CO1	Demonstrate understanding of concrete constituents, including cement, pozzolanic materials, aggregates, and preparation of concrete.						
CO2	Apply mix design methods (IS & ACI), evaluate the properties of both fresh and hardened concrete, and analyze factors that influence workability, durability, and structural performance.						
CO3	Perform non-destructive testing of concrete and interpret results to assess strength, quality, and serviceability.						
CO4	Identify causes of deterioration, recommend preventive measures, and evaluate repair technologies and special concretes such as lightweight, high-strength, fibre-reinforced, polymer composites, and prestressed concrete						

Unit I

Introduction: Introduction of Concrete, preparation of concrete, grades of concrete, advantages of concrete, concept of quality control.

Cement: Introduction of Cement, ingredients in cement, basic chemistry, types of cement, ordinary Portland cement, rapid hardening cement, low heat cement, sulphate resistant cement, Portland-pozzolana cement, high strength Portland cement, high alumina cement, waterproof cement, hydrophobic cement, field and laboratory tests on cement. Pozzolanic materials: (Fly ash, metakaoline, iron slag, rice husk ash):-properties, applications & limitations.

Unit II

Aggregates: Aggregates, classification of aggregates based on size, shape, and textures, deleterious substances in aggregates, bulking of fine aggregates, sieve analysis, grading of aggregates as per IS-383-1970, fineness modulus, quality of mixing water, and curing water.

Production of Concrete: Introduction, design of mix by IS & ACI methods, including batching of materials, mixing of concrete materials, transportation of concrete, compaction of concrete, ready mixed concrete, vibrators (internal vibrators, external vibrators), concrete curing, and formwork removal.

Unit III

Properties of Concrete: Workability, factors influencing workability, measurement of workability, requirements of workability, properties of hardened concrete, stress and strain characteristics of concrete, Young's modulus of concrete, creep and shrinkage of concrete, permeability of concrete, durability of concrete, thermal properties of concrete, construction joints, expansion and contraction joints.

Non-Destructive Testing of Concrete: Significance of non-destructive testing, rebound hammer, ultrasonic pulse velocity techniques, pullout tests, vibration methods, radioactive techniques, cover meter, and core-tests.

Unit IV

Deterioration of Concrete & its Prevention: Causes of concrete deterioration, deterioration by water, surface wear, frost action, deterioration by chemical reactions, sulphate attack, alkali-

aggregate reaction, corrosion of embedded steel in concrete, and prevention of deterioration of concrete.

Special Concrete: Light-weight concrete – definition and its properties, applications; high-strength concrete – definitions, properties, and applications; mass concrete, waste material-based concrete, shotcrete, fibre-reinforced concrete – materials, fibre types and properties; ferrocement, polymer concrete composites, heavy-weight concrete for radiation shielding.

Books:

1. Neville A M and Brookes J J “Concrete Technology” Pearson Publishers, New Delhi, 1994.
2. Neville A M “Properties of Concrete” Pearson Publishers, New Delhi, 2004.
3. Gambhir M L “Concrete Technology” Tata McGraw Hill, New Delhi, 1995.
4. Shetty M S “Concrete Technology” S. Chand & Company, New Delhi, 2002.
5. Mehta P K “Microstructure of Concrete” Indian Concrete Institute and ACC, Bombay.

B24-CE-370		Irrigation Engineering Design & Drawing					
Lecture	Tutorial	Practical	Credit	Internal Assessment	Practical Exam	Total	Duration of Exam
0	0	2	1	40	60	100	2
Course Outcomes (CO)							
CO1	Apply principles of hydraulics and soil mechanics to design weirs, barrages, guide banks, and flood routing systems under varied flow conditions.						
CO2	Design and prepare detailed drawings of cross-drainage works including syphon aqueducts, falls (Sarda type, sloping glacis), and energy dissipation arrangements.						
CO3	Analyze seepage behavior in earth dams and determine drainage provisions for stability and safety of hydraulic structures.						
CO4	Evaluate and design spillways, stilling basins, and other energy dissipation devices, ensuring structural efficiency and compliance with standard practices.						

Complete design and drawing of the following:

1. Design of weirs and barrages on permeable foundation for surface and sub surface flow conditions.
2. Design of Guide Banks.
3. Flood Routing using step by step method.
4. Design of Syphon Aqueduct.
5. Design of Sarda type fall & sloping glacis fall.
6. Seepage line in a homogeneous earth dams on impermeable foundation with horizontal drainage.
7. Design of Ogee Spillway and stilling basin.

B24-CE-372		Concrete Technology Lab					
Lecture	Tutorial	Practical	Credit	Internal Assessment	Practical Exam	Total	Duration of Exam
0	0	2	1	40	60	100	2
Course Outcomes (CO)							
CO1	Determine the physical properties of cement, including consistency, setting time, fineness, specific gravity, soundness, and compressive strength.						
CO2	Evaluate fine and coarse aggregates through fineness modulus, bulk density, water absorption, and specific gravity tests.						
CO3	Perform concrete mix design, assess workability using slump, compaction factor, and flow table tests, and determine compressive, tensile, flexural, and bond strength of concrete.						
CO4	Apply non-destructive testing methods such as rebound hammer and ultrasonic pulse velocity, and evaluate the compressive strength of bricks and tiles as per IS standards.						

List of experiments

1. To determine the standard consistency and initial and final setting time of cement using Vicat's apparatus.
2. To determine the fineness of cement by sieve analysis and Blaine's air permeability method.
3. To determine the specific gravity of cement,
4. To determine the soundness of cement by Le Chatelier's apparatus.
5. To determine the compressive strength of cement.
6. To determine the fineness modulus, bulk density, water absorption, and specific gravity of fine aggregates / coarse aggregates.
7. Mix design of concrete by IS methods.
8. Workability of cement concrete by
 - a. The slump test
 - b. The compaction factor test
 - c. The flow table test.
9. To determine the compressive strength of concrete by the cube test.
10. To determine the split tensile and flexural strength of concrete.

Books Recommended:

1. Concrete Manual-M.L. Gambhir, Dhanpat Rai & Sons, N.Delhi.
2. Concrete Technology-M.L. Gambhir, Tata McGraw-Hill, N.Delhi.
3. Concrete Technology – Nevellie, Pearson Education.

B24-CE-374		Environmental Engineering-II Lab					
Lecture	Tutorial	Practical	Credit	Internal Assessment	Practical Exam	Total	Duration of Exam
0	0	2	1	40	60	100	2
Course Outcomes (CO)							
CO1	Analyze the fundamental physio-chemical characteristics of sewage including acidity, alkalinity, solids, oil and grease.						
CO2	Determine major inorganic constituents such as chlorides and sulphates, and assess their impact on wastewater quality.						
CO3	Evaluate organic pollution parameters through BOD, COD, and TOC tests to understand biodegradability and treatment requirements.						
CO4	Perform microbiological and microscopic examinations of sewage to identify fecal contamination and microbial activity.						

LIST OF EXPERIMENTS

1. To determine the acidity of a sewage sample.
2. To determine the alkalinity of a sewage sample.
3. To determine total, suspended, dissolved and settleable solids in a sewage sample.
4. To determine volatile and fixed solids in a sewage sample.
5. To determine oil and grease in a sewage sample.
6. To determine the chloride concentration in a sewage sample.
7. To determine the sulphate concentration in a sewage sample.
8. To determine the B.O.D. of a given sewage sample.
9. To determine the C.O.D. of a given sewage sample.

• **Professional Elective Course -02**

B24-CEP-326		Engineering Geology					
Lecture	Tutorial	Practical	Credit	End-of-Semester Exam	Internal Assessment	Total	Duration of Exam
4	0	0	4	70	30	100	3
Course Outcomes (CO)							
CO1	Students will be able to understand the importance of geological knowledge such as earth, earthquake, volcanism and the action of various geological agencies.						
CO2	Students will get basics knowledge on properties of minerals.						
CO3	Students will gain knowledge about types of rocks, their distribution and uses.						
CO4	Students will be able to apply geological and geophysical investigation techniques						

UNIT I

Introduction: Definition, object, scope, and subdivision of geology, The interior of the earth, crust, mantle, and core, Importance of geology in Civil Engineering projects. Different branches of geology.

Physical Geology: Origin of Earth, external and internal geological forces causing changes, and erosion of the surface of the Earth. Geological work of ice, water, and wind, Soil profile and its importance, Earth movement, earthquakes, and volcanoes.

UNIT II

Mineralogy and Petrology: Definition of minerals and rocks, Classification of minerals, physical and chemical properties of minerals. Classification of rocks. Mineral composition, Textures, structure, and origin of Igneous, Sedimentary, and Metamorphic rocks.

Structural Geology and general stratigraphy of India: Elementary idea about outcrop, dip and strike, bedding plane, fold, fault, joint and unconformity. General principles of stratigraphy of India and their characteristics

UNIT III

Geological Investigations: Use of geological maps and interpretation of data, geological reports, hydrogeology, water table, springs and artesian wells, groundwater in engineering projects, artificial recharge of groundwater, Remote sensing techniques for geological and hydrological survey and investigation.

Geological conditions and stability of foundation sites and abutments: Geological condition and their influence on the selection, location, type, and design of dams, reservoirs, tunnels, highways, and bridges.

UNIT IV

Landslides: Types of rock slope failures, slope stability assessment, causes and consequences of earthquakes and landslides on engineering structures, and preventive/mitigation measures.

Improvement of foundation rocks: Precaution and treatment against faults, joints, and groundwater (electrical and seismic methods). Retaining walls and other treatments.

Text/Reference Books:

1. Engineering and General Geology by Prabin Singh
2. General & Engineering Geology by Dr. D.S. Arora Reference Books
3. A Text Book of Geology by P.K. Mukherjee.
4. Physical and General Geology, S.K. Garg
5. Introduction of Physical Geology by A. Holmes

B24-CEP-328		Airport Planning and Design					
Lecture	Tutorial	Practical	Credit	End-of-Semester Exam	Internal Assessment	Total	Duration of Exam
4	0	0	4	70	30	100	3
Course Outcomes (CO)							
CO1	Demonstrate understanding of airport planning, including regional development, site selection surveys, and preparation of drawings.						
CO2	Evaluate fine and coarse aggregates through fineness modulus, bulk density, water absorption, and specific gravity tests.						
CO3	Perform concrete mix design, assess workability using slump, compaction factor, and flow table tests, and determine compressive, tensile, flexural, and bond strength of concrete.						
CO4	Apply non-destructive testing methods, such as the rebound hammer and ultrasonic pulse velocity, to evaluate the compressive strength of bricks and tiles in accordance with IS standards.						

Unit I

Airport planning: General Regional planning, development of a new airport, Data required before site selection, Surveys for Airport Site Selection, Drawings to be prepared for airport site selection.

Unit II

Runway Design: Runway Orientation, Basic Runway Length, Corrections for Elevation, Temperature, and Gradient, Airport Classification, Runway Geometric Design, Airport Capacity, Runway Configurations, Runway Intersection Design.

Unit III

Structural Design of Airport Pavements: Introduction, Various Design Factors, Design Methods for Flexible Pavement, Design Methods for Rigid Pavement, LCN System of Pavement Design, Joints in Cement Concrete Pavement, Airport Pavement Overlays, Design of an Overlay.

Unit IV

Airport Grading and Drainage: Computation of Earthwork, Airport Drainage. Special Characteristics and Requirements of Airport Drainage, Design Data, Surface Drainage Design, Subsurface Drainage Design.

Books :

1. Airport Planning and Designing by S.K. Khanna, M.G. Arora.
2. Highway Engineering including Expressways and Airport Engineering by Dr. L. R. Kadyali, Dr. N. B. Lal.
3. Highway Engineering including Airport Pavements by Dr. S. K. Sharma.
4. Transportation Engineering by S. P. Chandola.

B24-CEP-330		Open Channel Flow					
Lecture	Tutorial	Practical	Credit	End-of-Semester Exam	Internal Assessment	Total	Duration of Exam
4	0	0	4	70	30	100	3
Course Outcomes (CO)							
CO1	Students will be able to understand basic fluid flow concepts and classifications of open channel flow.						
CO2	Students will be able to apply energy and momentum principles to analyze flow properties including critical depth and specific energy.						
CO3	Students will be able to analyze hydraulic jump and unsteady flow characteristics and their engineering applications.						
CO4	Students will be able to measure open channel flow using hydraulic structures and flow measuring instruments						

UNIT I

Basic fluid flow concepts: Definition, importance of study of open channel flow, Difference between pipe flow and channel flow, One-Dimensional method of flow analysis, Pressure Distribution

Flow in Open Channels: Types of channels, Classification of flows, Sub-Critical and Supercritical Flows, Velocity distribution in channel, Equation of Continuity, Energy Equation, Momentum equation.

UNIT II

Energy-Depth Relationships: Specific Energy, specific force, Critical Flow, critical depth, Calculation of Critical Depth for some shapes of channels.

Uniform Flow in rigid boundary channels: Introduction, shear stress on boundary, shear stress in open channels, velocity distribution and effect of secondary circulation on velocity distribution, Chezy Equation, Darcy-Weisbach Friction Factor, Manning's roughness Formula, Resistance Formulate for Practical Use, Normal Depth and it computation.

UNIT III

Unsteady Flow and Hydraulic Jumps: Froude Number and Types of Hydraulic Jumps, Applications, and Jumps in Channels. Unsteady flow equation, pre-jump and post-jump depths, length of Hydraulic Jump, and energy dissipation.

Uniform Flow in mobile boundary channels: Incipient motion, Shield's diagram, regimes of flow, bed forms, sediment load and its measurement, regime channels, design of stable channels.

UNIT IV

Rapidly-Variied Flow: Weirs, Sharp-crested Weir, Broad-crested Weir, submergence of weirs, Critical-Depth Flumes, Sluice-gate Flow, free and submerged flow and its analysis of the sluice gate

Flow Measurement: Pitot tube and current meters for velocity measurement, flow over Spillways, and free overfall flow.

Text/Reference Books:

1. Open Channel Hydraulics, Ven Te Chow
2. Flow Through Open Channel, K.G. Ranga Raju
3. Open Channel Hydraulics, Hanif Choudhary.
4. Flow in Open Channels, K. Subramanya

Open Elective courses - 01

B24-CEO-332		Introduction to Artificial Intelligence					
Lecture	Tutorial	Practical	Credit	End-of-Semester Exam	Internal Assessment	Total	Duration of Exam
3	0	0	3	70	30	100	3
Course Outcomes (CO)							
CO1	To determine a fundamental understanding of Artificial Intelligence (AI) and its core principles.						
CO2	To demonstrate fundamental concepts of problem solving, searching, inference, and perception.						
CO3	To demonstrate proficiency in applying AI techniques in various domains						
CO4	To examine role of AI in various application areas.						

UNIT I

Scope of AI: Introduction to Artificial Intelligence, History of Artificial Intelligence, Artificial Intelligence Languages, Multi-Agent Systems, natural language processing, vision and speech processing, robotics, expert systems.

UNIT II

Problem Solving, Searching and Planning: Problem spaces and search, Heuristic and Informed search strategies, Minmax search. Search and optimization (gradient descent method), Adversarial search, Planning and scheduling, Case study: Health Care System.

UNIT III

Knowledge Engineering, Representation, Reasoning, and finding Optimal Paths: Knowledge and Knowledge-based systems, Knowledge and rationality, Logic and inference, Propositional and predicate logic, Ontologies, Bayesian Reasoning, Temporal reasoning, Knowledge Discovery: Data and Web Mining.

UNIT IV

Applications of AI in Various Domains: AI in Marketing, AI in Banking, AI in Finance, AI in Agriculture, AI in Healthcare, AI in Gaming, AI in Space Exploration, AI in Autonomous Vehicles, AI in Chatbots, AI in Creativity.

Books:

5. E. Rich and K. Knight, "Artificial Intelligence", TMH, 2nd Ed.,1992.
6. N. J. Nilsson, "Principles of AI", Narosa Publ. House,1990.
7. M. N. Hoda, "Foundation Course in Artificial Intelligence", Vikas Pub.,2004.
8. Artificial Intelligence" R B Mishra, PHI.

B24-CEO-334		Human Resource Development					
Lecture	Tutorial	Practical	Credit	End-of-Semester Exam	Internal Assessment	Total	Duration of Exam
3	0	0	3	70	30	100	3
Course Outcomes (CO)							
CO1	Develop a basic understanding of Human Resource Management.						
CO2	Understand the process of Human resource training and development.						
CO3	Develop the Leadership quality.						
CO4	Develop the concept of formal and informal organizational behavior.						

UNIT I

HRD-Macro Perspective: HRD Concept, Origin and Need, HRD as a Total System; Approaches to HRD, Human Development and HRD, HRD at Macro and Micro Climate.

HRD-Micro Perspective: Areas of HRD, HRD Interventions, Performance Appraisal, Potential Appraisal, Feedback and Performance Coaching, Training, Career Planning, OD or Systems Development, Rewards, Employee Welfare and Quality of Work Life and Human Resource Information, Staffing for HRD, Roles of HR Developer, Physical and Financial Resources for HRD, HR Accounting, HRD Audit, Strategic HRD

UNIT II

Instructional Technology for HRD: Learning and HRD, Models and Curriculum, Principles of Learning, Group and Individual Learning, Transactional Analysis, Assessment Centre, Behavior Modeling and Self-Directed Learning, Evaluating the HRD Human

Resource Training and Development: Concept and Importance, Assessing Training Needs, Designing and Evaluating T&D Programmes, Role, Responsibilities and challenges to Training Managers. Training Methods: Training with in Industry (TWI): On the Job & Off the Job Training, Management Development: Lecture Method, Role Play, Simulation, Globalization challenges and Strategies of Training Program, Review on T&D Programmes in India.

UNIT III

Motivation: Types of Motives, Theories of Maslow, Herzberg, McGregor, Alderfers, Porter and Lawler's Model; Job Enlargement, Job Enrichment, Behavior Modification.

Leadership: Concept, Leader Vs. Manager; Classical Studies on Leadership, Trait Theories, Behavioral Theories, Group and Exchange Theories; Contingency Theory of Leadership, Leadership Styles.

UNIT IV

Formal and Informal Organizations: Origin of Formal and Informal Organizations, Problems Associated with Informal Organizations. Organizational Effectiveness (OE): Concept; Approaches to O E, Adoptive Coping Cycle for Effectiveness; Achieving OE, Organizational Climate: Concept, Determinants of Organizational Climate, Physical Environment; Values and Norms

Organization Theory: Classical Theory; Neo-Classical Theory, Modern Behavioral Theories, contingency theory, system theory, modern structural models, Organizational Culture, Creating and Sustaining Culture, Work Culture

Text/Reference Books:

1. Rao, T.V and Pareek, Udai: Designing and Managing Human Resource Systems, Oxford IBH Pub. Pvt.Ltd, New Delhi , 2005.
2. Viramani, B.R, and Seth, Parmila: Evaluating Management Development, Vision Books, New Delhi .
3. John, W. NMewstrom & Davis, Ketih : Organisational Behavior (Human Behavior at Work), Tata McGraw-Hill, New Delhi , 2002.
4. Nadler, Leonard : Corporate Human Resource Development.

B24-CEO-336		Soft skill & Interpersonal Communication					
Lecture	Tutorial	Practical	Credit	End-of-Semester Exam	Internal Assessment	Total	Duration of Exam
3	0	0	3	70	30	100	3
Course Outcomes (CO)							
CO1	Develop basic understanding of Communication.						
CO2	Understand the process of communication and speaking.						
CO3	Develop the Personality concepts and its implementation.						
CO4	Develop the basic of Group Discussion and interview.						

UNIT-I

Communication: Introduction verbal, nonverbal, kinesics, proxemics, chronemics, type of communication, extra personal communication, intrapersonal communication, mass communication, Creativity in communication, Role of communication, flow of communication and its need, Persuasive communication and negotiation; Time management in Persuasive communication, Importance of Persuasive Communication.

UNIT-II

Barriers in the way of communication, noise, intrapersonal barriers, interpersonal barriers, Organizational Barriers, Extra personal basics of communication: importance of communication process of communication, objectives and characteristics of communication, Communication skills: Accent, Intonation, Phonetics, Speaking skills, Confidence, clarity, Fluency, Quality pronunciation.

UNIT-III

Personality development, Personality, role of personality, heredity, environment, situation, Basic of personality, soft skill, need and training, activity and soft skill, Organization skill, introduction and its need, basic principle for organizational skill, stress management, Introduction, stress at home and office, stress presentation, analyze the model of stress.

UNIT-IV

Group discussion, form of group discussion, strategy for group discussion, discussing problems and solutions, oral presentation, introduction planning, occasion, purpose, modes of delivery, resume making, purpose of resume, resume design and structure, content in resume, type of resume, job interview, introduction, objective of interview, type of interview, stages of interview, face to face interview, campus interview.

Textbooks

1. Technical communication principles and practice by Minakshi Raman sangeeta Sharma by Oxford publication
2. Personality development and soft skill by Barun K. Mitra, Oxford publication
3. Communication skills for engineers by C. Muralikrishana and Sunita Mishra, pearson Publication

*****End of semester VI*****

B23-VAC-302	Hindi Language Skills						
Lecture	Tutorial	Practical	Credit	End Semester Exam	Internal Assessment	Total	Time
2	-	-	1	--	100	100	3

This course will be offered through NPTEL/MOOC online courses with the following link - https://onlinecourses.nptel.ac.in/noc23_hs125/preview.

The syllabus of NPTEL/MOOC platform will be acceptable. Students can also learn online from videos and internal assessment can be made in the Institute by taking an internal exam of 100 marks.

B23-VAC-304		Sanskrit Language Skills					
Lecture	Tutorial	Practical	Credit	End Semester Exam	Internal Assessment	Total	Time
2	-	-	1	--	100	100	3 Hrs
Course Outcomes (CO) At the end of this course, student will							
CO 1	Learn behavioural science from Bhagwat Gita						
CO 2	Learn self awareness and spirituality from Bhagwat Gita						
CO 3	Learn mind management from Bhagwat Gita						
CO 4	Learn responsible behaviour from Bhagwat Gita						

SYLLABUS FOR SANSKRIT STUDIES

Unit 1	<u>BEHAVIOURAL SCIENCE</u> • Learning different personality types from Gita. BG 14.6-8 • Dealing with stress, depression and self-destructive urges. BG 2.14 • Overcoming procrastination and hyperactivity. BG 18.35-36 • Developing <i>sattva</i> - platform of controlled action. BG 18.33 • Balancing physical, mental and emotional health. BG 6.16-17, 6.5 • Increasing productivity in activity through spirituality. BG 2.47 • Mind Intelligence mechanism. BG 3.42-43 • Tapping the power of meditation. BG 6.10-15
Unit 2	<u>SELF-AWARENESS</u> • Understanding Different Layers of Self - Physical, Mental and Spiritual – BG 2.13 • Becoming Sensitive Towards Other Beings and Nature at Large – BG 5.18, 6.29-32 • Cultivating Culture of Respect – BG 13.8-12 • Dealing with Grief – BG 2.11, 2.27 • Holistic Wellbeing Through Self-Awareness – BG 6.5, 6.7 • Recognizing the Impermanence of the Body – BG 2.14 • Cultivating Detachment for True Self-Awareness – BG 2.71, 5.29 • Connecting with the Higher Self Through Meditation – BG 6.10 • Transcending Ego for Inner Peace – BG 3.27 • Self-Reflection for Personal Growth – BG 6.5 • Overcoming False Identification with the Body – BG 2.30 • Seeing the Divine in All Beings – BG 9.22
Unit 3	<u>MIND MANAGEMENT - ART OF MIND CONTROL</u> • The Root of Frustration & Anger – BG 2.62-63 • Discover the Real Reason Behind Lack of Motivation – BG 3.36, 3.41 • Controlling the Uncontrolled Mind – BG 6.26 • Understanding the Mind & Its Power – BG 6.6, 3.42 • Mind Like a Boat in Stormy Waters – BG 2.67 • Learn to Stay Calm Under Pressure – BG 2.14, 2.56 • The Peaceful Mind of a Wise Person – BG 2.70, 2.56 • Freedom from Attachment = Peace – BG 2.71, 5.26 • Peace Through Detachment – BG 2.71, 5.20

Unit 4**RESPONSIBLE ACTION**

- Understanding Intricacies of Action and Reaction - Karma, Vikarma & Akarma – BG 4.17
- Principles of Forbearance and Tolerance – BG 2.14, 12.13-14
- Coping with Adversities and Reversals in Life – BG 2.14-15, 18.11
- Becoming Responsible in Action - Karma Yogi – BG 3.7, 3.19, 3.30, 5.10
- Performing Actions Without Attachment to Results – BG 2.47, 3.19
- Acting in Accordance with Dharma – BG 3.35
- Surrendering the Fruits of Actions to God – BG 9.22, 18.66
- Selflessness in Actions – BG 18.9
- Discerning Between Right and Wrong Actions – BG 18.63
- Balanced Approach to Work and Rest – BG 6.17
- Purifying Intentions Behind Actions – BG 18.11
- Taking Responsibility for One's Actions and Their Impact – BG 3.16

B23-VAC-306		German Language Skills					
Lecture	Tutorial	Practical	Credit	End semester Exam	Internal assessment	Total	Duration of exam (Hours)
2	0	0	1	-	100	100	3 Hrs
Purpose	To learn about German Language Skills						
Course Outcomes (CO)							
CO1	Introduce students to basic German language.						
CO2	Enable basic communication in German (self-introduction, daily routine, etc.).						
CO3	Develop foundational skills in vocabulary and grammar.						
CO4	Develop foundational skills in reading, writing, listening, and speaking.						

Unit 1: Introduction & Basics

- German alphabet and pronunciation
- Greetings and farewells
- Introducing oneself and others
- Numbers (0–100)
- Days, months, seasons

Unit 2: Vocabulary Building I

- Family and relationships
- Professions and nationalities
- Countries and cities
- Colors and clothing
- Weather

Unit 3: Grammar I

- Nouns: gender, singular/plural
- Articles: definite (der/die/das), indefinite (ein/eine)
- Personal pronouns (ich, du, er, etc.)
- Verb conjugation (regular verbs in Präsens)
- Sentence structure: main clause word order

Grammar II

- Verbs: haben, sein, modal verbs (möchten, können)
- Question words (wer, was, wo, etc.)
- Negation (nicht, kein)
- Possessive pronouns (mein, dein, etc.)
- Accusative case basics

Unit 4: Vocabulary Building II

- Food and drink
- Daily routine
- Time and date
- House and furniture
- Hobbies and leisure

Communication Practice

- Simple dialogues (in café, at university, at home)
- Role plays (shopping, asking directions, introductions)
- Listening practice (audio exercises)
- Writing practice (short texts, filling forms)

Assessment (Optional/Recommended)

- Vocabulary quizzes
- Short written assignments
- Oral presentation or role-play
- Final test (basic grammar and vocabulary)

B23-VAC-308	Japanese Language Skills						
Lecture	Tutorial	Practical	Credit	End semester Exam	Internal assessment	Total	Duration of exam (Hours)
2	0	0	1	-	100	100	3 Hrs
Purpose	Learn about Japanese Language Skills						
Course Outcomes (CO)							
CO1	Introduce students to basic Japanese language.						
CO2	Enable basic communication in Japanese (self-introduction, daily routine, etc.).						
CO3	Develop foundational skills in vocabulary and grammar.						
CO4	Develop foundational skills in reading, writing, listening, and speaking.						

Unit 1: Introduction & Basics

- Alphabet and pronunciation
- Greetings and farewells
- Introducing oneself and others
- Numbers (0–100)
- Days, months, seasons

Unit 2: Vocabulary Building I

- Family and relationships
- Professions and nationalities
- Countries and cities
- Colors and clothing
- Weather

Unit 3: Grammar I

- Nouns: gender, singular/plural
- Articles: definite and indefinite
- Personal pronouns
- Verb conjugation (regular verbs in present tense)
- Sentence structure: main clause word order

Grammar II

- Common verbs (e.g., to be, to have, modal verbs)
- Question words
- Negation
- Possessive pronouns
- Basic cases or particles (as applicable)

Unit 4: Vocabulary Building II

- Food and drink
- Daily routine
- Time and date
- House and furniture
- Hobbies and leisure

Communication Practice

- Simple dialogues (e.g., in café, at university, at home)
- Role plays (shopping, asking directions, introductions)
- Listening practice (audio exercises)
- Writing practice (short texts, filling forms)

Assessment (Optional/Recommended)

- Vocabulary quizzes
- Short written assignments
- Oral presentation or role-play and final test (basic grammar and vocabulary)

B23-VAC-310	French Language Skills						
Lecture	Tutorial	Practical	Credit	End semester Examination	Internal assessment	Total	Duration of exam (Hours)
2	0	0	1	-	100	100	3 Hrs
Purpose	To learn about French Language Skills						
Course Outcomes (CO)							
CO1	Introduce students to basic French language.						
CO2	Enable basic communication in French (self-introduction, daily routine, etc.).						
CO3	Develop foundational skills in vocabulary and grammar.						
CO4	Develop foundational skills in reading, writing, listening, and speaking						

Unit 1: Introduction & Basics

- Alphabet and pronunciation
- Greetings and farewells
- Introducing oneself and others
- Numbers (0–100)
- Days, months, seasons

Unit 2: Vocabulary Building I

- Family and relationships
- Professions and nationalities
- Countries and cities
- Colors and clothing
- Weather

Unit 3: Grammar I

- Nouns: gender, singular/plural
- Articles: definite and indefinite
- Personal pronouns
- Verb conjugation (regular verbs in present tense)
- Sentence structure: main clause word order

Grammar II

- Common verbs (e.g., to be, to have, modal verbs)
- Question words
- Negation
- Possessive pronouns
- Basic cases or particles (as applicable)

Unit 4: Vocabulary Building II

- Food and drink
- Daily routine
- Time and date
- House and furniture
- Hobbies and leisure

Communication Practice

- Simple dialogues (e.g., in café, at university, at home)
- Role plays (shopping, asking directions, introductions)
- Listening practice (audio exercises)
- Writing practice (short texts, filling forms)

Assessment (Optional/Recommended)

- Vocabulary quizzes
- Short written assignments
- Oral presentation or role-play and final test (basic grammar and vocabulary)