Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-201	Computational Methods	4		4
HS/MS	HS-203	Indian Knowledge System*	2		2
PC	CEC-205	Structural Analysis - I	4		4
PC	CEC-207	Structural Design - I	4		4
PC	CEC-209	Fluid Mechanics	4		4
PC	CEC-211	Geomatics Engineering	4		4
Practical / Viva Voce					
ES	ES-251	Computational Methods Lab		2	1
PC	CEC-253	Civil Engineering Drawing Lab		2	1
PC	CEC-255	Fluid Mechanics Lab		2	1
PC	CEC-257	Geomatics Engineering Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
BS	BS-202	Probability, Statistics and Linear Programming	4		4
HS/MS	HS-204	Technical Writing*	2		2
PC	CEC-206	Soil Mechanics	4		4
PC	CEC-208	Hydraulics and Hydrology	4		4
PC	CEC-210	Environmental Engineering - I	4		4
PC	CEC-212	Transportation Engineering	4		4
Practical / Viva Voce					
BS	BS-252	Probability, Statistics and Linear Programming Lab		2	1
PC	CEC-254	Soil Mechanics Lab		2	1
PC	CEC-256	Hydraulics Lab		2	1
PC	CEC-258	Transportation Engineering Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Paper Code(s): ES-201	**L**	**P**	**C**
Paper: Computational Methods	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand numerical methods to find roots of functions and first order unconstrained minimization of functions.
2.	To introduce concept of interpolation methods and numerical integration.
3.	To understand numerical methods to solve systems of algebraic equations and curve fitting by splines.
4.	To understand numerical methods for the solution of Ordinary and partial differential equations.

Course Outcomes (CO)

CO 1	Ability to develop mathematical models of low level engineering problems
CO 2	Ability to apply interpolation methods and numerical integration.
CO 3	Ability to solve simultaneous linear equations and curve fitting by splines
CO 4	Ability to numerically solve ordinary differential equations that are initial value or boundary value problems

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	2	-	-	-	2	2	2	3
CO 2	3	2	2	2	2	-	-	-	2	2	2	3
CO 3	3	3	3	3	2	-	-	-	2	2	2	3
CO 4	3	3	3	3	2	-	-	-	2	2	2	3

UNIT-I

Review of Taylor Series, Rolle 's Theorem and Mean Value Theorem, Approximations and Errors in numerical computations, Data representation and computer arithmetic, Loss of significance in computation
Location of roots of equation: Bisection method (convergence analysis and implementation), Newton Method (convergence analysis and implementation), Secant Method (convergence analysis and implementation). Unconstrained one variable function minimization by Fibonacci search, Golden Section Search and Newton's method. Multivariate function minimization by the method of steepest descent, Nelder- Mead Algorithm.

UNIT-II

Interpolation: Assumptions for interpolation, errors in polynomial interpolation, Finite differences, Gregory-Newton's Forward Interpolation, Gregory-Newton's backward Interpolation, Lagrange's Interpolation, Newton's divided difference interpolation
Numerical Integration: Definite Integral, Newton-Cote's Quadrature formula, Trapezoidal Rule, Simpson's one-third rule, simpson's three-eight rule, Errors in quadrature formulae, Romberg's Algorithm, Gaussian Quadrature formula.

UNIT-III

System of Linear Algebraic Equations: Existence of solution, Gauss elimination method and its computational effort, concept of Pivoting, Gauss Jordan method and its computational effort, Triangular Matrix factorization methods: Dolittle algorithm, Crout's Algorithm, Cholesky method, Eigen value problem: Power method
Approximation by Spline Function: First-Degree and second degree Splines, Natural Cubic Splines, B Splines, Interpolation and Approximation

UNIT - IV

Numerical solution of ordinary Differential Equations: Picard's method, Taylor series method, Euler's and Runge-Kutta's methods, Predictor-corrector methods: Euler's method, Adams-Bashforth method, Milne's method.
Numerical Solution of Partial Differential equations: Parabolic, Hyperbolic, and elliptic equations
Implementation to be done in C/C++

Textbook(s):

1. E. Ward Cheney & David R. Kincaid , "Numerical Mathematics and Computing" Cengage; 7th ed (2013).

References:

1. R. L. Burden and J. D. Faires, "Numerical Analysis", CENGAGE Learning Custom Publishing; 10th Edition (2015).
2. S. D. Conte and C. de Boor, "Elementary Numerical Analysis: An Algorithmic Approach", McGraw Hill, 3rd ed. (2005).
3. H. M. Antia, "Numerical Methods for Scientists & Engineers", Hindustan Book Agency, (2002).
4. E Balagurusamy "Numerical Methods" McGraw Hill Education (2017).

Paper Code(s): HS-203	**L**	**P**	**C**
Paper: Indian Knowledge System	**2**	**-**	**2**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks
3. This is an NUES paper, hence all examinations to be conducted by the concerned teacher.

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the Indian knowledge System.
2.	To understand the foundational concepts for science and technology.
3.	To understand the ancient Indian mathematics and astronomy.
4.	To understand the ancient Indian engineering and technology.

Course Outcomes (CO)

CO 1	Ability to understand the Indian knowledge System.
CO 2	Ability to understand and apply foundational concepts for science and technology.
CO 3	Ability to understand and apply ancient Indian mathematics and astronomy
CO 4	Ability to understand ancient Indian engineering and technology.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	-	-	-	-	-	3	-	-	-	-	-	2
CO 2	-	-	-	-	-	3	-	-	-	2	-	2
CO 3	3	3	-	-	-	-	-	-	-	-	-	2
CO 4	3	3	-	-	-	-	-	-	-	-	-	2

UNIT-I

Indian Knowledge System (IKS) - An Introduction:
Overview of IKS - Importance of Ancient Knowledge; Defining IKS; The IKS Corpus – A Classification Framework; Chaturdaśa-Vidyāsthāna; History of IKS, Some unique aspects of IKS;
The Vedic Corpus – Introduction to Vedas; The Four Vedas and their divisions; Vedāngas; Vedic Life;
Philosophical Systems – Indian Philosophical Systems; Vedic Schools of Philosophy; Non-Vedic Philosophical Systems; Wisdom through the Ages – Purānas, Itihāsa as source of wisdom, Rāmāyana, Mahābhārata, Niti-śāstras, Subhāssitas.

UNIT-II

Foundational Concepts for Science and Technology:
Linguistics - Components of Language; Pānini's work on Sanskrit Grammar; Phonetics in Sanskrit; Patterns in Sanskrit Vocabulary; Computational Concepts in Astādhyāyi, Logic for Sentence Construction; Importance of Verbs; Role of Sanskrit in Natural Language Processing

Number System and Units of Measurement – Number System in India; Salient Features of the Indian Numeral System; Unique approaches to represent numbers; Measurements for Time, Distance and Weight; Pingala and the Binary System
Knowledge: Framework and Classification – The Knowledge Triangle; Prameya; Pramāna; Samśaya; Framework for establishing Valid Knowledge

UNIT-III

Mathematic and Astronomy in IKS:
Mathematics – Unique aspects of Indian Mathematics; Great Mathematicians and their Contributions; Arithmetic; Geometry; Trigonometry; Algebra; Binary Mathematics and Combinatorial Problems in Chandah-śāstra of Pingala, Magic Squares in India
Astronomy - Unique aspects of Indian Astronomy; Historical Development of Astronomy in India; The Celestial Coordinate System; Elements of the Indian Calendar; Āryabhatiya and the Siddhāntic Tradition; Pancānga; Astronomical Instruments; Jantar Mantar of Rājā Jai Singh Sawai

UNIT - IV

Engineering and Technology in IKS:
Engineering and Technology: Metals and Metalworking – The Indian S & T Heritage; Mining and Ore Extraction; Metals and Metalworking Technology; Iron and Steel in India; Lost wax casting of Idols and Artefacts; Apparatuses used for Extraction of Metallic Components
Engineering and Technology: Other Applications – Literary sources for Science and Technology; Physical Structures in India; Irrigation and Water Management; Dyes and Painting Technology; Surgical Techniques; Shipbuilding; Sixty-four Art Forums; Status of Indigenous S & T

Textbook(s):
1. B. Mahadevan, Vinayaka Rajat Bhat & Nagendra Pavana R.N., "Introduction to Knowledge System: Concepts and Applications" PHI (2022).

References:
1. C.M Neelakandhan & K.A. Ravindran, "Vedic Texts and The Knowledge Systems of India", Sri Sankaracharya University of Sanskrit, Kalady (2010).
2. P.P. Divakaran, "The Mathematics of India: Concepts, Methods, Connections", Springer (2018)
3. C.A. Sharma, "Critical Survey of Indian Philosophy", Motilal Banarasidass Publication (1964)
4. G. Huet, A. Kulkarni & P. Scharf, "Sanskrit Computational Linguistics", Springer (2009).
5. A.K. Bag, "History of Technology in India", Indian National Science Academy, Vol 1, (1997)

Paper Code(s): CEC-205	**L**	**P**	**C**
Paper: Structural Analysis – I	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To know the concept of stress and strain for the calculation of internal forces in the structural member.
2.	To know the concept of shear force and bending moment.
3.	To calculate deflection in beams and column
4.	To familiarize students about the failure modes of materials.

Course Outcomes (CO)

CO 1	Define stress, strain, elastic constants, Hooke's Law, shear force, bending moment.
CO 2	Construct Mohr circle , shear force diagrams and bending moment diagrams to solve complex problems.
CO 3	Analyze principal stresses and principal strains, load carrying capacity of long columns with different end conditions.
CO 4	Determine bending and shear stress, slope and deflection of beams using various techniques, torsion of shafts.

Course Outcomes (CO) to Programme Outcomes (PO) mapping

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	2	-	-	-	-	-	-	-	-	-	-
CO 2	-	2	-	-	-	-	-	-	-	-	-	-
CO 3	-	3	-	-	-	-	-	-	-	-	-	-
CO 4	-	3	-	-	-	-	-	-	-	-	-	-

UNIT-I

Simple Stresses and Strains

Introduction, Normal and Shear stresses, Stress-Strain Diagrams, Hook's law, Modulus of elasticity, Elastic Constants, Principle stresses and strains, Mohr's circle.

One dimensional loading & Torsion

One dimensional loading on members of varying cross-section. Torsion: Introduction, Torsion of shafts of circular section, torque and twist- shear stress due to torque

UNIT-II

Shear Force and Bending Moment

Types of beams, loads and supports, shear force and bending moment diagram, bending stresses and shear stresses in beams.

Deflection of Beams

Deflection due to bending: The moment curvature relation, Macaulay's method, Moment area and Conjugate beam method, Deflection of determinate plane frames using strain energy and unit load method, Elastic curve sketch.

UNIT-III

Analysis of determinate structure

Classification of Structures, Stress Resultants, Degree of Freedom per node, Static and Kinematic degrees of indeterminacy. Work and Energy. Strain energy of deformable systems, Betti's theorem of reciprocal work and Maxwell's theorem. Principle of virtual work and complementary virtual work, Principle of total minimum stationary potential energy, Stable and unstable equilibrium, Castigliano's Theorem I and II

UNIT - IV

Columns and Struts

Theory of Columns, long column and short column, Euler's formula, Columns with eccentric axial loads, Rankine's formula, Secant formula, Buckling and stability, slenderness ratio, combined bending and direct stress, effect of end conditions on column buckling.

Textbook(s):

1. A Textbook of Strength of Materials, Prof. R. K Bansal, Laxmi Publications.
2. Strength of Materials, RK Rajput, S Chand
3. Strength of Materials, B.C. Punmia, Laxmi Publications.

References:

1. Strength of Materials, Vol. I: Elementary Theory and Problems Paperback – 2004 ,S. Timoshenko CBS Publishers & Distributors Pvt. Ltd., New Delhi
2. Strength of Materials by Pytel and Singer, Harper Collins.
3. Strength of Materials by Ryder, Macmillan.
4. Strength of Materials by Timoshenko and &Youngs, East West Press.
5. Mechanics of Materials, Popov Nagarjan & Lu, Prentice Hall of India, N. Delhi.

Paper Code(s): CEC-207	**L**	**P**	**C**
Paper: Structural Design - I	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1.	To develop basic understanding of reinforced concrete and steel as a construction material
2.	To develop understanding of various design philosophies and their differences.
3.	To understand mix design and its implementation in structure.
4.	To understand and analyse construction management in structure.

Course Outcomes (CO)

CO 1	Define different types of concrete its characteristic and parameters as per the requirement of the structure.
CO 2	Infer the properties of concrete, the concept of design philosophies, and behavior of load bearing masonry walls and the principles of retaining wall.
CO 3	Identify preliminary data of concrete structure by the code recommendations and concept of limit states.
CO 4	Analyse construction management methods including project scheduling and networking.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	-	-							-	-	-
CO 2		2	3	-	-	-	1	-	-			
CO 3	-	-	2	-		2	-	-	-			
CO 4	-	2	-	-			-	-	-	-	3	-

UNIT-I

Construction Materials:Properties of Cement & Aggregate, Bulking of Sand. Hydration of cement, initial and final setting type.
Structural Steel – Composition and its type, material properties and behaviour; stress strain curve, relaxation of steel.
Concrete: Mechanical properties of concrete: elastic modules, poisson's ratio, creep, shrinkage and durability of concrete.

UNIT-II

Working stress and Limit state design concepts.
Introduction to Various Design Philosophies including characteristic strength, Partial Safety Factor, Factored Load, Design stress strain curve. Assumptions in Limit State Design Method. Constituents, mix design, short-term and long-term properties. **(IS 456, IS 800, IS 10262)**

UNIT-III

Structural Steel, and its designation as per **IS: 800:2007**, Properties of Structural steel. Basics of types of members (Tension member, Compression member and flexural member)
Connections – Types of connections. Rivet Connections, Bolted Connections and Welded Connections.

UNIT- IV

Project Planning: Project Scheduling, Controlling, Method of Planning.
PERT & CPM: Activity time estimate, Start and finish time of Activities, Critical Path and critical activities. Development of PERT Network. Time estimate using PERT.

Textbook(s):

1. S.K. Duggal, "Building Materials", New Age International Publications.
2. L.S Negi, "Design of Steel Structure", Tata McGraw-Hill.
3. N Subramanyam, "PERT & CPM", Tata McGraw-Hill.

References:

1. Jain A.K., "Limit State Design of Reinforced Concrete Structures"., Nem Chand Publishers, Roorkee.
2. B.C. Purnima , R.C.C. Designs, Laxmi Publication
3. Raju K., "Reinforced Concrete", New Age International (P) Ltd., New Delhi.
4. Unikrishna Pillai S., "Reinforced Concrete Design"., Tata McGraw Hill Publishing Company Ltd., New Delhi.

Paper Code(s): CEC-209	**L**	**P**	**C**
Paper: Fluid Mechanics	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce fundamentals of stagnant fluid.
2.	To elaborate fundamentals of flowing fluid and governing equations
3.	To understand fluid flow through different conduits and measurement techniques for it.
4.	To study the effect of fluid flow using the concepts of dimensional analysis

Course Outcomes (CO)

CO 1	Define the fundamental properties of fluid.
CO 2	Explain pressure forces acting on body(submerged and floating)
CO 3	Solve flow rate problems to determine the flow condition and forces exerted
CO 4	Examine flow around Models or Prototype using Dimensional Analysis approach.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	1	1	-	-	-	-	-	1	-	-
CO 2	3	3	3	2	2	-	-	-	-	1	-	-
CO 3	3	3	2	1	1	-	-	-	-	1	-	-
CO 4	2	3	3	3	1	-	-	-	-	1	-	-

UNIT-I

Introduction: Fluid properties, Ideal and real fluids, Density, Specific weight, specific volume, compressibility, specific gravity, Concept of viscosity, viscometer, cohesion, adhesion, surface tension, Capillarity, Newtonian and Non Newtonian Fluids;

Fluid Statics: Fluid pressure and its measurement, types of manometers, Total pressure and centre of pressure, principles of equilibrium, buoyancy, centre of buoyancy, meta centre, stability conditions of floating and submerged bodies, Evaluation of pressure force on dams, lock gates, curved surfaces, pressure distribution in liquid subjected to constant horizontal/vertical acceleration.

UNIT-II

Fluid Kinematics: Variation of flow parameters in space and time, Lagrangian and Eularian concepts in fluid motion, Types of fluid flow: steady and unsteady, uniform and non-uniform, rotational and irrotational, Laminar and turbulent, one, two and three dimensional flow, control volume, streamline, pathline and streakline, Continuity equation and its applications, Velocity potential and stream function, Cauchy-Riemann equation, flownet.

Types of motion: Linear translation, linear deformation, Angular deformation, Rotation, Vorticity, Free and forced vortex flow

UNIT-III

Fluid Dynamics : Newton's, Reynolds's, Navier-Stokes and Euler's equations of motion, Derivation of Bernoulli's equation from Euler's equation and its limitations, Applications of Bernoulli's equations-Orifice and Mouth piece, Orifice-meter, Venturimeter, Weir and notch, Pitot's tube, Siphon, etc; hydraulic gradient and total energy lines and their Engineering significance. Momentum equation, Moment of momentum equation-Assumptions and limitations, applications, impact of jets and forces in bends.

UNIT - IV

Dimensional and Model Analysis: Dimensional homogeneity, methods of dimensional analysis, Buckingham's π theorem, selection of Repeating variables, Forces acting on moving fluid, Dimensionless numbers and their Engineering significance, Model analysis, Geometric, Kinematic and Dynamic similarity, Model testing of partially submerged bodies, scale ratios for distorted models.

Textbook(s):

1. P. N. Modi and S. M. Seth "Hydraulics and Fluid Mechanics (incl Hydraulic Machines)" Standard Publications
2.Frank White, "Fluid mechanics" Tata McGraw Hill Publications.

References:

1. S. Ramamrutham, Hydraulics Fluid Mechanics and Fluid Machines, Dhanpat Rai Publishing Company
2. Victor Streeter, "Fluid Mechanics", International Edition, Tata McGraw Hill Publications.
3. Hughes and Brighton, "Fluid Mechanics", Tata McGraw Hill.
4. Neville, "Fluid Mechanics", Pearson Education.

Paper Code(s): CEC-211	**L**	**P**	**C**
Paper: Geomatics Engineering	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To know the different methods and techniques used in surveying and the applications.
2.	To apply concepts of tachometry and levelling in surveying difficult and hilly terrains to obtain the topographical map of area.
3.	To use survey instruments in carrying out survey, collect data, write reports and able to perform required calculations.
4.	To build a map or plan of an area using surveying and levelling.

Course Outcomes (CO)

CO 1	Ability to understand the basic principles of surveying.
CO 2	Analyse and explain the various methods used in surveying and levelling.
CO 3	Apply the concepts various types of surveying in computation of distance, direction and elevation.
CO 4	Compare types of errors for different surveying techniques.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	-	-	3	-	-	-	-	-	-	-	-	-
CO 2	1	-	2	-	-	-	-	-	-	-	-	-
CO 3	-	-	2	-	2	-	-	-	-	-	-	-
CO 4	-	2	2	-	-	-	-	-	-	-	-	-

UNIT-I

Linear Measurement: Introduction, Principles of chain survey, use and adjustment of various instruments employed in chain survey, chaining on sloping grounds, Offsets and error in offsets, Obstructions in chaining, chaining angles, Errors and sources of error, Introduction to advance linear measuring instruments, Field book. Compass Survey: Use and adjustment of prismatic and surveyor's compass, Methods of surveying with a compass, Magnetic declination, local attraction, Errors in prismatic survey, plotting of compass survey, distribution of closing error.

UNIT-II

Levelling: definitions of terms used in levelling, different types of levels, parallax, staves, adjustments, bench marks, classification of levelling, booking and reducing the levels, rise and fall method, line of collimation method, errors in levelling, permanent adjustments, Two peg test, reciprocal levelling, Corrections to curvature and refraction, cross sections and longitudinal levelling.

Trigonometric Levelling: Definitions & terms, curvature & refraction Methods: direct & reciprocal, eye and object correction, coefficient of refraction. Contours: Definition, representation of reliefs, horizontal equivalent, contour interval, characteristics of contours, methods of contouring, contour gradient, uses of contour maps.

UNIT-III

Theodolite Traversing: types of theodolities, measurement of angles, temporary and permanent adjustments, closed & open traverse consecutive and independent co-ordinates, advantages & disadvantages of traversing closing error, Bowditch, Transit rules.

Triangulation: Principal, selection of base line and stations, order of triangulation, triangulation figures,scaffold and signals, marking of stations, Intervisibility and heights of stations, satellite stations, base linemeasurement and corrections, Introduction to adjustment of observations.

UNIT - IV

Photogrammetric Survey: Basic principles, elevation of a point, determination of focal length of lens, aerial camera, scale of a vertical photograph, relief displacement of a vertical photograph, height of object from relief displacement.

Curves: Types of curves, Elements of a curve, Simple curves, different methods of setting out, Introduction to compound, reverse, transition and vertical curves. Introduction to modern surveying Instruments /Techniques like Total station; Basics of remote sensing &GPS etc.

Textbook(s):

1 Surveying ,B.C. Punmia Vol - I,/II, Laxmi Publication
3 Surveying Vol -1 by K.R. Arora

References:

1. Plane and Geodetic Surveying by D. Clark
2. Plane and Geodetic Surveying by S. Ramamrutham
2 Surveying Vol.2, Duggal, McGraw Hill Education (I) Pvt.Ltd.
4 Surveying and Levelling by R. Subramanian

Paper Code(s): CEC-253	**L**	**P**	**C**
Paper: Civil Engineering Drawing Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions for paper setter

1. The course objectives and course outcomes are given below.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more.

Course Objectives :

1.	To understand the basics of Civil Engineering.
2.	To use software(s) for development of civil engineering drawing.
3.	To calculate item/component quantity using software.
4.	To develop civil engineering drawing.

Course Outcomes (CO)

CO 1	To understand and draw the symbols and conventions in civil engineering drawing.
CO 2	To develop the building drawing for the given line plan and data.
CO 3	To draw the different types of staircases
CO 4	To measure the item quantities from the drawing.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	-	-	-	-	3	-	-	-	-	2	-	-
CO 2	-	-	-	-	3	-	-	-	-	2	-	-
CO 3	-	-	-	-	3	-	-	-	-	2	-	-
CO 4	-	-	-	-	3	-	-	-	-	-	2	-

UNIT-I

Symbols and conventions of materials: concrete, brickwork, glazing, wood, iron etc.

Symbols and conventions of building components- doors and windows; and fittings used in buildings: electrical, mechanical, plumbing and firefighting, sanitary etc.

UNIT-II

Double line plan, elevation, sectional elevation at different sections for a RCC framed and load bearing/ structure building

Structural detailing – beam, column, slab, foundation,

UNIT-III

Details of various staircases, perspective view of building/structure

UNIT – IV

Measurement of various item/component quantities- excavation, brickwork, concrete, plastering etc.

Text Books

1. Computer Aided design and Manufacture, Grover M.P.Simmers, E.W. Prentice Hall
2. CAD/CAM/CIM, Radhakrishnan & Subramanyam, Willey Eastern Limited Publications (Reprint 2015)

Reference Books

1. A Guide to the Preparation of Civil Engineering Drawings, M. V. Thomas, springer link
2. Civil Engineering Drawing & House Planning, Dr. B.P. Verma, Khanna Publishers

Paper Code(s): CEC-255	**L**	**P**	**C**
Paper: Fluid Mechanics Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Fluid Mechanics) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To determine the pressure in a pipe line using various pressure measuring instruments.
2. To determine the metacentric height.
3. To verify the impulse momentum equation [impact of jet].
4. To verify Bernoulli's theorem using Bernoulli Instrument.
5. To determine cc, cv and cd of an orifice.
6. To calibrate a V- notch rectangular notch.
7. To calibrate a V- notch rectangular notch
8. To calibrate orifice meter.
9. To calibrate venturimeter.
10. To validate type of flow using Reynolds dye experiment.
11. Determination of frictional losses in pipes of different diameters.
12. Determination of minor losses in pipes.

Paper Code(s): ES-251	L	P	C
Paper: Computational Methods Lab	-	2	1

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Computational Methods) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

Implementation to be done in C/C++

1. Program for finding roots of f(x)=0 Newton Raphson method.
2. Program for finding roots of f(x)=0 by bisection method.
3. Program for finding roots of f(x)=0 by secant method.
4. To implement Langrange's Interpolation formula.
5. To implement Newton's Divided Difference formula.
6. Program for solving numerical integration by Trapezoidal rule
7. Program for solving numerical integration by Simpson's 1/3 rule
8. To implement Numerical Integration Simpson 3/8 rule.
9. Inverse of a system of linear equations using Gauss-Jordan method.
10. Find the Eigen values using Power method.
11. Program for solving ordinary differential equation by Runge-Kutta Method.

Paper Code(s): CEC-257	**L**	**P**	**C**
Paper: Geomatics Engineering Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Geomatics Engineering) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study of various instruments used in chain surveying.
2. To conduct the chain survey closed traverse around a building and plot the existing building.
3. To plot the plan of a given area by compass traversing
4. Study of theodolite in detail & measuring of horizontal angles by method of repetition
5. Locating given building by theodolite traversing.
6. Determination of elevation of various points with Auto level by collimation plane method and rise & fall method.
7. Determination of elevation of object if base of object accessible, using the principle of trigonometric levelling.
8. Determination of elevation of object if base of the object inaccessible and instrument stations in the same vertical plane as the elevated object
9. Determination of elevation of object if base of the object inaccessible and instrument stations not in same vertical plane as the elevated object, adopt trigonometrical levelling.
10. To study of various components of total station and measuring horizontal angle, vertical angle, horizontal distance and slope distance

11 To study about the stereoscope and determination of the line of flight on Aerial Photo.

12. Setting out a simple circular curve by different methods

Paper Code(s): HS-204	**L**	**P**	**C**
Paper: Technical Writing	**2**	**-**	**2**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks
3. This is an NUES paper, hence all examinations to be conducted by the concerned teacher.

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To improve grammar and sentence structure and build vocabulary.
2:	To understand how to write different types of writings.
3:	To understand how to compose different types of business documents.
4:	To understand business ethics and develop soft skills.

Course Outcomes (CO):

CO1:	Ability to improve grammar and sentence structure and build vocabulary.
CO2:	Ability to write different types of writings with clarity.
CO3:	Ability to write different types of business documents.
CO4:	Ability to apply business ethics and enhance personality.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	-	-	-	-	-	1	-	-	-	3	-	-
CO2	-	-	-	-	-	1	-	-	-	3	-	-
CO3	-	-	-	-	-	1	-	-	-	3	-	-
CO4	-	-	-	-	-	1	-	3	-	3	-	-

Unit I

Grammar and Vocabulary--- Types of sentences (simple, complex and compound) and use of connectives in sentences, Subject-verb agreement, Comprehension, Synonyms and Antonyms, Homophones and Homonyms, Word Formation: Prefixes and Suffixes, Indianism, Misappropriation and Redundant Words, Question Tags and Short Responses.

Unit II

Writing Styles -- Expository, Explanatory, Descriptive, Argumentative and Narrative.
Precis writing, Visual Aids in Technical Writing, Plagiarism and Language Sensitivity in Technical Writing, Dialogue Writing, Proposals: Purpose and Types.

Unit III

Letters at the Workplace—letter writing: Request, Sales, Enquiry, Order and Complaint.
Job Application---Resume and Cover letter, Difference between Resume and CV, Preparation for Interview.
Meeting Documentation--- Notice, Memorandum, Circular, Agenda, Office Order and Minutes of meeting, Writing Instructions.

Paper Code(s): CEC-208	**L**	**P**	**C**
Paper: Hydraulics and Hydrology	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To study different types of flow and forces exerted by flow on the boundary of conduit.
2.	To explain forces on submerged bodies, flow through pipes and principles of turbines.
3.	To assess the storage capacity of the reservoir and the process of mitigating floods.
4.	To determine runoff characteristics.

Course Outcomes (CO)

CO 1	Able To Define different types of flow, and hydraulic machines
CO 2	Able To Determine Various Components Of The hydrologic cycle affecting movement of water in the earth and various Stream flow measurements technique
CO 3	Able to analyse complex flow problems on boundary layers, pipe network and hydraulic turbines & pumps.
CO 4	Able to determine and analyse ground water hydraulics.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	1	1	-	-	-	-	-	-	-	1	-	-
CO 2	2	3	2	1	-	-	-	-	-	1	-	-
CO 3	2	3	2	1	-	-	-	-	-	-	1	-
CO 4	3	2	3	2	1	-	-	-	-	-	-	-

UNIT-I

Laminar Flow : Flow through circular pipe and parallel plates, Kinetic energy correction factor, Momentum correction factor; Loss of head due to friction; determination of coefficient of viscosity.
Boundary Layer: Concept and development of boundary layer, Laminar and turbulent boundary layers and their analysis, boundary layer thickness; Critical Reynolds number; Boundary layer separation and control.
Forces on submerged bodies: Forces exerted by flowing fluid, Concept and expression for Drag and lift; Pressure drag and friction drag; Stream line and bluff body; Drag on sphere and cylinder, Terminal velocity of a body, Lift on a circular cylinder, Drag force acting on a rotating cylinder, Development of lift on Airfoil.

UNIT-II

Flow through pipes: Loss of head / energy in pipes - Major losses-friction loss by Darcy Weisbach formula, Chezy's formula; Types of minor losses; Hydraulic gradient and total energy line, Flow through siphon, Pipes in series, concept of equivalent pipe, flow through parallel and branched pipes; Water hammer in pipes, sudden and gradual closure of valve; Analysis of Pipe network using Hardy Cross method.
Hydraulic machines: General layout of hydroelectric power plant, classification of hydraulic turbines, Pelton turbine and its main parts, Analysis and design of Pelton turbine for jet diameter, wheel diameter, width, depth

and number of buckets; Hydraulic, mechanical and overall efficiencies of turbine, Introduction to other turbines like Francis and Kaplan turbines, Specific speed and its significance.
Pumps: Centrifugal Pump, Introduction, Main parts; Head, efficiencies, specific speed, Cavitations in turbines and centrifugal pumps and their effects and precautions, Main parts of Reciprocating Pump.

UNIT-III

Hydrology: Hydrologic Cycle. Water Budget Equation, Precipitation: Types, measurements and analysis, error in estimation, missing data, consistency of rainfall records, Intensity during frequency (IDF) and probabilistic maximum Precipitation (PMP) curves. Evaporation and consumptive use: Process affecting factors, estimation, and measurement techniques. Infiltration: Process affecting factors, measurement and estimation, Infiltration Indices.
Surface Runoff: Components and factors affecting runoff, methods of estimation of runoff volume and peak runoff, rating curve, Rainfall – runoff relationships.
Hydrograph analysis: components, factors affecting hydrographs, base flow separation, Direct Runoff Hydrograph, Unit Hydrograph: Theory and assumptions. Derivation of Unit Hydrograph, Synthetic Unit Hydrograph.

UNIT – IV

Ground Water Hydrology: Zones of underground water, Aquifers and their types, important terms, Determination of discharge through unconfined and confined aquifers with steady flow conditions, Interference among wells, determination of aquifer constants, Well loss and specific capacity, efficiency of a well, types of water wells, bored and open wells, specific yield of a well, type of tube wells, well shrouding and well development, Suitable site selection for tube well, Types of open wells, Methods of lifting water. Infiltration galleries and Infiltration well.

Textbook(s):
1. P.N. Modi & S.M. Seth, Hydraulics and Fluid Mechanics including Hydraulics Machine Standard Book House, New Delhi.
2. Subramanya,K.,Engineering Hydrology,Tata McGraw Hill, New Delhi
3. Ramamrutham S., Hydraulics Fluid Mechanics and Fluid Machines, Dhanpat Rai Publicating Company, Delhi.
4. Fluid Mechanics: Including Hydraulic Machines by A.K. Jain.

References:
1. Modi,P.N.,IrrigationWaterResources,andWaterPowerEngineering,StandardBookHouse,NewDelhi.
2. Todd,D.K.,GroundwaterHydrology,1993JohnWiley&Sons.
3. Raghunath, H.M, Hydrology–Principles,AnalysisandDesign,1986,Wiley
4. Dr. P. Jaya Rami Reddy, A Textbook of Hydrology, University Science Press.
5. Garg S.K., Hydrology and Water Resources Engineering

Paper Code(s): CEC-212	**L**	**P**	**C**
Paper: Transportation Engineering	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To explain the basic modes of transportation and their importance in selecting the effective transportation mode.
2.	To analyse the various parameters including surveys for planning of new transportation systems.
3.	To design the layout of terminal facilities like railway stations, yards for railways, docks & harbours for waterways and airport for airways.
4.	To identify the forces and stresses to be considered while designing various transportation structures like railway track, harbour components, runways, and tunnels.

Course Outcomes (CO)

CO 1	Explain the basic modes of transportation and their importance in selecting the effective transportation mode considering the socio-economical and geographical aspects.
CO 2	Analyse the various parameters including surveys for planning of new transportation systems (Highways, Railways, Waterways and Airways).
CO 3	Design the layout of terminal facilities like railway stations, yards for railways, docks and harbours for waterways and airport for airways.
CO 4	Identify the forces and stresses to be considered while designing various transportation structures like railway track, harbour components, runway, and tunnels.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	-	2	-	1	-	3	3	-	-	-	-	2
CO 2	1	3	3	2	-	1	2	-	2	1	2	1
CO 3	3	-	3	3	3	1	3	-	3	1	3	2
CO 4	2	3	3	2	1	1	-	-	1	-	-	-

UNIT-I

Introduction to Transportation Systems: Modes of transportation, introduction to road, rail, air and water transportation, Comparison of various modes of transportation.

Highway Development and Planning: History of road development, Highway development in India, Classification of roads, Road patterns, Saturation system, Engineering surveys for highway alignment.

Introduction to Rail Transportation: Types of surveys, Permanent way–its various components and functions of rails, sleepers, ballast, etc., Requirements of an ideal permanent way, Defects in rails, Gauges in railway track, Coning of wheels, Tilting of rails, Rail joints, Rail fastenings, Sleeper density, Creep of rail.

UNIT-II

Geometric Design of Railway Track: Gradient and grade compensation, Superelevation, concepts of cant excess and deficiency, Negative superelevation, Safe permissible speed, transition curves, Widening of gauge on curves.

Railway Operation and Control: Points and crossings, Types of turnouts, Design of turnouts, Types of switches, Types of track junctions, Different types of stations and yards, Equipment in station yards, Signalling and Control systems–Classification of Signals, Absolute block system, Centralized traffic control system, Interlocking of signals.

Railway Construction and Maintenance: Construction of railway track–earthwork, plate laying and laying of ballast, Maintenance of railway tracks, Modern methods of track maintenance, Concept of high-speed trains.

UNIT-III

Water Transportation: Classification of Harbour, Harbour planning, Sounding methods, Classification of Ports, tide, wind and wave, Shore protection work, Littoral drift, Types of breakwaters, Classification and shape of Docks and basins, Jetties and wharves.

Tunnel Engineering: Necessity of tunnels, Classification of tunnels, Shape of tunnels, Shafts in tunnels, Methods of Tunnelling in rocks and in soft ground, Shield method, Compressed air method, Ventilation, drainage and lighting for tunnels.

UNIT – IV

Airport Planning and Design: Aircraft characteristics affecting airport, Airport planning, Surveys for site selection, Wind rose diagram and its utility, Concept of airport runway length, calculations and corrections, taxiway, Apron, Hanger, Radar, Air traffic control, and service equipment.

Text Books

1. S.C. Saxena & S.P. Arora, "A Textbook of Railway Engineering", Dhanpat Rai Publications, 7th Edition (2018).
2. S.K. Khanna, M.G. Arora & S.S. Jain, "Airport Planning and Design", Nem Chand & Bros., 6th Edition (2012).

Reference Books

1. S.K. Khanna, C.E.G. Justo, A. Veeraragavan, "Highway Engineering", Nem Chand & Bros., 10th Edition (2021).
2. V.N. Vazirani & S.P. Chandola, "Transportation Engineering–Vol. II", Khanna Publishers (2012).
3. Satish Chandra & M.M. Agarwal, "Railway Engineering", Oxford University Press, 2nd Edition (2013).
4. R. Srinivasan, "Harbour, Dock and Tunnel Engineering", Charotar Publishing House, 30th Edition (2022).
5. S.C. Rangwala, "Railway Engineering", Charotar Publishing House, 27th Edition (2017).

Paper Code(s): BS-202	**L**	**P**	**C**
Paper: Probability, Statistics and Linear Programming	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To understand probability and probability distributions.
2:	To understand methods of summarization of data.
3:	To understand and use test for hypothesis.
4:	To understand methods for solving linear programming problems.

Course Outcomes (CO):

CO1:	Ability to solve probability problems and describe probability distributions.
CO2:	Ability to describe and summarize data.
CO3:	Ability to use test for hypothesis.
CO4:	Ability to formulate and solve linear programming problems.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	-	3	1	1	1	-	-	-	-	-	1	2
CO2	-	3	1	1	1	-	-	-	-	-	1	2
CO3	-	3	2	2	1	-	-	-	-	-	2	2
CO4	-	3	3	3	1	-	-	-	-	-	2	2

Unit I

Basics: Probability and Statistical models, Sample Spaces and Events, Counting Techniques, Interpretations and Axioms of Probability, Unions of Events and Addition Rules, Conditional Probability, Intersections of Events and Multiplication and Total Probability Rules, Independence, Bayes' Theorem, Random Variables.
Discrete and Continuous Random Variables and Distributions: Probability Distributions and Probability Mass / density Functions, Cumulative Distribution Functions, Mean and Variance of a Random Variable, Discrete and continuous Uniform Distribution, Binomial Distribution, Geometric and Negative Binomial Distributions, Hypergeometric Distribution, Poisson Distribution. Normal Distribution, Normal Approximation to the Binomial, and Poisson Distributions; Exponential Distribution, Erlang and Gamma Distributions, Weibull Distribution, Lognormal Distribution, Beta Distribution.

Unit II

Joint Probability Distributions for Two Random Variables, Conditional Probability Distributions and Independence, Joint Probability Distributions for Two Random Variables, Covariance and Correlation, Common Joint Distributions, Linear Functions of RandomVariables, General Functions of Random Variables, Moment-Generating Functions.
Numerical Summaries of Data, Stem-and-Leaf Diagrams, Frequency Distributions and Histograms, Box Plots, Time Sequence Plots, Scatter Diagrams, Probability Plots. Point Estimation, Sampling Distributions and the Central

Limit Theorem without proof, General Concepts of Point Estimation, Methods of Point Estimation, Statistical Intervals for a Single Sample.

Unit III

Hypotheses Testing for a SingleSample: Tests on the Mean of a Normal Distribution with Variance Known / Unknown, Tests on the Variance and Standard Deviationof a Normal Distribution, Tests on a Population Proportion, Testing for Goodness of Fit, Nonparametric tests (Signed, Wilcoxon), Similarly Statistical Inference forTwo Samples.
Regression and Correlation: Linear Regression, Least Squares Estimators, Hypotheses testing for simple linear regression, Confidence Intervals, Adequacy of model, Correlation, Transformed Variables, Logistic Regression. Similarly, for multiple linear regression including aspects of MLR.

Unit IV

Linear Programming: Introduction, formulation of problem, Graphical method, Canonical and Standard form of LPP, Simplex method, Duality concept, Dual simplex method, Transportation and Assignment problem.

Textbooks:

1. *Applied Statistics and Probability for Engineers* by Douglas G. Montgomery and Runger, Wiley, 2018
2. *Linear Programming* by G. Hadley, Narosa, 2002

References:

1. *Miller and Freund's Probability and Statistics for Engineers* by Richard A. Johnson, Pearson, 10th Ed., 2018.
2. *Probability & Statistics for Engineers & Scientists* by Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Pearson, 2016.
3. *Statistics and probability with applications for engineers and scientists using Minitab, R and JMP*, C. Gupta, Irwin Guttman, and Kalanka P. Jayalath, Wiley, 2020.
4. *Probability and Statistics for Engineering and the Sciences*, Jay Devore, Cengage Learning, 2014.
5. *Probability and Statistics in Emgineering*, William W. Hines, Douglas C. Montgomery, David M. Goldman, and Connie M. Borror, Wiley, 2003.
6. *Operations Research: An Introduction* by Hamdy A. Taha, Pearson, 10th Edition, 2016

Paper Code(s): CEC-254	**L**	**P**	**C**
Paper: Soil Mechanics Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Soil Mechanics) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Determination of Water content by oven drying method.
2. Determination of Water content by pycnometer.
3. Determination of Water content by rapid moisture meter method.
4. Determination of Specific Gravity by:
   a) Density bottle.
   b) Pycnometer.
5. Determination of Particle size distribution by sieving.
6. Determination of Particle size distribution by hydrometer.
7. Determination of liquid Limit of soil.
8. Determination of Plastic Limit of soil.
9. Determination of Shrinkage limit, shrinkage ratio, and volumetric shrinkage of soil.
10. Determination of In-situ (Field density) by core cutter method.
11. Determination of In-situ (Field density) by sand replacement method.

Paper Code(s): CEC-256	**L**	**P**	**C**
Paper: Hydraulics Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Hydraulics and Hydrology) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study and compare the losses due to flow in smooth and rough pipes.
2. To draw the performance characteristics of variable speed centrifugal pump and single stage reciprocating pump.
3. To determine operating characteristics of pelton wheel turbine.
4. To determine operating characteristics of Francis turbine.
5. To determine operating characteristics of Kaplan turbine.
6. Reynolds dye experiment for flow characterization.
7. To determine the lift and drag force on different airfoils.
8. Measurement of Rainfall by non –recording rain gauge.
9. Measurement of rainfall by recording rain gauge.
10. To determine mean rainfall of an area by Thiessen mean Polygon method and isohyetal method.
11. To determine the velocity of a running of a stream in a canal by current meter and calculate the approximate discharge of the canal.
12. To design a regime channel by Lacey's theory for a given pattern of crops and area to be irrigated.

Paper Code(s): CEC-258	**L**	**P**	**C**
Paper: Transportation Engineering Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Transportation Engineering) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Aggregate crushing strength test.
2. Los Angeles Abrasion test.
3. Aggregate impact test.
4. Flakiness index and elongation index test.
5. Penetration test
6. Ductility test
7. Viscosity test.
8. Softening point test.
9. Flash and fire point test.
10. Determination of bitumen content by centrifuge extractor
11. Determination of marshal stability value.
12. Determination of rebound deflection of pavement by Benkelman beam.

Paper Code(s): BS-252	L	P	C
Paper: Probability, Statistics and Linear Programming Lab	-	2	1

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Probability, Statistics and Linear Programming) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

Implementation to be done in MATLAB or in equivalent software.

1. Installation of Scilab and demonstration of simple programming concepts like marix multiplication (scalar and vector), loop, conditional statements and plotting.
2. Program for demonstration of theoretical probability limits.
3. Program to plot normal distributions and exponential distributions for various parametric values.
4. Fitting of binomial distributions for given n and p.
5. Fitting of binomial distributions after computing mean and variance.
6. Fitting of Poisson distributions for given value of lambda.
7. Fitting of Poisson distributions after computing mean.
8. Fitting of normal distribution when parameters are given.
9. Fitting of linear regression line through given data set and testing of goodness of fit using mean error.
10. Fitting of Multiple Linear Regression (MLR) curve through given data set and testing of goodness of fit using mean error.
11. Solve a LPP of three variable using Simplex Method.
12. Solve a Transportation problem of three variables.
13. Solve an Assignment problem of three variables.