Vidya Pratishthan's

Kamalnayan Bajaj Institute of Engineering and Technology, Baramati

(An Autonomous Institute)

Board of Studies

Department of Civil Engineering

Syllabus

S. Y. B. Tech

Civil Engineering

(2025 Pattern w.e.f. AY: 2026-2027)

Vidya Pratishthan's
Kamalnayan Bajaj Institute of Engineering and Technology
Board of Studies: Civil Engineering
Syllabus: Second Year (B. Tech.) Civil Engineering
2025 Pattern w.e.f. AY:2026-2027

SEMESTER-III

Course Type	Course Code	Courses Name	Teaching Scheme			Examination Scheme and Marks							Credits				
			TH	PR	TUT	CAA	ISE	ESE	TW	PR	OR	Total	TH	PR	OR	TUT	Total
BS	BS25205TH	Advanced Mathematics for Civil Engineering	3	-	-	10	30	60	-	-	-	100	3	-	-	-	3
PCC	CE25201TH	Surveying	3	-	-	10	30	60	-	-	-	100	3	-	-	-	4
PCC	CE25201PR	Surveying	-	2	-	-	-	-	-	30	-	30	-	1	-	-	
PCC	CE25202TH	Geotechnical Engineering	3	-	-	10	30	60	-	-	-	100	3	-	-	-	4
PCC	CE25202PR	Geotechnical Engineering	-	2	-	-	-	-	-	-	30	30	-	1	-	-	
PCC	CE25203TH	Mechanics of Structure	3	-	-	10	30	60	-	-	-	100	3	-	-	-	4
PCC	CE25203PR	Mechanics of Structure	-	2	-	-	-	-	-	-	30	30	-	1	-	-	
MDM	MD250XXTH	Multi-Disciplinary Minor	2	-	-	10		60	-	-	-	70	2	-	-	-	3
MDM	MD250XXPR	Multi-Disciplinary Minor	-	2	-	-	-	-	30	-	-	30	-	1	-	-	
VSEC	CE25204PR	Civil Engineering Software Lab I	-	2	1	10	-	-	30	30	-	70	-	1	-	1	2
CEPFP	CE25205PR	Community Engineering. Project/ Field Project	-	4	-	10	-	-	30	-	30	70	-	2	-	-	2
Total			**14**	**14**	**1**	**70**	**120**	**300**	**90**	**60**	**90**	**730**	**14**	**7**	**-**	**1**	**22**

for

Dr. P. K. Singh
Academic Coordinator

Dr. C. B. Nayak
Head of Department

Dr. S .M. Bhosale
Dean Academics

Dr. A. H. Kolekar
Controller of Examinations

Dr. S. B. Lande
Principal

SEMESTER-IV

Course Type	Course Code	Courses Name	Teaching Scheme			Examination Scheme and Marks							Credits				
			TH	PR	TUT	CAA	ISE	ESE	TW	PR	OR	Total	TH	PR	OR	TUT	Total
PCC	CE25211TH	Concrete Technology	3	-	-	10	30	60	-	-	-	100	3	-	-	-	4
PCC	CE25211PR	Concrete Technology	-	2	-	-	-	-	-	-	30	30	-	1	-	-	
PCC	CE25212TH	Fluid Mechanics	3	-	-	10	30	60	-	-	-	100	3	-	-	-	4
PCC	CE25212PR	Fluid Mechanics	-	2	-	-	-	-	-	-	30	30	-	1	-	-	
PCC	CE25213TH	Structural Analysis	3	-	-	10	30	60	-	-	-	100	3	-	-	-	3
MDM	MD250XXTH	Multi-Disciplinary Minor	3	-	-	10	30	60	-	-	-	100	3	-	-	-	4
MDM	MD250XXPR	Multi-Disciplinary Minor	-	2	-	-	-	-	30	-	-	30	-	1	-	-	
OE	OE250XXTH	Open Elective	2	-	-	10	-	60	-	-	-	70	2	-	-	-	2
VEC	HS25211TH	Environmental Studies ✓	2	-	-	10	-	60	-	-	-	70	2	-	-	-	2
AEC	HS25213TH	Public Speaking and Aptitude	1	-	-	10	-	-	30	-	-	40	1	-	-	-	2
AEC	HS25213PR	Public Speaking and Aptitude	-	2	-	-	-	-	-	-	30	30	-	1	-	-	
Total			**17**	**8**	**-**	**70**	**120**	**360**	**60**	**-**	**90**	**700**	**17**	**04**	**-**	**-**	**21**

for
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Principal

List of Multi-Disciplinary Minor and Open Elective

Code	Multi-Disciplinary Minor	Code	Open Elective
AI25051	AI & Machine Learning	OE25001	Digital Marketing
AI25052	Data Science	OE25002	Professional Leadership
AI25053	Generative AI	OE25003	Organizational Behaviour
CO25051	Cloud computing	OE25004	Industrial Management
CO25052	High Performance Computing	OE25005	Disaster Management
CO25053	Computer Graphics & Gaming	OE25006	Energy Economics & Management
IT25051	Cyber Security	OE25007	Operation Research
IT25052	Full Stack Development	OE25008	Intellectual Property Rights
ET25051	Embedded Systems	OE25009	Cyber Laws
ET25052	Drone Technology	OE25010	Bioinformatics
ET25053	Internet of Things	OE25011	Biotechnology
CE25051	Waste Management	OE25012	International Relations
CE25052	Green Building & Smart Cities	OE25013	Universal Human Values
ME25053	3-D Printing	OE25014	Education Technology
ME25054	Robotics & Automation	OE25015	Design Thinking
EL25051	Solar Technology	OE25016	Accounting & Finance
EL25052	Industrial Automation	OE25017	Sustainability & Climate Change
GS25051	Nanotechnology	OE25018	Agriculture Technology
GS25052	Linear Algebra and Statistics	OE25019	Architectural Technology

for P.K.
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Vidya Pratishthan's
Kamalnayan Bajaj Institute of Engineering and Technology
Board of Studies: Civil Engineering
Syllabus: Honor Subjects
2025 Pattern w.e.f. AY:2026-2027

Semester	Course Code	Courses Name	Teaching Scheme (Hrs.)			Examination Scheme and Marks							Credits			
			TH	PR	TUT	CAA	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
III	CE25281 TH	Engineering Seismology	2	-	-	10	-	60	-	-	-	70	2	-	-	3
	CE25281 PR	Engineering Seismology	-	2	-	-	-	-	-	30	-	30	-	1	-	
IV	CE25291 TH	Advanced Mechanics of Structures	2	-	-	10	-	60	-	-	-	70	2	-	-	3
	CE25291 PR	Advanced Mechanics of Structures	-	2	-	-	-	-	-	30	-	30	-	1	-	
V	CE25381 .TH	Advanced Design of Industrial Steel Structure	3	-	-	20	20	70	-	-	-	110	3	-	-	4
	CE25381 PR	Advanced Design of Industrial Steel Structure	-	2	-	-	-	20	20	-	40	-	-	1	-	
VI	CE25391 TH	Advanced Design of Concrete Structure	3	-	-	20	20	70	-	-	-	110	3	-	-	4
	CE25391 PR	Advanced Design of Concrete Structure	-	2	-	-	-	-	20	20	-	40	-	1	-	
VI	CE25491 TH	Structural Dynamics	3	-	-	20	20	70	-	-	-	110	3	-	-	4
	CE25391 PR	Structural Dynamics	-	2	-	-	-	-	20	20	-	40	-	1	-	
Total			13	10	-	80	60	330	60	120	00	650	13	05	-	18

for Dr. P. K. Singh
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Principal

BS25205 Advanced Mathematics for Civil Engineering		
Teaching Scheme: **Theory: 3 Hours/Week**	**Credits 03**	**Examination Scheme:** **In-Semester: 30 Marks** **End-Semester: 60 Marks** **Activity: 10 Marks**

Prerequisites: Differential & Integral calculus, Taylor series, Differential equations of first order and first degree, Fourier series, Collection, classification & representation of data.

Course Objectives: To familiarize the students with concepts and techniques in Ordinary differential equations, Statistics & Probability, numerical methods, and their applications. The aim is to equip them with the strategies to understand advanced-level mathematics and its applications that would enhance analytical thinking power, useful in their discipline.

Course Outcomes (COs): On completion of the course, the learner will be able to

CO1: Solve Higher-order linear differential equations and apply them for modeling and analyzing Civil engineering problems.

CO2: Understand the concept of statistical methods correlation, and regression.

CO3: Learn the concept of Probability theory and apply it to Engineering problems.

CO 4: Apply various numerical methods such as interpolation, differentiation, and integration.

CO 5: Develop the concept of numerical methods for solving systems of linear equations, and ordinary differential equations.

CO 6: Solve Partial differential equations such as wave equations, and one and two-dimensional heat flow equations.

Course Contents

Unit I: Numerical Interpolation and Integration (07 Hours)

Interpolation: Finite Differences, Newton's and Lagrange's Interpolation formula, Numerical Differentiation.

Numerical Integration: Trapezoidal and Simpson's $1/3^{rd}$ and $3/8^{th}$ rules.

Unit II: Numerical method for Linear Systems and ODE (07 Hours)

System of linear equations: Cholesky, Jacobi, and Gauss-Seidel methods.

Solutions of ordinary differential equations: Euler's, Modified Euler's, Runge-Kutta 4th order methods.

Unit III: Linear Differential Equations (LDE) and Applications (07 Hours)

LDE of n^{th} order with constant coefficients, Complementary Function, Particular Integral, General method, Method of variation of parameters, Cauchy's and Legendre's DE, Modeling of problems on bending of beams, and whirling of shafts.

Unit IV: Statistics and Regression Analysis (07 Hours)

Measures of Dispersion, Moments, Skewness, and Kurtosis. Correlation and Regression Analysis: Least square method, Curve fitting: fitting of straight lines, and parabola.

Unit V: Probability and Probability Distributions (07 Hours

Probability, Theorems on probability, Random variables, Probability Mass function, Probability Density function, Mathematical Expectation. Probability distributions: Binomial, Poisson, and Normal, Test of hypothesis: Chi-square test.

Unit VI: Applications of Partial Differential Equations (07 Hours)

Basic concepts, modeling of Vibrating String, Wave equation, One and two-dimensional Heat flow equations, method of Separation of variables, use of Fourier series, Applications of PDE to problems of Civil and allied Engineering

Text Books:
1. Higher Engineering Mathematics by B.V. Ramana (Tata McGraw-Hill). 2. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication, Delhi).
Books and Other Resources
1. Advanced Engineering Mathematics, 10e, by Erwin Kreyszig (Wiley India). 2. Advanced Engineering Mathematics, 2e, by M. D. Greenberg (Pearson Education). 3. Advanced Engineering Mathematics, 7e, by Peter V. O'Neil (Cengage Learning). 4. Differential Equations, 3e by S. L. Ross (Wiley India). 5. Introduction to Probability and Statistics for Engineers and Scientists, 5e, by Sheldon M. Ross (Elsevier Academic Press). 6. Partial Differential Equations for Scientists and Engineers by S. J. Farlow (Dover Publications, 1993).

Course Coordinator | Dept. Autonomy Coordinator | BOS Chairman | Principal

CE25201 – Surveying

Teaching Scheme:	Credits: 4	Examination Scheme:
TH: 3 Hrs./week	Theory: 3	CAA: 10 Marks In semester: 30 Marks End Semester: 60 Marks
PR: 2 Hrs./week	Practical: 1	TW/PR: 30 Marks

Prerequisite:

Basic Introduction to Civil Engineering field, Engineering Mathematic.

Course Objectives:

1. To perform and correct surveying measurements.
2. To use and adjust leveling and angular measurement instruments.
3. To perform plane table, tacheometric and contour surveying.
4. 4. To measure angles, perform theodolite traversing, and compute coordinates.
5. 5. To set simple circular curves and understand geodetic surveying.
6. 6. To utilize GPS, EDM, Total Station, remote sensing, and drones.

Course Outcomes: After Completion of course students will be able to

CO1: Demonstrate various methods of linear and angular measurements.
CO2: Analyse different types of surveying data.
CO3: Conduct field work and application of scientific methodology in handling field data.
CO4: Apply various surveying techniques for civil engineering problems.
CO5: Analyse curve setting, geodetic surveying, triangulation, and station selection.
CO6: Apply GPS, EDM, Total Station, remote sensing, GIS, and drone technology in Civil Engineering.

Course Contents

Unit 1: Linear Measurements **07 Hours**

Introduction, Principles of surveying, types of errors, ranging, chaining, offsetting, plotting chain survey data, errors in chain and tapes, corrections- length, slope, temperature, pull, sag. Instruments for measuring right angles- open cross staff, optical square, use of prismatic compass, bearing of lines, types of bearings such as Whole Circle Bearing, Quadrantal Bearing, meridian and their types, local attraction, dip, magnetic declination etc. and calculation of true bearings, including numerical of all types

Unit 2: Levelling and Angular Measurements **06 Hours**

(a) Principle Axes of Dumpy Level: study of dumpy level, auto level & digital level, testing and adjustment of axis of bubble tube and line of collimation, rise and fall method, reciprocal levelling, curvature and refraction corrections, distance to the visible horizon.

(b) Theodolite: introduction to 20" Vernier Theodolite, Study of Vernier and Micro Optic Theodolite, Principle Axes of Theodolite: Testing and Permanent adjustments of Transit

Theodolite.

Unit 3: Plane Table Survey and Tacheometry 07 Hours

(a) Methods of Plane Table Survey- radiation, intersection, traversing and resection; Two point and Three-point problems and their solutions by different methods, Strength of fix, Lehman's Rules.

(b) (b) Principle of stadia, fixed hair method with vertical staff to determine horizontal distances and elevations of the points. Use of Tacheometry in Surveying, Tacheometric Contour Survey, use of contour maps, direct and indirect methods of contouring. Profile Levelling, Longitudinal Section and Cross-sections, Toposheets

Unit 4: Theodolite Traversing **06 Hours**

(a) Uses of Theodolite: measurement of horizontal angles, horizontal angles by repetition and by reiteration (errors eliminated), vertical angles, magnetic bearings, prolonging a line, lining in, setting out angles.

(b) Theodolite Traversing: computation of consecutive and independent coordinates, adjustment of closed traverse by Transit rule and Bowditch's rule, Gales traverse table, omitted measurements, area calculation by independent coordinates. Open Traverse- it's uses, measurement of deflection angles using transit theodolite, open traverse survey, checks in open traverse.

Unit 5: Curves and Geodetic Surveying **07 Hours**

(a) Curves: Introduction to horizontal and vertical curves, relation between radius and degree of curve, types of curves, notations used and properties of simple circular curves, horizontal curve setting by offsets from a long chord and Rankine's method.

(b) Geodetic Surveying: Objects, Methods in Geodetic surveying, Trilateration, Classification of triangulation systems, Triangulation figures, Strength of figure & derivation for well-conditioned triangle, Selection of stations, intervisibility & height of stations.

Unit 6: Advance Surveying Techniques **06 Hours**

Global Positioning System (GPS): Applications to Civil Engineering, concept of Global Positioning Systems [GPS] and differential GPS, Electromagnetic Distance Meters (E.D.M.) measurement, principle of EDM instruments, Total Station and its uses, fundamental parameters of Total Station, etc. Introduction to remote Sensing and GIS, Introduction to drone.

Books & Other Resources:

Textbooks

1. Basak N. N. "Surveying and Levelling", Tata McGraw-Hill Publishing Company Limited.
2. Kanetkar T.P. and Kulkarni S.V. "Surveying and Levelling – Part1", Pune Vidyarthi Griha Prakashan, Pune.

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3. Kanetkar T.P. and Kulkarni S.V. "Surveying and Levelling – Part2", Pune Vidyarthi Griha Prakashan, Pune

Reference Books

1. Duggal S. K. "Surveying Volume I", Tata McGraw-Hill Publishing Company Limited.
2. Duggal S. K. "Surveying Volume II", Tata McGraw-Hill Publishing Company Limited.
3. Bannister A, Raymond S & Baker R. "Surveying", Pearson Education Ltd.
4. Subramanium R., "Surveying & Levelling", Oxford University Press.
5. Clark David, "Plane and Geodetic Surveying for Engineers Volume–I", CBS, 6/E.
6. Clark David, "Plane and Geodetic Surveying for Engineers Volume –II", CBS, 6/E.
7. Punmia B. C. "Surveying-I", Laxmi Publications (P) Ltd. New Delhi.
8. Punmia B. C., Jain A, Jain A., "Surveying-II", Laxmi Publications (P) Ltd. New Delhi.
9. Jensen, John R. "Remote sensing of the environment: An earth resource perspective" 2/e. Pearson Education India, 2009.
10. Reddy, M. Anji. "Geoinformatics for environmental management." BS publications, 2004.

For term work submission students have to complete following practical/assignments.

Term work

a) Perform any 10 Exercises out of 1 to 15 and Any 02 projects:

1. Chain and compass traverse survey
2. Study and use of digital level & auto level to determine elevation of various points
3. Measurement of horizontal and vertical angles by 20'' transit theodolite
4. Measurement of horizontal angles by repetition method
5. Computation of horizontal distances and elevations by tacheometry
6. Radiation & intersection methods in plane table survey
7. Setting out a given building from a given foundation plan
8. Study and use of one second theodolite and measurement of horizontal angle
9. Setting out a given horizontal angles and measurement of vertical angles using 1'' or 20'' second theodolite
10. Setting out a circular curve by Rankine's method of deflection angles
11. Finding out elevation of high object by trigonometrical levelling using 1'' or 20'' second theodolite
12. Study and use of total station
13. Study and use of drone
14. Determination of air base distance using mirror stereoscope
15. Study and use of nautical sextant and measurement of horizontal angle

b) Projects: (Minimum Two)

1. 1. Road project using auto level/ digital level for a minimum length of 200 m including fixing of alignment, profile levelling, cross-sectioning, plotting of L-section and Cross Section. (One full imperial sheet including plan, L-section and any three typical Cross-section.
2. 2. Tachometric contouring project on hilly area with at least two instrument stations about 60 m to 100 m apart and generating contours using both methods, manual as well as using any suitable software such as Autodesk land desktop, Auto-civil, Foresight etc. (minimum contour interval 1 meter).
3. Total Station Traversing.

Practical examination and oral will be based on above term work.

Activity:
Assignment's based on each unit.

CE25202 - Geotechnical Engineering

Teaching Scheme:	**4 Credits**	**Examination Scheme:**
TH: 3 Hrs./week	**Theory: 03**	**Activity: 10 Marks**
PR: 2 Hrs./week	**Practical: 01**	**In semester: 30 Marks**
		End Semester: 60 Marks
		OR: 30 Marks

Prerequisite:

1. Fundamentals of Physics, 2. Mathematics, 3. Engineering Mechanics

Course Objectives:

1. To describe soil properties, classification and its behavior under stress.
2. To learn methods for measurements and determination of index & engineering properties of soil.
3. To study the interaction between water and soil and the effects of static vs flowing water on soil strength.

Course Outcomes: After Completion of course students will be able to

CO1: Identify and classify the soil based on the index properties and its formation process.

CO2: Explain permeability and seepage analysis of soil by construction of flow net.

CO3: Illustrate the effect of compaction on soil and identify suitable compaction methods.

CO4: Express shear strength of soil and its measurement under various drainage conditions.

CO5: Evaluate stresses within the soil mass and obtain bearing capacity of foundation.

CO6: Evaluate the earth pressure and analysis of stability of slopes for different types of soils.

Course Contents

Unit I: Introduction and Index Properties **(7 Hours)**

a) Introduction to Geotechnical Engineering, major soil deposits of India, Soil structure: single grained and honey combed, flocculated and dispersed.

b) Three phase soil system, weight volume relationships, index properties of soil - methods of determination and its significance, I.S. classification of soil.

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Unit II: Permeability and Seepage **(6 Hours)**

Darcy's law, Factors affecting permeability, Determination of permeability by constant head and falling head method as per IS - 2720, field test as per IS – 5529 (part I) - pumping in test and pumping out test. Permeability of layered soils, Seepage forces, General flow equation. Flow net and its application.

Unit III: Compaction **(7 Hours)**

Introduction, Comparison between compaction and consolidation, Factors affecting compaction, Zero air voids line, Effect of compaction on soil structure. Standard Proctor test and Modified Proctor test as per IS – 2720. Field compaction equipment and methods for cohesive and non-cohesive soils.

Unit IV: Shear Strength of Soil **(6 Hours)**

Mohr's circle, Mohr-coulomb failure criteria, Effective stress concept. Peak and residual shear strength. Factors affecting shear strength. Laboratory measurement of shear strength by direct, unconfined and triaxial tests under different drainage conditions. Vane shear test.

Unit V: Stress Distribution and Bearing Capacity **(7 Hours)**

a) Stress Distribution in Soils: Boussinesq theory- point load and Circular Load, Pressure Distribution diagram on a horizontal and vertical plane, pressure bulb, Westergaard's theory, equivalent point load method, and approximate stress distribution method.

b) Bearing Capacity of Foundation: Types of foundations, Terzaghi's and Meyerhoff bearing capacity analysis, effect of various BC factor on bearing capacity, Shear failure and Settlement criteria, Pile foundation. Use of field test (SPT and Plate Load) data for bearing capacity determination.

Unit VI: Earth Pressure **(6 Hours)**

a) Lateral Earth Pressure: Earth pressure on vertical wall, effect of wall movement on earth pressure, earth pressure at rest, Rankine's theory, lateral earth pressure due to submerged backfill, backfill with uniform surcharge, backfill with sloping surface, Coulomb's theory.

b) Stability of Slopes: Slope classification, slope failure, modes of failure. Infinite slope in cohesive and cohesion less soil, slope stability analysis using Swedish Slip Circle Method.

Books & Other Resources:

Textbooks:

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1. Gopal Ranjan and A S Rao, "Basic and Applied Soil Mechanics", G. K. Publications pvt. Ltd
2. V. N. S. Murthy, "Soil Mechanics and Foundation Engineering", B.S.Publications (3rd Edition)
3. B. C. Punmia, "Soil Mechanics and Foundation Engineering", Laxmi Publishing Co., New Delhi. 4. Dr. B. J. Kasmalkar ,"Geotechnical Engineering", Pune Vidyarthi Griha Prakashan, 1986

Reference books:

1. Joseph E Bowles, "Engineering Properties of Soils and Their Measurements", McGraw Hill Publications (2001)
2. Lambe and Whitman, "Soil Mechanics", S. Chand publications (SI Version), (1969).
3. Donald P Coduto, Man-chu Ronald Yeung and William A. Kitch "Geotechnical Engineering Principle and practice", McMillan Press (PHI) (2010) \
4. P Purushothma Raj, "Geotechnical Engineering", McGraw Hill Publication 4th Edition (2008)
5. Compendium of Indian standards on soil engineering part 1 (1980).

Geotechnical Engineering (CE25202PR)

The term work shall consist of a journal giving details of at least 08 out of 13 of the following experiments. Oral Examination would be based on the term work.

1. Water content determination by any one method a) Oven drying method, b) Infrared moisture method.
2. Specific gravity determination by Pycnometer /density bottle.
3. Sieve analysis, particle size determination and IS classification as per I.S. Codes.
4. Determination of Consistency limits and their use in soil classification as per I.S. Codes.
5. Field density test by a) Core cutter b) Sand Replacement.
6. Determination of coefficient of permeability by a) Constant head and b) Variable head method.
7. Determination of shear strength parameters of φ soil using direct shear test.
8. Determination of shear strength parameters of C-soil using unconfined Compression Test.
9. Determination of shear strength using lab. vane Shear Test.
10. Determination of shear strength parameters of C- φ soil using triaxial Test.

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11. Determination of compaction properties using standard Proctor test / modified Proctor test.
12. Determination of free swell index using differential free swell test.
13. Determination of swell pressure of soil using swelling pressure index test.
14. Exercise on the following topics
    a) Rebhann's and Cullman's graphical method for determination of earth pressure.
    b) Solution of problems on shear strength parameters using graph.

Activity:

Assignment on each unit.

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CE25203TH–Mechanics of Structure

Teaching Scheme:	Credits: 4	Examination Scheme:
TH: 3 Hrs./week	Theory: 3	CAA: 10 Marks In semester: 30 Marks End Semester: 70 Marks
PR: 2 Hrs./week	Practical: 1	OR: 30 Marks

Prerequisite:

1. Centroid and center of Gravity, Trigonometry and Geometry Basics, Beam Reactions

Course Objectives:

1. To study various types of stresses and strains for determinate structural members.
2. To learn the concept of shear force and bending moment diagrams for determinate beams.
3. To learn the concept of shear stress and bending stress for determinate beams.
4. To learn the concept of torsional and principle stresses and strain in structural members.
5. To learn the concept of solving axially and eccentrically loaded Columns.
6. To study the concepts to estimate the slope and deflection of determinate beams.

Course Outcomes: After Completion of the course, students will be able to

CO1: Understand the concept of stress-strain and determine different types of stress and strain in determinate, indeterminate, homogeneous, and composite structures.
CO2: Calculate shear force and bending moment in determinate beams for different loading conditions and illustrate the shear force and bending moment diagram.
CO3: Explain the concept of shear and bending stresses in beams and demonstrate shear and bending stress distribution diagram.
CO4: Use the theory of torsion to determine the stresses in the circular shaft and understand the concept of Principal stresses and strains.
CO5: Solve axially and eccentrically loaded Columns.
CO6: Determine the slopes and deflection of determinate beams.

Course Contents

Unit 1: Simple Stresses and Strains **6 Hours**

a) Materials used in construction and their nature, Hook's Law, Stress-Strain Diagram for elastic, plastic materials, and brittle material, Idealized stress-strain diagram, Concept of axial stresses, strains, and Elastic constants, Concept of stresses and strains due to temperature change.
b) Stresses, strains, and deformations in determinate structures for homogeneous and concept of composite structures under concentrated loads and temperature changes.

Unit2: Shear Force and Bending Moment Diagram **6 Hours**

Concept of shear force and bending moment, Shear force and bending moment diagrams for determinate beams due to concentrated, uniformly distributed, and couples. Bending moment and loading diagram from given shear force diagram.

Unit 3: Shear and Bending Stresses **6 Hours**

a. Shear stresses in beams: Concept of shear, shear stress formula, shear stress distribution for various cross sections, maximum and average shear stress for circular and rectangular sections.
b. Bending stresses in beams: Theory of simple or pure bending, assumptions, flexure formula, bending stress distribution diagrams.

Unit 4: Torsion of Circular Shafts and Principal Stresses and Strains **6 Hours**

a. **Torsion of circular shafts**: Theory of torsion, assumptions, torsion formula. Stresses, strains, and deformations in determinate shafts of hollow, solid, homogeneous cross-sections subjected to twisting moments. Power transmitted by shafts.
b. **Principal stresses and strains:** Concept of principal planes and principal stresses, normal and shear stresses on an oblique plane, magnitude, and orientation of principal stresses, and maximum shear stress.

Unit 5: Axially and Eccentrically Loaded Columns **6 Hours**

a. **Axially loaded columns:** Concept of critical load and buckling, Euler's formula for buckling load with hinged ends, concept of equivalent length for various end conditions, and limitations of Euler's formula.
b. **Direct and bending stresses:** Direct and bending stresses for eccentrically loaded short columns. Resultant stress diagrams due to axial loads, uniaxial, and bi-axial bending. Concept of the core of the section for solid and hollow rectangular and circular sections.

Unit 6: Slope and Deflection of Beams and Trusses **6 Hours**

Slope and deflection of determinate beams by Macaulay's method, Castigliano's first theorem. Joint displacement of determinate and indeterminate trusses by the unit load method.

Books & Other Resources:

Text books:

1. Mechanics of Structures Vol. I &II by S. B. Junnarkar and Dr. H. J. Shah, Twenty second edition, Charotar Publishing House Pvt Ltd.
2. Strength of Materials by R. Subramanian, Oxford University Press.
3. Strength of Materials by S. S. Ratan, Tata McGraw Hill.

Reference books:

1. Elements of Strength of Materials by Timoshenko and Young, East-West Press Ltd.
2. Strength of Materials by F.L. Singer and Andrew Pytel, Harper and Row Publication.
3. Mechanics of Materials by Beer and Johnston, McGraw-Hill Publication.
4. Introduction to Mechanics of Solids by E.P. Popov, Prantice Hall Publication.
5. Mechanics of Materials by Gere & Timoshenko, CBC publisher.
6. Elementary Structural Analysis by Norris, Wilbur, and Utku, Tata McGraw-Hill Publisher.

7. Intermediate Structural Analysis by R. C. Hibbler, Pearson Education Publishers.

For oral examination, students have to complete the following practical/assignments.

List of Laboratory Experiments/Assignments

A. Metals
1. Tension test on mild and TMT steel.
2. Shear (Single and Double) test on mild steel.
3. Torsion test on mild steel.
4. Impact (Izod and Charpy) test on mild steel, Aluminium, and Brass.

B. Timber and Plywood
1. Compression test on timber (Parallel and Perpendicular)
2. Bending test on timber and plywood.

C. Bricks and Tiles
1. Field tests on bricks
2. Water absorption test on bricks.
3. Efflorescence test on bricks.
4. Compressive strength test on bricks
5. Flexural strength of flooring tiles.
6. Abrasion test of flooring tiles.

D. Market survey of structural materials including its costing.
E. One Assignment on each unit of this subject
Oral: Based on the above syllabus

Activity:
1. Solve SFD, BMD problems using commercial software individually.
2. Perform tension test on MS or TMT steel in a group of 5 students.

CE25052 – Green Building and Smart Cities		
Teaching Scheme:	**Credits: 4**	**Examination Scheme:**
TH: 3 Hrs./week	**Theory: 3**	**CAA: 10 Marks**
		In semester: 30 Marks
		End Semester: 60 Marks
PR: 2 Hrs./week	**Practical: 1**	**TW: 30 Marks**

Prerequisite:

1. Global Warming, Building Materials.

Course Objectives:

1. To understand the definition, concept & objectives of the green building and to imbibe basics of green design.
2. To understand planning specifications of green building.
3. To understand the definition, concept & objectives of the smart city.
4. To understand the policies of smart city.

Course Outcomes: After Completion of course students will be able to

CO1: Demonstrate green concept skills and apply tools of green building assessment.

CO2: Select appropriate green building material and technique.

CO3: Acquaint knowledge on energy conservation building code.

CO4: Acquaint knowledge on smart cities planning and development.

CO5: Select alternative resources of energy.

CO6: Develop work break down structure, scheduling and project management of smart cities.

Course Contents

Unit 1: Concept of Green Buildings **06 Hours**

a) Definition of Green Buildings, typical features of green buildings, Necessity, Initiatives, Green buildings in India, Green building Assessment- Green Building Rating Systems (BREEAM, USGBC, LEED, IGBC, TERI-GRIHA, GREEN STAR), Criteria for rating, Energy efficient criteria, environmental benefits economic benefits, health and social benefits, Major energy efficiency areas for building, Life cycle cost of buildings, Codes and Certification Program

b) **Green Design**: Definition, Principles of sustainable development in Building Design, Characteristics of Sustainable Buildings, sustainably managed Materials, Integrated Lifecycle design of Materials and Structures (Concepts only)

Unit 2: Green Building Materials, Planning and Specifications	07 Hours
a) **Green Building Materials**: Sustainably managed Materials, depleting natural resources of building materials; renewable and recyclable resources; energy efficient materials; Embodied Energy of Materials, Green cement, Biodegradable materials, Smart materials, Manufactured Materials, Volatile Organic Compounds (VOC's), Natural Non-Petroleum Based Materials, Recycled materials, Renewable and Indigenous Building Materials, Engineering evaluation of these materials. b) **Green Building Planning and Specifications**: Environment friendly and cost-effective Building Technologies, Integrated Life cycle design of Materials and Structures, Green Strategies for Building Systems, Alternative Construction Methods, Energy Conservation Measures in Buildings, Waste & Water management and Recycling in Sustainable Facilities, Heating, Ventilation and Air Conditioning, Passive Solar & Daylight, Plumbing and its Effect on Energy Consumption	
Unit 3: Building Integrated Photo Voltaic	**06 Hours**
Introduction to use of Building Integrated Photo Voltaic (BIPV) and other renewable energy in building their basic concepts and efficiency, introduction to energy conservation code (ECBC-2017), introduction to concepts of overall thermal transfer value (OTTV).	
Unit 4: Introduction to Smart cities	**07 Hours**
a) Introduction of Smart City, Concept of smart city, Objective for smart cities, History of Smart city world and India. Need to develop smart city. Introduction to city planning, Concept, principle stakeholders, key trends in smart cities developments. b) **Intelligent transport systems**: Smart vehicles and fuels, GIS, GPS, Navigation system, traffic safety management, mobility services, E-ticketing	
Unit 5: Singular- Hybrid Smart Cities	**06 Hours**
Conventional Cities, dimensions of smart cities, phases stages of project and their approval status, smart city components, energy demand, green approach to meet energy demand, introduction to static analysis.	
Unit 6: Policies in Smart Cities	**07 Hours**
Integrated infrastructure management systems for smart city, Infrastructure management system applications for existing smart city. Worldwide policies for smart city Government of India - policy for smart city, Mission statement & guidelines, Smart cities in India, Case studies of smart city.	
Books & Other Resources:	

Textbooks

1. Alternative Building Materials and Technologies – By K S Jagadeesh, B V Venkata Rama Reddy & K S Nanjunda Rao – New Age International Publishers .
2. Integrated Life Cycle Design of Structures – By AskoSarja – SPON Press.
3. Green Buildings (McGraw hill publication): by Gevorkian.
4. Smart City on Future Life - Scientific Planning and Construction by Xianyi Li.
5. The Age of Intelligent Cities: Smart Environments and Innovation-for-all Strategies (Regions and Cities) by Nicos Komninos.
6. Mission statement &guidelines on Smart City Scheme". Government of India - Ministry of Urban Development.

List of free reference guides/resources available on the net:

1. http://smartcities.gov.in/upload/uploadfiles/files/Smart City Guidelines.
2. IGBC reference guide.
3. Free abridged versions of LEED reference guides.

For term work submission students have to complete following practical/assignments.

Term work

1. Assignment on- Identify sources of pollution in your area.
2. Assignment on- Technology involved in different construction of green building.
3. Assignment on- Technology involved in different construction of smart building
4. Assignment on- Permanent installation of energy meter.
5. Assignment on- Reducing the consumption of water used outdoors
6. Assignment on- Collecting and sorting of waste during the operation of the building
7. Site visit to green building/ smart city.
8. Case study of Structural Audit on green building.

Activity (CAA):

Students shall complete one assignment for each of the six units as mandatory requirement under this academic activity.

CE25204PR Civil Engineering Software Lab I

Teaching Scheme:	Credits	Examination Scheme:
Tut: 01 Hour/Week	02	Activity: 10 Marks
PR: 02 Hours/Week		TW: 30 Marks
		PR : 30 Marks

Prerequisites: Only basic geometry concepts clear in mind.

Course Objectives:

1. To know the basic concepts of 2D Planning using AutoCAD.
2. To prepare Typical Floor Plan of Various Construction Projects.

Course Outcomes:

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

1. Understand the basic concepts of 2D Planning using AutoCAD software.
2. Modelling of Typical Floor Plans using AutoCAD for Construction Projects.

Course Contents

1: Getting Started with AutoCAD Opening and Creating Drawings

Exploring the AutoCAD interface Zooming and Panning

2: Basic Drawing & Editing Commands

Using the Mouse, Keyboard, and Enter Key to work quickly and efficiently in AutoCAD Lines

3: Projects - Creating a Simple Drawing

Using Object Snap Tracking to extrapolate a projected top view Using Modify tools to arrange an office layout

4: Drawing Precision in AutoCAD Polar and Ortho Tracking

Entering Coordinates and Angles Object Snaps and Tracking

5: Making Changes in Your Drawing

Move, Copy, Rotate, Mirror, Scale

Using the reference option with the Scale Tool

6: Drawing Templates

Using Template Files (.dwt) to Make New Drawing

Exploring what Settings and Elements are saved with Templates

7: Organizing Your Drawing with Layers

Layer States Properties by Layer Tools

8: Advanced Object Types

Polylines, Arcs, Polygons, Ellipses

9: Analyzing Model and Object Properties

10: Advanced Editing Commands

Trim and Extend, Fillet and Chamfer

Polyline Edit and Spline Offset and Explode Join

11: Inserting Blocks

The Insert Block Command Inserting Blocks with Tool Palettes Dynamic Blocks

Migrating Blocks and other Elements between Drawings with Design Center

12: Projects - Creating More Complex Objects

Starting a 2D Floor Plan with section & elevation

Practical:

1. Draw a line plan of any structure by using AutoCAD.
2. Drawing a G+1 Typical Floor Plan of Residential Building with Plan, Section & Elevation with specifications and construction notes using AutoCAD.
3. Drawing of a Center Line/ Face Line Plan for foundation of building.

List of Books:

1. AutoCAD: Introduction to AutoCAD 2D Design, Kindle Edition
2. AUTOCAD (CIVIL & ARCHITECTURE) EXERCISE BOOK
3. AutoCAD 2024 for Engineers and Designers, Basic and Intermediate, BPB Publication
4. AutoCAD 2D Design Fundamentals, S.K. Kataria & Sons

Activity: Line plan of residential and public building.

CE25205 - Community Engagement Project

Teaching Scheme:
Practical: 04 Hours/Week

Credits
02

Examination Scheme:
CAA: 10 Marks
Oral: 30 Marks
Term work: 30 Marks

Prior knowledge of

General awareness of societal problems

is essential.

Course Objectives:

The course is aimed to:

1. Develop the ability to identify and define community challenges and needs that can be addressed through engineering solutions.
2. Acquire skills in project planning, including defining project scopes, setting goals, developing timelines, and managing resources effectively.
3. Develop and enhance technical skills relevant to the environmental engineering discipline involved in the community project.
4. Identify potential risks associated with the community project and develop strategies for risk assessment.

Course Outcomes:

At the end of the course, the student will be able to:

CO1: Identify and comprehend the specific needs and challenges within a community that can be addressed through engineering solutions.

CO2: Incorporate sustainable engineering practices into project designs, considering environmental, social and economic impacts

Guidelines:

1. The project group shall consist of not more than 3 students per group.
2. Work should be carried out in the Design / Projects Laboratory.
3. Project design ideas can be necessarily adapted from recent issues of electronic design magazines Application notes from well-known device manufacturers may also be referred.
4. Use of Hardware devices/components is mandatory.
5. Layout versus schematic verification is mandatory.
6. Bare board test report shall be generated.
7. Assembly of components and enclosure design is mandatory.

- A **guide should be assigned** to individual groups who will help them with the learning and development process.

Selection: Domains for projects may be from the following, but not limited to:

1. Instrumentation and Control Systems
2. Electronic Communication Systems
3. Biomedical Electronics
4. Power Electronics
5. Audio, Video Systems
6. Embedded Systems
7. Mechatronic Systems
8. Artificial Intelligence/ Image Processing, etc.

- Use Microchip PIC controllers / ATmega controller / AVR microcontrollers / Arduino / Raspberry Pi.

Project Report Contains:

1. Certificate
2. Certificate from Sponsoring Organization (if any)
3. Acknowledgement
4. Abstract
5. List of Abbreviations (as applicable)
6. List of Figures (as applicable)
7. List of Graphs (as applicable)
8. List of Tables (as applicable)
9. Introduction
10. Need / Importance
    a. Forms of community service
    b. Ways to participate in the community
11. Literature Survey
12. Problem Statement and Objective
13. Proposed System
    a. Hardware / Algorithm
    b. Design details
14. System Architecture
15. Project Plan / Activities Planned
16. System Implementation
17. Test Cases
18. Working Modules / GUI
19. Activities Conducted
20. Experimental Results
21. Conclusion and Future Work
22. References

Appendices:

a) Plagiarism Report of Paper and Project Report
b) Tools Used / Hardware Components Specifications (if any)

Completion of Project

Week 1 & 2: Formation of groups, Finalization of Mini project & Distribution of work.
Weeks 3 & 4: PCB artwork design using an appropriate EDA tool, Simulation.
Weeks 5 to 8: PCB manufacturing through vendor/at lab, Hardware assembly, programming (if required) Testing, Enclosure Design, Fabrication, etc.
Weeks 9 & 10: Testing of final product, Preparation, Checking & Correcting of the Draft Copy of Report
Weeks 11 & 12: Demonstration and Group presentations.

Evaluation Criteria:

1. Originality of Problem Statement: 10% (03 Marks)
2. Depth of Understanding the Problem Statement: 10% (03 Marks)
3. Literature Survey / Field work with identified gaps: 10% (04 Marks)
4. Design and Analysis of Algorithm / Model / Architecture / System: 40% (12 Marks)
5. Presentation Skill: 10% (03 Marks)
6. Report Preparation: 10% (05 Marks

CE25211TH – Concrete Technology

Teaching Scheme:	Credits: 4	Examination Scheme:
TH: 3 Hrs./week	Theory: 3	CAA: 10 Marks In semester: 30 Marks End Semester: 60 Marks
PR: 2 Hrs./week	Practical: 1	OR: 30 Marks

Prerequisite:

1. Knowledge of Building construction materials

Course Objectives:

1. To know properties of various ingredients of concrete and concept of mix design.
2. To learn the behavior and properties of concrete in fresh and hardened state.
3. To understand special concrete and their applications.
4. To understand the durability aspects and preventive measures to enhance the life of concrete.

Course Outcomes: After Completion of course students will be able to

CO1: Determine properties of various ingredients of concrete.
CO2: Evaluate various factors affecting quality of fresh concrete.
CO3: Evaluate various factors affecting quality of hardened concrete.
CO4: Design concrete mix as per the field requirement using various codes.
CO5: Get acquainted to concreting equipment's, techniques and different types of special concrete.
CO6: Predict deteriorations in concrete and get acquainted to various repairing methods and techniques.

Course Contents

Unit 1: Ingredients of Concrete **7 Hours**

Cement: Manufacture of Portland cement, chemical composition, hydration of cement, classification and types of cement, tests on cement. Aggregate: Classification of aggregate, physical and mechanical properties of aggregate, deleterious materials in aggregate, alkali- aggregate reaction, Fineness and gradation of aggregates using sieve analysis, tests on aggregates. Water and admixture: Quality of water for use in concrete, role of admixture, classification and types of admixtures like accelerators, retarders, plasticizers, super plasticizers, mineral admixtures-fly ash, silica fume, ground granulated blast furnace slag.

Unit 2: Fresh Concrete **7 Hours**

Workability: Factors affecting workability, measurement of workability, segregation and bleeding of concrete. Process of manufacturing fresh concrete: batching, mixing, transportation, compaction, curing of concrete, curing methods, influence of temperature, maturity rule. Tests on fresh concrete: Workability by slump cone, compaction factor, Vee-Bee consist meter and flow table apparatus,

Effect of admixture on workability of concrete and optimum dosage of admixture by Marsh cone test.

Unit 3: Hardened Concrete **7 Hours**

Strength of concrete, factors affecting strength, stress-strain relationship, relation between tensile and compression strength, impact strength, abrasion resistance, creep and shrinkage. Destructive tests: compression strength, flexural strength, indirect tensile strength, core test. Nondestructive tests: rebound hammer, ultrasonic pulse velocity and pullout test.

Unit 4: Concrete Mix Design **6 Hours**

Concept and objectives of concrete mix design, factors affecting the mix design, quality control, acceptance criteria, Grade designation and IS requirements as per IS 456 (Exposure conditions, minimum & maximum cement content and maximum W/C ratio. IS code method and DOE method (with and without mineral admixture), Use of spreadsheet/programming/ software for concrete mix design.

Unit 5: Concreting Equipment's, Techniques and Special concretes **6 Hours**

Concreting Equipment's and Techniques: Batching plants, concrete mixers, hauling pumps, concrete vibrators and compaction equipment. Special concreting techniques: ready mix concrete, under water concreting, roller compacted concrete, cold and hot weather concreting. Special concretes: Light weight concrete, foam concrete, self-compacting concrete, fiber reinforced concrete, geopolymer concrete and Ferro cement technique.

Unit 6: Deterioration and Repairs in Concrete **6 Hours**

Deterioration: Durability, factors affecting the durability of concrete, Permeability, sulphate attack, acid attack, chloride attack, corrosion of reinforcement, carbonation of concrete. Repairs: Symptoms and diagnosis of distress, evaluation of cracks, selection of repair procedure, repair of defects using various types and techniques: shotcrete and grouting. Introduction to retrofitting of concrete structures by fiber reinforced polymer (FRP), polymer impregnated concrete. Corrosion monitoring and preventive measures.

Books & Other Resources:

Textbooks

1. Concrete Technology by M. S. Shetty, S Chand, New Delhi-110055.
2. Concrete Technology by M. L. Gambhir, Tata McGraw-Hill.
3. Concrete technology by A. M. Neville, J.J. Brooks, Pearson.

Reference Books

1. Concrete Technology by A. R. Shantakumar, Oxford University Press, 2018.
2. Properties of Concrete by A. M. Neville, Longman Publishers.

3. Concrete Technology by R.S. Varshney, Oxford and IBH.
4. Microstructure and Properties of Concrete by P. Kumar Mehta, Prentice Hall.
5. Concrete Mix Design by A. P. Remideos, Himalaya Publishing House.
6. Concrete Structures, Repair, Rehabilitation and Retrofitting by J. Bhattacharjee, CBS Publishers & Distributors Pvt. Ltd.
7. Durability Design of Concrete Structures, by A. Sarja and E. Vesiari, E & FN Spon Publication, 1996.

Indian Standards Codes:

Latest revised editions of IS codes: IS 456, IS 269, IS 1489, IS 4031, IS 383, IS 2386, IS 9103, IS 516, IS 1199, IS 10262, SP 23.IS 13311.

For term work submission students have to complete following practical/assignments. (CE25211 PR)

Term work

Oral is based on the term work. It consists of a journal giving details of all the following experiments.

1. Fineness test on cement.
2. Standard consistency, Initial and final setting time and Soundness test on cement.
3. Compressive strength of cement.
4. Fineness modulus, silt content and specific gravity and bulk density test on fine aggregate.
5. Fineness modulus, water absorption and specific gravity and bulk density test on coarse aggregate.
6. Concrete mix design by IS code method using spread sheet.
7. Workability of concrete with and without admixture by slump cone, compaction factor method.
8. Compressive strength test of concrete on cubes by destructive and non-destructive method (Rebound Hammer and Quality of concrete by ultra-sonic pulse velocity).
9. Compressive strength test of concrete on cylinder.
10. Split tensile strength and flexural strength of hardened concrete.
11. Site visit to RMC plant.

Activity (CAA):

1. Assignment on each unit.

CE25212 – Fluid Mechanics

Teaching Scheme:	Credits: 4	Examination Scheme:
TH: 3 Hrs./week	Theory: 3	CAA: 10 Marks In semester: 30 Marks End Semester: 60 Marks
PR: 2 Hrs./week	Practical: 1	OR: 30 Marks

Prerequisite:

Engineering Physics, Engineering Mathematics and Engineering Mechanics

Course Objectives:

1. To understand conceptually the properties of fluid, fluid statics, fluid kinematics and fluid dynamics, dimensional analysis, boundary layer theory, open channel flow and fluid flow around submerged objects.
2. Apply principles of continuity, mass, momentum and energy as applied to fluid at rest as well as for fluid flow in open channel.
3. To apply fundamental principles of fluid mechanics for the solution of practical Civil Engineering problems.

Course Outcomes: After Completion of course students will be able to

CO1: Solve the problems related to fluid statics.

CO2: Solve the problems related to fluid kinematics and dynamics.

CO3: Apply the concept of dimensional analysis and boundary layer theory for solving practical problems with fluid flow.

CO4: Solve the problems on fluid flow through pipes.

CO5: Design the most economical open channel.

CO6: Estimate the GVF profile and calculate drag force and lift force of the fluid flow around objects.

Course Contents

Unit I: **(7 Hours)**

a. Introduction: Fluid & Fluid Mechanics, Applications in Civil Engineering, Physical properties of fluids-mass density, unit weight, specific gravity, compressibility, bulk modulus, surface tension, viscosity, Newton's law of viscosity, Dynamic and kinematic viscosity, classification of fluids.

b. Fluid Statics: Measurement of pressure by manometers and gauges, Hydrostatic law, pressure at a point, Pascal's law, Pressure head, Atmospheric pressure, Absolute and gauge pressure, Total pressure and center of pressure, Pressure diagram, Determination of Total pressure on plane and curves surfaces (water tanks, earthen and gravity dams, spillways, spillway gates, sluice gates, sluice

valves). Buoyancy and Floatation: Introduction, Buoyant force and center of buoyancy, Archimedes Principle, Principle of floatation, Metacenter and metacentric height, Equilibrium of floating bodies.

Unit II: **(6 Hours)**

a. Fluid kinematics: Types of flow-steady & unsteady, uniform & non-uniform, laminar & turbulent, one, two & three dimensional, rotational & irrotational, compressible and incompressible, Streamline, Streak line, Path line, Stream tube, Stream function, Velocity potential, Flow net- uses, limitations & methods of drawing, Discharge, Continuity equation of fluid flow.

b. Fluid Dynamics: Euler's equation of motion, Bernoulli's equation, assumption and limitations, different forms of energy heads, loss of head, Modified form of Bernoulli's theorem, Energy gradient line and Hydraulic gradient line, Impulse momentum equation, applications of Bernoulli's equation.

Unit III: **(7 Hours)**

a. Dimensional Analysis and Model Studies:

Dimensional homogeneity, dimensional analysis using Buckingham's π theorem method, geometric, kinematic and dynamic similarity, important dimensionless Numbers (Reynolds No., Froude No., Euler No., Mach no. and Weber No) and their significance, Model Laws (Reynold's law and Froude's Law).

b. Boundary layer Theory: Concept, development of boundary layer on flat plate and factors affecting growth, Boundary layer thickness, displacement thickness, momentum and energy thickness, Laminar sub layer, Local and mean drag coefficients, Hydrodynamically smooth and rough boundary, boundary layer separation and methods to control separation.

Unit IV: **(6 Hours)**

a. Laminar & Turbulent Flow through Pipe: Characteristics of laminar flow, laminar flow through a circular pipe: Hagen Poiseuille equation, Characteristics of turbulent flow, instantaneous velocity, temporal mean velocity, scale of turbulence and intensity of turbulence, Prandtl's mixing length theory, velocity distribution equation, variation of friction factor for laminar flow and for turbulent flow, resistance to flow in smooth and rough pipes, friction factor for commercial pipes, Moody's diagram.

b. Flow through pipes: Major losses and minor losses, Darcy Weisbach equation, Factor affecting friction factor, Coefficient of friction for commercial pipes, Moody's diagram, Flow through simple pipes, Flow through pipes in series, Flow through pipes in parallel, siphons pipes, Equivalent pipes, Water hammer in pipes-causes, effects & remedial measures

Unit V: **(7 Hours)**

a. Introduction to Open channel flow: Classification of channels, channel flows and geometric elements of channel, Basic governing equations of Channel flow, Velocity distribution in open channel flow.

b. Uniform flow in open channels: Uniform flow formulae: Chezy's and Manning's formulae; Factors affecting Manning's roughness coefficient; Important terms pertaining to uniform flow, Uniform flow computations. Most efficient channel sections: rectangular, triangular, and trapezoidal. Depth-Energy Relationships in Open Channel Flow, Critical depth, Conditions for occurrence of critical flow; Froude's number, flow classification based on it, Important terms pertaining to critical flow

Unit VI: **(6 Hours)**

a. Gradually Varied Flow (GVF) in Open Channel Flow: Theory and Computation Basic Assumptions of GVF; Dynamic equation of GVF - Alternative forms; Classification of channel bed slopes, Various GVF profiles, Methods of GVF computations: Direct Step method. (mention of other method).

b. Flow around immersed objects: Concept of boundary layer theory, Practical problems involving flow around immersed objects, Drag and lift-definition & expression, Types of drag, Pressure drag on flat plate, Streamline & bluff bodies.

Books & Other Resources:

Textbooks:

1. Hydraulics & Fluid Mechanics, Modi and S.M. Seth, 14th edition, Standard Book House, New Delhi,2009.

2. Fluid Mechanics, Hydraulics and Hydraulic Machines, Dr. A.K. Arora, 9th edition Standard Publishers Distributors, New Delhi,2009.

Reference books:

1. 1000 Solved Problems in Fluid Mechanics, K. Subramanya, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2008.

2. Fluid Mechanics through Problems, R.J. Gadre, New Age International Publishers, New Delhi, 2011.

3. Fluid Mechanics & its Applications, Vijay Gupta & Santosh K. Gupta, 2nd edition, New Age International Publishers, New Delhi, 2011.

4. Fluid Mechanics & Machinery, Agrawal S.K., Tata McGraw Hill Publishing Co. Ltd, 1997. Course.

Students have to complete following practical, assignments.

Suggested List of Laboratory Experiments/Assignments. (Any 8)

1. Measurement of viscosity of fluid by Redwood viscometer.
2. Experimental verification of Bernoulli's theorem with reference to loss of energy.
3. Calibration of Venturi meter / Orifice meter.
4. Determination of Darcy-Weisbach friction factor (f) for a given pipe and study of variation of f with Reynolds Number (Re).
5. Study of Uniform Flow Formulae for Open channel.
6. Flow around a Circular Cylinder/Aero foil.
7. Determination of Minor Losses in pipes.
8. Calibration of Rectangular / Triangular Notch.
9. Determination of Stability of Floating Bodies using Ship Model.
10. Drawing Flow net by Electrical Analogy for flow below Weir (with & without sheet pile).
11. Study of Measurement of Pressure using different Pressure Measuring Devices (including Transducers /state of arts Digital Instruments also).

B) Exercises: Any two assignments mentioned below.

1. Analysis of pipe network using Hardy Cross Method (Minimum two loops) – both by hand calculations and using computer any language/software solution.
2. Developing a Demo Model related to any fluid flow phenomenon (physical model/soft model).
3. Demonstration of any Software related to Fluid Mechanics/Hydraulics.
4. GVF computation using any computer Language/Software

C) Site visit: Report on Site visit to any fluid structure or research institute.

Oral examination is based on the above laboratory work.

CAA:

Student should write assignments on each unit as a part of CAA.

CE25213TH - Structural Analysis

Credits: 03

Teaching Scheme:
Theory : 03 Hrs. /week

Examination Scheme:
CAA: 10 Marks
ISE: 30 Marks
ESE: 60 Marks

Prerequisites:

Fundamentals of Physics, Mathematics, Engineering Mechanics and Mechanics of Structures

Course Objectives:

1. This subject will build on the concepts from Engineering Mechanics and Mechanics of Structures.
2. This will create a foundation for analysing real life structures by imparting knowledge about various methods involved in the analysis of indeterminate structures.

Course Outcomes:

On completion of the course, learner will be able to:
1. Understand the basic concept of static and kinematic indeterminacy and analyzed three hinged arches.
2. Able to draw influence line diagrams.
3. Implement application of the slope deflection method to beams and portal frames.
4. Analyse beams and portal frames using moment distribution method.
5. Determine response of beams and portal frames using structure approach of matrix method.
6. Apply the concepts of plastic theory in the analysis of steel structures

Contents

Unit 1: Fundamentals of structure and analysis of three hinged arches **(07 Hours)**

Types and classification of structures based on structural forms, concept of indeterminacy, static and kinematics degree of indeterminacy.

Analysis of Three-Hinged arches, calculation of S.F., B.M and normal thrust.

Unit 2: Influence line diagram **(07 Hours)**

Influence line for rolling loads on beams with concentrated and uniformly distributed loads, for reactions, maximum B.M. and S.F.

Influence lines for forces in members of simple trusses.

Unit 3: Slope-Deflection Method **(07 Hours)**

Slope-deflection equations, equilibrium equation of Slope-deflection method, application of Slope deflection method to beams with and without joint translation and rotation, yielding of support, application to non-sway rigid jointed rectangular portal frames, shear force and bending moment diagram.

Sway analysis of rigid joint rectangular single bay single storey portal frames using Slope deflection method. (Involving not more than three unknowns)

Unit 4: Moment Distribution Method **(06 Hours)**

Stiffness factor, carry over factor, distribution factor, application of Moment distribution method of analysis to beams with and without joint translation and yielding of support, application to non-sway rigid jointed rectangular portal frames, shear force and bending moment diagram.

Sway analysis of rigid jointed rectangular single bay single storey portal frames using Moment distribution method.

Unit 5: Matrix Method **(06 Hours)**

Fundamental concepts of flexibility and stiffness, relation between them. Stiffness method of analysis-Structure approach only. Application to beams (Involving not more than three unknowns). Application of Stiffness structure approach to rigid jointed rectangular portal frames (Involving not more than three unknowns).

Unit 6: Plastic Theory **(06 Hours)**

Introduction to plastic theory, assumptions in plastic theory, concept of plastic hinge, load factor, shape factor. Type of mechanisms and failures calculation of collapse load and plastic moment capacity (Mp).

Books

Text books:

1. Theory of Structures by S. Ramamrutham and R. Narayan, Dhanpat Rai Publishing Company (P) Ltd.
2. Structural Analysis-I & II by S. S. Bhavikatti, Vikas Publishing House Pvt. Ltd.
3. Structural Analysis: A Matrix Approach by G.S.Pandit and S. P. Gupta, Tata McGraw Hill Education Pvt. Limited.

Reference Books:

1. Timoshenko S. P. & Young D.H. "Theory of Structures; International edition", McGraw Hill, 1965.
2. C.S.Reddy "Basics Structural Analysis" McGraw Hill 3rd edition 2010
3. Jain, O.P. & Arya, A.S. "Theory and Analysis of Structures; Vol. I & II", Nemchand Brothers; Roorkee.
4. Meghre, A.S.; &Deshmukh, S.K. "Matrix Methods of Structural Analysis (1st Edition)", Anand; Charotar Publs, 2003.

Activity

An activity can be designed such as to enhance students learning experience. The students need to submit assignment on each unit as part of activity.

CE25051 - Waste Management

Teaching Scheme:
TH: 3 Hrs./week
PR: 2 Hrs./week

4 Credits

Examination Scheme:
Activity: 10 Marks
In semester: 30 Marks
End Semester: 60 Marks
TW: 30 Marks

Prerequisite:

1. Fundamentals of Environmental Studies, Engineering Chemistry

Course Objectives:

1. To understand problems of waste, estimate and characterize waste.
2. To apply the knowledge of mathematics, science, and engineering for effective waste collection systems and for waste collection route optimization.
3. To understand the working of waste to energy system.
4. To understand management and legal requirements of special waste, reuse, recycle and material recovery.

Course Outcomes: After Completion of course students will be able to

CO1: Apply the basics of waste management towards sustainable development.
CO2: explain methods of storage, collection and transportation of waste.
CO3: describe waste to energy systems from solid waste.
CO4: understand the process of conversion of waste to energy
CO5: understand legal requirements of special waste
CO6: understand the need of finance in waste management

Course Contents

Unit 1: Evolution, Sources and Types of Waste **07 Hours**

Introduction of waste, Functional elements, Types and sources of waste, Sampling and characteristics, Estimation of waste quantity, Factors affecting waste generation rate.

Unit 2: Collection and Transportation of Waste **07 Hours**

Integrated waste management, different methods of waste collection, transfer and transportation of waste, use of radio frequency identification (RFI)/global positioning system (GPS) for tracking vehicle location and optimization of route, methods of measuring waste.

Unit 3: Waste to energy **07 Hours**

Basic principles of processing and treatment of municipal solid waste, Materials recovery and recycling, composting, anaerobic digestion or bio methanation, incineration and sanitary landfilling.

Unit 4: Source Reduction, Product Recovery & Recycling **06 Hours**

Source Reduction, Product Recovery and Recycling: basics, purpose, implementation monitoring and evaluation of source reduction, significance of recycling, planning of a recycling programme, recycling programme elements, commonly recycled materials and processes, a case study.

Unit 5: Special Waste Management and Regulations **06 Hours**

Objectives and key points of hazardous and other waste management rules- 2016, domestic hazardous waste, e-waste, biomedical waste, plastic waste, nuclear waste, slaughterhouse waste, construction & demolition waste, and lead battery waste.

Unit 6: Finance and Public-Private-Partnership (PPP) in Waste Management **06 Hours**

Introduction, purpose of Public-Private-Partnership (PPP), Financing in Waste management Projects, Public-Private-Partnership in Waste Management.

Books & Other Resources:

Textbooks

01 Integrated Solid Waste Management: Engineering Principles and Management Issues, George Tchobanoglous, Hilary Theisen, Samuel Vigil, Tchobanoglous George, Vigil Samuel, McGraw-Hill Companies, Incorporated.

02 Solid waste management, Dr. A.D. Bhide

03 Solid Waste Management, Sasikumar K and Sanoop Gopi Krishna, PHI.

Reference Books

01 Solid waste Engineering, Vesilind P. A., Worrell W and Reinhart, Thomson Learning Inc., Singapore.

02 CPHEEO, Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2000.

03 Hazardous Waste Management, Charles A. Wentz, Second Edition, McGraw Hill International Edition, New York.

04 C for Environmental Scientists and Engineers, Y. Anjaneyulu and Valli Manickam, Wiley Publications. 05 Standard Handbook of Hazardous Waste Treatment and Disposal, Harry Freeman, McGraw-Hill Education, 1998

For term work submission students have to complete following practical/assignments.

Term work

1. Report on site visit to municipal solid waste management (Society/village/town/city).
2. Practical/theoretical identification of impacts of improper management of municipal solid waste.
3. Practical/theoretical sampling methods and characterization study of municipal solid waste.
4. Practical/theoretical estimation of solid waste generation and estimation of quantity
5. Prepare a report for management of any of the special wastes.
6. Prepare a report on use of smart technologies in solid waste management.
7. Determine calorific value of municipal solid waste using bomb calorimeter.

8. Determine moisture content and volatile solids for organic fraction of municipal solid waste.

Activity:

Assignments on each unit.

OE25005- Disaster Management

Teaching Scheme:	Credits: 2	Examination Scheme:
TH: 2 Hrs./week	Theory: 2	CAA: 10 Marks End Semester: 60 Marks

Prerequisite:

1. Basic Geography and Environmental Science

Course Objectives:

1. To provide basic conceptual understanding of disasters.
2. To study approaches of Disaster Management.
3. To build skills to respond to disaster.
4. To enhance disaster preparedness through training, awareness, GIS techniques, and risk assessment.

Course Outcomes: After Completion of course students will be able to

CO1: To remember disaster types, risks, vulnerabilities, and management of natural and man- made events.

CO2: To understand the various types of natural disasters, their management strategies, and the socio-economic and environmental impacts, with a focus on case studies from Sikkim.

CO3: To summarize disaster mitigation, management techniques, policies, and construction in seismic zones.

CO4: To apply skills in disaster preparedness, awareness, GIS usage, and risk assessment projects

Course Contents

Unit 1: Disasters Risks & Vulnerabilities **6 Hours**

Definition and types of disaster Hazards and Disasters, Risk and Vulnerability in Disasters, Natural and Man-made disasters, earthquakes, floods drought, landside, land subsidence, cyclones, volcanoes, tsunami, avalanches, global climate extremes. Man-made disasters: Terrorism, gas and radiations leaks, toxic waste disposal, oil spills, forest fires.

Unit 2: Major Disasters: Types, Management, and Impacts **6 Hours**

Study of important disasters, Earthquakes and its types, magnitude and intensity, seismic zones of India, major fault systems of Indian plate, flood types and its management, drought types and its management, landside and its managements, case studies of disasters in Sikkim (e.g.) Earthquakes, Landside). Social Economics and Environmental impact of disasters.

Unit 3: Disaster Mitigation and Management Techniques **6 Hours**

Mitigation and Management techniques of Disaster, Basic principles of disasters management, Disaster Management cycle, Disaster management policy, National and State Bodies for Disaster Management, Early Warming Systems, Building design and construction in highly seismic zones,

retrofitting of buildings.

Unit 4: Disaster Preparedness: Training & Awareness **6 Hours**

Training, awareness program and project on disaster management, Training and drills for disaster preparedness, Awareness generation program, Usages of GIS and Remote sensing techniques in disaster management, Disaster risk assessment and preparedness for disasters with reference to disasters in Sikkim and its surrounding areas.

Books & Other Resources:

1. Disaster Management Guidelines, GOI-UND Disaster Risk Program (2009-2012).
2. Damon, P. Copola, (2006) Introduction to International Disaster Management, Butterworth Heineman.
3. Gupta A.K., Niar S.S and Chatterjee S. (2013).
4. Disaster management and Risk Reduction, Role of Environmental Knowledge, Narosa Publishing House, Delhi.
5. Murthy D.B.N. (2012) Disaster Management, Deep and Deep Publication PVT. Ltd. New Delhi.
6. Modh S. (2010) Managing Natural Disasters, Mac Millan publishers India LTD.

For term work submission students have to complete following practical/assignments.
Activity: Assignment on each unit.

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HS25211 - Environmental Studies

Teaching Scheme:	Credits	Examination Scheme:
Theory: 02 Hours/Week	02	Activity: 10 Marks End Semester: 60 Marks

Prerequisite Courses, if any:

Course Objectives:

The course is aimed to:

1. Understand the fundamental concepts of environmental science and its relevance to engineering.
2. Analyze the environmental impact of various engineering industries.
3. Learn about sustainable engineering practices, pollution control, and waste management.
4. Study environmental laws in India and global initiatives for environmental conservation.
5. Explore corrective measures and preventive technologies for mitigating environmental damage.

Course Outcomes:

At the end of the course, the student will be able to:

CO1: Gain an understanding of environmental issues related to engineering industries.
CO2: Analyze the impact of engineering industries on the environment
CO3: Learn sustainable engineering solutions for mitigating environmental damage.
CO4: Be aware of Indian and global initiatives for environmental protection
CO5: Develop a sense of responsibility towards environmental conservation in their professional field.

Course Contents

Unit I: Introduction to Environmental Studies (06 Hrs.)

Importance of Environmental Studies, Components of the Environment: Atmosphere, Hydrosphere, Lithosphere, and Biosphere, Ecosystems and Biodiversity: Types, Importance, and Conservation, Sustainable Development Goals (SDGs) and Role of Engineers in Sustainability, Renewable and Non-Renewable Resources, Water Resources: Overuse, Pollution, and Engineering Solutions, Energy Resources: Fossil Fuels, Nuclear Power, and Renewable Energy Alternatives, Land Resources: Soil Degradation, Deforestation, and Urbanization.

Unit II: Impact of Engineering Industries on Environment (07 Hrs.)

Manufacturing & Automobile Industry: Air pollution, Carbon emissions, Waste disposal, Chemical & Pharmaceutical Industry: Water and soil contamination, Hazardous waste, Construction & Infrastructure: Land degradation, Dust pollution, Waste generation, Electronics & IT Industry: E-waste, Energy consumption, Semiconductor waste, Power Generation (Thermal, Hydropower, Nuclear): Pollution, Waste heat, Radiation hazards, Causes and Effects of Climate Change, Global Warming and Greenhouse Effect.

Unit III: Engineering Solutions for Environmental Mitigation and Sustainable Practices (07 Hrs.)

Carbon Capture and Storage (CCS), Green Chemistry & Eco-friendly Materials, Sustainable Design & Life Cycle Assessment (LCA), Energy-efficient Technologies & Smart Grids, Case Studies on Successful Pollution Reduction Waste Management Strategies: Solid Waste and Biomedical Waste Management, E-Waste: Sources, Impact, and Recycling, Hazardous Waste Handling and Treatment, Circular Economy and Zero-Waste Technologies Sustainable Engineering Practices: Renewable Energy Technologies (Solar, Wind, Biomass, Hydropower) Green Buildings and Sustainable Architecture, Electric Vehicles and Smart Transportation Systems, Sustainable Agriculture and Water Conservation Technologies.

Unit IV: Environmental Initiatives in India and Worldwide (06 Hrs.)

National Initiatives: Swachh Bharat Abhiyan, Namami Gange, National Green Tribunal (NGT), Corporate Social Responsibility (CSR) & Environmental Compliance, Environmental Activism and the Role of NGOs, Environmental Laws and Policies in India, The Environmental Protection Act, 1986, Role of

Central Pollution Control Board (CPCB) and State Pollution Control Boards (SPCB), International Environmental Agreements (Kyoto Protocol, Paris Agreement, COP Summits), Global Initiatives: UNEP, IPCC, World Bank Environmental Policies.

Text Books:

1. Benny Joseph, Environmental Studies, McGraw Hill Education, 3rd Edition, 2021.
2. Anubha Kaushik & C.P. Kaushik, Environmental Studies, New Age International Publishers, 5th Edition, 2022.

Reference Books:

1. R. Rajagopalan, Environmental Studies: From Crisis to Cure, Oxford University Press, 3rd Edition, 2021.
2. Erach Bharucha, Textbook of Environmental Studies for Undergraduate Courses, University Press, 3rd Edition, 2021.
3. Suresh K. Dhameja, Environmental Science and Engineering, S.K. Kataria & Sons, 2nd Edition, 2020.

Additional Reports & Resources:

1. Government of India - Ministry of Environment, Forest & Climate Change (MoEFCC) Reports (Website)
2. United Nations Environment Programme (UNEP) Reports (Website)
3. IPCC Climate Change Reports (Website)
4. Central Pollution Control Board (CPCB) Reports (Website)

List of Activities

Unit 1: Introduction to Environmental Studies

- Ecosystem Study Report – Visit a local park, water body, or forested area and document its ecosystem components (flora, fauna, and food chains).
- Sustainability Case Study – Choose one of the Sustainable Development Goals (SDGs) and prepare a report on its implementation in India.
- Renewable vs. Non-Renewable Resources – Prepare a comparative chart listing sources, usage, and sustainability factors.
- Water Conservation Survey – Conduct a survey in your neighborhood or campus to assess water consumption and suggest conservation strategies

nit 2: Impact of Engineering Industries on Environment

- Industrial Impact Assessment – Select an engineering industry (automobile, chemical, IT, etc.) and analyze its environmental impact
- Carbon Footprint Calculation – Calculate the carbon footprint of your daily activities (electricity, transportation, food, etc.) and suggest ways to reduce it.
- Climate Change Awareness Video – Create a short video (2–3 min) explaining global warming and its impact.
- Case Study on Pollution Control Failures – Research a real-world incident of industrial pollution (e.g., Bhopal Gas Tragedy, Minamata Disease) and analyze the causes and consequences

Unit 3: Engineering Solutions for Environmental Mitigation and Sustainable Practices

- Waste Management Audit – Conduct a waste audit in your college or home, classify the waste generated, and propose a waste management plan.
- E-Waste Collection Drive – Organize a drive to collect and safely dispose of e-waste in your locality. Submit a report on the amount collected and its disposal method.
- Renewable Energy Model – Create a working or conceptual model of a solar panel, wind turbine, or biomass plant.
- Green Building Analysis – Identify a green building in your city (or college) and analyze its energy-efficient features.

Unit 4: Environmental Initiatives in India and Worldwide

- Report on National Environmental Policies – Summarize key environmental laws in India and their

effectiveness.

- International Climate Agreements Presentation – Prepare a presentation on major agreements like the Paris Agreement, Kyoto Protocol, and their impact on India.
- NGO/CSR Initiative Study – Research an NGO or corporate social responsibility (CSR) initiative focused on environmental protection and prepare a report.
- Swachh Bharat Implementation Review – Visit a local area, document cleanliness conditions, and suggest improvements under Swachh Bharat Abhiyan

Evaluation Criteria (10 Marks Total)

1. Depth of Research & Analysis (3 Marks)
2. Presentation & Clarity (3 Marks)
3. Creativity & Practical Application (2 Marks)
4. Timely Submission (2 Mark)

HS25212 - Public Speaking and Aptitude

Teaching Scheme:	Credits	Examination Scheme:
Theory: 01 Hour/Week	02	Activity: 10 Marks
Practical: 02 Hours/Week		Oral: 30 Marks
		Term work: 30 Marks

Course Objectives:

The course is aimed to:

1. To develop fluency in spoken English by improving vocabulary, pronunciation, intonation, and conversational skills for effective communication.
2. To enhance presentation skills by focusing on body language, voice modulation, strategic pauses, and empathetic communication for impactful public speaking.
3. To strengthen quantitative aptitude through problem-solving techniques in data interpretation, numerical computation, and statistics.
4. To develop logical and spatial reasoning skills for better analytical thinking and problem-solving in competitive exams.

Course Outcomes:

At the end of the course, the student will be able to:

CO1: Communicate effectively in various spoken interactions, including telephone conversations and discussions.

CO2: Deliver structured and engaging presentations with appropriate body language, voice modulation, and confident speech techniques.

CO3: Solve quantitative problems efficiently using data interpretation, numerical computation, and statistical analysis techniques.

CO4: Apply logical reasoning and spatial aptitude skills to analyze complex problems.

Course Contents

Unit I: Spoken English (04 Hrs.)

Pre-Assessment, Vocabulary made easy, the Power of Words, Introduction to Word Accent, Introduction to Rhythm: Intonation, Rising Intonation, Falling Intonation, Introduction & Specific scenarios: Telephone Skills: Taking & Making Calls, Voice, Intonation, and Language, Conversations: The Role of Questions.

Unit II: Impactful Presentations (04 Hrs.)

Body Language: Introduction, Mechanics and Style

Voice Modulation: Voice Projection, replacing Fillers, and Emphasis

Power of Pause: Pause to engage audience in Conversation, Combine Pause & Repetition Techniques, Demonstrate Confidence & Control, establish Presence

Empathy: Essential Human Quality, Practice Heartful Communication, Impact of Communication, How to deliver memorable speech.

Unit III: General Aptitude for all Competitive Exams (06 Hrs.)

Quantitative Aptitude

Data interpretation: data graphs (bar graphs, pie charts, and other graphs representing data), 2- and 3-dimensional plots, maps, and tables Numerical computation and estimation: ratios, percentages, powers, exponents and logarithms, permutations and combinations, and series Mensuration and geometry Elementary statistics and probability.

Analytical Aptitude

Logic: deduction and induction, Analogy, Numerical relations and reasoning.

Spatial Aptitude

Transformation of shapes: translation, rotation, scaling, mirroring, assembling, and grouping paper folding, cutting, and patterns in 2 and 3 dimensions.

Unit IV: Environmental Initiatives in India and Worldwide (06 Hrs.)

National Initiatives: Swachh Bharat Abhiyan, Namami Gange, National Green Tribunal (NGT), Corporate Social Responsibility (CSR) & Environmental Compliance, Environmental Activism and the Role of NGOs, Environmental Laws and Policies in India, The Environmental Protection Act, 1986, Role of Central Pollution Control Board (CPCB) and State Pollution Control Boards (SPCB), International Environmental Agreements (Kyoto Protocol, Paris Agreement, COP Summits), Global Initiatives: UNEP, IPCC, World Bank Environmental Policies.

Textbooks

1. "A Course in Phonetics and Spoken English" – T. Balasubramanian
2. "Effective Technical Communication" – M. Ashraf Rizvi
3. "Quantitative Aptitude for Competitive Examinations" – R.S. Aggarwal

Reference Books

1. "High School English Grammar & Composition" – Wren & Martin
2. "How to Speak, How to Listen" – Mortimer J. Adler
3. "Logical and Analytical Reasoning" – A.K. Gupta

NPTEL Course:

Mastering Speaking and Presentations: A case Based Approach by Prof. Seema Singh, IIT Kharagpur https://onlinecourses.nptel.ac.in/noc25_hs96/preview

Additional Reports & Resources:

1. Government of India - Ministry of Environment, Forest & Climate Change (MoEFCC) Reports (Website)
2. United Nations Environment Programme (UNEP) Reports (Website)
3. IPCC Climate Change Reports (Website)
4. Central Pollution Control Board (CPCB) Reports (Website)

Lab Session Plan

Session 1: Vocabulary & Word Accent Mastery

- Pre-Assessment: Conduct a quick spoken test to evaluate pronunciation and fluency.
- Vocabulary exercises using flashcards & interactive word-building games.

Session 2: Intonation & Rhythm in Speech

- Introduction to rising and falling intonation with examples.
- Roleplay exercises for practicing intonation in different scenarios (expressing surprise, asking questions, etc.).
- Rhythm practice: Reading passages with proper pauses and stress patterns.

Session 3: Telephone Skills & Professional Conversations

- Practicing making and taking calls with simulated dialogues.
- Focus on voice modulation, clarity, and polite expressions.

Session 4: Body Language & Stage Presence

- Mirror exercises to improve facial expressions and gestures.
- Practicing posture, movement, and eye contact while speaking.

Session 5: Voice Modulation & Power of Pause

- Exercises on voice projection and eliminating fillers.
- Practicing pauses strategically to enhance speech impact.
- Repetition and emphasis techniques using speech excerpts.

Session 6: Empathy & Heartfelt Communication

- Interactive storytelling to practice emotional connection.
- Exercises on active listening and empathetic responses.
- Speech practice: delivering a short talk with an emotional appeal.

Session 7: Quantitative Aptitude – Data Interpretation & Computation

- Solving numerical problems based on bar graphs, pie charts, and tables.

- Quick estimation exercises using ratios, percentages, and logarithms.
- Group challenges on permutations and combinations.

Session 8: Analytical Aptitude – Logical & Numerical Reasoning

- Deduction and induction puzzles.
- Solving analogy-based reasoning questions.
- Speed tests for numerical relations and reasoning.

Session 09: Spatial Aptitude – Shape & Pattern Recognition

- Hands-on paper folding and cutting exercises.
- Visualization tasks for rotation, scaling, and mirroring of shapes.
- Solving pattern-based problems in 2D and 3D space.

Session 10 : Mock test from online test series of companies like TCS, Infosys employability tests like CoCubes, AMCAT etc.