DIT UNIVERSITY

Dehradun

Detailed Course Structure & Syllabus of

B.Tech. – Civil Engineering

(with specialization in Construction Planning and Management)

Credit and Course Requirement of the Program

S.N.			
1	**General Requirement**	**Credit(Min.)**	**Courses(Min.)**
	Core Maths	8	2
	Science Foundation	10	2
	Engineering Foundation	24	7
	Ability Enhancement	6	2
	Skill Enhancement	8	4
	Free Elective	9	3
	Humanities Electives	6	2
	Value Added	8	4
2	**Discipline Requirement**		
	Discipline Core	53	17
	Discipline Elective	18	6
3	**Internship**	2	1
4	**Capstone Project**	12	1
5	**Total**	**164 (Min)**	**51 (Min)**

Semester-wise Study Plan

	Semester-1				Semester-2			
Year	**Course Category**	**Course Code**	**Course Title**	**Credit**	**Course Category**	**Course Code**	**Course Title**	**Credit**
1	AEC	ENGN101	Professional Communication	3	CM	MAN102	Engineering Mathematics II	4
	SF	PYN101	Engineering Physics	5	AEC	ENGN286	Indian English Literature	3
	CM	MAN101	Engineering Mathematics I	4	SF	CHN101	Engineering Chemistry	5
	EF	CSN101	Programming for Problem Solving	4	EF	CSN102	Data Structures	4
	EF	MEN101	Engineering Graphics	4	EF	MEN112	Engineering Mechanics	4
	Total Credit			**20**	**Total Credit**			**20**
2	VAC	CVC101	Environmental Science	2	DC	CEN211	Sewage and Solid Waste Engineering	3
	EF	CEN205	Building Materials and Construction	2	DC	CEN212	Structural Analysis I	3
	DC	CEN201	Fundamentals of Fluid Mechanics	3	DC	CEN213	Concrete Technology	3
	DC	CEN202	Solid Mechanics	4	DC	CEN214	Transportation Engineering	3
	DC	CEN203	Geomatics Engineering	4	DC	CEN215	Engineering Geology	3
	DC	CEN204	Water Supply Engineering	3	DC	CEN216	Survey Camp	1
	EF	EEN143	Electrical and Electronics Engineering Practice	4	EF	CEN217	Building Planning and Drawing	2
					VAC	CVC102	Indian Constitution	2
	Total Credit			**22**	**Total Credit**			**20**

	Semester-1				Semester-2			
Year	**Course Category**	**Course Code**	**Course Title**	**Credit**	**Course Category**	**Course Code**	**Course Title**	**Credit**
3	DC	CEN301	Soil Mechanics	3	DC	CEN311	Design of Steel Structures	4
	DC	CEN302	Design of Reinforced Concrete Structures	4	DC	CEN312	Structural Analysis II	4
	DC	CEN303	Hydraulics and Hydraulic Machines	3	DC	CEN313	Foundation Engineering	3
	DE		Discipline Elective	3-4	DE		Discipline Elective	3-4
	DE		Discipline Elective	3-4	DE		Discipline Elective	3-4
	SEC		Skill Enhancement	2	SEC		Skill Enhancement	2
	HE		HE Elective	3-4	SEC		Skill Enhancement	2
					FE		Free Elective	3
	Total Credit			**21-24**	**Total Credit**			**24-27**
Summer - SEC-CEN314-Summer Internship - 2 credit								
4	DC	CEN401	Estimation and Costing	2	Capstone Project	CEN405	Capstone Project	12
	DE		Discipline Elective	3-4				
	DE		Discipline Elective	3-4				
	VAC		Value Added Courses	2				
	VAC		Value Added Courses	2				
	SEC		Skill Enhancement	2				
	FE		Free Elective	3-4				
	FE		Free Elective	3-4				
	HE		HE Elective	3-4				
	Total Credit			**23-28**	**Total Credit**			**12**
Total Credit Requirement for BTCE Program – 164 Credits (Min)								

Course Structure & Syllabus of B.Tech.– Civil Engineering (with specialization in Construction Planning and Management) Applicable for Batch: 2024-28

List of courses bucket-wise:

a. Discipline Core:

S.N.	Course Code	Course Name	L	T	P	Course Credits
1	CEN201	Fundamentals of Fluid Mechanics	2	0	2	3
2	CEN202	Solid Mechanics	3	0	2	4
3	CEN203	Geomatics Engineering	3	0	2	4
4	CEN204	Water Supply Engineering	2	0	2	3
5	CEN211	Sewage and Solid Waste Engineering	2	0	2	3
6	CEN212	Structural Analysis I	3	0	0	3
7	CEN213	Concrete Technology	2	0	2	3
8	CEN214	Transportation Engineering	2	0	2	3
9	CEN215	Engineering Geology	2	0	2	3
10	CEN216	Survey Camp	0	0	2	1
11	CEN301	Soil Mechanics	2	0	2	3
12	CEN302	Design of Reinforced Concrete Structures	2	0	4	4
13	CEN303	Hydraulics and Hydraulic Machines	2	0	2	3
14	CEN311	Design of Steel Structures	2	0	4	4
15	CEN312	Structural Analysis II	3	0	2	4
16	CEN313	Foundation Engineering	3	0	0	3
17	CEN401	Estimation and Costing	0	0	4	2

b. Discipline Elective:

S.N.	Course Code	Course Name	L	T	P	Course Credits
1	CEN345	Pavement Management System and Planning	3	0	0	3
2	CEN349	Infrastructure Economics and Financing	3	0	0	3
3	CEN354	Construction Planning and Project Management	3	0	0	3
4	CEN361	Fundamentals of GIS	3	0	0	3
5	CEN369	Ground Water Hydrology	3	0	0	3
6	CEN372	Water Resources Management	3	0	0	3
7	CEN378	Disaster Preparedness Planning & Management	3	0	0	3
8	CEN379	Natural Dynamics	3	0	0	3
9	CEN381	Resource Dynamics and Economic Implications	3	0	0	3
10	CEN382	Properties of Materials	3	0	0	3
11	CEN447	Smart Materials and Composites	3	0	0	3
12	CEN448	Coastal and Off-Shore Geotechnology	3	0	0	3
13	CEN449	Soil Reinforcement	3	0	0	
14	CEN452	Soil Exploration	3	0	0	3

c. Humanities Elective:

S.N.	Course Code	Course Name	L	T	P	Course Credits
1	ECON106	Micro Economics	4	0	0	4
2	ECON257	Principles of Management	3	0	0	3
3	ECON354	Engineering Economics	3	0	0	3
4	ENGN107	Poetry:14th-18th Century	4	0	0	4
5	ENGN108	Prose	4	0	0	4
6	ENGN386	Literature, Language & Society	3	0	0	3
7	ENGN401	Creative Writing	3	0	0	3
8	PSYN106	Introduction to Psychology	4	0	0	4
9	PSYN186	Psychology of Life Skills	3	0	0	3
10	PSYN249	Educational Psychology	4	0	0	4
11	PSYN286	Stress Management	3	0	0	3
12	ENGN217	Fiction: 20th Century	4	0	0	4
13	PSYN246	Youth Psychology	4	0	0	4

d. Value added courses:

S.N.	Course Code	Course Name	L	T	P	Course Credits
1	CVC101	Environmental Science	2	0	0	2
2	CVC102	Indian Constitution	2	0	0	2
3	CVC103	Human Values	2	0	0	2
4	CVC104	Yoga /Physical Education/Sports/NCC	0	0	4	2
5	CVC105	Indian Knowledge System	2	0	0	2
6	CVC106	Entrepreneurship and Start-ups	0	0	4	2
7	CVC107	Intellectual Property Rights	2	0	0	2
8	CVC108	Environmental Studies & Sustainability	2	0	0	2
9	CDC201	Aptitude and Soft Skills	2	0	0	2

e. Ability Enhancement Courses:

S.N.	Course Code	Course Name	L	T	P	Course Credits
1	ENGN101	Professional Communication	2	0	2	3
2	ENGN286	Indian English Literature	3	0	0	3
3	ENGN403	English Language Teaching	3	0	0	3
4	ENGN102	Corporate Communication	2	0	2	3

f. Skill Enhancement Courses:

S.N.	Course Code	Course Name	L	T	P	Course Credits
1	CEN355	AutoCAD and MATLAB	0	0	4	2
2	CEN373	STAAD-PRO	0	0	4	2
3	CEN374	Q-GIS	0	0	4	2
4	CEN454	CSI SAP2000: Structural Analysis Program	0	0	4	2

g. Core Mathematics Courses:

S.N.	Course Code	Course Name	L	T	P	Course Credits
1	MAN101	Engineering Mathematics I	3	1	0	4
2	MAN102	Engineering Mathematics II	3	1	0	4

h. Science Foundation Courses:

S.N.	Course Code	Course Name	L	T	P	Course Credits
1	PYN101	Engineering Physics	3	1	2	5
2	CHN101	Engineering Chemistry	3	1	2	5

i. Engineering Foundation Courses:

S.N.	Course Code	Course Name	L	T	P	Course Credits
1	CSN101	Programming for Problem Solving	3	0	2	2
2	MEN101	Engineering Graphics	2	0	4	4
3	CSN102	Data Structures	3	0	2	4
4	MEN112	Engineering Mechanics	3	0	2	4
5	EEN143	Electrical and Electronics Engineering Practice	3	0	2	4
6	CEN205	Building Materials and Construction	2	0	0	2

7	CEN217	Building Planning and Drawing	0	0	4	2

j. Capstone Project:

S.N.	Course Code	Course Name	L	T	P	Course Credits
1	CEN405	Capstone Project	0	0	24	12

k. Internship:

S.N.	Course Code	Course Name	L	T	P	Course Credits
1	CEN314	Summer Internship	0	0	4	2

1. Department offering the course	**Civil Engineering**
2. Course Code	**CEN201**
3. Course Title	**Fundamentals of Fluid Mechanics**
4. Credits (L:T:P:C)	**2:0:2:3**
5. Contact Hours (L:T:P)	**2:0:2**
6. Prerequisites (if any)	**None**
7. Course Basket	**Discipline Core**

8. Course Summary

The course is designed to understand the different fluid properties and the mechanics of fluid motion with help of different governing laws and theorems including mass and energy conservation for fluid flow.

9. Course Objectives

The basics of Fluid Mechanics are further utilized to determine the hydrostatic force on surfaces, understand the concept of buoyancy and floatation, velocity and shear stresses in a pipe flow and learn about the different flow measuring devices.

10. Course Outcomes

On successful completion of the course, students will be able to achieve the following:

CO1: Understand the different fluid properties and the laws governing the physical phenomenon in a fluid.

CO2: Understand the distribution of forces exerted by static fluid and the mechanics of fluid flow with and without considering the role of different forces i.e. kinematics and fluid dynamics**.**

CO3: Understand the variation of different parameters under different regimes of flow, the different forms of losses and the phenomenon of water hammer**.**

CO4: Apply the knowledge of principle of floatation for determining the stability of floating bodies and safe design of watercrafts**.**

CO5: Apply the concepts of mass, energy and momentum conservation for solving different fluid flow problems and learn about different flow measuring devices**.**

CO6: Perform the dimensional analysis and determine the mathematical expression for the relationship between different physical quantities.

11. Curriculum Contents

Unit 1 Fluid Properties and Hydrostatics (7L)

Introduction to Fluid Mechanics, Definition of Fluid, Solid and Fluid Continuum. Definition, Units and dimensions of Mass density, Specific weight, Specific Volume, Relative density, Viscosity, Capillarity & Surface Tension. Newton's law of viscosity, Equation for capillarity. Definition of Pressure, Hydrostatic pressure equation, Absolute and Gauge pressures. Measurement of Pressure, Force exerted by a liquid on a flat surface, concept of buoyancy.

Unit 2 Kinematics and Dynamics of Fluid Flow (6L)

Introduction, Classification of flow, Three-dimensional continuity equation (Cartesian coordinates), General Continuity equation, Stream function, Velocity potential, Streamline, Equipotential line, (Two dimensional only). Concept of inertia force and forces causing motion. Derivation of Euler's equation & Bernoulli's equation with assumptions and limitations, problems on application of Bernoulli's equation.

Unit 3 Flow through Pipes (6L)

Introduction, Reynolds's number and its significance, Laminar and Turbulent Flow, Hagen-Poiseulle's equation, Major and minor losses in pipe flow Equation for head loss due to friction (Darcy's), Equation for head loss due to sudden expansion. Pipes in series, pipes in parallel and equivalent pipes, Water Hammer in pipes.

Unit 4-Dimensional Analysis and Model Studies (5L)

Introduction to Dimensional analysis, Units and dimensions, Dimensional Homogeneity. Raleigh's and Buckingham's methods of analysis, Model studies, similitude, dimensional parameters, Types of models, Froude's models: Reynold's models.

Unit 5 Flow Measurements (4L)

Introduction, Equation for discharge over triangular notch, Rectangular notch, Trapezoidal notch. Classification of orifices, Hydraulic coefficients of an orifice, Problems on Vertical Orifice.

12. Text Book:

1. Bansal, R. K., "Fluid Mechanics and Hydraulic Machine", Lakshmi Publications, New Delhi, 2010
2. Subramanya. K., "Fluid Mechanies", Tata McGraw Hill, New Delhi.
3. Rajput, R.K., "A Textbook of Fluid Mechanics and Hydraulic Machines", S. Chand Publications, 6th Edition. 2016

13. Reference Books:

1. Modi, P. N., Seth, S. M., "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi, 2019.
2. Jain, A.K., "Fluid Mechanics: Including Hydraulic Machines", Khanna Publishers, New Delhi, 1998

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in MS Team. Assignments, Class Tests etc. will be done. Refer to your course in MS Team for details. Various teaching methods like Discussion Method, Case Study Method and Lecture Method will be adopted.

15. List of Experiments

S.No.	Name of Experiments
1)	Verification of Bernoulli's theorem.
2)	Determination of metacentric height.
3)	Determination of coefficient of discharge for rectangular notch.
4)	Determination of coefficient of discharge for triangular notch.
5)	Determination of coefficient of discharge for trapezoidal notch.
6)	Determination of coefficient of discharge for Venturimeter.
7)	Determination of coefficient of discharge for Orificemeter.
8)	Determination of frictional losses in pipe flow.
9)	To find Critical Reynolds number for a pipe flow

10)	To determine the minor losses due to sudden enlargement, sudden contraction and bends

1. School offering the course	**Civil Engineering**
2. Course Code	**CEN202**
3. Course Title	**Solid Mechanics**
4. Credits (L: T:P:C)	**3:0:2:4**
5. Contact Hours (L: T:P)	**3:0:2**
6. Prerequisites (if any)	**None**
7. Course Basket	**Discipline Core**

8. Course Summary

This course provides the knowledge of basic building blocks for computations, understanding and exploiting structure in computational problems, design space, costs, and trade-offs in computer, register transfer and Micro operations, I-O, and memory organization.

9. Course Objectives

The course objective is to learn the strength behavior of materials and properties of those materials used in Civil Engineering

10. Course Outcomes

On successful completion of the course, students will be able to achieve the following:

CO1: Define the several types of statically determinate beams and draw shear force diagrams and bending moment diagrams

CO2: Explain Euler's and Rankine's theories in the analysis of columns with different end conditions**.**

CO3: Apply the knowledge of variation of bending stresses and shear stresses and draw them across various beam sections**.**

CO4: Analyse the deflections and rotations for statically determinate beams subjected to different types of loadings by Macaulay's method**.**

CO5: Evaluate the uniaxial and biaxial stresses and strains and compare the relationship among elastic constants**.**

11. Curriculum Contents

Unit 1:Uniaxial and Biaxial Stresses and Strains (8 hours)

Uniaxial Stresses and Strains: Elastic Properties of Materials, Stress, Strain, Hooke's law, Poisson's Ratio, Stress–Strain diagram for structural steel, Principle of superposition, Problems based on applications of uniaxial stress-strain. Elastic constants and their relationship. Biaxial Stresses and Strains: Introduction, biaxial Stresses – strains, components on any plane, Principal Stresses and Strains, Principal planes, Mohr's Circle of stresses, theories of failures.

Unit 2: Bending Moment and Shear Force in Beams (10 hours)

Introduction, Shear force and Bending moment, Sign conventions, Relationship between load, shear force and bending moment, Shear force and bending moment equations, shear Force and bending moment diagrams for determinate beams with different loading conditions.

Unit 3: Bending Stress and Shear Stress in Beams (7 hours)

Introduction – Bending stress in beams, concept of pure and simple bending theory, Derivation of moment-curvature relationship for pure bending, Expression for horizontal shear stress in beam, Shear stress distribution for rectangular, 'I' and 'T' sections.

Unit 4: Elastic Stability of Columns and Torsion (7 hours)

Elastic stability of columns - Introduction – Short and long columns, Euler's Buckling theory on columns for different end conditions, Limitations of Euler's theory, Rankine's formula. Concept of Torsion - Torsion of circular shafts, Solution of application problems.

Unit 5: Deflection of determinant beams and frames (7 hours)

Deflection of determinate Beams and frames, Moment area method, Conjugate beam method, concept of strain energy & energy theorem, unit load method and their applications in deflection computation.

12. Text book

1. R. Subramanian "Strength of Materials" Oxford University Press, India, ISBN: 9780199464739, Third Edition, November 21, 2016.
2. Timoshenko, S. P., "Elements of Strength of Materials", East West Press, 5th edition, 1 January 2003.

13. Reference Books

1. Beer, F. P., Johnston, E. R., DE Wolf, J. J. T., "Mechanics of Materials", The McGraw Hill Companies, 3rd **Edition**.
2. Pytel, A., Singer, F. L., "Strength of Materials", Harper Collins Publications, 4th edition, 1999.
3. Russell C. Hibbeler, Mechanics of materials, Pearson, 10th Edition, 2016.
4. G H Ryder, "Strength of Materials", Macmillen, 3rd edition
5. F L Singer, "Strength of Materials", Awl publication, 1999
6. R K Rajput, "Strength of Materials", S Chand Publication, 7th edition.

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Assignments, Class Tests etc. will be done. Various teaching methods like Discussion Method, Case Study Method and Lecture Method will be adopted.

15. List of Experiments

S.N.	Name of Experiments
1)	Tension test on Mild and TOR steel.
2)	Compression test on different metals.
3)	Compression test on Timber (parallel & across the grains).
4)	Shear test on Mild steel.
5)	Brinell and Rockwell Hardness test on different metals.
6)	Impact test on different metals.
7)	Bending test on Mild steel.

1. Department offering the course	**Civil Engineering**
2. Course Code	**CEN203**
3. Course Title	**Geomatics Engineering**
4. Credits (L:T:P:C)	**3:0:2:4**
5. Contact Hours (L:T:P)	**3:0:2**
6. Prerequisites (if any)	**None**
7. Course Basket	**Discipline Core/Minor**

8. **Course Summary:** Geomatics Engineering covers the entire concepts of surveying and advanced surveying with the idea of GIS and GPS.

9. **Objective**: The course is designed to gain the ability to execute surveying/Geomatics project activities for delivery in response to the needs of private and public industry. The students have an appropriate understanding of standards and specifications of surveying/Geomatics practices in analysing positional accuracy of measurement systems and in preparing land records and plots by meeting legal requirements. They can give solutions by making maps in various software to resolve engineering problems.

10. **Course Outcomes:**

On successful completion of the course, students will be able to achieve the following:

CO1: Understand the different methods and techniques of surveying like levelling, compass survey, contouring, curve settings, and GPS surveying etc. and their applications in surveying.

CO2: Experiment with survey instruments for carrying out survey, collect data, write reports and able to perform required calculations to achieve the objective for different types of surveying for different Engineering projects.

CO3: Analyze problems with solutions for surveying in difficult and hilly areas to obtain the topographical map of area

CO4: Criticize the information from remotely sensed data and interpret the data for survey

CO5: Design and develop maps in GIS software to give engineering solutions to decision makers

11. **Curriculum Content**

Unit 1: Introduction to Chain, and compass surveying 6 lectures

Types and classification of the survey. Principles of surveying. Units of measurement. Scales-types and uses, Maps Chain surveying – Types, difficulties during chain surveying, corrections of chain length, Operation and use of metric chain and tape. Use of ranging rods, cross staff, arrows, pegs, etc. Types of surveying, Bearings - Whole circle and Reduced Bearing -Traversing - Local attraction - Magnetic dip and declination. Bowditch method.

Unit 2: Plane Table Surveying and Tachometric Surveying 4 lectures

Plane table survey and accessories- Radiation, intersection, and traversing. Two-point problem, Three-point problem. Vertical Control- Definitions of terms used in leveling, different types of levels and leveling processes, adjustments, and benchmarks. MSL, the height of instrument method, the rise and fall method, inverse leveling, and the plane of collimation method. Tachometric Surveying. Profile levelling, longitudinal and cross sectioning.

Unit 3: Theodolite Survey 10 lectures

Theodolite- Definition, types, principle, and fundamental axes. Temporary adjustments. Measurements of horizontal and vertical angles. Method of repetition and Reiteration. Finding out the height and elevation of objects by single and double plane methods. Curves: Simple Curve-Elements of simple curves. Designation of a curve. Setting out simple curve Tabulation and setting out of the compound, reverse, transition, combined, and vertical curves. Area and volume computations; cross-sections and profiles

Unit 4: Contouring and Theory of Errors 9 lectures

Contouring- definition and characteristics of contours. Uses of contours. Methods of contouring-direct and indirect. Errors-Types and sources of errors, theory of least squares, method of weights, method of correlates, angle and station adjustment, figure adjustment. Necessity of Control Surveying, Principle of Triangulation, Classification of Triangulation Systems, Station Marks, Towers and Signals, Satellite station, Reconnaissance, Inter-visibility of stations, Angular Measurement, Base line measurement and its extension

Unit 5: GPS and GIS 7 lectures

Global Positioning System- NAVSTAR GPS system. Advantages of GPS. Components of GPS-Space, control and user segments. Principles of position fixing with GPS. Relative and differential positioning. Factors affecting GPS observations, GPS applications. Geographic Information systems: Components of GIS. Benefits and applications of GIS. Geographic data-

data input, processing –data structures- raster and vector, database management-layer concepts, spatial manipulation and analysis and graphical output and visualization.

12. Text Books

1. Punmia, B. C., Jain, A. K., "Surveying", Laxmi Publications Pvt. Ltd., New Delhi, Vol. I, 16th Edition, 2005.
2. Punmia, B. C., Jain, A. K., "Surveying", Laxmi Publications Pvt. Ltd., New Delhi, Vol. II, 15th Edition, 2005.
3. Engineering Roy, S. K., "Fundamentals of surveying", Prentice Hall of India, New Delhi, 2nd Edition, 2010.
4. Reddi, M. A., "Remote Sensing and Geographical Information Systems", BS Publications, 2001.

13. References

1. Chandra, A. M., "Plane Surveying", New age International, 2nd Edition, 2006.
2. Beer FP and Johnson ER, "Mechanics for Engineers- Dynamics and Statics"-3rd SI Metric edition, Tata McGraw Hill.-2008
3. De, A., "Plane surveying", S. Chand and Company Ltd., 2000.
4. Roy S. K., "Fundamental of surveying", Prentice Hall of India, 2nd Edition, 2010.
5. Chandra, A. M., "Plane Surveying", New age International, 2nd Edition, 2006.
6. Arora, K.R., "Surveying", Standard Book House, Delhi, Vol. II & III, 11th Edition, 2010.
7. McCormac, J. C., Sarasua, W., Davis, W., "Surveying", Wiley India, 6th Edition, 2012.
8. Lillesand, T. M., Kiefer, R.W., Chipman, J. W., "Remote Sensing and Image Interpretation", John Wiley & Sons Limited, Canada, 5th Edition, 2004.
9. Agor, R., "A Text Book of Surveying and Levelling", Khanna Publications, Delhi, 11th Edition, Vol. II & III, 2012.

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

15. List of Experiments

Sl.No.	EXPERIMENT NAME
1	To prepare conventional symbol chart based on the study of different types of topographical maps.
2	Locating various objects by chain & cross staff surveying.
3	To measure the bearings of a closed traverse by prismatic compass and to adjust the traverse by graphical method. Correct the latitude and departure of a closed traverse by Bowditch rule.
4	Method of radiation, intersection and resection by plane table surveying.
5	Fixing bench mark with respect to temporary bench mark with Auto/dumpy level by fly levelling and check levelling.
6	L-Section and cross section of road using Auto/Dumpy Level.
7	To study parts of a Vernier theodolite and measurement of horizontal and vertical angle.
8	To determine horizontal angle between two objects by repetition /reiteration method
9	To determine the height of any vertical structure using trigonometrically levelling by taking observations in single vertical plane.
10	To study various parts of Electronic Theodolite, Total Station and practice for Measurement of distance, horizontal and vertical angles.
11	To plot the contour map for a given area by direct/indirect method
12	To set out a simple circular curve by Rankin's method

1.	**Department offering the course**	**Civil Engineering**
2.	**Course Code**	**CEN204**
3.	**Course Title**	**Water Supply Engineering**
4.	**Credits(L:T:P:C)**	**2:0:2:3**
5.	**Contact Hours (L:T:P)**	**2:0:2**
6.	**Prerequisites (if any)**	**None**
7.	**Course Basket**	**Discipline Core**

8. **Course Summary:** Water Supply Engineering covers the design of community water supply systems.

9. **Course Objectives:** The course provides an understanding of drinking water quality, treatment and design of treatment units, water supply and water connections to households.

10. **Course Outcomes:**

On completion of this course, the students will be able to

CO1: Define various water demands and show the skill to forecast population by various methods

CO2: Explain about drinking water sources and quality parameters as per National and International standards

CO3: Develop thorough understanding of Drinking Water Treatment Procedures

CO4: Analyze the water distribution system and storage capacity of reservoir through problem solving

CO5: Explain the complete design and layouts of various components of house water supply system

11. **Curriculum Content**

Unit 1: Need for public water supply and role of engineers **4L**

Quantity of water, Different water demands, design period and population Forecast-Arithmetic mean, Geometric mean and incremental increase method.

Unit 2: Quality of water: Sources of water **5L**

Physical, chemical and bacteriological water quality parameters, Standards of Water quality desired for domestic water supplies – BIS and WHO Standards - Water borne diseases.

Unit 3: Treatment of water **7L**

Objectives. Conventional treatment plant layout. Different treatment units (location and its function) - Screening, Aeration, Sedimentation, Filtration and Disinfection etc. Concept of flow though treatment units

Unit 4: Storage and distribution of water **5L**

Layouts of distribution systems, Methods of distribution: pressure and gravity distribution systems, concept of service and balancing reservoirs, capacity of distribution reservoirs.

Unit 5: Water supply to buildings **5L**

Components of house water supply system, Pipe sizes and recommended velocities and pressures. Pipe fittings and pipe joints. Valves and taps. Hot water supply, Rainwater harvesting, Fire safety and firefighting installation in buildings.

12. Text Books

1. Garg, S. K., "Water Supply Engineering", Khanna Publishers (RS), New Delhi.
2. Punmia, B. C., Jain, A. K., Jain, A. K ,"Water Supply Engineering", Laxmi Publication (P) Ltd., New Delhi, 2016.

13. References

1. Rangwala, Water Supply And Sanitary Engineering (Including Environmental Engineering), Charotar (2016)
2. Manual on Water Supply and Treatment, CPHEEO, Ministry of Urban Development, Government of India, New Delhi.
3. Panchdhari, A. C., "Water Supply and Sanitary Installations", New Age International Publishers, New Delhi, 2nd Edition, 2000.
4. Nazaroff, W. W., Cohen, A. L., "Environmental Engineering Science", Wiley India, 2001.

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

15. List of Experiments

S.No.	EXPERIMENT NAME
1	Determination of turbidity, colour and conductivity
2	Determination of pH, alkalinity and acidity
3	Determination of hardness and chlorides
4	Determination of residual chlorine and chlorine demand
5	Determine the fluoride content in drinking water
6	Determine the Nitrate content in drinking water

1. Department offering the course	**Civil Engineering**
2. Course Code	**CEN205**
3. Course Title	**Building Materials and Construction**
4. Credits (L:T:P:C)	**2:0:0:2**
5. Contact Hours (L:T:P)	**2:0:0**
6. Prerequisites (if any)	**None**
7. Course Basket	**Engineering Foundation**

8. Course Summary: The subject covers the fundamental study of the material characteristics

9. Course Objective: The course objective is to learn the behavior of materials and properties of those materials used in Civil Engineering

10. Course Outcome:

Outcomes are designed to provide students with a well-rounded understanding of building materials and construction processes, enabling them to make informed decisions in selecting materials, ensuring quality, and implementing safe and efficient construction practices. At the end of the course, students will be able to:

CO1: Select the suitable building materials, its properties and specific application.

CO2: Explain the principles of bricklaying, block laying, location of doors & windows and use of plastering and pointing.

CO3: Compare different types of materials used for same construction purpose.

11. Curriculum Content

Unit 1:Brick and Stone Masonry [6 Hours]

Stone as building material; Requirement of good building stones, dressing of stones, Deterioration and Preservation of stone work, Bricks; Classification, Manufacturing of clay bricks, Requirement of good bricks, Field and laboratory tests on bricks; compressive strength, water absorption, efflorescence, dimension and warpage, Cement Concrete blocks, Autoclaved Aerated Concrete Blocks, Sizes, requirement of good blocks. Timber as construction material. Definition and terms used in masonry. Brick masonry, characteristics and requirements of good brick masonry, Bonds in brick work, Header, Stretcher, English, Flemish bond, Stone masonry,

Requirements of good stone masonry, Classification, characteristics of different stone masonry, Joints in stone masonry. Types of walls; load bearing, partition walls, cavity walls, other building materials including innovative materials.

Unit 2: Floors and Roofs [6 Hours]

Floors; Requirement of good floor, Components of ground floor, Selection of flooring material Procedure for laying of Concrete (VDF), Mosaic, Kota, Slate, Marble, Granite, Tile flooring, Cladding of tiles. Roof: Requirement of good roof, Types of roofs, Elements of a pitched roof, trussed roof, King post Truss, Queen Post Truss, Steel Truss, Different roofing materials, R.C.C. Roof.

Unit 3: Doors & Windows [6 Hours]

Location of doors and windows, technical terms, Materials for doors and windows: PVC, CPVC and Aluminum. Types of Doors and Windows: Paneled, Flush, Collapsible, rolling shutter, Paneled and glazed Window, Bay Window, French window. Steel windows, Ventilators, Sizes as per IS recommendations.

Stairs: Definitions, technical terms and types of stairs: Wood, RCC, Metal, Requirements of good stairs. Geometrical design of RCC doglegged and open-well stairs.

Formwork: Introduction to form work, scaffolding, shoring, under pinning.

Unit 4: Plastering and Pointing [4 Hours]

Mortar and its types, Purpose, materials and methods of plastering and pointing: Sand faced plastering, Stucco plastering, lathe plastering, defects in plastering, Water proofing with various thicknesses

Unit 5: Miscellaneous Materials [6 Hours]

Lime, cement, cement concrete, fly-ash, glass, timer, steel and other building materials.

Damp proofing- causes, effects and methods.

Paints- Purpose, types, technical terms, ingredients and defects, Preparation and applications of paints to new and old plastered surfaces, wooden and steel surfaces.

12. Text Book:

1. Sushil Kumar "Building Materials and construction", 20th edition, reprint 2015, Standard Publishers
2. Dr. B. C. Punmia, Ashok kumar Jain, Arun Kumar Jain, "Building Construction, Laxmi Publications (P) ltd., New Delhi.
3. Rangawala S. C. "Engineering Materials", Charter Publishing House, Anand, India.

13. Reference Books:

1. S. K. Duggal, "Building Materials", (Fourth Edition) New Age International (P) Limited, 2016 National Building Code(NBC) of India
2. P C Vergese, "Building Materials", PHI Learning Pvt.Ltd
3. Building Materials and Components, CBRI, 1990, India
4. Jagadish. K.S, "Alternative Building Materials Technology", New Age International,2007

14. Teaching and Learning Strategy

All materials (ppts, labs, etc.) will be uploaded on MS Teams. Refer to your course in MS Teams for details.

1. Department offering the course	**Civil Engineering**
2. Course Code	**CEN211**
3. Course Title	**Sewage and Solid Waste Engineering**
4. Credits (L:T:P:C)	**2:0:2:3**
5. Contact Hours (L:T:P)	**2:0:2**
6. Prerequisites (if any)	**None**
7. Course Basket	**Discipline Core**

8. Course Summary

Sewage and Solid Waste Engineering covers the design of community sewage conveyance systems, sewage treatment methods and solid waste management.

9. Course Objectives

The course provides an understanding of drinking water quality, treatment and design of treatment units, water supply and water connections to households.

10. Course Outcomes

On successful completion of the course, students will be able to achieve the following:

CO1: Define basic components of sewerage system and show the variations of several factors on its design.
CO2: Classify waste water characteristics.
CO3: Develop a thorough understanding of waste water treatment processes.
CO4: List various components in secondary treatment units and analyze the design aspects.
CO5: Determine the importance of tackling solid wastes in society and justify the process of its management.

11. Curriculum Contents

Unit 1 Introduction (6L)

Introduction, Basic Definitions, Need for waste water collection, Conveyance, Treatment and disposal, Types of sewerage systems, Quantity of sewage, Dry weather flow and factors affecting dry weather flow, Flow variations and their effects on design of sewerage system, Computation of design flow, Street inlets, Catch basins, Manhole and drop manhole.

Unit 2 Wastewater Characterization (7L)

Analysis of sewage, Physical, chemical and biological characteristics with emphasis on BOD and COD, Concept of aerobic and anaerobic activity, Sampling, Effluent standards.

Unit 3 Treatment of Sewage (6L)

Flow diagram of municipal sewage treatment plant, Primary treatment, Screening, Grit chamber, Skimming tank, Primary sedimentation tank, Design approaches

Unit 4 Secondary Treatment
(5L)

Theory and operation of trickling filter and types of trickling filters, Design of single stage trickling filter, Activated sludge process and its modifications, Design aspects of activated sludge process, Sludge digestion, Sludge drying beds, other methods of sludge disposal on site treatment method.

Unit 5 Solid Waste Management (4L)

Introduction; source, types, quantity, characteristics of solid wastes. Sampling & analyses of solid wastes. Municipal solid waste management: storage, collection, transfer, and transportation. Treatment & disposal of solid wastes: sanitary land filling, composing, incineration. Typical design problems on solid waste management.

12. Text Books

1. Garg, S. K., "Environmental Engineering: Sewage Disposal and Air Pollution Engineering", Khanna Publishers, New Delhi, 26th Edition(Paperback), Vol. II, 2008.
2. Punmia, B. C., Jain, A. K., "Waste Water Engineering", Firewall Media, New Delhi, 1998.

13. Reference Book

1. Manual on Sewage and Sewerage Treatment, CPHEEO, Ministry of Urban Development, New Delhi.

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in MS Team. Refer to your course in MS Team for details.

15. List of Experiments

S.No.	Name of Experiments
1)	Determination of physical characteristics of sewage
2)	Determination of Biochemical oxygen demand (BOD)of sewage
3)	Determination of COD of sewage
4)	Determination of Sulphur content of sewage
5)	Case study of quantization of solid waste
6)	Determine the density of solid waste

1. Department offering the course	**Civil Engineering**
2. Course Code	**CEN212**
3. Course Title	**Structural Analysis-I**
4. Credits (L:T:P:C)	**3:0:0:3**
5. Contact Hours (L:T:P)	**3:0:0**
6. Prerequisites (if any)	**None**
7. Course Basket	**Discipline Core**

8. Course Summary: Course enables the students on analysis of elements for axial forces and reactions for static as well as moving loads.

9. Objective: The course is designed to make students aware of the basic concepts of structural analysis and the different design principles used their in it.

10. Course Outcomes:

Outcomes are designed to provide students with a strong foundation in the analysis of structures, preparing them for more advanced topics in structural engineering and design. At the end of the course, students will be able to:

CO1: Define the different types of statically determinacy of the structures.

CO2: Explain the principle of superposition, Maxwell & Castigliano's theorems and concept of strain energy.

CO3: Apply the knowledge of deflection of beams and plane trusses in practical analysis.

CO4: Evaluate the influence line diagram for shear forces and bending moments of structures.

11. Curriculum Content

Unit 1: Fundamental of Structures (8L)

Basic: Types of statically determinate & indeterminate structures, static and kinematic indeterminacy of beams and frames, stability of structures, principle of superposition and Maxwell reciprocal theorem & Maxwell Betti's theorem.

Unit 2: Deflection of Beams (8L)

Analysis of statically indeterminate beams using strain energy, three moment theorem and other methods. Deflection of statically indeterminate beams.

Unit 3: Three Hinged Arches and Cables (8L)

Three hinged parabolic & circular arches with supports at the same and different levels, Analysis of cables under point loads and UDL at same and different levels.

Unit 4: Moving Loads and Influence Line Diagram (8L)

Concept of influence lines (ILD) and moving loads, ILD for reactions, SF and BM for statically determinate beams, ILD for trusses & three hinge arches, applications of ILD

12. Text Books

1. Theory of Structures, Stephen P. Timoshenko and D.H. Young, McGraw-Hill Book Company, 2nd Edition, 1965.
2. Theory of Structures, Punmia, B. C., Jain, A. K., Jain, A. K., Laxmi publication Co. New Delhi, 16th edition, 2005.

13. References

1. Elementary Structural Analysis, Norris, C. H., Wilbur, J. B., International Student Edition, Literary Licensing, LLC, 2012.
2. Basic Structural Analysis, Reddy, C. S., Tata McGraw Hill, 1st Edition New Delhi, 2011.
3. Theory of Structures, S. Ramamrutham and R. Narayan, 15th Edition, 2018, Dhanpat Rai & Co. Ltd.

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in MS-Teams. Refer to your course in MS-Teams for details.

1. School offering the course	**Civil Engineering**
2. Course Code	**CEN213**
3. Course Title	**Concrete Technology**
4. Credits (L: T:P:C:S)	**2:0:2:3**
5. Contact Hours (L: T:P:S)	**2:0:2**
6. Prerequisites (if any)	**None**
7. Course Basket	**Discipline Core**

8. Course Summary

In this course students will learn about the concrete and its microstructure, different properties of the concrete in green stage and in hardened stage. Mix designing of the concrete as per Indian standards and various special concretes needs to be produced as per the demands of the market and various industries.

9. Course Objectives

The objectives of this course are to learn the design concrete mixes for various mix proportions using different types of blending materials such as silica fume, fly ash and blast furnace slag.

10. Course Outcomes

Outcomes aim to equip students with a comprehensive understanding of concrete technology, enabling them to contribute to the design, production, and maintenance of durable and sustainable concrete structures. At the end of the course, students will be able to:

CO1: Define the basic constituents of concrete.

CO2: Explain the behaviour of admixture, fresh concrete and proportioning of concrete mix.

CO3: Apply the knowledge of mix design to calculate the mix proportions of cement, sand, aggregates, admixtures etc.

CO4: Distinguish among various types of concrete mixes as per their application and properties

11. Curriculum Contents

Unit 1: Concrete Ingredients and Microstructure (5 hours)

Cement – Chemical composition, hydration of cement, types of cement, manufacture of OPC with flow charts. Tests on cement, Quality of mixing water, fine and coarse aggregate and their tests, admixtures and their role in concrete, IS codes on concrete ingredients.

Unit 2: Proportioning of Concrete Mix and Fresh Concrete (5 hours)

Concept and applications of concrete mix design– batching, Mixing, transporting, placing, compaction, and curing of concrete, w/c ratio, gel/space ratio, properties of fresh concrete.

Unit 3: Chemical and Mineral Admixtures (5 hours)

Accelerators-Retarders- Plasticizers- Super plasticizers- Water proofers – Mineral Admixtures like Fly Ash, Silica Fume, Ground Granulated Blast Furnace Slag and Meta-kaolin -Their effects on concrete properties.

Unit 4: Hardened Concrete (6 hours)

Factors affecting strength, compressive strength, tensile strength, bond strength, modulus of rupture, modulus of elasticity, Poisson's ratio, the relationship between these parameters, curing, Shrinkage and creep of concrete, Durability, permeability, sulphate attack, chloride attack, carbonation, freezing and thawing, Tests on hardened concrete.

Unit 5: Special Concretes (5 hours)

Constituents, Properties and applications of lightweight concrete, self-compacting and self-healing concrete, fiber-reinforced concrete, pumped concrete, underwater concrete, pre-mix concrete, Various IS codes Provisions.

12. Text book

1. Shetty, M. S., "Conerete Technology", S. Chand & Co. Ltd, New Delhi, 8th Edition, 2019.
2. Mehta, P. K, Monteiro, P. J. M., "Concrete: Microstructure, Properties, and Materials", McGraw Hill Professional, 4th Edition, 2014.
3. Gambhir, M. L., "Concrete Technology", Tata McGraw Hill, New Delhi, 6th Edition, 2024.
4. Neville, A. M., Brooks, J. J., "Concrete Technology", Prentice Hall, 2nd Edition, 2010.

13. Reference Books

1. Neville, A. M., "Properties of concrete", ELBS Publications, London, 5th Edition, 2012.
2. IS: 10262: 2019 "Recommended Guidelines for Concretes Mix design", BIS Publication.

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details

15. List of Experiments

S.N.	Name of Experiments
1)	Normal consistency of cement.
2)	Initial and final setting time of cement.
3)	Compressive strength of cement.
4)	Soundness of cement.
5)	Tensile strength of cement
6)	Bulking of sand
7)	Water absorption of bricks.
8)	Compressive strength of bricks.
9)	Workability test: Slump Test and Compaction Factor Test
10)	Flow Test
11)	Compressive Strength Test of Hardened Concrete.
12)	Flexural Strength Test of Hardened Concrete.
13)	Split Tensile Strength Test of Hardened Concrete.
14)	Non-Destructive Testing of Concrete

1. Department offering the course	**Civil Engineering**
2. Course Code	**CEN214**
3. Course Title	**Transportation Engineering**
4. Credits (L:T:P:C)	**2:0:2:3**
5. Contact Hours (L:T:P)	**2:0:2**
6. Prerequisites (if any)	**None**
7. Course Basket	**Discipline Core**

8. **Course Summary:** The course syllabus covers all essentials of Road Plans, Vehicle Characteristics, Highway Planning, Highway Alignment, Highway Geometric Design, Highway Materials and their properties, Basics of Traffic Engineering, and Design Considerations for construction of Flexible and Rigid Pavements as per latest IRC Codal Guidelines.

9. **Course Objective**: The objective of the course is to provide a basic exposure to the students about fundamental aspects of transportation engineering and provide a glimpse about how a transportation engineer can apply the concepts in today's professional world.

10. **Course Outcomes:**

On successful completion of the course, students will be able to achieve the following:

CO1: Understand the basic concepts of highway planning, geometric design of roads and the fundamental concepts of traffic flow.

CO2: Understand the basic properties of highway materials and design principles of construction of pavements.

CO3: Apply the knowledge from the above to estimate the traffic vehicular load and stresses to be considered for design of pavements.

CO4: Plan for alignment and construction of flexible or rigid pavements by considering the utility criteria and traffic load criteria.

CO5: Identify appropriate materials with desired properties for the construction of pavements

11. **Curriculum Content**

Unit 1: Introduction to Highway Planning (4 L)

Importance of transportation, Different modes of transportation and their characteristics, Classification of roads, Different road patterns, Jaykar Committee recommendations and

implementation, Survey and Detailed Project Report, Application of RS, DEM and GIS in road design and planning, Twenty year road development plans in India, IRC Vision- 2021 and Rural Road Vision- 225.

Unit 2: Highway Geometric Design (6L)

Highway Cross sectional elements, Sight distances, Super elevation, Camber, Extra widening on curves, Design of horizontal and vertical alignments.

Unit 3: Introduction to Traffic Engineering (6L)

Introduction to Traffic Engineering, Traffic Flow Characteristics, Road user and vehicular characteristics, Traffic Studies, Traffic operations, Traffic control devices.

Unit 4: Introduction to Highway Materials (5L)

Soil and unbound granular materials, stabilization of soil and aggregates, bituminous binders, bitumen characterization

Unit 5: Design of Pavements (5L)

Types of pavements, flexible and rigid pavements, Elements of Highway Construction: embankment, subgrade, sub-base and base courses, bituminous surface courses, concrete pavements, Various factors of pavement design, estimation of traffic volume and load for pavement design, IRC method of design of flexible pavements (as per IRC 37:2018).

12. Text Books

1. Khanna, S. K., Justo, C. E. J., Veeraraghavan, A., "Highway Engineering", Nem Chand and Bros., Roorkee, 10th Edition, 2015.
2. Kadiyali, L. R., Lal, N. B., "Principles and Practices of Highway Engineering", Khanna Publishers, New Delhi, 5th Edition, 2013.
3. Kadiyali, L. R., "Traffic Engineering and Transportation Planning", Khanna Publishers, New Delhi, 7th Edition, 2010.
4. IRC-37-2018, "Guidelines for the Design of Flexible Pavements" (Fourth Revision), India Roads Congress, New Delhi, 2018.
5. IRC-58-2015," Guidelines for the Design of Rigid Pavements" (Fourth Revision), India Roads Congress, New Delhi, 2015.

13. Reference Books

1. Sharma, S. K., Sharma, R. C., “Principles and Design of Highway Engineering”, S. Chand & Company. 2012
2. Khanna, S. K., Justo, C. E. J., “Highway Material Testing Laboratory Manual”, Nem Chand And Bros., Roorkee.

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

15. List of Experiments

S.No.	EXPERIMENT NAME
1	Specific gravity test of bitumen
2	Ductility test of bitumen
3	Flash point and fire point test of bitumen
4	Penetration test of bitumen
5	Softening test of bitumen
6	Viscosity test of bitumen
7	Bitumen Content
8	Stripping Test on aggregate
9	Abrasion test of aggregate
10	Shape test (flakiness, elongation and angularity number) of aggregate
11	Impact value test of aggregate
12	Specific gravity test of aggregate
13	Crushing strength of aggregate
14	Marshall Test for stability and flow value
15	Benkelman Beam Test (Demonstration)

1.	**Department offering the course**	**Civil Engineering**
2.	**Course Code**	**CEN215**
3.	**Course Title**	**Engineering Geology**
4.	**Credits (L:T:P:C)**	**2:0:2:3**
5.	**Contact Hours (L:T:P)**	**2:0:2**
6.	**Prerequisites (if any)**	**None**
7.	**Course Basket**	**Discipline Core/Minor**

8. Course Summary: Engineering Geology covers the basic idea about the deformation of structures and the criteria to select any project site

9. Course Objectives: The objectives of this course are to apply geological concepts and approaches to engineering projects and to use the principles of geological investigations to establish civil engineering structures.

10. Course Outcomes:

On completion of this course, the students will be able to

CO1. **Understand** the basic geological and geophysical concepts required for the safe development of civil works.

CO2. Apply the knowledge to **identify** the basic rock types and the properties of these rocks that an engineer may be concerned with.

CO3. A**ssess and analyse** the dynamic actions of natural forces on civil engineering structures (Dam and Reservoir, Tunnel, Bridges construction) and recommend remedial measures

CO4. Recommend mitigation strategies for geologic hazards such as Earthquakes, landslides, flooding

11. Curriculum Content:

Unit 1

Physical Geology **6 lectures**

Geology and its importance in civil engineering projects; internal structure of the earth and its composition; Epigene and Hypogene geological agents; Weathering of rocks, Kinds of weathering; Formation of soil and its classification, Soil profile, Concept of plate tectonics and seafloor spreading.

Unit 2

Applied Mineralogy and Petrology **4 lectures**

Definition of mineral, Classification of minerals based on chemistry such as rock forming Minerals, Economic ore minerals and industrial minerals. Silicate Structure, Igneous rocks: Mode of occurrence, Classification, Texture and Structure. Sedimentary rock: Mode of occurrence, textures and structures. Metamorphic rocks- Metamorphism, Agents of metamorphism, Types of metamorphism, Textures and Structure

Unit 3

Structural Geology **6 lectures**

Concepts of Dip and Strike; Compass clinometer; Description of folds, Faults, Joints and Unconformities with their Types; Recognition of folds and faults in the field and its consideration in Civil Engineering projects.

Unit 4

Site selection criteria for engineering projects **4 lectures**

Geological site investigation, surface and subsurface explorations by geological and geo-Physical investigations, Selection of Geological site for construction of Dams and Reservoirs, Tunnels, Bridge Sites, and Highways.

Unit 5

Case studies **2 lectures**

Geological hazards such as landslides, volcanoes and earthquakes- causes, effects and remedial measures; Various case studies deal with failure of engineering projects- Reason and precaution measures.

12. Text Books

1. Singh, P., "Engineering Geology", S. K. Kataria & Sons, New Delhi, 2009.

2. B.S. Satyanarayana Swamy, Engineering Geology Laboratory Manual, Dhanpat Rai Sons, New Delhi.

13. References

1. Reddy D. V., "Engineering Geology', Vikas Publishing House Pvt. Ltd, Noida.

2. Varghese, P. C., “Engineering geology for Civil Engineers”, PHI Learning Pvt. Ltd., 2012.

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

15. List of Experiments

Sl.No.	EXPERIMENT NAME
1	Detail Identification of minerals in hand specimen
2	Detail Identification of igneous rocks in hand specimen
3	Detail Identification of sedimentary rocks in hand specimen
4	Detail Identification of metamorphic rocks in hand specimen
5	Detail identification of minerals (thin section) under microscope
6	Study and Interpretation of Contour map and profile section
7	Solving Dip and Strike Problems
8	Preparation of structural maps and their interpretation
9	Plotting of poles and planes of various discontinuity surfaces in stereo plots

1.	**Department offering the course**	**Civil Engineering**
2.	**Course Code**	**CEN216**
3.	**Course Title**	**Survey Camp**
4.	**Credits (L:T:P:C)**	**0:0:2:1**
5.	**Contact Hours (L:T:P)**	**1 week (Field Study)**
6.	**Prerequisites (if any)**	**None**
7.	**Course Basket**	**Discipline Core**

8. **Course Summary:** Survey Camp provides practical knowledge and hands-on experience in surveying concepts.

9. **Objective**: The course prepares students to conduct surveying-related real-time projects for both private and public sectors. They will learn the standards and specifications required to assess positional accuracy, create land records, and comply with legal guidelines. Additionally, students will develop skills to address engineering challenges using software tools to produce maps.

10. **Course Outcomes:**

On successful completion of the course, students will be able to achieve the following:

CO1: **Understand** the concepts of all methods and master a variety of surveying methods and techniques, such as compass surveys, leveling, contouring, and GPS surveying, while understanding their practical applications in real-world scenarios.

CO2: **Apply** the knowledge and engage in hands-on experience with survey instruments, accurately conducting surveys, collecting data, drafting comprehensive reports, and executing essential calculations for a diverse range of engineering projects.

11. **Module of the Course**

Module 1: Engage in hands-on Compass surveying and complete a close traverse in the specified area.

Module 2: Practice traversing using Plane Table Surveying techniques.

Module 3: Gain practical experience in Levelling with an Auto level.

Module 4: Learn Levelling and measure vertical heights with a Theodolite.

Module 5: Conduct contouring with both Auto level and Theodolite.

Module 6: Observe a Total Station demonstration and create a road profile section using the Total Station.

1. Department offering the course	**Civil Engineering**
2. Course Code	**CEN217**
3. Course Title	**Building Planning and Drawing**
4. Credits (L:T:P:C)	**0:0:4:2**
5. Contact Hours (L:T:P)	**0:0:4**
6. Prerequisites (if any)	**None**
7. Course Basket	**Engineering Foundation**

8. Course Summary: The subject covers the fundamental study of the drawing and planning

9. Course Objective: The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences

10. Course Outcome:

Outcomes are designed to equip students with the knowledge and skills needed to engage in the planning and design of buildings, considering both functional and aesthetic aspects, and adhering to relevant codes and regulations. At the end of the course, students will be able to:

CO1: Explain the significance of symbols, signs and conventions from the given drawing.
CO2: Construct the line plans of residential and public buildings using principles of building planning.
CO3: Apply building planning knowledge for design (as per IS codes and local guidelines) of two-point perspectives drawing for given building plans.

11. Curriculum Content

Unit 1:Conventions and Symbols [12 Hours]

Conventions as per IS 962-1989, symbols for different materials such as earthwork, brickwork, stonework, concrete, woodwork and glass used in civil engineering, construction, Graphical symbols for door and window, Abbreviations, symbols for sanitary and electrical installations, Types of lines- visible lines, centre line, hidden line, section line, dimension line, extension line, pointers, arrow head or dots. Appropriate size of lettering and numerals for Titles, sub titles, notes and dimensions, Types of scale- Monumental, Intimate, criteria for Proper Selection of scale for various types of drawing, Sizes of various standard papers/sheets, Reading and

interpreting readymade Architectural building drawing (To be procured from Architect, Planning Consultants, Planning Engineer).

Unit 2: Planning of Building [12 Hours]

Principles of planning of Residential and Public building- Aspect, Prospect. Orientation, Grouping, Privacy, Elegance, Flexibility, Roominess, Circulation, Furniture requirements, Sanitation, Economy, Space requirement and norms for minimum dimension of different. Units in the residential and Public buildings as per IS 962-1989, Rules and bye-laws of sanctioning authorities for construction work., Plot area, built up area, super built up area, plinth area, carpet area, floor area and FAR (Floor Area Ratio) / FSI, Line plans for residential building of minimum three rooms including w/c, bath and staircase as per principles of planning. Line plans for public building-school building, primary health center, restaurant, bank, post office, hostel, Function halls and Library

Unit 3: Drawing of Framed Structure using Auto CAD software [12 Hours]

Drawing of Two story Framed Structure (G+l) residential building (2 BHK) and public building with staircase, Data drawing – developed plan, site plan, schedule of openings construction notes with specifications area statement. Planning and design of staircase Rise and Tread for residential, working drawing of Framed Structure -developed plan, elevation, section passing through staircase or w.c. and bath, Foundation plan of Framed Structure, Details of RCC footing, column, Beam, Chajjas Lintel, Staircase and slab, drawing with CAD- Draw commands, modify commands, layer commands.

12. Text Book:

1. Civil Engg: Drawing Balagopal and RS Prabhu–Spades
2. Engineering Drawing N D Bhatt
3. Building planning and drawing by Dr. N. Kumara Swamy & A. Kameswara Rao
4. AutoCAD 2018 Training Guide, by Linkan Sagar

13. Reference Books:

1. Civil Engineering Drawing, by R S Malik and G S Meo
2. Building planning and drawing (with cd containing autocad commands with screen shots by M. V. Chitawadagi & S. S. Bhavikatti.

14. Teaching and Learning Strategy

All materials (ppts, labs, etc.) will be uploaded on MS Teams. Refer to your course in MS Teams for details.

1. Department offering the course	**Civil Engineering**
2. Course Code	**CEN301**
3. Course Title	**Soil Mechanics**
4. Credits (L:T:P:C)	**2:0:2:3**
5. Contact Hours (L:T:P)	**2:0:2**
6. Prerequisites (if any)	**None**
7. Course Basket	**Discipline Core**

8. Course Summary: To understand the basics of soils through hands-on experience in the soil laboratory. Some of the important topics which will be learned during the course: soil structure and grain size; identification and classification of soils for engineering purposes; physical and engineering properties of soils; fundamental behaviour of soils subjected to various forces; groundwater and seepage through soils; compaction; consolidation; shear strength. Upon successful completion of the course, students should be able to apply the fundamentals of soil mechanics and principles of geotechnical engineering in the analysis, design, and construction of civil engineering projects.

9. Objective: The objectives of this course are to understand the basic properties of soil, to determine the strength of soil so that various properties can be known before design and to undertake a variety of laboratory tests on soils.

10. Course Outcomes:

On successful completion of the course, students will be able to achieve the following:

CO1: Understand the relationships between physical characteristics and mechanical properties of soil.

CO2: Analyzing the experimental measurements of physical and mechanical soil properties commonly used in engineering practice.

CO3: Evaluating settlement characteristics of soil from consolidation and compaction.

11. Curriculum Content

Unit 1: Introduction [6 Hours]

Different types of soil, Definition of void ratio, porosity, percentage air voids, air content, degree of saturation, moisture content, specific gravity, bulk density, dry density, saturated density, submerged density and their inter relationships. Index property of soil: Definition and laboratory method of determination of index properties of soil: moisture content, specific gravity, particle size distribution (Sieve analysis and hydrometer analysis only), in situ density by Core cutter & sand replacement methods, relative density, consistency limits and indices and its determination, activity, thixotropy, sensitivity, collapsibility.

Unit 2: Classification of soils [8 Hours]

Purpose of soil classification, basis of soil classification, particle size classification- textural soil classification and IS classification system, plasticity chart. Clay mineralogy and Soil Structure: single grained, honey combed, flocculent and dispersed structure, Electric diffuse a double layer, Adsorb water, Structural water, capillary water, gravity water. Common Clay mineral in soil and their structure- Kaolinites, Illite and montmorillonite. Bulking of sand. Stress Distribution in soil: Boussineq's Theory, Westergaurd's Theory, Isobars, Vertical pressure due to various loading conditions (line load, point load, uniform load, and corner of uniformly loaded rectangular area, equivalent point load, trapezoidal method) Newmark's influence chart method.

Unit 3: Effective stress and permeability [6 Hours]

Effective stress, total pressure and pore water pressure, capillary phenomenon. Darcy's law-assumptions and validity, coefficient of permeability and its determination (laboratory, field and indirect method equations: Kozney-Karman, Allen-Hazen, Terzaghi, Consolidation) factor affecting permeability, permeability of stratified soil. Seepage Analysis: Pressure head, total head, elevation head, seepage pressure, critical hydraulic gradient, quick sand phenomenon, flow net, application of flow net, phreatic line and its determination.

Unit 4: Compaction of Soils [8 Hours]

Principle of compaction, standard and modified proctor's tests, Optimum moisture content, factor affecting compaction, proctor needle, effect of compaction on soil properties, method of compaction, compaction equipment's. Consolidation of Soils: Definition, Initial compression, primary consolidation, secondary consolidation, normally consolidated, under consolidated and over consolidated soils, Terzaghi's one dimensional consolidation theory assumption and limitation, oedometer, Consolidation characteristics of soil, determination of consolidation characteristic, degree of consolidation and its determination, Time factor,

determination of coefficient of consolidation by square root of time fitting method, logarithmic time fitting method. Settlement Analysis (total settlement, differential settlement, angular settlement). Immediate settlement. Determination of primary consolidation settlement and secondary consolidation.

Unit 5: Shear Strength of Soils [6 Hours]

Concept of shear strength, Mohr-coulomb theory, conventional and modified failure envelope, types of shear strength (undrained, drained shear strength), different types of shear test on the basis of drainage (UU, CD, CU, CD). Laboratory test (direct shear, triaxial, vane shear, ring shear, unconfined compression test). Determination of sensitivity of clay. Shear characteristics of soil. Stress path.

12. Text books:

1. Punmia, B. C., Jain, A. K., Jain, A. K., "Soil Mechanics and Foundations", Laxmi publication Co. New Delhi, 16th edition, 2005.
2. Ranjan, G., Rao, A. S. R., "Basic and Applied Soil Mechanics", New Age International (P) Ltd., New Delhi, 2nd Edition, 2005.

13. References books:

1. Das, B. M., Sobhan, K., "Principles of Geotechnical Engineering" 8th Edition. Thomson business information India (P) Ltd., India
2. Singh, A., Chowdharyg, R.,"Soil Engineering in Theory and Practice", CBS publishers and distributors Ltd., New Delhi.
3. Murthy, V. N. S., "Soil Mechanics and Foundation engineering", 4th Edition, UBS publishers and Distributors, New Delhi.
4. Sitaram, T. G., Ramamuthy, T. N., "Geotechnical engineering", S. Chand & Co New Delhi.
5. Off., H. M. S., "Soil mechanics for road engineers, Road Research Laboratory", U. K., Vol. I, 1952

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details

15. List of Experiments

S.No.	EXPERIMENT NAME
1	Determination of Water content by Oven Dry Method.
2	Determination of Specific Gravity and Water content by Pycnometer Method.
3	Determination of In Situ Density and dry density by Core Cutter Method and Sand Replacement Method.
4	Determination of Particle Distribution curve by Sieve Analysis.
5	Determination of Specific Gravity by Hydrometer Analysis.
6	Determination of Liquid Limit, Plastic Limit & Shrinkage Limit.
7	Determination of coefficient of permeability by Permeability Test (Constant and Variable).
8	Determination of Optimum moisture content by Proctor Compaction Test
9	Determination of shear strength by Triaxial Compression Test
10	Determination of shear strength by Direct Shear Test.

1. Department offering the course	**Civil Engineering**
2. Course Code	**CEN302**
3. Course Title	**Design of Reinforced Concrete Structures**
4. Credits (L:T:P:C)	**2:0:4:4**
5. Contact Hours (L:T:P)	**2:0:4**
6. Prerequisites (if any)	**CEN202**
7. Course Basket	**Discipline Core**

8. Course Summary: Course will make the students able to understand various design parameters, analysis and design methodology of RCC structures.

9. Objective: The course is designed to make students aware about the various principles of reinforced concrete structures and to design various elements using limit state method.

10. Course Outcomes:

Outcomes aim to prepare students for the challenges of designing reinforced concrete structures by providing a comprehensive understanding of material behavior, code requirements, and the application of design principles. The goal is to ensure that graduates can contribute to the safe and efficient construction of buildings and infrastructure. At the end of the course, students will be able to:

CO1: Outline the basic principle of limit state and working state method as per IS code.
CO2: Apply the different types of loading in different reinforcement concrete elements.
CO3: Construct the reinforcement detailing of various building components.
CO4: Analyse the different structural elements of a RCC structures as per the IS code Provision.
CO5: Creating a detailed RCC design as per IS codes and local guidelines for two-point perspectives drawing for given building plans.

11. Curriculum Content

Unit 1: Introduction to Limit State Design (8L)

Introduction about the materials used in the concrete. Various design approaches and introduction to working stress method. Design of flexural members using working stress method.

Philosophy and principle of limit state design along with the assumptions, concept of balanced, under reinforced and over reinforced sections, limit state of collapse in flexure of rectangle and flanged sections with examples.

Unit 2: Limit State Design of Beams (8L)

Design problems on singly doubly and fanged simply supported beams with torsion shear and anchorage consideration. Design of cantilever beams and continuous beams

Unit 3: Limit State Design of Slabs (8L)

Introduction to one way and two-way slabs, design of one-way cantilever, simply supported and continuous slab and design of two-way slabs by IS code method.

Unit 4: Limit State Design of Columns and Footings (10L)

General design concept of compression members, Design of short axially loaded columns, Design of columns subjected to uniaxial and biaxial bending using interaction curves, Design Principles of slender columns, Design and detailing of isolated rectangular and basic principles of trapezoidal footing for axial load and uniaxial moment.

Unit 5: Design of Stair Cases (8L)

General specifications, Types of stair cases, loads on stair cases, Effective span of stairs, Design of dog legged stair case, Design principles of other type of staircases.

12. Text Books

0. Design of reinforced concrete structure- Pillai, S. U., Menon, D., Tata McGraw hill publications, 3rd Edition, 2009.
1. Limit State Design of Reinforced Concrete, Varghese, P. C., PHI Learning Pvt. Ltd., India, 2nd Edition, 2008.
2. Reinforced Concrete Design by N. Krishna Raju and R.N. Pranesh, 4th Edition, 2017, New Age International Publishers, New Delhi.

13. References

1. Design of concrete structures – Arthus H. Nilson, David Darwin, and Chorles W. Dolar, Tata McGraw-Hill, 3rd Edition, 2005.
2. Reinforced Concrete Design by S. N. Sinha, 3rd Edition, 2018, Tata McGraw-Hill Education, New Delhi.
3. Reinforced Concrete Structures by R. Park and T. Paulay, 2nd Edition, 2018, John Wiley & Sons, New York.

4. Reinforced Concrete Limit State Design by A. K. Jain, 2nd Edition, 2017, Nem Chand & Brothers, Roorkee.

14. List of Experiments

1. Design of singly doubly and flanged reinforced beams.
2. Design and detailing of simply supported and continuous beams.
3. Design and detailing of one-way and two-way slabs.
4. Design and detailing of Columns.
5. Design and detailing of Footings.
6. Design and detailing of Staircase.
7. Design of G+1 RCC Building (commercial / Residential).

Group Project with 3 students per group. The plan considered for design must have both one way and two-way slabs along with a dog legged staircase with minimum two flights. Design for RCC elements to be done in A4 pages and detailing of the elements to be done in A3/A2 sheets.

15. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in MS-Teams. Refer to your course in MS-Teams for details.

1. Department offering the course	**Civil Engineering**
2. Course Code	**CEN303**
3. Course Title	**Hydraulics And Hydraulic Machines**
4. Credits (L:T:P:C)	**2:0:2:3**
5. Contact Hours (L:T:P)	**2:0:2**
6. Prerequisites (if any)	**None**
7. Course Basket	**Discipline Core**

8. Course Summary

This course will offer knowledge about the open channel flow, pumps and turbines.

9. Course Objectives

The objective of this course is to introduce the students to various hydraulic engineering problems related to open channel flows and hydraulic machines and learn the applications of basic concepts of fluid mechanics. Students must be able to design most economical channel section and learn about solving problems for different regimes of flow in open channel and hydraulic jump. At the completion of the course, the student should be able to apply the knowledge of Fluid Mechanics in design and working of different hydraulic structures and the design of hydraulic machines.

10. Course Outcomes

On successful completion of the course, students will be able to achieve the following:

CO1: Understand the different properties of open channel flow with help of applying the knowledge of fluid mechanics.

CO2: Attain the knowledge of hydro power plants and their different components and learn about different turbines and their working principles.

CO3: Apply the knowledge of specific energy and critical flow to understand the different flow regimes i.e. uniform, gradually and rapidly varied flows in steady state condition and the phenomenon of hydraulic jump.

CO4: Attain the skill for designing most economical channel section and learn about the phenomenon of velocity distribution and understand the concept of specific energy.

CO5: Compute the forces on flat plate and curved vanes by the impact of jet of water and apply the knowledge to design hydraulic machines like turbines and pumps.

11. Curriculum Contents

Unit 1 Open Channel Flow (7L)

Definition of open channel, Geometric properties, Uniform flows in open channels: Chezy and Manning‘s equation, Velocity Distribution in Open Channel. Most Economical sections: Rectangle and Trapezoidal

Unit 2 Specific Energy (6L)

Specific Energy, Specific energy curve, condition for minimum specific energy and maximum discharge, Critical flow in Rectangular channels, Problems. Gradually Varied Flow, Flow profiles, Hydraulic Jump in a rectangular channels, classification of jump.

Unit 3 Impact of Jet on Vanes (6L)

Introduction to impulse momentum equation and its applications, Force exerted by a jet on a fixed target, Derivations, Force exerted by a jet on a moving target, derivations, Force exerted by a jet on a series of a curved vanes, concept of velocity triangles, equation for work done and efficiency.

Unit 4 Hydro-electric power plant (5L)

Components and functions, Hydraulic Turbines, Introduction, types and classifications, Pelton wheel, equation for work done and efficiency, Specific speed, Francis and kaplan turbine-Theory, equation for work done and efficiency, Design parameters, Draft tube.

Unit 5 Centrifugal and Reciprocating Pumps (4L)

Definition of pumps and classification, Principle of working, priming and methods, Specific speed, Work done and efficiencies of centrifugal and reciprocating pumps, Minimum starting speed, Cavitation in centrifugal pumps, multistage pumps.

12. Textbook:

1. Bansal, R. K., “Fluid Mechanics and Hydraulic Machine”, Lakshmi Publications, New Delhi, 2010.

2. Subramanya. K., “Flow in open Channel”, Tata McGraw Hill, New Delhi, 2019.

13. Reference Books

1. Modi, P. N., Seth, S. M., “Hydraulics and Fluid Mechanics”, Standard Book House, New Delhi, 2019.
2. Jain, A.K., “Fluid Mechanics: Including Hydraulic Machines”, Khanna Publishers, New Delhi, 2010.

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in MS Teams. Refer to your course in MS Teams for details.

15. List of Experiments

S.No.	Name of Experiments
1)	Determination of Manning‘s roughness coefficient for a give n channel bed.
2)	Study the characteristics of Hydraulic jump.
3)	Determination of efficiency of Pelton wheel turbine.
4)	Determination of efficiency of Francis turbine.
5)	Determination of efficiency of Multistage centrifugal pump.
6)	Determination of efficiency of Reciprocating pump.
7)	Determination of efficiency of impact of jet on vanes.

1. Department offering the course	**Civil Engineering**
2. Course Code	**CEN311**
3. Course Title	**Design of Steel Structures**
4. Credits (L:T:P:C)	**2:0:4:4**
5. Contact Hours (L:T:P)	**2:0:4**
6. Prerequisites (if any)	**None**
7. Course Basket	**Discipline Core**

8. Course Summary: This course consists of plastic analysis of the structure, various rolled sections which are used in the construction industry for the steel buildings along with their properties. Bolted and welded connections. Different tension, compression members and their design. Analysis and design of flexural members and intro to the plate girders used in the steel structures.

9. Objective: The course objective is to gain knowledge regarding design of steel structures, stability, strength and serviceability.

10. Course Outcomes:

Outcomes aims to prepare students for the challenges of designing steel structures by providing a comprehensive understanding of material behaviour, code requirements, and the application of design principles. The goal is to ensure graduates can contribute to the safe and efficient construction of buildings, bridges, and other infrastructure using steel. At the end of the course, students will be able to:

CO1: Define the required codal provisions for design of steel structures

CO2: Outline the detailing of various steel connections.

CO3: Develop design of steel structure with limit state analysis.

CO4: Examine the different steel structural elements (Tension, compression and flexural members).

CO5: Creating a detailed steel design as per IS codes & steel handbook and local guidelines for two-point perspectives drawing for given building and industrial infrastructures.

11. Curriculum Content

Unit 1: Introduction & Plastic Analysis (8 HRS)

Introduction, Types & properties of structural steel rolled sections, Grades of steel, Codal Provisions Plastic behaviour of structural steel – shape factor – plastic hinge concept – collapse load – methods of plastic analysis – plastic design of beams and portal frames.

Unit 2: Connections (8 HRS)

Concept in the design of connections, Codal Provisions, Simple and moment resistant welded and bolted connections and eccentric connections

Unit 3: Tension Members (8 HRS)

Introduction, Codal provisions, Analysis and design of tension members with different cross sections subjected to axial tension, splicing of tension member and Lug angle

Unit 4: Compression Members (10 HRS)

Codal provisions, Slenderness ratio, Analysis and design of simple compression members (angles and I-Sections), including continuous strut and discontinuous strut. Built up compression members, Lacing and battening.

Unit 5: Flexural Members (10 HRS)

Concept in the design of flexural member, Codal provisions, Analysis and design of laterally restrained and unrestrained beams, built up beams, Web buckling and web crippling. Introduction to lintels, purlins and castellated beams. Introduction to plate girders.

12. Textbook(s):

1. Design of Steel structures by K.S. Sai Ram, Person Education.
2. Design of Steel Structures Vol. 1 & 2 – Ramchandra, Standard Publications.
3. Design of steel structures, Structures, S.S. Bhavikatti, I.K Publication House, New Delhi, 2010.
4. Structural Design and Drawing by N. Krishna Raju, Universities

13. Reference Books:

1. Limit State Design Steel Structures, S. k. Duggal, Tata Mc Graw hill.
2. Design of Steel Structures - N. Subramanian, Oxford University Press
3. IS800:2007, Code of practice for general construction in steel.

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

15. List of Experiments

Studio/Lab

1. Design and detailing of bolted connections (Including Gussent plate).
2. Design and detailing of welded connections (Including Gussent plate).
3. Design and detailing of column base and connection. (Including Base plate)
4. Design and detailing of steel beam
5. Design and detailing of steel columns
6. Design and detailing of complete roof truss for industrial sheds.

1. Department offering the course	**Civil Engineering**
2. Course Code	**CEN312**
3. Course Title	**Structural Analysis-II**
4. Credits (L:T:P:C)	**3:0:2:4**
5. Contact Hours (L:T:P)	**3:0:2**
6. Prerequisites (if any)	**None**
7. Course Basket	**Discipline Core**

8. Course Summary: This course consists of various methods of finding the shear force, bending moment, slope and deflection of the various elements of the indeterminate structures.

9. Course Objective: The course is designed to make students aware of the basics and analysis of indeterminate structures and different design principles used their in.

10. Course Outcomes:

Outcomes are designed to provide students with a strong foundation in the analysis of structures, preparing them for more advanced topics in structural engineering and design. At the end of the course, students will be able to:

CO1: Recall the concepts of static and kinematic indeterminacy.

CO2: Explain different methods for analysis of indeterminant structures

CO3: Analyse and evaluate forces and moments in indeterminant structures.

CO4: Propose applicability of different types of analysis methods on different types of structures.

11. Curriculum Content

Unit 1: Slope-Deflection Method (8L)

Introduction and Derivation of slope-deflection equation, application to continuous beams with and without sinking of supports, Analysis of Single Bay – single storey Portal Frames Including Side Sway

Unit 2: Moment Distribution Method (8L)

Analysis of continuous beams with and without sinking of supports using Moment Distribution Method, Analysis of Single Bay Single Storey Portal Frames including side sway. Kani's Method: concept of kani's method for the solution of indeterminate structures

Unit 3: Indeterminate Arches (8L)

Two Hinged Arches- Introduction, Analysis of two hinged parabolic & circular arches and fixed arches

Unit 4: Matrix Methods of Analysis (12L)

Concept of stiffness and flexibility methods, Analysis of beams and frames using the stiffness method and flexibility methods.

12. Text Books

1. Elementary Structural Analysis by A. K. Jain, 1st Edition, 1990, Nem Chand & Bros, Roorkee.
2. Theory of Structures by B. C. Punmia, A. K. Jain, and A. K. Jain, 16th Edition, 2005, Laxmi Publications, New Delhi.

13. References Books

1. Elementary Structural Analysis, Norris, C. H., Wilbur, J. B., International Student Edition, Literary Licensing, LLC, 2012.
2. Basic Structural Analysis, Reddy, C. S., Tata McGraw Hill, 1st Edition New Delhi, 2011.
3. Theory of Structures by S. Ramamrutham and R. Narayan, 15th Edition, 2018, Dhanpat Rai & Co. Ltd.

14. List of Experiments

S.No.	EXPERIMENT NAME
1	Comparison of experimental and theoretical results of forces and displacement components at redundant joints
2	To find loads in suspension rods of elastically coupled beam apparatus and verify theoretically
3	To find the deflection of trusses
4	To determine the support reaction and draw ILD for a three-hinge arch
5	To verification of Maxwell's reciprocal theorem using beam apparatus
6	To determine the horizontal thrust in two hinge arch support and its theoretical verification
7	To find the value flexural rigidity for a beam and its theoretical verification
8	Behavior study of a portal frame under different end conditions
9	Study of elastic displacement of curved members

15. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

1. Department offering the course	**Civil Engineering**
2. Course Code	**CEN313**
3. Course Title	**Foundation Engineering**
4. Credits (L:T:P:C)	**3:0:0:3**
5. Contact Hours (L:T:P)	**3:0:0**
6. Prerequisites (if any)	**None**
7. Course Basket	**Discipline Core**

8. **Course Summary:** The course will focus on the design of shallow foundation and axially loaded pile and well foundation. Students will learn about the stability of soil under different conditions. Upon successful completion of the course, students should be able to apply fundamentals of soil mechanics and principles of geotechnical engineering in the analysis, design, and construction of civil engineering projects.

9. **Course Objective**: The objective of this course is to learn application of soil mechanics and other related techniques to design and analyse various types of foundation by learning methods of soil exploration; bearing capacity and settlements determination for shallow and deep foundation and provision of earth retaining structures.

10. Course Outcomes:

On successful completion of the course, students will be able to achieve the following:

CO1: Remembering about types and purposes of different foundation systems and structures.

CO2: Applying applications of geotextiles for reinforced earth and soil stabilization.

CO3: Analyzing the stability of retaining wall and slope stability.

CO4: Evaluate the feasibility of foundation design to different types of soil conditions.

11. Curriculum Content

Unit 1: Earth Pressures and Slope Stability [6 Hours]

Brief review of soil mechanics principles used in foundation engineering, Earth pressure at rest, Active and passive earth pressure, Rankine's and Coulomb's earth pressure theories, Earth pressure due to surcharge, Retaining walls, Stability analysis of retaining walls, Slopes: Mode of

failure- Mechanism, Stability analysis of infinite slopes, Swedish slip circle method, Taylor's stability number.

Unit 2: Shallow Foundation [8 Hours]

Types of Foundations, Mechanism of load transfer in shallow and deep foundations, Shallow foundations, Terzaghi's bearing capacity theory, Computation of bearing capacity in soil, Effect of various factors, Use of field test data in design of shallow foundations, Stress below the foundations, Settlement of footings and rafts, proportioning of footings and rafts, Sheeting and bracing of foundation excavation.

Unit 3: Deep Foundations [6 Hours]

Types and methods of construction, estimation of pile capacity, Capacity and settlement of group of piles, Group efficiency, Proportioning of piles, under rammed piles. Standard penetration test.

Unit 4: Well foundation [4 Hours]

Methods of construction of well foundation, Tilt and Shift, Remedial measures, Bearing capacity, Settlement and lateral stability of well foundation.

Unit 5: Soil Exploration, Reinforced Earth and Geotextiles [6 Hours]

Reinforced Earth, Geotextile: Definition, types, functions. Use of Geotextiles in Earth dams, roads, railways, erosion control and bearing capacity improvement. Storage, handling and placement of Geotextiles. Methods of soil exploration, Boring, Sampling, Penetration tests, Correlations between penetration resistance and soil design parameters, geophysical and advance soil exploration methods.

12. Text Books

1. Punmia, B. C., Jain, A. K., Jain, A. K., "Soil Mechanics and Foundations", Laxmi publication Co. New Delhi, 17th edition, 2017.
2. Ranjan, G., Rao, A. S. R., "Basic and Applied Soil Mechanics", New Age International (P) Ltd., New Delhi, 3rd Edition, 2016.

13. References

1. Bowles, J. E., "Foundation Analysis and Design", McGraw-Hill, New Delhi, International Edition, 2001.

2. Singh, A., Chowdhary, G. R., “Soil engineering in theory and practice”, CBS Publishers, New Delhi.

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

1.	**Department offering the course**	**Civil Engineering**
2.	**Course Code**	**CEN341**
3.	**Course Title**	**Traffic Engineering and Management**
4.	**Credits (C)**	**2:0:2:3**
5.	**Contact Hours (L:T)**	**2:0:2**
6.	**Prerequisites (if any)**	**None**
7.	**Course Basket**	**Discipline Elective (BTCE and BTCE with**

8. Course Summary: Traffic engineering management covers the design of traffic facilities like signage, signals, and intersections and also allows to give alternatives in order to manage urban traffic.

9. Course Objectives: The objective of this course is to familiarize the students with the concepts of transportation planning and analysis and to ensure that students can use the knowledge in solving real time problems in traffic engineering field.

10. Course Outcomes:

On completion of this course, the students will be able to

CO1. Understand the governing principles of traffic flow theory and travel demand management.

CO2. Apply the knowledge of traffic engineering to solve complex engineering problems related to traffic facilities and urban travel demand.

CO3. Analyse the problems and deficiencies in existing traffic facilities in urban areas and identify solutions for overcoming the problems

CO4. Evaluate and compare between alternative traffic facilities and come up with feasible engineering solutions

CO5: Develop designs or models for feasible engineering solutions to tackle modern-day traffic and travel demand problems

11. Curriculum Content

Unit 1 **(5L)**

Fundamentals of traffic engineering: Characteristics of traffic engineering elements- vehicle, driver, road; Fundamentals of traffic flow- speed, density, flow and their relationship.

Unit 2 **(5L)**

Traffic flow characteristics: Uninterrupted traffic flow- data collection, different models related to traffic flow; Interrupted traffic flow- shock wave, flow at signalized and un-signalized intersections; Delay and queue analysis.

Unit 3 **(5L)**

Traffic facilities: Intersections – signalized and un-signalized. Interchanges – types, warrant. Parking – different types, Road signs, Road markings, Bus terminals.

Unit 4 **(5L)**

Transportation planning process: Goals, objectives, Transportation needs, Generation, evaluation of alternatives and their implementation.

Unit 5 **(6L)**

Travel demand analysis: Introduction, nature and analysis of travel demand, Data collection, Four stage transportation models, Trip generation, trip distribution, modal split and traffic assignment.

12. Text Books

1. Chakroborty, P., Das, A., "Principle of Transportation Engineering", 2nd Edition, 2017, Prentice Hall of India Pvt. Ltd.
2. Flaherty, C. A. O., "Transport Planning and Traffic Engineering", 1997, Butterworth-Heineman.

13. References

1. Roger P. Roess William R.McShane & Elena S. Prassas, Traffic Engineering, Prentice – Hall, 1990.

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

15. List of Experiments

S.No.	EXPERIMENT NAME
1	Spot speed study using speed Gun.
2	Speed –density linear relationship using Speed Gun.
3	Two Phase signal design using video data at an intersection.
4	Trip Generation analysis, using regression method.
5	Parking study characteristics.
6	Modal Choice using binary logit model using data of O-D survey.

1.	**Department offering the course**	**Civil Engineering**
2.	**Course Code**	**CEN342**
3.	**Course Title**	**Port & Harbour Engineering**
4.	**Credits (L:T:P:C)**	**3:0:0:3**
5.	**Contact Hours (L:T:P)**	**3:0:0**
6.	**Prerequisites (if any)**	**None**
7.	**Course Basket**	**Discipline Elective (BTCE)**

8. Course Summary: Ports and Harbor Engineering covers the planning aspects, and the design and repair aspect of facilities essentially required in the port and harbour areas.

9. Course Objectives: The objective of this course is to equip students with the fundamental knowledge and technical skills required for the planning, design, construction, and maintenance of ports, harbors, and related coastal structures.

10. Course Outcomes:

On completion of this course, the students will be able to

CO1. Understand the fundamental concepts of transportation through waterways, along with principles of harbour planning and dock construction

CO2. Apply the above knowledge to develop models for new ports, harbours or docks

CO3. Analyse problems related to dock and coastal maintenance and select appropriate remedial measures.

CO4. Compare different alternatives and determine the suitability of different types of ports, harbours and docks.

11. Curriculum Content:

Unit 1 **(7L)**

National Waterways: Inland water transportation in India, classification of waterways, economics of inland waterways transportation, national waterways

Unit 2 **(8L)**

Harbour Planning: Types of water transportation, water transportation in India, requirements of ports and harbours, classification of harbours, selection of site and planning of harbours, location

of harbour, traffic estimation, master plan, ship characteristics, harbour design, turning basin, harbour entrances

Unit 3 **(8L)**

Docks and Repair Facilities: Type of docks, its location and number, Site investigations hydrographic survey, topographic survey, soil investigations, current observations, tidal observations, Design and construction of breakwaters, berthing structures - jetties, fenders, piers, wharves, dolphins, trestle, moles, Harbour docks, use of wet docks, design of wet docks, repair docks, lift docks, dry docks, keel and bilge blocking, construction of dry docks, gates for dry docks

Unit 4 **(8L)**

Port facilities: Port development, port planning, port building facilities, transit sheds, warehouses, cargo handling facilities, container handling terminal facilities, shipping terminals, inland port facilities.

Unit 5 **(8L)**

Dredging and Coastal Protection: Classification, types of dredgers, choice of dredger, uses of dredged materials, coastal erosion and protection, sea wall, revetment, bulkhead, coastal zone and beach profile.

12. Text Books

1. Bindra, S.P., "Docks and Harbour Engineering", Dhanpat Rai Publications, 2012
2. Srinivasan, R., "Harbour, dock and tunnel engineering", Charotar publishing house pvt ltd, 2015
3. Oza, Gautama H. and Oza, Hasmukh1 P., "Dock & Harbour Engineering", Charotar Publishing house pvt ltd, 2012

13. References

1. Subramanian, K.P., "Highway, Railway, Airport and Harbour Engineering", Scitech publications (India) pvt.. Ltd, 2018.

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details

1.	**Department offering the course**	**Civil Engineering**
2.	**Course Code**	**CEN343**
3.	**Course Title**	**Railway and Airport Engineering**
4.	**Credits (L:T:P:C)**	**3:0:0:3**
5.	**Contact Hours (L:T:P)**	**3:0:0**
6.	**Prerequisites (if any)**	**None**
7.	**Course Basket**	**Discipline Elective (BTCE)**

8. **Course Summary: The** course covers the basic characteristics of Rail and Air Transport, components of Railway transportation and Airport Engineering along with the design of their geometric components.

9. Course Objective:

This course covers complete knowledge of "Cross-section, Components, and geometric design of railway track as well as development of railway station and yards." In this course all Airport characteristics, Geometric design and Air traffic control are covered.

10. Course Outcomes:

On completion of this course, the students will be able to

CO1. Understand the basic functional components and geometric design of railway track and airports

CO2. Apply the knowledge from the above and develop designs for placement of railway track components and also develop designs for runway, taxiway etc. for airports

CO3. Analyse safety issues in railways and airport functioning from engineering aspect and provide solutions to the same.

CO4. Compare various railway track designs and judge the suitability of various designs for alternative circumstances.

CO5. Compare various airport designs and judge the suitability of various designs for alternative circumstances.

11. Curriculum Content:

Unit 1 **(7L)**

Introduction and Components: Role of railways in transportation, The Permanent way, Gauges in railway track, Typical cross sections of railway track, Coning of wheels, Track components: Type of rails, Rail Joints and Welding of rails, Sleepers, Ballast, and Fixtures, Creep of Rails, Adzing of sleepers Stresses in rails, Tractive resistances.

Unit 2 **(8L)**

Geometric Design of Railway Tracks: Geometric design of tracks- speed calculations, Gradients-ruling, momentum, pusher and minimum gradient, Super elevation, Cant Deficiency, Negative super elevation, Component of turn outs, points and crossings, Track Junctions, cheek rails on curves

Unit 3 **(8L)**

Railway Station and Yards: Classification of railway Stations, Types of station Yards, Signaling and Control System, Interlocking of Signals and Points. Modern Development of Railways Earthwork – Stabilization of track on poor soil –- Tunneling Methods, drainage and ventilation –- Calculation of Materials required for track laying - Construction and maintenance of tracks – Modern methods of construction & maintenance - passenger amenities- Urban rail – Infrastructure for Metro, Mono and underground railways. Objectives, Classification of Signals, Types of Signals in Stations and Yards, Automatic Signalling, Principal of Interlocking MAGLEV, TACV

Unit 4 **(8L)**

Role of Airways in transportation, Aeroplane Component Parts, Aircraft Characteristics, Airport planning, Site selection, Airport Obstructions, Air transport characteristics-airport classification- airport planning: objectives, components, layout characteristics, socio-economic characteristics of the Catchment area, criteria for airport site selection and ICAO stipulations, Typical airport layouts, Case studies, Parking and circulation area.

Unit 5 **(8L)**

Geometric Design and Air Traffic Control: Wind rose diagram, Basic runway length, and corrected runway length, Geometric runway and Taxiway Design, Turning radius of taxiway,

Exit taxiway- design factors and elements, Airport markings and lightings, Air traffic control, Instrument landing systems. Configuration and Pavement Design Principles – Elements of Taxiway Design – Airport Zones – Passenger Facilities and Services – Runway and Taxiway Markings and lighting.

12. Text Books

1. Saxena, S. C., Arora, S. P., "A Text Book of Railway Engineering", DhanpatRai Publications Pvt. Ltd.,NewDelhi, 6th Edition,2001.

2. Khanna, S. K., Arora, M. G., and Jain, S. S., "Airport Planning and Design", Nem Chand and Bros.,Roorkee,6th Edition,2008.

13. Reference Books

1. Horonjeff, R. M., Mckelvey, F. X., Sproule, W. J., and Young, S., "Planning and Design of Airports", Mc-Graw Hill Publications, New Delhi, 5th Edition, 2010.

2. Chandra, S., and Agrawal, M. M., "Railway Engineering", Oxford University Press, 2007.

3. Saxena S.C, "Airport Engineering, Planning and Design'', CBS Publishers and Distributors, Pvt. Ltd. Reprint Ed. 2015.

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

Course Structure & Syllabus of B.Tech.– Civil Engineering (with specialization in Construction Planning and Management) Applicable for Batch: 2024-28

1.	**Department offering the course**	**Civil Engineering**
2.	**Course Code**	**CEN344**
3.	**Course Title**	**Advanced Highway Engineering**
4.	**Credits**	**3:0:0:3**
5.	**Contact Hours (L:T)**	**3:0:0**
6.	**Prerequisites (if any)**	**None**
7.	**Course Basket**	**Discipline Elective (BTCE)**

8. Course Objective: The obvjective of this course is to provide in-depth knowledge and analytical skills related to the planning, design, construction, maintenance, and management of modern highway systems.

9. Course Outcomes:

On completion of this course, the students will be able to

CO1. Understand the basic concepts of financial planning of highways and also the design principles for construction of flexible, rigid, WBM pavements.

CO2. Apply the above knowledge for identifying the various distresses in pavement structures.

CO3. Distinguish among various distress types and provide solution to the same.

CO4. Evaluate between alternative types of pavement construction projects and provide economically and financially feasible solutions.

CO5. Plan and design for the construction of various pavement types along with providing a detailed feasibility justification.

10. Curriculum Content:

Unit 1 **(7L)**

Financial Planning of Highways: Different Modes of Highway Projects Public Private Partnership (PPP), Build Transfer (BT), Build Operate Transfer (BOT), Build Own Operate Transfer (BOOT), Operation & Maintenance (O&M), Rehabilitate Own Operate (ROT), Rehabilitate Own Operate Transfer (ROOT), Design Build Operate (DBO), Design Build Finance Operate & Transfer (DBFOT), Engineering Procurement Construction (EPC) & Performance Based Contract (PBC), Economic Evaluation of highway projects, Vehicle Operating Cost.

Unit 2 **(8L)**

Bituminous Mix Design: Bituminous Mix design Methods (Marshall, Hubbard Field and Hveem), Soil Stabilized Roads: Properties of Soil- Aggregate mixtures, Proportioning, types of stabilization, advantages and limitation, Highway drainage- Surface and Sub surface drainage.

Unit 3 **(8L)**

Pavement Distresses in Flexible Pavements & Measurement: Surface Defects - Fatty Surface, Bleeding, Delamination, Smooth Surface, Streaking Surface, Hungry Surface, Polished aggregate. Cracks – Block Cracks, Alligator cracks, Edge Cracks, Edge Fatigue Crack, Longitudinal & Transverse Cracks, Fatigue Cracks, slippage crack, Reflective Cracking, Thermal Cracking. Deformation- Rutting, Corrugation, Shoving, Settlements, Upheavals. Disintegration- Pumping, Reveling, Pot Holes, Polished Aggregate. Benkelman Beam Deflection as per IRC-81-1997, Light Weight Deflectometer, Falling Weight Deflectometer, B.I. & I.R.I indexes.

Unit 4 **(8L)**

Pavement Distresses in Rigid Pavements & Measurement: Cross cracks, Spalling at joints and corners, Transverse cracks, Patching, Longitudinal crack, Raveling, Pumping & Water Bleeding, Shrinkage cracks, Distortion, Settlement or Faulting, Corner cracking, durability cracking, Polished aggregate, Popouts, Blowups, Joint Seal Damage, Shattered slab, scaling, Map cracking & Crazing, Contaminants.

Unit 5 **(8L)**

Highway Construction: Construction of ***Slope Subgrade Embankment,*** Water bound Macadam road, Bituminous Pavements, Concrete Roads. Reinforced Concrete Roads, Prestressed Concrete Pavements. Introduction to MORTH Guidelines for highway construction.

11. Text Books & Relevant Codes

1. Yoder, E. J., M. W. Witczak “Principle of Pavement Design”, Wiley, 2nd Edition. (2011).
2. Huang, Y.H., “Pavement Analysis and Design” Prentice Hall. 2nd edition (2008).

3. MORTH – Ministry of Road Transport & Highways, "Pocket Book for Highway Engineers", Indian Roads Congress, New Delhi, 2019.
4. IRC SP 30: 2019 – Manual on Economic Evaluation of Highway Projects in India (Third Edition), Indian Roads Congress, New Delhi, 2019.
5. IRC:81-1997 Guidelines for Strengthening of Flexible Road Pavements Using Benkelman Beam Deflection Technique (First Revision) Indian Roads Congress, New Delhi, 1997.
6. IRC:115-2014 Guidelines for Structural Evaluation and Strengthening of Flexible Road Pavements Using Falling Weight Deflectometer (FWD) Technique" Indian Roads Congress, New Delhi, 2014.

12. References

1. Khanna, S. K., Justo, C. E. G., "Highway Engineering", Nem Chand and Bros, 2001.
2. Kerbs, R. D., and Walker, R. D., "Highway Materials", McGraw-Hill, 1971.

1. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

Course Structure & Syllabus of B.Tech.– Civil Engineering (with specialization in Construction Planning and Management) Applicable for Batch: 2024-28

1. Department offering the course	**Civil Engineering**
2. Course Code	**CEN345**
3. Course Title	**Pavement Management System and Planning**
4. Credits (L:T:P:C)	**3:0:0:3**
5. Contact Hours (L:T:P)	**3:0:0**
6. Prerequisites (if any)	**None**
7. Course Basket	**Discipline Elective (BTCE with specialization in**

8. **Course Summary:** This course provides a solid working knowledge of the most common pavement maintenance and preservation practices. Basic principles, best field practices and safety issues are covered.

9. **Course Objective**: By the end of this course, students will have a better understanding of the most common pavement maintenance strategies and materials, and their most appropriate uses in an agency's overall pavement management plan.

10. Course Outcomes:

On successful completion of the course, students will be able to achieve the following:

CO1: Learn basic concepts about distresses and maintenance and rehabilitation methods for flexible and rigid pavements.

CO2: Interpret the different types of pavement distress conditions and select suitable methods for maintenance and rehabilitation.

CO3: Apply the knowledge of the above, to estimate the cost of maintenance and rehabilitation of pavements.

CO4: Examine real-life pavement conditions and infer probable rectification measures along with cost for those measures.

CO5: Compare various rectification measures and provide economically feasible solutions.

11. Curriculum Content

Unit 1: Introduction (7L)

Types of pavements, pavement distresses in flexible and rigid pavement

Unit 2: Techniques for Evaluation of Pavements (8L)

Functional and structural evaluation techniques, Network and project survey and evaluation, Collection and Analysis of Pavement Performance Data, Subgrade, Materials, Drainage and Structural Evaluation

Unit 3: Techniques for Maintenance (8L)

Rigid Pavement Maintenance Techniques, Flexible Pavement Maintenance Techniques

Unit 4: Rehabilitation Techniques (8L)

Rigid Pavement Rehabilitation Techniques, Flexible Pavement Rehabilitation Techniques, Recycling of Concrete Pavements, Shoulder Rehabilitation, Overlay techniques

Unit 5: Initial and Life-cycle Cost Analysis (8L)

Construction cost calculation, LCCA, economic and financial feasibility analysis of highway projects, maintenance scheduling and cost

12. Text Books

1. Kumar, R.S., "Pavement Evaluation and Maintenance Management System", Universities Press (India) Private Limited, 2020.
2. Ralph Haas and Ronald W. Hudson, ‗Pavement Management System', McGraw Hill Book Co. 1978.

13. Reference Books

1. Zimmerman, K.A., 2017. *Pavement management systems: Putting data to work* (No. Project 20-05, Topic 47-08).

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details

1. Department offering the course	**Civil Engineering**
2. Course Code	**CEN346**
3. Course Title	**Urban Transportation Planning**
4. Credits (L:T:P:C)	**3:0:0:3**
5. Contact Hours (L:T:P)	**3:0:0**
6. Prerequisites (if any)	**None**
7. Course Basket	**Discipline Elective (BTCE with**

8. **Course Summary:** This class is an introduction to the concepts of transportation planning for urban areas. The course will cover the history of urban transportation planning, transportation data sources and surveys, fundamentals of travel demand and network modelling, financial and economic issues, transportation planning and environmental issues.

9. **Course Objective**: Student will understand and apply basic concepts and methods of urban transportation planning. Student will learn methods of designing, conducting and administering surveys to provide the data required for transportation planning. In addition, students will understand and be able to apply travel demand modelling, project development and financing, regulations and policies, environmental related issues, land use and contemporary issues in transportation planning.

10. **Course Outcomes:**

On successful completion of the course, students will be able to achieve the following:

CO1: Understand the fundamental concepts of urban transportation systems planning and 4-step travel demand modelling.

CO2: Apply the above knowledge, to develop sustainable solutions to traffic routing and planning problems.

CO3: Analyse real-life traffic congestion problems in urban areas and identify alternative solutions to the same.

CO4: Evaluate the urban transport planning schemes employed in urban areas and provide perceptive judgement on the sustainability of the same.

CO5: Design sustainable urban transportation plans, including vehicle demand estimation, routing and scheduling.

11. Curriculum Content

Unit 1: Fundamentals of transportation system planning (7L)

Transportation system planning process, Characteristics of Travel and urban transportation system, Demand theory and supply theory of transportation system, Introduction to 4-step travel demand modelling (TDM)

Unit 2: Trip Generation (8L)

Trip generation, factors affecting trip generation, Numerical models of trip generation: cross-classification and regression techniques

Unit 3: Trip Distribution (8L)

O-D matrix, constrained O-D matrix (origin constrained and destination constrained matrix). Growth Factor Model: Average growth factor, uniform growth factor, Fratar Method. Synthetic Model: Gravity Model, singly constrained and doubly constrained model, balancing of O-D matrix.

Unit 4: Mode Choice Methods and Traffic Assignment (8L)

Introduction to choice modelling, Binary Logit Model, mode-choice models, labelled and un-labelled choice experiments, Incremental logit model. Introduction to network and graph theory, types of assignment techniques, All-or-nothing assignment, Dijikstra's Shortest Path Algorithm, User-equilibrium and System-optimal techniques for traffic assignment. Combined mode-choice and traffic assignment methods.

Unit 5: Land-Use Transportation Planning (8L)

Introduction to land-use transport interaction, types of land-use transport models, Lowry's derivative models, Garin-lowry model

12. Text Book:

1. Kadiyali, L.R., 2018. Traffic Engineering and Transport Planning, 9th Ed (1st Reprint) Khanna Publishers, New Delhi, India.
2. Khisty, C.J., and Lall, B.K., 2016. Transportation Engineering: An Introduction, 3rd Edition, Pearson India Education Services Pvt. Ltd., Noida, India.

13. Reference Book:

1. Hutchinson, B.G., 1974. Principles of Urban Transport Systems Planning, Scripta Book Company, Germany.

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details

1. Department offering the course	**Civil Engineering**
2. Course Code	**CEN347**
3. Course Title	**Intelligent Transportation Systems**
4. Credits (L:T:P:C)	**3:0:0:3**
5. Contact Hours (L:T:P)	**3:0:0**
6. Prerequisites (if any)	**None**
7. Course Basket	**Discipline Elective (BTCE with**

8. **Course Summary:** This course will discuss the fundamental concepts and practices of Intelligent Transportation Systems (ITS). The primary topics of this course cover 1) National ITS Architecture; 2) Active Transportation and Demand Management (ATDM) and Active Traffic Management (ATM); 3) Integrated Corridor Management (ICM); 4) Connected and Automated Vehicles; and 5) Data Collection and Communications Technologies for ITS. Students will be assigned to a group project to hone their hands-on experiences of designing and evaluating real-world ITS applications.

9. **Course Objective: T**he objective of Intelligent Transportation Systems (ITS) is to provide students with knowledge of advanced technologies and their applications in improving the efficiency, safety, and sustainability of transportation networks.

10. Course Outcomes:

On successful completion of the course, students will be able to achieve the following:

CO1: Understand the fundamental concepts of ITS and its various functional components

CO2: Apply the above concepts to integrate the functional components of ITS into advanced traveller information and management systems.

CO3: Analyse scenarios and provide solutions to various modern-day ITS related problems in urban areas.

CO4: Compare among alternative solutions and recommend appropriate ITS application for urban areas.

11. Curriculum Content

Unit 1: Introduction to ITS (7L)

Introduction to Intelligent Transportation Systems (ITS) -Definition – Role and Responsibilities – Advanced Traveller Information System – Fleet Oriented ITS Services – Electronic Toll Collection – Critical issues – Security – Safety

Unit 2: ITS Architecture and Hardware (8L)

Architecture – ITS Architecture Framework – Hardware Sensors – Vehicle Detection – Techniques – Dynamic Message Sign – GPRS – GPS – Toll Collection

Unit 3: Advanced Transportation Management System (8L)

Video Detection – Virtual Loop - Cameras - ANPR – IR Lighting – Integrated Traffic Management – Control Centre – Junction Management Strategies- ATMS – Advanced Traveller Information Systems (ATIS)- Route Guidance – Issues -– Historical – Current – Predictive Guidance – Data Collection – Analysis – Dynamic Traffic Assignment (DTA) – Components – Algorithm.

Unit 4: Advanced Traveller and Information System (8L)

Travel Information – Pre Trip and Enroute Methods- Basic ATIS Concepts – Smart Route System – Data Collection – Process – Dissemination to Travelers – Evaluation of Information – Value of Information – Business Opportunities

Unit 5: Case Studies (8L)

Automated Highway Systems - Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries

12. Text Book:

1. Intelligent Transport Systems, Intelligent Transportation Primer, Washington, US, 2001.
2. Tyagi, A.K. and Sreenath, N., 2023. *Intelligent Transportation Systems: Theory and Practice*. Springer.

13. Reference Book:

1.Sitausu S. Mittra, "Decision Support Systems – Tools and Techniques", John Wiley, New York, 1986.
2.Cycle W.Halsapple and Andrew B.Winston, "Decision Support Systems – Theory and Application", Springer Verlog, New York, 1987
3.ITS Hand Book 2000: Recommendations for World Road Association (PIARC) by Kan Paul Chen, John Miles.

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details

1. Department offering the course	**Civil Engineering**
2. Course Code	**CEN348**
3. Course Title	**Fundamentals of Urban and Regional Planning**
4. Credits (L:T:P:C)	**3:0:0:3**
5. Contact Hours (L:T:P)	**3:0:0**
6. Prerequisites (if any)	**None**
7. Course Basket	**Discipline Elective (BTCE with specialization in**

8. Course Objective: The course provides a basic knowledge on Urbanization and its trend and deals with different types of plans, its implementation, rural development and management for sustainable growth.

9. Course Outcome

At the end of the course, the student can:

CO1. Learn basic concepts about urban and regional planning principals, government policies and schemes, regulations, etc.

CO2. Understand the utilities and characteristic features of different policies and their intended interpretations.

CO3. Apply the above knowledge and identify suitable developmental strategies for various scenarios.

CO4. Analyse real-life spatial planning schemes and conclude about appropriate and sustainable designs.

CO5: Evaluate the feasibility of various urban and regional developmental projects.

10. Curriculum Content

Unit 1: Basic Concepts, Policies and Programmes (7L)

Definitions and Concept- Urbanization, Towns, Cities, Metropolis, Megalopolis, Satellite and New towns, CBD, Peri urban areas, Suburban areas, Census Definition, Classification of urban settlements, TOD, National policies, National Urban Transport Policy 2006, National Policy for Urban street vendors 2009- Programme objectives and salient features of Jawaharlal Nehru National Urban Renewal Mission (JNNURM), Urban infrastructure development scheme for small and medium towns (UIDSSMT), Rajiv Awas Yojana (RAY).

Unit 2: Planning Process **(8L)**

Steps in Planning Process- Plans; levels; objectives, content, and data requirement-regional plan, master plan, detail development plan, city development plan, development control regulation, Zoning Regulation, Layout and Building Regulations.

Unit 3: Socio-Economic and Spatial Planning **(8L)**

Economic and social concepts in urban and regional planning and their relevance, Economic principals of zoning, Components of sustainable development, Planning for Inclusive development, Compact cities, Quality of life-Form of cities, issues related to inner city fringe areas, and suburban areas, Application of Remote sensing and GIS in Urban and Regional planning.

Unit 4: Project Formulation and Evaluation **(8L)**

Constraints for plan implementation – Industrial, Financial and Legal Constraints, Institutional Arrangements for Urban Development – Financing of Urban Developments - Legislation related to Urban Development. Urban infrastructure projects planning, appraisal, formulation, feasibility and preparation of detailed project report, site planning, layout, road network, and service ducts under the road.

Unit 5: Urban Governance and Management **(8L)**

Planning laws; Town and Country planning act: Urban Development authorities Act, Constitutional (74th Amendment) Act 1992- Local bodies, Functions, powers and Interfaces-development of small town and smart cities-case studies

11. Text Books:

1. Harneet Kaur, "Fundamentals and Principles of Urban and Regional Planning", OrangeBooks Publication, 1st Edition, 2023

12. References:

1. CMDA, Second Master Plan for Chennai, Chennai 2008

2. CMDA 2018, “Combined Development Regulation of Building Rules 2018”, CMDA, Chennai.

13. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details

1. Department offering the course	**Civil Engineering**
2. Course Code	**CEN349**
3. Course Title	**Infrastructure Economics and Financing**
4. Credits (L:T:P:C)	**3:0:0:3**
5. Contact Hours (L:T:P)	**3:0:0**
6. Prerequisites (if any)	**None**
7. Course Basket	**Discipline Elective (BTCE with specialization in**

8. Course Objective: The objective of the course to provide students with a thorough grounding in the key concepts of Infrastructure economic and to illustrate how these concepts and standard economic tools can be used to analyse Infrastructure-related Theory and policy issues.

9. Course Outcomes:

On successful completion of the course, students will be able to achieve the following:

CO1: Understand the basic concepts about demand and supply functions, and different modes of project governance

CO2: Apply the above concepts to solve problems related to financial and economic evaluation of infrastructure projects

CO3: Analyse case studies of various projects and conclude about the most feasible and sustainable solutions

CO4: Evaluate project appraisals by integrating technical, economic, social and regulatory frameworks for infrastructure sector planning and resource management

10. Curriculum Content

Unit 1: Demand and Supply (7L)

Concept of demand and elasticity of demand, demand-supply interaction models, market equilibrium

Unit 2: User and Operator Cost-Benefit (8L)

Concept of infrastructure-user cost and benefit, operator cost and benefit, factors affecting user-costs and benefits, Cost curve models: Fixed cost, variable cost, marginal cost, average cost,

Unit 3: Economics of Infrastructure (8L)

Introduction to Design of Experiments, Theory of choice modelling, User benefit estimation, Willingness-to-pay, willingness-to-accept, introduction to Revealed Preference (RP) and Stated Preference (SP) Data for infrastructure evaluation

Unit 4: Techniques for Estimating Aggregate User-benefits (8L)

Concept of time-value of money, NPV/NPW, IRR, Cost-benefit Analysis of Infrastructure Systems

Unit 5: Financing Infrastructure Projects (8L)

Infrastructure development in India, PPP models, Risk management, project financing, credit rating of infrastructure projects, Analysis of project viability

11. Text Books

1. José A. Gómez-Ibáñez, Zhi Liu, Infrastructure Economics and Policy, Columbia University Press, 2022.
2. Prasad, A.R: Working Tools of Microeconomics, 2023.
3. Jain, T.R: Microeconomics and Basic Mathematics, 2023.

12. Reference Books

1. Crew. M.A & P.R. Kleindorfer: Public Utility Economics, Macmillan, London.
2. ICSSR (1976): Economics of Infrastructure, Vol. VI, New Delhi.
3. Parikh, K.S. (Ed.): India Development Report-1999-2000, Oxford, New Delhi.

13. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

1. Department offering the course	**Civil Engineering**
2. Course Code	**CEN351**
3. Course Title	**Remote Sensing, Photogrammetry and Image Processing**
4. Credits (L:T:P:C)	**3:0:0:3**
5. Contact Hours (L:T:P)	**3:0:0**
6. Prerequisites (if any)	**None**
7. Course Basket	**Departmental Elective (BTCE)/ Minor (Geoinformatics)/ Minor (Earth System and Technology)/Open Elective**

8. Course Summary: Remote Sensing and Image Processing covers the understanding of satellite images, Aerial Photography, and the concept of the Electromagnetic spectrum

9. Course Objectives: The course objective is to make students learn about fundamental aspects of Aerial Photogrammetry, Satellite/Aerial Photo interpretation and its applications in various thematic domains. They will also learn analogue and digital based approaches in photogrammetry. They will understand the recent developments and role of satellite in terrain modelling and mapping.

10. Course Outcomes:

On completion of this course, the students will be able to

CO1. **Understand** the basic concepts and principles of Remote Sensing, Photogrammetry and Image Processing.

CO2. **Apply** the knowledge of Remote Sensing and Photogrammetry for better analysis of satellite data, aerial images, and photographs.

CO3. **Explain the Analytical** aspects of Photogrammetric technique.

CO4. **Justify** the need for orthophotos and satellite based photogrammetry and explain the modern digital photogrammetric approaches using satellite, GPS.

CO5. Able to **design/create** thematic maps for policy and decision makers.

11. Curriculum Content:

Unit 1 **8 lectures**

Principles of Remote Sensing: Sources of Energy, active and passive radiation, Electromagnetic spectrum, radiation laws, interaction of energy with atmosphere scattering, absorption, atmospheric windows, and interaction of EMR with earth surface features-spectral signatures, stages in remote sensing.

Unit 2 **10 lectures**

Fundamentals of Aerial Photogrammetric: Fundamentals of Aerial Photogrammetry: Introduction, Classification, Aerial Camera, Films and Filters, Geometrical elements of vertical photograph, Scale, Relief Displacements, photo and ground coordinates

Unit 3 **6 lectures**

Stereoscopy: Stereoscopic vision, Lens and Mirror stereoscope, parallax equations, Parallax bar, Measurement of heights and heights and slopes, Ground control for aerial Photography, Topo sheets, Photographs and Mosaics.

Unit 4 **6 lectures**

Aerial Photo Interpretation: Basic considerations, principles of photo interpretation, Characteristics of photographic images, Techniques of photo interpretation, photo interpretation key, Ground truth verification.

Unit 5 **8 lectures**

Image Processing

Image processing software, digital data products and their characteristics, digital image formats, color image generation, initial data statistics, histogram and scatter plot, mosaic, pre-processing, Image enhancement, contrast stretching, noise removal, low and high pass filters, other filters, edge detection, texture image, Ratio and NDVI images, PCA and its uses

Applications in Civil Engineering: Water Resources, Watershed Management, Environmental studies, Land use and Land Cover mapping – Urban sprawl and Transportation Network mapping, Geology and soil mapping, Ground Water Exploration.

12. Text Books

1. Lillesand, T. M., Kiefer, R.W., Chipman, J. W., "Remote Sensing and Image Interpretation", John Wiley & Sons Limited, Canada, 5th Edition, 2004.

2. Punmia, B. C., Jain, A. K., Jain, A. K., "Surveying", Laxmi Publications Pvt. Ltd., New Delhi, Vol. II, 12th Edition, 2005.

13. References

1. Wolf P. R., Elements of Photogrammetry with Application in GIS, McGraw Hill International Book Company, 2013.

2. Moffitt, Francis H. & Mikhail, Edward M., Photogrammetry, Harper and Row Publishers, 1980.

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details

1. Department offering the course	**Civil Engineering**
2. Course Code	**CEN352**
3. Course Title	**Fundamentals of Geoinformatics and Its Application**
4. Credits (L:T:P:C)	**2:0:2:3**
5. Contact Hours (L:T:P)	**2:0:2**
6. Prerequisites (if any)	**None**
7. Course Basket	**Discipline Elective (BTCE with specialization in Smart**

8. Course Summary: Students will learn the fundamentals of remote sensing, focusing on data conversion from analogue to digital and using GIS software with machine learning techniques.

9. Course Objectives: Students will gain a congregate concepts and fundamentals of physical principles of remote sensing. They will develop knowledge on conversion of data from analogue to digital and working with GIS software with machine learning approaches.

10. Course Outcomes: At the end of the course, the student will be able to

CO1: Collect data and **delineate** various elements from the satellite imagery using their spectral signature.

CO2: Investigate and **select** best remote sensing data sources for certain application

CO3: Evaluate image spatial and spectral transforms and their effect on image quality and data integrity

CO4: Develop skill set to deal with different types and forms of satellite data

CO5: Apply stochastic and deterministic image classification techniques including those based on machine learning vision algorithms

11. Curriculum Content:

Unit 1 **10L**

Physics of Remote Sensing: Sources of Energy, Active and Passive Radiation, Electromagnetic Radiation -Reflectance, Transmission, Absorption, Thermal Emissions, Interaction with Atmosphere, Atmospheric windows, Spectral reflectance of Earth's surface features, Multi concept of Remote Sensing. Platforms and Sensors: Various types of platforms, different types of aircraft, manned and unmanned spacecraft used for data acquisition - characteristics of

different types of platforms - airborne and spaceborne, IRS Satellite Sensors, LANDSAT, SPOT, IKONOS, Quickbird, GeoEye, Kompsat, Worldview II & III, etc.

Unit 2 **10L**

Map – mapping concepts, analysis with paper-based maps, limitations, Computer Automated Cartography – History and Developments, GIS- Definition, advantages of digital maps, projections and coordinate systems, Fundamentals of GIS – Information Systems, Modeling Real World Features Data, Data, Models – Spatial and Non-spatial, Components, Data Collection and Input, Data Conversion, Metadata, Database Management – Database Structures, Files; Standard Data Formats, Compression, Techniques, Hardware and Software

Unit 3 **12L**

Topology – Types of Errors, Editing, and Error Rectification, Types of Topologies, Modeling Topological Relationships, Tolerances. Spatial Analysis – Proximity Analysis, Overlay Analysis, Buffer Analysis, Network Analysis, Digital Elevation Models, Map composition, Preparation of qualitative and quantitative maps, levels of maps, map elements, and map scales. GIS Project Planning and Implementation; Understanding the Requirements, Phases of Planning, Specifications, and Procedure for Analysis and design projects.

Unit-4 **8L**

Interpolation Methods: Local and Global methods of Interpolation, Kriging methods, Geostatistical Methods, DTM Applications: Slope and aspect; site selection studies, viewshed, and watershed
analysis; Working with Open-Source Dem's.

Unit-5 **8L**

GIS models: Demonstration of ERDAS IMAGINE software, Modelling Process, Classification; Model builder tools; Programming Tools: Python, R programming, Free and Open-Source GIS - Components, Data Sources, Free and open-source GIS software, and applications

12. Textbooks

Lillesand T.M & Kiefer R.W., Remote Sensing and Image Interpretation, John Wiley, and Sons, 2008.
James B. Campbell & Randolph H. Wynne., Introduction to Remote Sensing, The Guilford Press, 2011.
Paul Longley., Geographic Information Systems and Science, John Wiley & Sons, 2005.
John E. Harmon & Steven J. Anderson., The design and implementation of Geographic Information Systems, John Wiley & Sons, 2003.

13. References

C.P.Lo., Albert K and W.Yeung, Concepts and Techniques of Geographic Information Systems, Prentice Hall India Pvt.Ltd, New Delhi, 2002.
Manual of various softwares

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details

1. Department offering the course	**Civil Engineering**
2. Course Code	**CEN353**
3. Course Title	**Terrain Planning**
4. Credits (L:T:P:C)	**2:0:2:3**
5. Contact Hours (L:T:P)	**2:0:2**
6. Prerequisites (if any)	**None**
7. Course Basket	**Discipline Elective (BTCE with specialization in**

8. Course Summary: Students will learn the details of terrain and the landscape features in terrain analysis.

9. Course Objectives: Students will learn how GIS and related technologies, such as GPS and remote sensing, are now being used, with the aid of computer modelling, in terrain analysis.

10. Course Outcomes: At the end of the course, the student will be able to

CO1: Understand the basic principles of terrain analysis

CO2: Apply the principles to **assess** the Quality of mapping

CO3: Employ spatial models and basic cartographic principles to communicate the results of landscape and terrain

11. Curriculum Content:

Unit 1 Digital Terrain Analysis 6L

Digital Elevation Data Sources and Sources, calculation and use of topographic attributes in hydrological, geomorphological and biological applications, digital terrain analysis methods

Unit 2 Digital Elevation Models and Representation of terrain Shape 8L

Introduction, Sources of topographic data, DEM interpolation methods, filtering of remotely sensed gridded DEMs, Quality assessment of DEMs, Optimisation of DEM Resolution

Unit 3 Primary and Secondary Topographic Attributes 6L

Terrain Analysis on Gridded DEMs, Elevation Residual Analysis, Terrain Analysis of contour DEMs EROS, SRAD etc.

Unit-4 Effect of Data Source **10L**

Introduction, Spatial Analysis of Soil Moisture Deficit, Mapping Contributing Areas for Storm water discharge to streams using Terrain Analysis, Soil Moisture modelling in humid mountainous landscapes, modelling approach, parameterization and calibration

Unit-5 Application of Geographical Information Systems to Terrain Analysis 10L

The role of terrain analysis in soil mapping: the potential of terrain analysis, theories of paedogenesis and modelling for prediction, examples of the use of terrain analysis

11. Textbooks

Wilson, J. P., & Gallant, J. C. (Eds.). (2000). Terrain analysis: Principles and applications. New York: Wiley.

Deng, Y. X., Wilson, J. P., & Gallant, J. C. (2007). Terrain analysis. In J. P.Wilson & A. S.Fotheringham (Eds.), Handbook of geographic information science (pp. 417–435). Oxford, UK: Blackwell.

John P.Wilson and YongxinDeng http://dx.doi.org/10.4135/9781412953962.n209

12. References

C.P.Lo., Albert K and W.Yeung, Concepts and Techniques of Geographic Information Systems, Prentice Hall India Pvt.Ltd, New Delhi, 2002.
Manual of various softwares

13. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details

14. List of Experiments

1. Importing satellite images and layers from various sources
2. Understanding and Importing the Vector and Raster Data set
3. Understanding the Digital Terrain Data
4. Importing the Primary and secondary Terrain Attributes
5. Landform Classification and Object Extraction
6. Terrain Analysis in Practice

Course Structure & Syllabus of B.Tech.– Civil Engineering (with specialization in Construction Planning and Management) Applicable for Batch: 2024-28

1. Department offering the course	**Civil Engineering**
2. Course Code	**CEN354**
3. Course Title	**Construction Planning and Project Management**
4. Credits	**3:0:0:3**
5. Contact Hours (L:T:P)	**3:0:0**
6. Prerequisites (if any)	**None**
7. Course Basket	**Discipline Elective (BTCE and BTCE with**

8. Course Summary: Course provides the tools to analyze the time and resources which subsequently provides cost for the project

9. Course Objectives: To learn network techniques in construction planning and management and to learn control and safety procedures in construction

10. Course Outcomes:

Outcomes aim to equip students with a comprehensive understanding of construction planning and project management, enabling them to contribute to the project design, production, and maintenance of durable and sustainable RCC structures. At the end of the course, students will be able to:

CO1: Select the various network techniques for planning, scheduling and management of any construction project.
CO2: Explain the concepts involved in CPM and PERT network analysis techniques.
CO3: Organise the application of the various machines involved in construction projects.
CO4: Test for the importance of safety in construction projects and in-situ.

11. Curriculum Content:

Unit 1 **(8 HRS)**

Network Techniques: Introduction to network techniques, Use of Computer aided CPM and PERT for planning, Scheduling and control of construction works, Bar charts, Error in networks, Types of nodes and node numbering systems

Unit 2 **(6 HRS)**

PERT: Time Estimates, probability distribution, time computations, slack, network analysis, critical path

Unit 3 **(8 HRS)**

CPM: CPM processes, network, activity time estimates, float, network analysis, critical path

Unit-4 **(8 HRS)**

Control and Safety in Construction: Construction quality control and inspection, Significance of variability and estimation of risk, Construction cost control, crashing of networks. Resource planning and scheduling, Introduction, Evolution of safety, Cause of accident, injury. Principle of safety, safety act and regulations, roles of safety personnel, safety management system

Unit- 5 **(6 HRS)**

Construction Equipment and Methods: Equipment for earthworks, Concrete construction, Aggregate production, Concrete production, Handling and placement, Mixers, Vibrators and temperature control

12. Text Books

1. Shrivastav, U. K., "Construction Planning Management", Galgotia Publications.
2. Peurifoy, R. L., "Construction Planning, Equipment and Methods", McGraw Hill Publication, New Delhi, 7th Edition, 2013.
3. Jha, K. N., "Construction Project Management: Theory and Practice", Pearson Publication, New Delhi, 2012.

13. References

1. Ahuja, H. N., "Construction Performance Control by Networks", John Wiley & Sons, 1976.

2. Satyanarayna, B., Saxena, S. C., “Construction, Planning and Equipment”, Standard Publishers, 3rd Edition, 1985.

3. Moder, J. J., Phillips, C. R., “Project Management with CPM and PERT”, Van Nostrand Reinhold Co., 2nd Edition, 1970.

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

1. School offering the course	**Civil Engineering**
2. Course Code	**CEN355**
3. Course Title	**AutoCAD and MATLAB**
4. Credits (L:T:P:C)	**0:0:4:2**
5. Contact Hours (L: T:P)	**0:0:4**
6. Prerequisites (if any)	**None**
7. Course Basket	**Skill Enhancement Course**

8. Course Summary

The course includes drawing details of connections, features and specifications. This course also provides a foundational understanding of MATLAB, emphasizing its use in technical computing and data visualization.

9. Course Objectives

The course covers essential concepts and hands-on skills for beginners, enabling efficient problem-solving in engineering and scientific domains

10. Course Outcomes

On completion of this course, the students will be able to

CO1. Recall and draw various specifications of residential buildings, and also perform computational data analysis

CO2. Understand the various bye laws corresponding to industrial and residential buildings.

CO3: Apply the knowledge of technical computing to analyse new data

11. Curriculum Content (AutoCAD): 13 (hours)

List of Experiments

1. Planning and drawing of (G+2) residential building in a computer-based drawing tool (e.g. AutoCAD)

a. Plan and elevation

b. Section passing through staircase

c. Site plan. Area statement & brief specifications.

2. Full set of working drawings of (G+2) residential building in a computer-based drawing tool (e.g. AutoCAD)

a. Different types of foundation: combined, isolated

b. Furniture layout plan. c. Electrification plan

d. Water supply & drainage plan.

3. Project report in the form of drawings giving details of following systems in a computer based drawing tool (e.g. AutoCAD)

a. Drainage System

b. Water Supply System c. Water Tank

d. H Septic Tank

e. Design of terrace Drainage System

Curriculum Content (MATLAB): 13 (hours)

Lesson 1: A Minimum MATLAB Session

Introduction to MATLAB interface and environment.

Performing basic mathematical operations and understanding command-line inputs and outputs.

Lesson 2: Creating and Working with Arrays of Numbers

Understanding arrays and their creation methods.

Performing array operations and manipulations using MATLAB functions.

Lesson 3: Creating and Printing Simple Plots

Introduction to MATLAB plotting capabilities.

Generating 2D plots and customizing graphs (titles, labels, legends).

Lesson 4: Creating, Saving, and Executing a Script File

Writing reusable code in script files.

Saving, editing, and executing scripts to automate tasks.

Lesson 5: Creating and Executing a Function File

Defining functions and their syntax.

Understanding inputs and outputs for modular programming.

Lesson 6: Working with Arrays and Matrices

Advanced operations on arrays and matrices.

Applications of linear algebra (matrix multiplication, inverses, and eigenvalues).

Lesson 7: Contouring

Creating contour plots for visualizing 3D data in 2D representations.

Customizing contour levels and adding annotations.

Lesson 8: Regression Analysis

Performing linear regression.

Analyzing data trends and fitting models using MATLAB's regression tools.

12. Textbook(s):

1. Kumar, S., “Building Construction”, Standard Publishers Distributors, New Delhi, 16th Edition, 2006.

2. Rangwala, S. C., “Engineering Materials (Material Science)”, Charotar Publishing House Pvt. Limited, 2008.

3. Rudra Pratap, Getting Started with MATLAB: A Quick Introduction for Scientists & Engineers, Oxford; Edition (1 January 2010)

13. Reference Books:

1. I.S. 962 – 1989 Code for Practice for Architectural and Building Drawings

2. Shah, Kale, Patki, “ Building Drawing”, Tata McGraw- Hill

3. SP 7- National Building Code Group 1 to 5 - B.I.S. New Delhi

4. Y. S. Sane, “ Building Design and Drawing”, Allied Book Stall, Pune

1. Department offering the course	**Civil Engineering**
2. Course Code	**CEN356**
3. Course Title	**Statistical Approach to Environmental Data Analysis**
4. Credits(L:T:P:C)	**2:0:2:3**
5. Contact Hours	**2:0:2**
6. Prerequisites (if any)	**None**
7. Course Basket	**Minor (Disaster Management)**

8. Course Objectives: The objective of the course to know about the basics of statistical analysis of environmental datasets and apply this knowledge for numerical modeling and forecasting of datasets.

9. Course Outcomes:

CO1. Identify the various types of environmental data, and data dimensions.

CO2. Have the idea about various data formats

CO3. Gain the idea about regression analysis

CO4. Learn the detailed statistical analysis

CO5. Gain the idea about data smoothing

10. Curriculum Content:

Unit I: Introduction **5L**

Introduction: Introduction to environment and various parameters, various data sources, concept of one and multidimensional datasets, concept of data matrices, temporal and spatial datasets. Various types of grids, Cartesian, spherical, cylindrical, coordinate systems**.**

Unit II: Basics of data formats and plotting **5L**

Basics of data formats and plotting: Introduction to various formats of datasets, Comma Separated Values, ASCII, NetCDF format, text values, plotting of time series, scatter plot, contouring, concept of shaded contouring.

Unit III: Regression analysis of environmental datasets 5L

Regression analysis of environmental datasets: Regression analysis, predictor-predictand relationship, residual error, confidence intervals, t score test, null hypothesis, degrees of freedom

Unit-IV: Analysis of long-term datasets and identification of prominent features 6L

Analysis of long term datasets and identification of prominent features: Eigenvalues and Eigen function, Singular value decomposition, Root mean square error, Correlation, Standard deviation, variance, skill score analysis, index calculation**.**

Unit- V: Data smoothing and interpolation 5L

Data smoothing and interpolation: Simple linear interpolation, error analysis, gridding concepts, objective analysis, Barnes and Cressman methods, concept of moving average**.**

11. Text Book:

1. "Statistics for Environmental Science and Management" by Bryan F.J. Manly, 2nd Ed., 2008
2. "Statistical Methods for Environmental and Agricultural Sciences" by Reza Hoshmand, 3rd Ed., 2018

12. Reference books

1."Applied Environmental Statistics: With R" by Abbas F. M. Al-Karkhi and Wasin A. A. Alqaraghuli, 1st Ed., 2019.

13. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

15. List of Experiments

1 Introduction to MATLAB, basic application of MATLAB,

2 Representation of 1D, and multi- dimensional datasets,

3	creating arrays, writing script file, executing script file
4	Matrices and vectors, matrix and array operations
5	Character strings, command line functions
6	Plotting and formatting of multidimensional datasets
7	Eigenvalues, Eigen vectors, Singular Value Decomposition
8	Regression analysis, all statistical operations
9	Objective analysis, gridding from scattered datasets
10	Interpolation and moving average concepts

1. Department offering the course	**Civil Engineering**
2. Course Code	**CEN357**
3. Course Title	**Disaster Risk Assessment, Vulnerability Analysis and Post Disaster Management Plan**
4. Credits(L:T:P:C)	**3:0:0:3**
5. Contact Hours	**3:0:0**
6. Prerequisites (if any)	**None**
7. Course Basket	**Minor (Disaster Management)**

8. Course Summary: This course covers risk concepts, assessment techniques, vulnerability analysis, and strategies for disaster risk reduction. It also explores crisis management, emergency response, and psychological aspects of disaster recovery.

9. Course Objective: To help the students to learn how to assess disaster risk and prepare DRM Plans and how to implement them

10. Course Outcome: At the end of the course students will learn

CO1- about basics of risk

CO2- the quantitative and qualitative risk assessment

CO3- the idea of vulnerability assessment

CO4- the emergency response

CO5- the psychological response and management

11. Curriculum Content:

Unit I: Introduction **8L**

Risk Concepts, Elements of Risk, Perception of Risk, Acceptable risk, Requirements in Risk Assessment, Risk Reduction-Mainstreaming “Risk”, Science and technology's contribution to Disaster Risk Reduction, Risk mitigation approaches, Strategies of Risk reduction, International Mobilization of Risk reduction

Unit II: Risk Assessment & Reduction **8L**

Risk analysis techniques; Process of Risk assessment, Analytical systems for risk assessment, Natural hazard/ risk assessment, understanding climate risk, Mapping of risk assessment, Risk reduction strategies and decision-making processes, Challenges in evaluating risks, Justification for involving the public in risk assessment, Contributions of non-governmental organizations, Consequences of worldwide interconnectedness, Community-based initiatives and responsibilities for mitigating risks Participatory risk assessment methods, Safety Audit-Components of safety audit, types of audit, audit methodology, nonconformity reporting (NCR), audit checklist and report – review of inspection

Unit III: Vulnerability and reduction 7L

Observation and perception of vulnerability- Vulnerability Identification, Vulnerability types and dimensions, Vulnerability- Social factors and economic factors**,** Susceptibility to informal settlements; Urban vulnerability, Hazards in metropolitan areas, Challenges in city planning, Programs for hazard mitigation in India. Disaster-resistant architectural designs and building techniques, Systematic management, and Strategic planning for vulnerability reduction

Unit IV: Emergency Response and Crisis Management 8L

Crisis Management – Rescue, relief, rehabilitation, and reconstruction; Crisis Management plan; Case studies, Emergency response – Standard Operation Procedure (SOP) for disaster response. Information Management System; Warning Dissemination; Evacuation; Search and Rescue operations; Relief operations; Emergency Operation Center (EOC); Resource Management & Networking – India Disaster Resource Network; Role of Disaster Response Forces and Community Based Organizations (CBO) in emergency response mechanism

Unit V: Psychological Response and Management 8L

Disaster Response Plan - Communication, Participation, and Activation of Emergency Readiness Strategy, Search and Recovery, Evacuation and Logistics Coordination, Psychological Response and Management (Trauma, Stress, Misinformation, and Panic), Relief and Recovery, Medical Health Response to Different Disasters

12. Textbooks:

1. Disaster Administration and Management, Text & Case studies- SL Goel-Deep and Deep Publications
2. Disaster Management- G.K Ghosh-A.P.H. Publishing Corporation

3. Disaster management – S.K.Singh, S.C. Kundu, Shobha Singh A – 119, William Publications, New Delhi.

13. Reference Books

1. Disaster Management – Vinod K Sharma- NIDM, New Delhi
2. Disaster Risk Reduction in South Asia- by Pradeep Sahni - Prentice – Hall of India
3. Disaster Mitigation and Management Post – Tsunami Perspectives P, Jagadish Gandhi
4. Disaster Mitigation – Experiences and reflections – By Pradeep sahni - Prentice –Hall of India

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details

1. Department offering the course	**Civil Engineering**
2. Course Code	**CEN358**
3. Course Title	**Solid Waste Management**
4. Credits(L:T:P:C)	**3:0:0:3**
5. Contact Hours	**3:0:0**
6. Prerequisites (if any)	**None**
7. Course Basket	**Open Elective/ Minor (Disaster Management)**

8. Course Summary: The course provides a comprehensive overview of solid waste management, covering waste characteristics, health and environmental implications, sampling, treatment, disposal methods, resource recovery, and legal and financial aspects.

9. Course Objectives: The Course objective of this course is to learn basic concepts of Solid Waste Management and increase the ability to solve problems involving segregation of waste & resource generation from waste.

10. Course Outcomes:

CO1. Identify principals of solid waste management community waste management problems.
CO2. Apply Standard rules of waste management prescribed by Government of India.
CO3. Optimization of transportation of solid waste.
CO4. Assessing the resources value of solid waste.

11. Curriculum Content:

Unit 1: Introduction **7L**

Sources, types, quantity, characteristics of solid wastes. Health & environmental implication of solid waste handling. Sampling & analyses of solid wastes, storage, collection, transfer, and transportation.

Unit 2: Composition and quantity of solid waste **8L**

Terminology and classification, need for analysis, field investigations, number of samples to be collected, collection of samples of solid waste, physical characteristics: density, moisture content, size of waste constituents, calorific value, chemical characteristics.

Unit 3: Treatment & disposal of solid wastes **8L**

Sanitary land filling, Indore & Bangalore methods of composting, factors affecting the composting process, different designs and configurations of anaerobic digestion, different types of incineration plant, Indian scenario for adoption of incineration technology, pyrolysis/gasification.

Unit 4: Resource Conservation and Recovery **8L**

Sorting at source, centralized sorting, sorting prior to waste processing or landfilling, biological processes, thermal processes, other processes

Unit 5: Legal Aspects and Financial Evaluation **8L**

Present scenario of legal aspects, proposed legal provisions, examples of enforcement Present financial provision, expenditure and cost of solid waste management, project life cycle analysis, principle elements of the financial management plan.

12. Textbooks:

1. Dr. H.S. Bhatia, A Comprehensive Book on Solid Waste Management with Application, Misha Books (1 January 2019)
2. **R**athoure, A. K., Katiyar, S., Chandra, H., Luhariya, R. K., Sustainable Practices for Waste Management, Discovery Publishing House Pvt Ltd; First Edition (4 January 2021)

13. Reference Books

1. Manual on municipal solid waste management, Ministry of Urban Development, Government of India, year 2000

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

1. Department offering the course	**Civil Engineering**
2. Course Code	**CEN359**
3. Course Title	**Environmental Risk Assessment and Disaster Management**
4. Credits(L:T:P:C)	**3:0:0:3**
5. Contact Hours	**3:0:0**
6. Prerequisites (if any)	**None**
7. Course Basket	**Discipline Elective (BTCE)/ Open Elective**

8. Course Summary: Environmental Risk Assessment and Disaster Management covers various disaster profiles in detail, scientific and technical assessment of disasters and management cycle.

9. Course Objectives: The objectives of this course are to learn basics concepts of Environmental components, Impact assessment, Natural hazards and mitigation strategies.

10. Course Outcomes:

On completion of this course, the students will be able to

1. Define environmental attributes, components of Impact assessment
2. Demonstrate the capability to assess risk and impact
3. Identify the types of impact associated with various disasters and apply the mitigation measures
4. Analyze the roles of various Government and non-Government agencies for enforcing Environmental laws and disaster mitigations
5. Explain the preparedness for required for disaster, vulnerability assessment and sustainable planning

11. Curriculum Content:

Unit 1: Environmental attributes and assessment **7L**

Introduction and Scope utility of the Environmental Impact Assessment process, expended and narrowed scope of Environmental Impact Assessment, impacts of development activities, planning and management of impact studies. Environmental attributes and environmental indices and indicators, environmental assessment, methods and techniques, matrices, network and checklist methods, prediction techniques for quality of environmental attributes

Unit 2: Environmental Impact and Risk Assessment **8L**

Impact evaluation, assessment of impact on air, water, soil and ground water, noise, biological environment. Assessment of impact on socio-economic environment, evaluation methods, mitigation measures. Health risk assessment, Hazard identification, toxicology and dose response characterization, exposure characterization, risk characterization, uncertainty in estimates. Risk evaluation, risk acceptance, basic principles of health risk management.

Unit 3:Understanding Disasters **8L**

Meaning, nature, characteristics and types of Disasters, Causes and effects, Disaster: A Global View, Disaster Profile of India, The Disaster Management cycle. Natural Phenomena: Earthquakes, Volcanic eruption, Landslides, Snow Avalanches, and Water Related Natural Disaster: Floods and Flash Floods, Droughts Cyclones, Tsunamis, Man Made Disasters: Understanding Man Made Disasters: Fires and Forest Fires, Nuclear, Biological and Chemical disaster, Road Accidents.

Unit 4: Disaster Risk Reduction and Role of various Organizations **8L**

Disaster Management: Prevention, Preparedness and Mitigation. Roles and responsibilities of different agencies and Government. Technologies for Disaster Management. Disaster Mitigation Strategies.

Unit 5: Development and future scope **8L**

Accessibility in Disaster Contexts and Emergency Services for differently abled publics (Accessibility in context of Disaster Preparedness, Response, Mitigation and reconstruction). Energy Balance & Management Review; Operational Control; Case Studies on EIA.

12. Text Books

1. Dr. Alok Satsangi & Anshuman Sharma, Environmental Impact Assessment (EIA) and Disaster Managment, Rajat Publications
2. CK Rajan, N Pandharinath – 2009, Earth and Atmospheric Disaster Management: Nature and Man- made, BS publications
3. Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.
4. Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication.
5. Ghosh G.K., 2006, Disaster Management, APH Publishing Corporation.

13. References

1. Kenneth, W., Werner, F. C., Davis W. T., "Air Pollution: Its Origin and Control", 3rd Edition, Prentice Hall.
2. Mishra, P. C., "Fundamentals of Air and Water Pollution", South Asia Books, 1990.
3. Masters, G., "Introduction to Environmental Engineering and Science", Prentice Hall of India, 2004.
4. Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication.

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

1.	**Department offering the course**	**Civil Engineering**
2.	**Course Code**	**CEN361**
3.	**Course Title**	**Fundamentals of GIS**
4.	**Credits (L:T:P:C)**	**3:0:0:3**
5.	**Contact Hours (L:T:P)**	**3:0:0**
6.	**Prerequisites (if any)**	**None**
7.	**Course Basket**	**Discipline Elective (BTCE, BTCE with specialization in Smart Infrastructure and Sustainable City Planning, BTCE with specialization in Construction Planning and Management)/ Open Elective/ Minor (Geoinformatics)**

8. **Course Summary:** Students will learn the details of terrain and the landscape features in terrain analysis.

9. **Course Objectives:** The course provides wide knowledge about basics of GIS and its applications in various fields.

10. **Course Outcomes:**

On completion of this course, the students will be able to

CO1. Have a basic understanding of GIS concepts, components.

CO2. Analyze geo-spatial data with various techniques and GIS tools

CO3. Apply the concepts in solving environmental and engineering problems CO4. Create new information and theoretical knowledge after applying GIS tools

11. **Curriculum Content:**

Unit-1: Introduction to DEM **8L**

Definition of GIS, Cartography and GIS, GIS database: spatial and attribute date; Spatial models: Semantics, spatial information, temporal information, conceptual models of spatial information, representation of geographic information: point, line and area futures, topology,

Unit-2: Derivation of Terrain Factors from DEM **12L**

Raster and vector data, raster to vector data conversion, map projection, analytical transformation, rubber sheet transformation, manual digitizing and semi-automatic line following digitizer; Remote sensing data as an input to GIS data;

Unit-3: Classifications and Functions **10L**

Attribute database: scale and source of inaccuracy; GIS functionality; data storage and data retrieval through query, generalization, classification, containment search within a spatial region;

Unit-4: Index and Matrix Overlay **5L**

Overlay: arithmetical, logical and conditional overlay, buffers, inter visibility, aggregation; Network analysis;

Unit-5: Applications **4L**

Applications of GIS in planning and management of utility lines and in the filed of environmental engineering, geotechnical engineering, transportation engineering and water resources engineering.

12. Reference Book

1. Geographic Information Systems: A Management Perspective, by Stan Arnoff, WDL Publications.
2. Fundamentals of Spatial Information Systems by Robert laurini and Derek Thompson, Academic Press.
3. Geographical Information Systems, Vol. I and II edited by Paul Longely, M.F. Goodchild, et.al, John Wiley and Sons, Inc. 199

13. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details

1.Department offering the course	**Civil Engineering**
2.Course Code	**CEN362**
3.Course Title	**Green Buildings and Energy Conservation**
4.Credits(L:T:P:C)	**3:0:0:3**
5.Contact Hours	**3:0:0**
6.Prerequisites (if any)	**None**
7.Course Basket	**Discipline Elective (BTCE and BTCE with specialization in Smart Infrastructure and Sustainable City Planning/ Minor (Disaster Management)**

8. Course Summary: Green Building and energy conservation describes about the various aspects of green building in terms of their design and material **uses.**

9. Course Objectives: The Objective of the course is to learn basics of green building concepts, design and energy efficiency.

10. Course Outcome

On completion of this course, the students will be able to gain knowledge about

CO1. Green building concepts and design
CO2. Energy savings and efficient use
CO3. Indoor Environment quality and maintenance

11. Curriculum Content

Unit 1: Introduction **7L**

Definition of Green Buildings, Importance of Green Buildings, Key requisites for constructing a Green Building, Green Building Concepts and Practices in India and Worldwide, Green Building Councils in India and Worldwide, Green Building Rating Systems

Unit 2: Green Building Design Features **8L**

Sustainable Sites, Material and Resources, Water Efficiency, Energy Efficiency, Indoor Environment Quality, Sustainable Sites; Pollution Prevention, Site Selection, Transportation, Storm water Design, etc

Unit 3: Material and Resources **8L**

Reducing, Reusing, Recycling. Water Efficiency; Water Use Reduction, Water Efficient Landscaping, Wastewater Technologies

Unit 4: Energy Efficiency **8L**

Optimize Energy Performance, On-site Renewable Energy, Refrigerant Management, Measurement and Verification, Green Power

Unit 5: Indoor Environment Quality **8L**

Indoor Air Quality Performance, Increased Ventilation, Low Emitting Materials, Thermal Comfort, Controllability of Systems

12. Text Books:

1. IGBC, Introduction to Green Buildings & Built Environment, Second Edition, BS Publications / BSP Books; Second Edition (12 November 2024)
2. Handbook on Green Practices published by Indian Society of Heating Refrigerating and Air conditioning Engineers, 2009.

3. IGBC-LEED for New construction and Major Renovations, Version 3.0, 2014.

13. Recommended References:

1. Green Building Illustrated by Francis D. K. Ching and Ian M. Shapiro, 2014
2. Complete Guide to Green Buildings by Trish riley
3. Standard for the design for High Performance Green Buildings by Kent Peterson, 2009

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

1.	**Department offering the course**	**Civil Engineering**
2.	**Course Code**	**CEN363**
3.	**Course Title**	**Air and Water Pollution**
4.	**Credits(L:T:P:C)**	**3:0:0:3**
5.	**Contact Hours**	**3:0:0**
6.	**Prerequisites (if any)**	**None**
7.	**Course Basket**	**Discipline Elective (BTCE)**

8. Course Summary: Course includes evaluation of various parameters of air and water pollution

9. Course Objectives: The objective of this course is to learn the knowledge for various air and water pollutants, dispersion of the pollutants, mitigations measures, quality improvement and various standards.

10. Course Outcomes:

On completion of this course, the students will be able to

CO1. Define the concepts of air pollutants, its sources, types and interactions

CO2.Demonstrate the knowledge about air quality dispersion, modeling and control technologies.

CO3. Identify the water pollutant types, dispersion and tracer kinetics

CO4. Analyze the water pollution measurement and treatment processes

CO5. Evaluate the impact of air and water quality on living world and explain the remedial measures with technology and legal provisions

11. Curriculum Content:

Unit 1: Introduction: 7L

Introduction and scope, air pollutant and types, classification, Dispersion and interaction of pollutants, Air pollutant chemistry and interactions at various atmospheric levels, Aerosols and its characteristics, noise pollution

Unit 2: Measurement of Air Quality and control of air pollution: 8L

Overview of Air quality, Mass balance approaches, Box model approaches, Gaussian plume model, regression model. Air quality dispersion- modelling approaches, Emission inventory, Air pollution monitoring and analysis, Different measurement methods, Key meteorological data, Plume shape, Air quality indices, Control technologies.

Unit 3: Overview of Water Pollution: 8L

Physico-chemical properties of water, molecular structure, common sources of water pollution, surface, ground, Ocean water pollution, water pollutant chemistry, pollutant transport, tracer kinetics, Eutrophication.

Unit-4: Water Pollution measurement and Treatment: 8L

Physical, chemical, biological quality parameters, quality indices for surface and ground water, interpretation of quality indices, numerical modeling approaches, treatment-primary, secondary and tertiary. Oxidation pond.

Unit- 5: Impact of air and water quality, regulations, standards: 8L

Air and water pollution versus health risk and global climate change, Ecological risk, Air and water quality standards, National and international regulations and legislations. Reclamation of water bodies, National and International regulatory bodies, Mitigation strategies.

12. Textbook(s):

1. D. N. Ghosh, Air and Water Pollution Control Engineering, New Central Book Agency; First Edition (1 January 2012)
2. Mishra, P. C., “Fundamentals of Air and Water Pollution”, APH Publishing Corporation, 2008.
3. Kenneth, W., Warner, F. C. and Davis W. T., “Air Pollution, Its Origin and Control”, Prentice Hall, 3rd Edition, 1997.

13. Reference Books:

1. Davis, M. L. and Cornwell, D. A., “Introduction to Environmental Engineering”, McGraw-Hill, 5th Edition, 2012.

2. Chin, D. A., “Water Quality Engineering in Natural Systems: Fate and Transport Processes in the Water Environment, John Wiley, 2nd Edition, 2012.

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

1.	**Department offering the course**	**Civil Engineering**
2.	**Course Code**	**CEN364**
3.	**Course Title**	**Smart Waste Management**
4.	**Credits(L:T:P:C)**	**3:0:0:3**
5.	**Contact Hours**	**3:0:0**
6.	**Prerequisites (if any)**	**None**
7.	**Course Basket**	**Discipline Elective (BTCE with specialization in Smart Infrastructure and Sustainable City Planning)**

8. **Course Summary:** The course will provide a detailed knowledge about waste management in smart cities. Modern cities as a result of rapid urbanization are facing huge amount of wastes generated which are very harmful for living beings. Effective application of technologies and integrated approach towards waste management are essentially required for waste management in a smart city. All such approaches will be discussed in this course.

9. **Course Objectives:** The student will learn the concepts of wastes generated in our society, effects of those wastes and associated management principles

10. **Course Outcomes**:

On completion of this course, the students will be able to

CO1: Define waste management planning and execution, types and sources of wastes

CO2: Illustrate Sustainable approaches towards waste management in smart cities.

CO3: Apply modern engineering principles in waste control and abatement

CO4: Analyze use of information technology and sensors in waste management

CO5: Explain status of waste management in India and effective implementation

11. Curriculum Content:

Unit 1: Introduction **7L**

Historical background of waste management, characteristics of smart and sustainable Cities, Effect of urbanization on waste generation and its management. Infrastructure planning, execution, carrying capacity of cities waste types and sources. Effect of waste on health and ecosystems. Environmental monitoring of wastes.

Unit 2: Management principles of wastes in a smart city 8L

Concept of sustainable approaches to waste reduction. 3R and 5R principles. Focus on effective collection, segregation, disposal of wastes. Conservation principles to various resources used in society. Determination of carbon and ecological footprints. Effective removal of hazardous substances. Approaches towards climate neutrality. Green economy and green building concepts. Theoretical and modeling approaches to waste management planning. Efficient control of landfill activities. Overall management of human and technological resources. Waste to wealth generations.

Unit 3: Use of modern tools and technological approaches in waste management 8L

Air pollution monitoring stations, air sampling processes and control technologies. Design of sewage treatment plant. Various processes involved in sewage treatment, Biological treatment. Traditional and non-traditional treatment. Landfill methods of solid wastes, pyrolysis process, vermicomposting, incineration, biogas generation, compaction.

Unit-4: Role of Information technology, and digital era for smart waste control 8L

E-waste kiosks, Artificial intelligence (AI) recycling robots, AI waste sorting, data accumulation, location of wastebins, through sensors and mobile based applications, self-driving trucks, robotic trashcans, smart dustbins, use of internet of things for tracking waste level and informing waste collectors. Pneumatic waste collection system, Solar-powered trash compactors

Unit-5: Waste Management Practices in India and Implementation 8L

Swachh Bharat Mission and Smart Cities Program, Current Issues in Solid Waste Management and Review of MSW Management Status in First List of 20 Smart Cities in the Country. National Environmental Policy, Environmental Laws in India, Municipal Solid Waste (MSW) Rules 2016, Role of Government agencies in effective implementation of solid waste rules. Status of waste management in construction and development industry.

12. Suggested Textbooks:

1. “Municipal Solid Waste Management Rules 2016”, Central Pollution Control Board, Govt. of India, 2016.

2. “Construction and Demolition Waste Management Rules 2016”, Ministry of Environment and Forest and Climate Change, Govt. of India, 2016.

13. Reference books

1. Smart Cities Council (2015) Smart Cities Readiness Guide. The Planning Manual for Building Tomorrow’s Cities Today

2. Renata Paola Dameri (Ed.) and Camille Rosenthal-Sabroux (Ed.) (2016): Smart City: How to Create Public and Economic Value with High Technology in Urban Space. Springer; Softcover Reprint of the Original, 1st

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

1.	**Department offering the course**	**Civil Engineering**
2.	**Course Code**	**CEN365**
3.	**Course Title**	**Impact Assessment and Life Cycle Assessment**
4.	**Credits(L:T:P:C)**	**3:0:0:3**
5.	**Contact Hours**	**3:0:0**
6.	**Prerequisites (if any)**	**None**
7.	**Course Basket**	**Discipline Elective (BTCE with specialization in Smart Infrastructure and Sustainable City Planning)**

8. **Course Summary:** The course will provide a detailed knowledge about Environmental impact Assessment and Life cycle Assessment. The topics are very important from sustainability perspective and to prevent damage to Environment and Man-made structures.

9. **Course Objectives:** The student will learn the concepts of impact assessment and mitigation strategies.

10. **Course Outcomes**:

On completion of this course, the students will be able to

CO1: Recall basic concepts of Environmental Impact Assessment (EIA)

CO2: Illustrate and outline various Methodologies of EIA

CO3: Apply qualitative and quantitative assessment

CO4: Examine concepts of life cycle assessment

CO5: Justify understanding and applications of LCA and interpretations

11. Curriculum Content:

Unit 1: Introduction to Environmental Impact Assessment (EIA) 7L

The Need for EIA, Government policies for EIA, The EIA Cycle and Procedures, Steps of EIA Public announcement, discussions, decisions for various projects pertaining to EIA process. Roles oof various committees in the EIA Process. Government of India Ministry of Environment and Forest Notification

(2000), Environment clearance norms and applicability, How to process Application form, Rules for Ecological sensitive places, International agreements, coastal zones, buffer zones.

Unit 2: Types of EIA, Methodologies 8L

Basis of Choice of methods. Environmental attributes-Criteria for the selection of EIA methodology, impact types and Evaluation, impact communication, Methods-Adhoc methods, Checklists methods, Matrices methods, Networks methods, Overlays methods. EIA review- Baseline Conditions - Construction Stage Impacts, post project impacts.

Unit 3: EIA of Environmental components 8L

Qualitative and Quantitative Impact Assessment on Soil, Water, Air, Noise. Indices determination. Social Impact Assessment**.**

Unit-4: Basics of Life Cycle Assessment (LCA) 8L

Basic definitions, Goal and scope definition , Inventory analysis. Impact assessment, Interpretation, circular economy, Why LCA is needed?, The Product Life Cycle, Standards & Legal Situation, Activity Based Footprinting, LCA software tools, LCA-Criticism.

Unit-5: LCA interpretation and application 8L

ISO Framework, Inventory data analysis, Design for sustainability, Sustainable materials**.**

12. Suggested Textbooks:

1. Surjya Narayana Pati, Life Cycle Assessment Future Challenges, CRC Press, 2024
2. Aiduan Borrion , Life Cycle Assessment: A Metric for the Circular Economy, Royal Society of Chemistry, 2021

13. Reference books

1. Smart Cities Council (2015) Smart Cities Readiness Guide. The Planning Manual for Building Tomorrow's Cities Today

2. Renata Paola Dameri (Ed.) and Camille Rosenthal-Sabroux (Ed.) (2016): Smart City: How to Create Public and Economic Value with High Technology in Urban Space. Springer; Softcover Reprint of the Original, 1st

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

1.	**Department offering the course**	**Civil Engineering**
2.	**Course Code**	**CEN366**
3.	**Course Title**	**Environmental Management and Sustainability**
4.	**Credits(L:T:P:C)**	**3:0:0:3**
5.	**Contact Hours**	**3:0:0**
6.	**Prerequisites (if any)**	**None**
7.	**Course Basket**	**Discipline Elective (BTCE)**

8. **Course Summary:** The course describes interlinkages of energy, environment, and economy, emphasizing sustainability engineering, environmental resource management, legal frameworks, and global efforts toward achieving the United Nations Sustainable Development Goals

9. **Course Objectives:**

The course will enable students to gather the knowledge of Environmental monitoring, resource management and Environmental acts for the benefits of society

10. **Course Outcomes**:

On completion of this course, the students will be able to

- Define the inter linkages of society-environment and economics
- Illustrate and outline the environmental resource management with qualitative and quantitative assessment
- Identify various laws and legislations and apply in environmental management appropriately
- Examine the perspectives of Environmental sustainability
- Determine the importance of sustainable development and determine the areas where to apply the same

11. **Curriculum Content:**

Unit 1: Introduction **6L**

Introduction and scope, Inter-linkages of energy-environment and economy from engineering infrastructure perspective.

Unit 2: Environmental Resources, Monitoring and Management: 8L

Concepts of environmental components and ecology, Systems approach and sustainability engineering, Interaction between energy and environmental resources, Environmental quality standards and indices (Indian and International), Environmental monitoring, Analysis, Statistics and data interpretation, Environmental management system.

Unit 3: Environmental Laws and Policy: 9L

Introduction to environmental laws and policies, Governance, understanding climate change, carbon crediting, carbon foot print etc., Introduction to trade and environment. International environmental laws, Right to Environment as Human Right, International Humanitarian Law and Environment, environment and conflicts management, Famous international protocols like Kyoto.

Unit 4 Concept of Sustainability: 8L

Introduction, United Nations, Scenario of Current Model of Growth and Development Need for Change, Concepts and definitions of Sustainability, Perspectives of journey from millennium development goals to sustainable development goals. UN 2030 Agenda and objectives,

Unit 5 Contextual sustainability Actions: 8L

Equity and Inclusion in Education, Using the SDGs for Government Action, Energy Saving at Sea, Climate smart agriculture, E waste prevention, Reduction of Plastic pollution, Basel convention, Food waste prevention, Climate change negotiations and health,

12. Text Book:

1. Khullar, D.R. & Rao, J A C S, Environment and Disaster Management, Mcgraw-Hill Education , 2021
2. Ravi P. Agrahari, Environmental Ecology, Bio-Diversity, Climate Change & Disaster Management, Mcgraw-Hill.
3. Kenneth, W., Warner, F. C. and Davis W. T., “Air Pollution, Its Origin and Control”, Prentice Hall, 3rd Edition, 1997.
4. Baker, S., “Sustainable Development”, Routledge Publication, New York, 2008.

13. Reference Books:

1. Davis, M. L. and Cornwell, D. A., “Introduction to Environmental Engineering”, McGraw-Hill, 5th Edition, 2012.

Chin, D. A., “Water Quality Engineering in Natural Systems: Fate and Transport Processes in the Water Environment, John Wiley, 2nd Edition

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

1.	**Department offering the course**	**Civil Engineering**
2.	**Course Code**	**CEN367**
3.	**Course Title**	**Hydraulic Structures and Hydropower Engineering**
4.	**Credits**	**3:0:0:3**
5.	**Contact Hours (L:T:P)**	**3:0:0**
6.	**Prerequisites (if any)**	**None**
7.	**Course Basket**	**Discipline Elective (BTCE)**

8. Course Summary

This course will impart knowledge about hydraulic structures and the aspects of hydropower engineering.

9. Course Objectives

The course enables the student to learn about the design and working principles of various hydraulic structures such as dams, spillways, head works, canal structures etc. This course will help the student to understand about the design and operations of reservoirs, their utility, types and their site selection criteria. Students will be able to learn about the various aspects of hydropower plants such as their types and their components in detail.

10. Course Outcomes:

On completion of this course, the students will be able to

CO1. Learn about the working principles and utility of different hydraulic structures.

CO2. Understand the operations of reservoirs in detail, their types, losses and the criteria for site selection.

CO3. Learn the design and functions of the embankment and gravity dams including the analysis of forces acting on them and the different failure criteria.

CO4. Understand the functions, design and working principles of the different components of head works and canal structures like drops and cross drainage works.

CO5: Classify and design various types of spillways and learn about different types of hydro-electric power plants and the different components of hydro-electric power plants.

11. Curriculum Contents

Unit 1 Introduction to Reservoirs (7L)

Hydraulic structures for water resources projects. Types of reservoir, selection of site for reservoir, investigation of reservoir and damsite, Definition of general term. Reservoir capacity from mass curve. Life of reservoir and its computation. Water losses from reservoir. Principles of reservoir operation.

Unit 2 Embankment and Gravity dams (9L)

Embankment Dam: Types, design considerations, seepage analysis and control, stability analysis, construction techniques. Gravity Dam: Forces acting on failure of a gravity dam, stress analysis, elementary profile, design of gravity dam, other functional features of a gravity dam.

Unit 3 Head works and Canal Structures (8L)

Layout, components, canal regulators: function and types of regulators. Canal drops component and types of canal drop. Cross drainage works: classification, canal outlets. Hydraulic design for a notch type of drop.

Unit 4 Spillways and hydropower plant (8L)

Types and their design, spillwaygates, Cavitation, Aerators and energy dissipation (terminal structures). Terms relating to hydropower, basic design aspects of different unit of hydropower plant

Unit 5 Types of hydropower plants and intake structures (7L)

Classification of hydropower plants, Base and peak load hydropower plants, Run-of- river plants Storage power plant and Pumped-storage power plants, Intake structure: functions, location and types, penstocks

12. Textbooks

1. Garg, S. K., "Irrigation engineering and hydraulic structures", Khanna Publishers, New Delhi, 38th Edition, 2023.
2. Singh, B., "Fundamentals of Irrigation Engineering", Nem Chand & Bros, 9th Edition, 1997.

13. Reference Books

1. Asawa, G. L., "Irrigation Engineering", New Age International, 2nd Edition, 1996.
Sahasra Budhe, "Irrigation Engineering and Hydraulic Structures", Dhanpat Rai Publication

Ltd., New Delhi.

2. Chow, V. T., “Open Channel Hydraulics”, McGraw-Hill, 1959.

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in MS Teams. Refer to your course in MS Teams for details.

1. Department offering the course	**Civil Engineering**
2. Course Code	**CEN368**
3. Course Title	**Hydrology And Irrigation Engineering**
4. Credits (L:T:P:C)	**3:0:0:3**
5. Contact Hours (L:T:P)	**3:0:0**
6. Prerequisites (if any)	**None**
7. Course Basket	**Discipline Elective (BTCE and BTCE**

8. Course Summary

This course will provide knowledge about various aspects of hydrology and irrigation engineering.

9. Course Objectives

The objectives of this course is to understand the basic principles of hydrology accompanied with detailed study of various components of hydrologic cycle such as precipitation and its losses in the form of evapotranspiration and runoff and being able to analyse and solve different practical problems using hydrograph, unit hydrograph and S-curve method. This course will also provide knowledge about principles of water management, various methods of irrigation, head works, spillways and the application of the concepts of sediment transport for the design of irrigation channels.

10. Course Outcomes:

On successful completion of the course, students will be able to achieve the following:

CO1: Understand the different components of hydrologic cycle in detail and water budget equation.

CO2: Understand the concept of evapotranspiration and learn about different types of precipitation and scientific methods to measure the precipitation and different methods to present rainfall data.

CO3: Explain and estimate the runoff in a catchment. To learn the concept of hydrograph, unit hydrograph and S-curve method and learn the different methods of flood forecasting.
Predict and compute flood and flood routing using different methods.

CO4: Understand and evaluate different methods of irrigation, canal distribution system and the concept of soil-water relationship, irrigation scheduling and standards of irrigation water. Identify the importance of irrigation practices and water requirement of crops. To learn the basic concepts related to ground water availability and distribution

CO5: Analyse the different forces acting on gravity dam and design of spillways and canal regulation works.

CO6: Understand the concept of incipient motion and sediment transport and learn the different regime theories for the design of earthen channels.

11. Curriculum Contents

Unit 1 Introduction (8L)

Hydrologic cycle, water-budget equation. Precipitation, forms and types of precipitation. Measurement of rainfall, Computation of average rainfall over a Catchment area. Computation of missing rainfall by different methods. Water Losses, types of losses. Evaporation- definition, factor affecting evaporation, methods of measurement, methods of reducing evaporation. Potential evapotranspiration, measurement, estimation of consumptive use. Infiltration, factor affecting, infiltration indices, measurement of infiltration.

Unit 2 Runoff (9L)

Components of runoff, factor affecting runoff, SCS-CN method of estimating runoff volume. Runoff hydrograph: components, separation of base flow, unit hydrograph theory, assumption, limitations and advantages, derivation of unit hydrograph from simple storm hydrographs, S curve and its uses. Flood and flood routing, Various methods of flood discharge-Rational method, Empirical method, Unit hydrograph method, Gumbel's method, Introduction to flood routing, Basic equations.

Unit 3 Basic concept of ground water (9L)

Definition, occurrence and distribution, Darcy laws – transmissibility of aquifers. Necessity of Irrigation, Scope, Concept of soil water potential and its components, Crop water requirements, Irrigation Scheduling, Irrigation efficiencies, Duty-Delta-base period, Surface and Subsurface methods of Irrigation, Standards for irrigation water, Water logging and consequences.

Unit 4 Canal losses (7L)

Lining of canals; Regime theories for the design of earthen channels, sediment transport theory, incipient motion of sediment. Modes of sediment transport. Different types of diversion weirs – Components of diversion headworks. Causes of failures of diversion, weirs – Weirs on permeable foundation with design principles.

Unit 5 Bligh's Creep theory, Khosla's Theory (6L)

Gravity dams, Forces acting on a gravity dam (including seismic load) – Stability requirement and spillways, General principles of design, types, spillway gates –energy dissipation downstream of spillway. Canal regulation works, river training works.

12. Textbooks

1. Modi., P. N., "Irrigation water resources and water power engineering", Standard Book, House, New Delhi, 2019.
2. Garg, S. K., "Irrigation engineering and hydraulic structures", Khanna Publishers, New Delhi, 38th Edition, 2023.
3. Subramanya, K., "Engineering Hydrology", Tata McGraw Hill, New Delhi, 4th Edition, 2013.

13. Reference Books:

1. Sharma, R. K. Sharma, T., "A Text book of Hydrology and Water Resources Engineering", Dhanpat Rai, New Delhi, 1987.
2. Sahasrabudhe, "Irrigation Engineering and Hydraulic Structures", Dhanpat Rai Publication Ltd., New Delhi.

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in MS Teams. Refer to your course in MS Teams for details.

1.Department offering the course	**Civil Engineering**
2.Course Code	**CEN369**
3.Course Title	**Ground Water Hydrology**
4.Credits	**3:0:0:3**
5.Contact Hours (L:T:P)	**3:0:0**
6.Prerequisites (if any)	**None**
7.Course Basket	**Discipline Elective (BTCE with specialization**

8. Course Summary

This subject includes the study of different ground water phenomenon.

9. Course Objectives

The aim of this course is to get the insight of the ground water resources, the fundamental principle of the ground water flow and model the ground water flows in order to solve the complex problems related to the ground water flow. Students will be able to deal with the practical problems like design of tube wells and learn about the concepts of well hydraulics, ground water exploration and pumping test.

10. Course Outcomes

On successful completion of the course, students will be able to achieve the following:

CO1: Understand the nature and occurrence of ground water potential and the concepts of flow through porous media.

CO2: Understand the different types of ground water flow problems and learn about the application of ground water flow theory in well hydraulics and construction.

CO3: Modelling of the ground water flow and learn about the different types of ground water tests and explorations.

CO4: Design of tube wells for irrigation and drinking purposes.

11. Curriculum Contents

Unit 1 **(9L)**

Ground water Resources, Occurrence of Ground Water, Flow of Water through porous Media, Aquifer properties, Flow net.

Unit 2 **(10L)**

Ground water flow problems. Steady flow in unconfined Aquifer with recharge. Steady flow in confined Aquifers of constant and variable thickness, Tile Drain Problem.

Unit 3 **(10L)**

Well Hydraulics. Steady Radial Flow into well, Partial Penetrated well, Spacing of wells, well losses. Design of water wells, Methods of well construction.

Unit 4 **(9L)**

Ground water Exploration, Pumping Test. Introduction to Unsteady flow into wells. Flow through leaky aquifers.

12. Text Books

1.Chow V. T., "Hand Book of Applied Hydrology", Mc Graw-Hill, N.Y., USA, 1964.

2. K.C. Patra, "Hydrology and water process Engg.", 2008.

13. References

1.G.L. Asawa, "Irrigation Engg.", New Age, New Delhi, India.

2.Todd D.K., "Ground water Hydrology", John Wiley and Sons, N.Y.,USA, 1980.

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in MS Teams. Refer to your course in MS Teams for details.

1. Department offering the course	**Civil Engineering**
2. Course Code	**CEN371**
3. Course Title	**Fundamentals of Urban Hydrology**
4. Credits	**3:0:0:3**
5. Contact Hours (L:T:P)	**3:0:0**
6. Prerequisites (if any)	**None**
7. Course Basket	**Discipline Elective (BTCE with specialization in**

8. Course Objectives

This course is helpful in understanding the hydrology of urban areas and the different runoff components in urban watersheds along with learning the concepts of IDF relationship, stormwater management and rainwater harvesting.

9. Course Outcomes:

On successful completion of the course, students will be able to achieve the following:

CO1: Understand the different characteristics of urban and natural watersheds.

CO2: Understand the runoff characteristics in urban areas.

CO3: Study and analyse the IDF relationship for urban establishments.

CO4: Learn and assess stormwater management and rainwater harvesting.

10. Curriculum Contents

Unit 1 **(10L)**

Distinctive characteristics of natural and urban watersheds.

Unit 2 **(10L)**

Urban Heat Island; Changes in rainfall, infiltration and runoff characteristics in urban watershed;

Unit 3 **(9L)**

IDF relationship and its adaptation for urban settings; Adjusting runoff record for urbanization;

Unit 4 **(9L)**

Stormwater Management and rainwater harvesting; Urban drainage: layout, structures, flooding and control, combined sewer overflows, sedimentation.

11. Text Book

1. Abrar Yousuf and Manmohanjit Singh, “Watershed Hydrology, Management and Modeling”, CRC press.

12. References

1. Allison Sergeant, “Hydrology and Earth Systems”, Syrawood publishing house.

13. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in MS Teams. Refer to your course in MS Teams for details.

1.Department offering the course	**Civil Engineering**
2.Course Code	**CEN372**
3.Course Title	**Water Resources Management**
4.Credits	**3:0:0:3**
5.Contact Hours (L:T:P)	**3:0:0**
6.Prerequisites (if any)	**None**
7.Course Basket	**Discipline Elective (BTCE with specialization**

8. Course Summary

This subject includes the different aspects of planning and management of water existing in nature.

9. Course Objectives

The objective of the course is to have an understanding of planning and management of water resources project, economic analysis of water resources project and knowledge of flood damage mitigation. On completion of this course, students will be able understand the river basin systems and different analysis methods.

10. Course Outcomes

On successful completion of the course, students will be able to achieve the following:

CO1: Develop an understanding of planning and management for water resources project.

CO2: Understand the engineering economic analysis of water resources project.

CO3: To learn about the different aspects of simplified river basin system.

CO4: Apply the knowledge in assessment of floods and able to design the various component to have least damage due to flood.

11. Curriculum Contents

Unit 1 **(10L)**

Objectives and Planning of water resources developments, Levels of planning, Project formulation and Evaluation, Environmental considerations, Functional requirements in Multiple-purpose projects.

Unit 2 **(10L)**

Engineering economy in water resources planning, Annual cost comparisons, Selection of an interest rate for an economy study, Economic design of hydraulic structures.

Unit 3 **(9L)**

Flood damage mitigation, Design floods, Flood mitigation reservoirs, Design of levees and flood walls, Flood ways, Channel improvement, Evacuation and flood proofing.

Unit 4 **(9L)**

Simplified river-basin system, Conventional planning process, Simulation analysis, Mathematical models.

12. Text Books

1. Biswas A.K., Systems Approach to Water Management, McGraw Hill, Kogakusha Ltd., 1976.

13. References

1. Linsley and Franzini, Water resource Engineering, McGraw-Hill, 1979.

2. L.D. James and R.R.Lee, Economics of Water Resources Planning, McGraw-Hill New York, 1971.

3. Loucks, D.P., J.R. Stedinger D.A., Haith: Water Resources sytems, Planning and Analysis, Prentice Hall, 1981.

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in MS Teams. Refer to your course in MS Teams for details

1. School offering the course	**Civil Engineering**
2. Course Code	**CEN373**
3. Course Title	**STAAD-PRO**
4. Credits (L: T:P:C)	**0:0:4:2**
5. Contact Hours (L: T:P)	**0:0:4**
6. Prerequisites (if any)	**None**
7. Course Basket	**Skill Enhancement Course**

8. Course Summary

Learning commercial software STAAD PRO. Knowledge of this course will increase the proficiency and employability of the students

9. Course Objectives

Increasing abilities of converting civil engineering knowledge to solving practical problems using numerical solutions in linear and nonlinear range.

10. Course Outcomes

On successful completion of the course, students will be able to achieve the following:

CO1. Learn commercial codes for different types of problems

CO2. Interpret the domain knowledge converting that into mathematical modelling and solving the multi- story building analysis problem.

11. Curriculum Contents

List of Experiments

Practical No.	Objectives
1	Basic Introduction of STAAD Pro GUI
2	Analysis of Determinate Beams with Different Load Types
3	Analysis of Indeterminate Beams with Different Load Types
4	Analysis of Continuous Beams with Different Load Types
5	Analysis of Portal Frames with Different Load Types
6	Analysis of Determinate and Indeterminate 2D- Truss with Different Load Types

7	Analysis of 3D- Space Truss with Different Load Types
8	Analysis of Beam with Moving Load
9	Analysis of Two and Three Hinged Circular Arch
10	Analysis of Two and Three hinged Parabolic Arch
11	Analysis of Indeterminate Beams with sinking and rotation of support with inclined Load Types
12	Design of Steel Beam under Different Load Type

12. Text book

1. Manual: STAAD PRO

13. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

1.	**Department offering the course**	**Civil Engineering**
2.	**Course Code**	**CEN374**
3.	**Course Title**	**QGIS**
4.	**Credits (L:T:P:C)**	**0:0:4:2**
5.	**Contact Hours (L:T:P)**	**0:0:4**
6.	**Prerequisites (if any)**	**None**
7.	**Course Basket**	**Skill Enhancement Course**

8. **Course Summary:** This fundamental course is designed to equip the students with the theoretical and practical knowledge of applied GIS analysis through QGIS software

9. **Course Objective:** Quantum GIS (QGIS) is an open-source Geographic Information System that supports most geospatial vector and raster file types and database formats. The program offers wide GIS functionality, with various mapping features and data editing. This enables cutting-edge, global-scale analysis and visualization.

10. **Course Outcome:**

CO1: Students will **understand and learn** how to import, edit, and export spatial data. Also, they can create maps using base maps, plugins, and visualization tools.

CO2: Students **develop** the knowledge of how to perform spatial analysis tasks like buffering, overlaying, and querying

CO3: Students **employ** best practices for data processing and how to validate datasets. They **apply** the knowledge of how to share and collaborate on data using QGIS

CO4: Students **apply** their knowledge to solve real-world geographic information system (GIS) problems

11. **Course curriculum:**

Module 1:

1.1 Introduction

1.2 Hands on data

1.3 Preparing QGIS Environment

Module 2:

1.4 Working with Vector Data

1.5 Various Style of Mapping

1.6 Working with Raster Data

Module 3:

1.7 Digital Elevation Model

1.8 Data Digitalization and processing

1.9 Working with Attribute Tables

Module 4:

1.10 External files and spatial interpolation

1.11 Maps and Visualization

Module 5:

1.12 Exercises on project

12. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

1.	**Department offering the course**	**Civil Engineering**
2.	**Course Code**	**CEN375**
3.	**Course Title**	**Recovery, Rehabilitation and Reconstruction**
4.	**Credits(L:T:P:C)**	**3:0:0:3**
5.	**Contact Hours**	**3:0:0**
6.	**Prerequisites (if any)**	**None**
7.	**Course Basket**	**Minor (Disaster Management)**

8. Course Summary: The course explores the concepts and practices of rehabilitation, reconstruction, and recovery, emphasizing disaster mitigation, damage assessment, infrastructure development, socio-economic rehabilitation, and sustainable recovery strategies.

9. Course Objectives: To understand post disaster issues in recovery and rehabilitation. To undertake reconstruction as an opportunity to build disaster resilient structures and safe habitat.

10. Course Outcomes:

CO1- Learn concepts of rehabilitation

CO2- Have idea about the roles of different organizations in risk assessment.

CO3- Get detailed idea about reconstruction

CO4- Get detailed idea about rehabilitation

CO5- learn the recovery process

11. Curriculum Content:

Unit-I Basic concepts of Rehabilitation, Reconstruction and Development 9L

Reconstruction Rehabilitation and Development- Concept, Meaning, types of Rehabilitation and Reconstruction, Importance of Disaster Mitigation, Cost – benefit analysis, relationship between vulnerability and development, Damage Assessment- Post Disaster Damage assessment, estimated damage assessment due to probable disasters, Sample Surveys, Epidemiological Surveillance,

Nutrition Centered, Health Assessment, Remote sensing and Aerial photography, nature and damage to houses and infrastructure due to different disasters

Unit II Role of Different organization in Rehabilitation **5L**

The Government and Disaster Recovery and rehabilitation; Disaster and Non-governmental efforts; Role of Local Institutions; Insurance, Police, Media

Unit III Reconstruction **9L**

Speedy Reconstructions- Essential services, social infrastructures, immediate shelters/camps, Contingency plans for reconstructions, Development of Physical and Economic Infrastructure- Developing Physical and Economic Infrastructure, Environmental Infrastructure development, Disaster resistant House Construction- Guidelines for Disaster resistant construction, traditional techniques, Seismic strengthening of houses in low rain/High rainfall area, earthquake resistant construction technique, Funding arrangements- Funding arrangements at state level and central level, Fiscal discipline, role of International agencies, mobilization of community for resource generation

Unit IV Rehabilitation **8L**

Socio- economic Rehabilitation- Temporary Livelihood Options and Socio-Economic Rehabilitation, Role of Housing / building authorities- Education and awareness and role of Information Dissemination, Participative Rehabilitation, Role of various agencies in Recovery Work- Monitoring and evaluation of rehabilitation work, Rehabilitation process

Unit V Recovery **8L**

Concept of recovery, livelihood and approach to reconstruction, Livelihood restoration, Speedy recovery, Linking Recovery with safe development, Creation of Long-term job opportunities,

12. Textbooks

1. Asian Development Bank, Disaster Mitigation in Asia and the Pacific, Manila ADB, 1991

2. Disaster Administration and Management, Text & Case studies- SL Goel-Deep and Deep Publications
3. Disaster Management- G.K Ghosh-A.P.H. Publishing Corporation

13. Reference Books

1. Disaster management – S.K. Singh, S.C. Kundu, Shobha Singh A – 119, William Publications, New Delhi
2. Disaster Management – Vinod K Sharma- IIPA, New Delhi,1995
3. Encyclopedia of Disaster Management- Goel S.L. - Deep and Deep Publications, New Delhi, 2006.

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

1. Department offering the course	**Civil Engineering**
2. Course Code	**CEN376**
3. Course Title	**Government Interventions and Institutional Mechanism for Disaster Management**
4. Credits(L:T:P:C)	**3:0:0:3**
5. Contact Hours	**3:0:0**
6. Prerequisites (if any)	**None**
7. Course Basket	**Minor (Disaster Management)**

8. Course Summary: The course examines disaster management policies, funding mechanisms, e-governance, techno-legal frameworks, capacity building, and insurance strategies for effective disaster risk reduction and recovery.

9. Course Objectives: At the end of this course students are expected to analyze Disaster Risk in India, importance of disaster management, institutional framework, policy in disaster management and various dimensions of a sound disaster management policy.

10. Course Outcomes:

CO1- Student will learn the national policies about disaster management
CO2- Student will have idea about various funding agencies
CO3- Student can learn about E governance
CO4- Student will learn about capacity building
CO5- Student will get knowledge about various insurance schemes

11. Curriculum Content:

Unit-I Disaster Management Policy Environment and local Action 7L

Disaster Management Act 2005; Disaster Management Authority at National, State and District levels; Roles and responsibilities of Govt. Authorities including Local Self Govt. at various levels.

Unit II Funding for Disaster Management 8L

State Disaster Mitigation fund, State Disaster response fund (SDRF), National Disaster Response Fund (NDRF), Prime Minister National Relief Fund (PMNRF), Chief Minister Relief Fund and Role.

Unit III E-Governance **8L**

E-Governance: Concept and Significance, E-Governance in Urban Development, E-Governance in Rural Development, ICT Implementation in Governance: Issues and Challenges

Unit IV Disaster management, techno legal regime, capacity building **8L**

Study of different measures in different phases of Disasters, Revision of Municipal regulations, Land use planning, Safe Construction practices, Training and capacity development. Setting up EOCs at state, district and block levels; Raising National/State Disaster Response Force; Training and Capacity building of all stakeholders – National Institute of Disaster Management (NIDM); Disaster Management Centers (DMC) in every State; Centers of Excellence. Various case studies.

Unit V Insurance Policies for Disaster Management **8L**

Evaluation of risk funding and risk transfer policies; Catastrophe insurance pool; Reserve funds and contingent credit policies; Role of Government and market participants; Insurance policy design; Fiscal cost of relief and reconstruction; Grants and low interest loan for reconstruction.

12. Textbooks:

1. Disaster Administration and Management, Text & Case studies- SL Goel-Deep and Deep Publications
2. Natural Hazards and Disaster Management: Vulnerability and Mitigation - R B
3. Disaster Management- G.K Ghosh - A.P.H. Publishing Corporation

13. Reference Books:

1. Disaster management – S.K. Singh, S.C. Kundu, Shobha Singh A – 119, William Publications, New Delhi.
2. Disaster management - H.K. Gupta, 2003
3. Disaster Management – Vinod K Sharma- IIPA, New Delhi,1995

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

1.	**Department offering the course**	**Civil Engineering**
2.	**Course Code**	**CEN377**
3.	**Course Title**	**Application of GIS in Disaster Management**
4.	**Credits(L:T:P:C)**	**2:0:2:3**
5.	**Contact Hours**	**2:0:2**
6.	**Prerequisites (if any)**	**None**
7.	**Course Basket**	**Minor**

8. Course Objectives: Application of GIS in Disaster Management covers the application of GIS in disaster management. Trained students with the help of GIS will assist disaster management teams in reducing disaster risk.

9. Course Outcomes:

CO1- develop the concept of GIS

CO2- Get the idea about database management in GIS

CO3- understand the use of GIS for landslide and earthquake

CO4- understand the application of GIS in Disaster Management

CO5- understand the basics of GIS software

10. Curriculum Content:

Unit-I: Introduction **5L**

Geographical Information Systems - definition, development, data sources, data structures, raster and vector, data capturing, pre-processing, Introduction to Geomorphology and Geology, Study the stratigraphy of India, Morphometric analysis with the help of remote sensing & GIS techniques.

Unit II: Data base management systems in GIS **5L**

Concept and scope, data manipulations and product generation- Environmental GIS, Data acquisition system using GPS applications.

Unit III: Earthquake/ Landslide **6L**

Earthquakes – Causative factors, hazard assessment, selection of factors, creation of thematic data layers, preparation of seismic hazard zonation maps, regional risk assessment, Geomatics tools for risk mitigation plans. Case studies. Damage Assessment. Landslides – Causative factors, hazard assessment, selection of factors – triggering and non-triggering, creation of thematic data layers, preparation of landslide hazard zonation maps, regional and site-specific risk assessments, Modelling for risk mitigation plans. Case studies

Unit IV: Cyclones and Flooding/ Drought and Desertification 6L

Cyclone related parameters and effects on land and sea – damage assessment. Flooding: causes, identification of factors, space-time integration, GIS data layers, flood prone area demarcation, analysis and management, risk assessment. Damage Assessment. Case studies, Damage assessment. Drought and Desertification: Types of droughts, factors influencing droughts, identification of variables, development of vegetation index, assessment of land use and ground water level changes, delimiting drought prone areas, processes of desertification, over utilization of water and land resources. GIS data layer creation – Management strategies. Case studies.

Unit V: GIS SOFTWARE 4L

Overview of GIS software - Arc Info; Arc View Principles, operation protocols and hands on training query-based information retrieval Web GIS Online GIS and its data applications. Development of GIS based decision support for disaster risk reduction.

11. Textbooks:

1. Remote Sensing Principles & Applications - B.C. Panda - Viva Book Pvt. Ltd.
2. Remote Sensing and Geographical Information systems - M. Anji Reddy JNTU Hyderabad 2001, B.S. Publications

12. Reference Books:

1. Remote Sensing and its applications - LRA Narayana - University Press 1999
2. Principals of Geo physical Information Systems - Peter A Burragh and Rachael ,A. Mc Donnell- Oxford Publishers 2004
3. Concepts & Techniques of GIS - C.P.Lo Albert, K.W. Yonng - Prentice Hall (India) Publications.

13. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

14. List of Experiments

1. Demo on various GIS software and their salient features.
2. Scanning and digitization (on screen).
3. Registration of various maps and digitization and editing of features
4. Database creation and management.
5. Buffer and overlay analysis.
6. Map preparation and composition.
7. Spatial and Mathematical operations.
8. Area and query-based analysis
9. Customized application in GIS.
10. Web publishing of GIS layers.
11. 3D GIS.
12. Demo on various GIS based application.

1.Department offering the course	**Civil Engineering**
2.Course Code	**CEN378**
3.Course Title	**Disaster Preparedness Planning and Management**
4 Credits(L:T:P:C)	**3:0:0:3**
5.Contact Hours	**3:0:0**
6.Prerequisites (if any)	**None**
7.Course Basket	**Discipline Elective (BTCE, BTCE with specialization**

8. Course Summary: The course explores the concepts, classifications, impacts, and risk reduction of disasters, emphasizing the link between disasters, environmental management, socio-economic effects, and sustainable development practices.

9. Course Objectives: The overall aim of this course is to develop an understanding of disaster concepts, risks, and impacts, and equip learners with knowledge of mitigation strategies, disaster management frameworks, and sustainable recovery approaches.

10. Course Outcomes:

CO1. Identify the Concepts of Disaster Management

CO2. Explain various types of Natural events and Manmade Disasters.

CO3. Identify Categories and severity of Disasters

CO4. Analyze various scientific and Engineering methods for disaster risk reduction

CO5. Determine various factors for sustainability and societal development.

11. Curriculum Content:

Unit-1: Introduction 7L

Concepts and definitions: disaster, hazard, vulnerability, risks- severity, frequency and details, capacity, impact, prevention, mitigation). Climate Disaster, Link of Economy and Disaster, Demand of Energy and material resources and effects on socioeconomic perspectives, Scientific Assessments.

Unit 2: Disasters and Classifications 8L

Basic concepts of all disasters: Difference between natural phenomena and manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills, transportation accidents, terrorist strikes, etc.); Biological war and Bioterrorism hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility. Seismic micro zonation, Economic disasters, Effects on Ecology and biodiversity. Food safety, adulteration in food and vulnerabilities.

Unit 3: Disaster Impacts Assessment 8L

Disaster impacts (environmental, physical, social, ecological, economic, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters. Role of remote sensing and numerical modelling to assess impacts.

Unit 4: Disaster Risk Reduction (DRR) 8L

Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; structural

and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post- disaster environmental response (water, sanitation, food safety, waste management, disease control, security, communications); Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority. Role of educational and research institutions in creating science behind vulnerability management. Promotion of Environmental Ethics, provisions of laws in constitution for enforcement and implementations

Unit 5: Disasters, Environment and Development 8L

Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land-use changes, urbanization etc.), sustainable and environmental friendly recovery; reconstruction and development methods. Generation of economic benefits from waste, waste recycling, planning of green and clean Environment, Initiatives for sustainable resource exploitation, Integration of awareness programs with education. Concept of eco village, green building and food waste minimization, smart cities.

12. Textbooks

1. Dhawan, N. G., Khan, A. S. Disaster Preparedness Planning and Management, CBS Publishers
2. Pratima Nair, Disaster Preparedness and Response, Academic Aspirations, 2021
3.http://ndma.gov.in/ (Home page of National Disaster Management Authority)
4. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs).
5. Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.
6. Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication.

13. Reference Books:

4.Ghosh G.K., 2006, Disaster Management, APH Publishing Corporation

5. Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June 2003

6. Inter-Agency Standing Committee (IASC) (Feb. 2007). IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings. Geneva: IASC

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details

1.Department offering the course	**Civil Engineering**
2.Course Code	**CEN379**
3.Course Title	**Natural Dynamics**
4 Credits(L:T:P:C)	**3:0:0:3**
5.Contact Hours	**3:0:0**
6.Prerequisites (if any)	**None**
7.Course Basket	**Discipline Elective (BTCE with specialization in**

8. Course Summary: This course explores environmental components, pollution, and resource conservation, covering water and air quality, solid waste management, and noise pollution. It also examines ecology, ecosystem interactions, and environmental regulations.

9. Course Objectives: The course provides wide knowledge about environmental process and sustainability.

10. Course Outcomes:

CO1: Remember the basic knowledge of environmental process and causes of pollution

CO2: Explain the concepts of air, water quality parameters, purification process and apply in real scenario

CO3: Explain the concepts of noise pollution assessment and solid waste management

CO4: Analyze the ecological and problems and create a sustainable environment

CO5: Appreciate the elements and scope of Sustainable Development Goals.

11. Curriculum Content:

Unit -1: Environment **6L**

Environment and its components, pollution of environment by human activity, kinds of pollution.

Unit-2: Water and Air Quality **8L**

Water Quality Measure of water quality, water quality standards, water treatment; waste water transport and treatment, sludge treatment and disposal. Water quality indices, quantification of water parameters. Air Quality Sources and effects of air pollution, major air pollutants, air quality control, treatment of emissions, dispersion of air pollutants. Air quality indices**.**

Unit-3: Noise Pollution Assessment and Solid Waste Management **9L**

Solid waste Collection of refuse, removal and transport, disposal of refuse. Energy generation from waste. Noise Pollution Effect of noise on human health and its control. Use of sound energy**.**

Unit-4: Ecology **8L**

Ecology and Ecosystems, concept of ecological imbalances, physical and climate factors, biotic components, energy and material flows in ecosystems, human influence on ecosystems. Herbivore-Ecosystem Interactions. Population Regulation in an Ecosystem. Law of thermodynamics in ecology.

Unit-5: Conservation of Natural Resources **8L**

Water resources, mineral resources, agricultural and forestry resources, agriculture soil and need of nutrients, fertilizers and pesticides. Brief introduction about environmental legislation and environmental audit**.**

12. Text Books:

1. Garg, S. K., "Water Supply Engineering", Khanna Publishers (RS), New Delhi, 2010.
2. S. Deswal & A. Deswal 2015. A Basic Course in Environmental Studies. Dhanpat Rai & Co.

13. Reference Books

1. Vesilind, "Introduction to Environmental Engineering," Thomson Asia Pvt. Ltd. Singapore.

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details

1.Department offering the course	**Civil Engineering**
2.Course Code	**CEN381**
3.Course Title	**Resource Dynamics and Economic Implications**
4 Credits(L:T:P:C)	**3:0:0:3**
5.Contact Hours	**3:0:0**
6.Prerequisites (if any)	**None**
7.Course Basket	**Discipline Elective (BTCE with specialization in**

8. Course Summary: The course examines the economic aspects of environmental and natural resource management, including property rights, valuation, policy analysis, market strategies, pollutant impacts, and sustainable economic development.

9. Course Objectives: The overall aim of this course is to provide broad understanding about the basic concepts of resources, its utilization, economics associated with resource allocation, marketing, trade and policy. Also the subject deals with how environmental degradation and pollution are able to create economic impact on society, Trade rules, ethics, policies, environmental property rights etc.

10. Course Outcomes: After completion of course, the students will be able to learn

CO1: The application of identifications of natural resources

CO2: the concept of economic analysis in natural resources

CO3: economic benefits and disadvantages in energy resources

CO4: sustainable growth in environmental economics

11. Curriculum Content:

Unit-1: Introduction 7L

The Economic approach, Property rights in environment, environmental problems, Hazard analysis and impact on environment, Role of Govt in marketing strategies of natural resources. Effect of Imperfect marketing Strategies. Legislative regulations in natural resource management.

Unit 2: Economic analysis 8L

Normative criteria, Divergence, cost effective analysis, valuation of natural resources, cost benefit analysis of climate change. Economics of Kyoto protocol. Climate protection, carbon tax, emission

trading, Economic policy related to global warming. Economic incentives. Economic modeling of green house gases.

Unit 3: Energy, resources and economics 8L

Recyclable resources, marketing of recyclable resources, problems, efficient allocation, waste characterizations, water scarcity, Depletable resources, impact on economics, Storable and renewable resources from forests, revenue generation from natural resources. Crude oil economics. Property rights.

Unit 4: Pollutants and economic implications 8L

Pollutants characteristics, classifications, taxonomy, market allocations, stationary, regional conventional pollutants, control strategies, toxic substances, environmental justice. Economic, legal & practical problems with hazardous wastes. Pollution policy.

Unit 5: Sustainable Economic Development 8L

Sustainability of development, Trade rules, Trade and development, WTO, 'Natural Resource Curse' hypothesis, Growth Development Relationship. Technological change and environment

12. Textbooks References

1. Tietenberg, T. H., & Lewis, L. (2016). *Environmental and natural resource economics*. Routledge.
2. Hanley, N., & Owen, A. D. (2004). *The economics of climate change* (Vol. 3). Routledge.

13. Reference Books

1. Arrow, K. J., Intriligator, M. D., Dasgupta, P., Pattanayak, S. K., Smith, V. K., Brock, W. A., ... & Abbott, J. K. (2005). Handbook of environmental economics.

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details

1.Department offering the course	**Civil Engineering**
2.Course Code	**CEN382**
3.Course Title	**Properties of Materials**
4.Credits (L:T:P:C)	**3:0:0:3**
5.Contact Hours (L:T:P)	**3:0:0**
6.Prerequisites (if any)	**None**
7.Course Basket	**Discipline Elective (BTCE with specialization in**

8. Course Objectives: The objectives of this course are to learn the design concrete mixes for various mix proportions using different types of blending materials such as silica fume, fly ash and blast furnace slag.

9. Course Outcomes:

CO1. Study the microstructure of basic constituents of concrete.

CO2. Study the behavior of fresh concrete and hardened concrete.

CO3. Design different types of concrete mixes.

CO4. Design different types of special concretes.

10. Curriculum Content:

Unit- 1: Lime, Mortar and Stones [5 Hours]

Lime: Classification and its application; Stone: Types of building stone, uses, deterioration and preservation, dressing stones and tests; Mortar: Importance, types and its ingredients.

Unit 2: Concrete Ingredients and Microstructure [9 Hours]

Cement – Chemical composition, hydration of cement, types of cement, manufacture of OPC with flow charts. Tests on cement – field testing, fineness, normal consistency, setting time, soundness, and compressive strength (detailed procedures covered in laboratory). Quality of mixing water. Structure of aggregate phase, structure of hydrated cement paste, structure - property relationship in hydrated cement paste, transition zone in concrete, influence of transition zone on properties of concrete.

Unit 3: Fresh Concrete [7 Hours]

Workability – definition, factors affecting workability, measurement of workability by slump, compaction factor, Vee-Bee, flow tests. Segregation and bleeding, process of manufacture of concrete – batching. Mixing, transporting, placing, compaction, curing of concrete. Chemical admixtures – plasticizers, accelerator, retarders and air entraining agents. Mineral admixtures – fly ash, blast furnace slag, meta kaolin, Silica fume, rice husk ash.

Unit 4: Hardened Concrete [10 Hours]

Factors affecting strength, w/c ratio, gel/space ratio, maturity concept, effect of aggregate properties, compressive strength, tensile strength, bond strength, modulus of rupture, modulus of elasticity, Poisson's ratio, relationship between these parameters. Accelerated curing, aggregate- cement bond strength. Shrinkage – plastic shrinkage and drying shrinkage, factors affecting shrinkage. Creep – measurement of creep, factors affecting creep, effect of creep. Durability – definition, significance, permeability, sulphate attack, chloride attack, carbonation, freezing and thawing. Factors contributing to cracks in concrete – plastic shrinkage, settlement cracks, construction joints. Thermal expansion, transition zone, structural design deficiencies. Tests on hardened concrete – compressive strength, split tensile strength, flexural strength, non-destructive testing of concrete.

Unit- 5: Special Concretes [8 Hours]

Constituents, Properties and applications of lightweight concrete, high performance concrete (HSC, SCC), high density concrete, fibre reinforced concrete, Ferro-cement.

11. Textbook

1.Shetty, M. S., "Conerete Technology", S. Chand & Co. Ltd, New Delhi, 6th Edition, 2005.

12.References

1. Mehta, P. K, Monteiro, P. J. M., "Concrete: Microstructure, Properties, and Materials", McGraw Hill Professional, 2013.

2. Gambhir, M. L., "Concrete Technology", Tata McGraw Hill, New Delhi, 5th Edition, 2013.

3. Neville, A. M., Brooks, J. J., "Concrete Technology", Prentice Hall, 2nd Edition, 2010.

13. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details

1. Department offering the course	**Civil Engineering**
2. Course Code	**CEN401**
3. Course Title	**Estimation And Costing**
4. Credits (L:T:P:C)	**0:0:4:2**
5. Contact Hours (L:T:P)	**0:0:4**
6. Prerequisites (if any)	**None**
7. Course Basket	**Discipline Core**

8. Course Summary: Evaluating the material quantity for different types of structures.

9. Objective: To learn the estimation of RCC, masonry and road structures and to study different terms related to contracts and tenders.

10. Course Outcomes:

Outcomes aim to prepare students for the challenges of estimating the reinforced concrete structures by providing a comprehensive understanding of material and labour cost, codal requirements, and the application of design principles of estimating and costing. The goal is to ensure graduates can contribute to the safe and cost-efficient construction of buildings and infrastructure. At the end of the course, students will be able to:

CO1: Recognizing the various methods of estimation of quantities.

CO2: Explain the role of contracts and tenders in the civil engineering construction industry.

CO3: Apply the concepts to estimate the quantities required in RCC structures.

CO4: Comprehend the concepts of various construction specifications and their rates.

CO5: Compute the quantities of materials required in road construction.

11. Curriculum Content

Unit 1: Introduction & Estimation of Buildings (8L)

Introduction - Importance of estimation in Civil Engineering, Different types of Estimates. Estimation methods: Methods in Estimation, Methods of taking out quantities and cost by Centre line method and long wall and short wall method.

Unit 2: Estimation of R.C.C. Structures (8L)

Estimation of simple RCC structures - Estimates of components RCC works in beams, column footings and roof slabs; Estimation of complex RCC structures - Estimation of septic tank, manhole and RCC slab culverts.

Unit 3: Specifications and Rate Analysis (8L)

Specifications of items: Definition of specifications, objectives of writing specification, essentials of specification of various items of working in buildings; Rate Analysis of quantities estimated: Importance working out quantities and rates for the following standard items of works-earth works in different types of soils, cement concrete of different mixes, Brick masonry, Painting and steel works, wooden works for doors, windows.

Unit 4: Estimation of Earth Work and Road Projects (8L)

Earthwork: Methods for computation of Earthwork-cross sections-mid sections formula, trapezoidal and average end area or mean sectional formula; Road Projects: Estimation of Road Works -WBM, Bituminous mixes and cement concrete roads.

Unit 5: Contracts and Tender (8L)

Contracts: Types of contracts, essential of contracts agreement and document- legal aspects, penal provisions on breach of contract; Tender: Tender- E.M.D, Security deposit, Tender form, Tender notification procedures, Nominal muster roll, Measurement book.

12. TextBooks

1. Estimating, Costing, Specification and Valuation in Civil Engineering by M. Chakraborti, 29th Revised & Enlarged Edition, 2006, Khanna Publishers
2. Estimating and Costing in Civil Engineering: Theory and Practice by B.N. Dutta, 24th Edition, 2018, UBS Publishers & Distributors

13. References Books

1. Quality Surveying by P.L. Basin, 1st Edition, 2015, S. Chand & Co.
2. Estimating, Costing and Valuation by S.C. Rangwala, 18th Edition, 2023, Charotar Publishing House
3. Professional Practice for Civil Engineers by J. Nanavati, 1st Edition, 2018, Laxmi Publications

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded to MS-Teams. Refer to your course in MS-Teams for details.

1. School offering the course	**Civil Engineering**
2. Course Code	**CEN441**
3. Course Title	**Pre-stressed Concrete**
4. Credits (L: T:P:C:S)	**3:0:0:3**
5. Contact Hours (L: T:P:S)	**3:0:0**
6. Prerequisites (if any)	**None**
7. Course Basket	**Discipline Elective (BTCE)**

8. Course Summary

Analysis of stresses in concrete due to prestress and design based on that.

9. Course Objectives

The course objective is to understand the need for prestressed concrete structures and to understand pre-tensioning, post-tensioning, full and partial prestressing concepts.

10. Course Outcomes

Outcomes aim to provide students with a deep understanding of prestressed concrete principles, enabling them to design efficient and safe structures using this advanced construction material and technique. At the end of the course, students will be able to:

CO1: Define the prestressed concrete, prestressing concrete principles in addition to the difference of traditional concrete and prestressed concrete.

CO2: Explain the design of pre-stressed concrete structure with limit state analysis.

CO3: Analyse the different structural elements of a pre-stressed structure as per the IS code Provision. Design and construct reinforced earth retaining structures.

CO4: Design Prestressed concrete element as per IS codal provisions and local guidelines.

11. Curriculum Contents

Unit 1 **(9 hours)**

Materials, Basic Principles of Pre-Stressing, Pre-stressing Systems: Basic concepts of pre-stressing, High strength concrete and steel, Stress-strain characteristics and properties, Various pre-

stressing systems, Pre-tensioning and post-tensioning systems with anchorages, Advantages and limitations of pre-stressed concrete

Unit 2 **(9 hours)**

Analysis of Sections for Flexure: Basic assumptions, Analysis of stresses in concrete due to pre-stress and loads for different types of cross section, Pressure line or thrust line, Cable profile, Concept of load balancing, Cracking moment

Unit 3 **(7 hours)**

Losses of Pre-Stress & Deflections: Nature of losses in pre-stress, various losses encountered in pre-tensioning and post tensioning methods, Deflection, Factors influencing deflection, Elastic deflection under transfer loads and due to different cable profile. Deflections limits as per IS-1343. Effects of creep on deflection, crack widths

Unit 4 **(7 hours)**

Flexural and Shear Strength of Prestressed Concrete Sections: Types of flexural failure, IS code recommendations for flexure, Ultimate flexural strength of section. Shear and principal stresses, Ultimate shear resistance of prestressed concrete members, Shear reinforcement

Unit- 5 **(7 hours)**

Transfer of Prestress in Pre-tensioned Members and Anchorage Zone Stresses in Post Tensioned Members: Transmission of pre-stress in pre-tensioned members, Transmission length, Bond stresses, Codal provisions for bond and transmission length, Anchorage stress in post- tensioned member. Bearing stress and bursting tensile force, IS code provisions.

12. Text book

1. Raju, N. K., "Pre-stressed concrete", Tata McGraw Hill, New Delhi, 6th Edition, 2018.

2. Ramamruthum, S., "Pre-stressed Concrete", Dhanpat Rai Publishing Company (P) Ltd., New Delhi, 5th Edition, 2013.

3. Lin, T. Y., Burns, N. H., "Design of pre- stressed Concrete Structures", John Wiley and Sons. New York, 3rd Edition, 1981.

13. Reference Books

1. Prestressed concrete by N.Raja Gopalan, Nerosa Publishing house, 2nd edition, 2017.
2. IS-1343: 2012

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

1.	**Department offering the course**	**Civil Engineering**
2.	**Course Code**	**CEN442**
3.	**Course Title**	**Fundamentals of Earthquake Engineering**
4.	**Credits (L: T:P: C)**	**3:0:0:3**
5.	**Contact Hours (L: T:P)**	**3:0:0**
6.	**Prerequisites (if any)**	**None**
7.	**Course Basket**	**Discipline Elective (BTCE)**

8. Course Summary: Earthquake engineering includes mechanics behind the behaviour of buildings during an earthquake

9. Course Objectives: The course is designed to incorporate earthquake effects in the analysis of structures and to learn about seismicity and various parameters related to the measurement of earthquake effects.

10. Course Outcomes:

Outcomes aim to prepare students for the challenges associated with earthquake-resistant design and retrofitting, considering both the structural and non-structural aspects of buildings and infrastructure. The goal is to ensure that graduates can contribute to the creation of earthquake-resistant structures and participate in the seismic risk assessment and recovery processes. At the end of the course, students will be able to:

CO1: Define the basic terminologies & concepts of earthquake engineering.
CO2: Explain the Earthquake Design Philosophy for earthquake resistance buildings as per IS code.
CO3: Identify the effects of the earthquake on the ground and structure, landslides and cracks & collapse of structures.
CO4: Analyse the mode shapes for Single Degree of Freedom (SDOF) and Multi-Degree of Freedom (MDOF) systems.
CO5: Evaluating a detailed ductile design for RCC and Masonry structures by using codal provisions.

11. Curriculum Content

Unit 1 Basic Earthquake Seismology (8L)

Earth's interior and plate tectonics, Global Seismic Belts, Seismic waves, Earthquake measurement parameters, Indian seismic zoning map, the effect of soil on earthquake.

Unit-2 Concept of Earthquake Resistant Design (10L)

Philosophy of earthquake resistance design, earthquake proof V/s earthquake resistant design building, four virtue of earthquake resistance structures (strength, stiffness, ductility and configuration), seismic structural configuration, introduction of IS:1893 part-1 2016 and IS 875 part-5-2000 Equivalent lateral force for Earthquake, Response spectrum method for analysis of structures and its codal provisions, codal provisions for seismic isolation.

Unit 3 Strong Ground Motion (8L)

Ground failures, Local site effects, Effects on ground and structure, Land-slides, Cracks & collapse of structures

Unit 4 Earthquake Vibration Buildings (10L)

Single degree of freedom system: SDOF Un-damped and damped free vibration with viscous damping, forced vibrations, Steady-state, Vibration Isolation, Introduction response of un-damped systems to time-dependent force functions (Pulse/impulses)

Multi Degree of Freedom Systems: Mode shapes, orthogonally of modes, of frequency and mode shapes by Holzer method, Stodola Method, Rayleigh's method

Unit 5 Ductile Design of Structures (8L)

Concept of ductile design and detailing of various structural components as per IS 13920:2016 provision.

Special Topics

Introduction to earthquake features of unreinforced and reinforced masonry structures, Confined masonry structures, soil liquefaction, structural control and seismic strengthening

12. TextBooks

1. Chopra, A.K., "Dynamic of structures", Prentice Hall, 4th Edition,2011.
2. Paz, M., Leigh, W., "Structural Dynamics: Theory of Computation", 5th edition, 2006, Springer.
3. Pankaj Agarwal and Manish Shrikhande, "Earthquake Resistant Design of Structures", 1st edition, 2016, PHI publication.

13. References Books

1. Krishna, J., Chandrasekaran A. K. and Chandra B. “Elements of Earthquake Engineering”, South Asia Publisher, New Delhi,2nd edition, 2015
2. S. K Duggal “Earthquake Resistant Design of Structures” Oxford publication, 2nd edition, 2016
3. Park and Paulay “Behaviour of RC structures”, 2nd edition, Wiley Publication, 2016
4. ***Indian Standard Code – Criteria for earthquake resistant design of structures, IS:1893-part-1 2016.***
5. ***Indian Standard code – Ductile detailing of reinforced concrete structures subjected to seismic forces- code of practice, IS:13920:1993.***

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in MS-Teams. Refer to your course in MS-Teams for details.

1.	**Department offering the course**	**Civil Engineering**
2.	**Course Code**	**CEN443**
3.	**Course Title**	**Building Science**
4.	**Credits (L:T:P:C)**	**2:0:2:3**
5.	**Contact Hours (L:T:P)**	**2:0:2**
6.	**Prerequisites (if any)**	**None**
7.	**Course Basket**	**Discipline Elective (BTCE)**

8. Course Summary: Course will enhance knowledge on basic fundamentals of building planning, design and construction materials

9. Course Objectives: Students are expected to be more conversant with minute details of civil engineering domain structures such as residential houses, storage ware-houses and industrial buildings.

10. Course Outcomes:

Outcomes are designed to provide students with a well-rounded understanding of building materials and construction processes, enabling them to make informed decisions in selecting materials, ensuring quality, and implementing safe and efficient construction practices. At the end of the course, students will be able to:

CO1: Select the different types of materials used in building construction.

CO2: Explain the role of detailed documentation of building materials in the construction process.

CO3: Apply the knowledge of Building science in the sequencing of construction activities implementation in-situ.

11. Curriculum Content:

Unit 1 **(8 HRS)**

Introduction to Building Planning: Planning of Residential Buildings, Site Selection criteria. Principles of Building planning. Significance Sun diagram. Wind Diagram. Orientation, factors affecting, criteria under Indian condition. Lowcost Housing-Materials & Methods (conceptual introduction only) Maintenance, Repairs, Rehabilitation of Structures (conceptual introduction only).

Unit 2 **(6 HRS)**

Building Services: Plumbing system, Various Materials for system like PVC, GI, AC, CI, HDPE, and Stoneware. Various types of traps, Fittings, Chambers, Need of Septic Tank, Concept of Plumbing & Drainage plan, introduction to rainwater harvesting. Concept of rain water Gutters. Rainwater outlet & Down Tank Systems.

Unit 3 **(8 HRS)**

Electrification: Concealed & Open Wiring, Requirements & Location of various points, Concept of earthing. Fire resistance in building: Fire protection precautions, confining of fire, fire hazards, Characteristics of fire resisting materials. **Ventilation:** - Definition and necessity of Ventilation, functional requirement, various system & section criteria. Air conditioning: - Purpose, Classification, Principles, Systems & Various Components of the same.

Unit 4 **(8 HRS)**

Thermal Insulation: - General concept, Principles, Materials, Methods, Computation of Heat loss & heat gain in Buildings. **Introduction to Acoustics:** Absorption of sound, various materials, Sabine's formula, optimum reverberation time, conditions for good acoustics. **Sound Insulation:** Acceptable noise levels, Noise prevention at its source, Transmission of noise. Noise control - general considerations.

UNIT 5 **(6 HRS)**

Building Finishes: Paints: Different types and application methods. Varnishes & application methods. Plastering, Pointing & various techniques. Tile cladding, skirting, dado work with various materials. Miscellaneous finishes such as POP, sand blasting techniques, wall paper.

12. Textbook(s):

1. Kumar, S., "Building Construction", Standard Publishers Distributors, New Delhi, 16th Edition, 2006.

2. Rangwala, S. C., "Engineering Materials (Material Science)", Charotar Publishing House Pvt. Limited, 2008.

13. Reference Books:

1. David Frey, “AutoCAD”, BPB Sybex Publications

2. George Omura, “ AutoCAD”

3. I.S. 962 – 1989 Code for Practice for Architectural and Building Drawings

4. Shah, Kale, Patki, “ Building Drawing”, Tata McGraw- Hill

5. SP 7- National Building Code Group 1 to 5 - B.I.S. New Delhi

6. Y. S. Sane, “ Building Design and Drawing”, Allied Book Stall, Pune

7. Rai, M., Jaisingh, M. P., “Advanced Building Materials and Construction” CBRI Publications, Roorkee, 1985.

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

15. List of Experiments

1. Introducing AutoCAD using various Commands

2. AUTOCAD 2D drawing; plan, elevation, section etc using all the 2D commands according to building planning bye laws under regulations as per SP-7, 1983 National Building code of India

3. Drawing to a scale in AUTOCAD: Foundations, Stone Masonry, Brick masonry bonds, Doors &Windows, Stairs

4. Sketch Book:

A. Lettering, Symbols, Types of lines and dimensioning as per IS 962. B. Types of Stone masonry

C. Types of Doors

D. Types of Windows

E. Types of Roofs

F. Types of Stairs

G. R.C.C. Lintel & Chajja

H. Types of Timber Trusses

5. Flexure test on flooring tiles.

6. Water absorption & compression test on Burnt brick.

***NOTE: Use of SolidWorks or any other numerical tool can also be used for all of the above drawing practical**

1. School offering the course	**Civil Engineering**
2. Course Code	**CEN444**
3. Course Title	**Bridge Engineering**
4. Credits (L: T:P:C:S)	**3:0:0:3**
5. Contact Hours (L: T:P:S)	**3:0:0**
6. Prerequisites (if any)	**None**
7. Course Basket	**Discipline Elective (BTCE)**

8. Objectives

The course is designed to gain knowledge of basic concepts in proportioning and design of bridges in terms of aesthetics and geographical location.

9. Course Outcomes

Outcomes aim to prepare students for the challenges of designing bridges by providing a comprehensive understanding of material behaviour, code requirements, and the application of design principles. The goal is to ensure graduates can contribute to the safe and efficient construction of bridges. At the end of the course, students will be able to:

CO1: Outline the principle of different types and components of bridges and their evolution.

CO2: Develop the different types of classifications of bridges as per IRC specifications and calculate loads/forces acting on bridges.

CO3: Analyse and design bridges with IRC classifications.

CO4: Evaluate the various components of bridges with IRC classifications and draw SF and BM diagrams as per the loading conditions.

CO5: Design a bridge as per IS codes & handbooks for two-point perspectives drawings.

10. Curriculum Contents

Unit 1 **(6 hours)**

Introduction: Definition, Components of bridge, Historical Developments, Site Selection for bridges, classification of bridges, Survey and data collection for bridge site selection, Hydraulic design, Design Discharge, Linear waterway, Economical span.

Unit 2 **(6 hours)**

Specifications of Road Bridges: Indian road Congress Bridge code, carriageway, clearance, forces on bridge, review of IRC loadings, applications of loads on bridge such as dead load, impact load, live load etc.

Unit 3 **(9 hours)**

R.C.C. Slab Culvert: RCC Slab culvert, dead load BM and SF, BM and SF for IRC class AA tracked vehicle, BM and SF for IRC class AA wheeled vehicle, BM and SF for IRC Class A loading, structural design of slab culvert.

Unit-4 **(9 hours)**

T-Beam Bridge: Proportioning of components, analysis of slab using IRC class AA tracked vehicle, structural design of slab, analysis of cross girder for dead load and IRC class AA tracked vehicle, structural design of cross girder, analysis of main girder using COURBON'S method, calculation of dead load and SF, calculation of live load BM and SF using IRC class AA tracked vehicle, structural design of main girder.

Unit- 5 **(9 hours)**

Substructure, Foundations, Bearings, Joints and Appurtenances: Definition of pier and abutment, design and drawing of pier and abutments, scour at abutments and pier, types of foundations, pile, well and pneumatic caissons, importance of bridge bearings, sketches of different types of bearings.

11. **Text book**

1. Raju, N. K., "Design of bridges", Oxford and IBH publishing Co., New Delhi, 5th Edition, 2019.
2. Victor, J., "Essentials of bridge engineering", Oxford and IBH publishing Co., New Delhi, 6th Edition, 2019.

12. Reference Books

1. Bindra, S. P., "Principles and practice of bridge Engineering", Dhanpat Rai and Sons, New Delhi, 7th Edition, 2000.

2. “IRC 6-2017 Standard Specifications and code of practice for Road Bridges Section II loads and stresses”, The Indian Road Congress, New Delhi.
3. Bridge Deck Analysis, R. P. Pama & A. R. Cusens, John Wiley & Sons, 1976.
4. Design of Bridge Structures, T. R. Jagadish & M. A. Jairam, Prentice Hall of India, N. Delhi, 2nd edition 2009.
5. Indian Standard Codes: IRC:5, 2015, IRC:6, 2017, IRC:21, 2000, SP:16, 2019

13. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details

1.	**Department offering the course**	**Civil Engineering**
2.	**Course Code**	**CEN445**
3.	**Course Title**	**Fundamentals of Finite Element Analysis**
4.	**Credits (L:T:P:C)**	**3:0:0:3**
5.	**Contact Hours (L:T:P)**	**3:0:0**
6.	**Prerequisites (if any)**	**None**
7.	**Course Basket**	**Discipline Elective (BTCE)**

8. Course Summary: Includes stress analysis based on discretization of structural elements into a finite number of individual elements

9. Course Objectives: This course aims to understand the basics of Finite Element Method and its application related to engineering problems.

10. Course Outcomes:

These outcomes aim to provide students with a comprehensive understanding of the fundamentals of finite element analysis and equip them with the skills necessary to apply FEM to solve engineering problems. At the end of the course, students will be able to:

CO1: Define the basic terminologies & concept of finite element analysis.

CO2: Explain the numerical methods and algorithms used in solving finite element equations.

CO3: Apply problem-solving techniques to address challenges encountered during the analysis process.

CO4: Examine the finite element analysis to solve practical engineering problems.

11. Curriculum Content:

Unit 1 **(8 HRS)**

Introduction: Basic concepts, Background review, Basic theory of finite element method, application of finite element method, Advantages and disadvantages, matrix displacement formulation, simple application in structural analysis

Unit 2 **(8 HRS)**

Fundamentals of Finite element Method: Displacement function by stiffness matrix approach for bar element, 2D truss and beam element, application for FEM for the analysis of bar, truss, continuous beam.

Unit 3 **(8 HRS)**

Analysis of 2D continuum Problems: Element and shape function, Triangular, rectangular and quadrilateral element, different type of element, their characteristics and suitability for application, polynomial shape function, Lagrange's and Hermitian polynomial, compatibility and convergence requirements of shape functions.

Unit-4 **(8 HRS)**

Theory of Isoparametric Element: Isoparametric, Two dimensional isoparametric elements, computation of stiffness matrix, characteristics of isoparametric quadrilateral elements.

Unit- 5 **(8 HRS)**

Introduction to plate bending problems and techniques: Introduction to plate bending problems and techniques for nonlinear analysis, Structure of computer program for FEM analysis, description of different modules, pre and post processing.

12. Text Books

1. Krishnamoorthy, C. S., "Finite Elements Analysis-Theory and Programming", Tata McGraw Hill Co. Limited, New Delhi.
2. Abel, J. F., Desai, C. S, "Introduction to the Finite element Method", Affiliated East West Press Pvt. Ltd., New Delhi.

13. References

1. Bathe, K. J, "Finite Elements Procedure", and PHI Pvt. Ltd, New Delhi.
2. Zienkeiwicz, O. C., "The Finite Element Method", Tata McGraw Hill Co. Limited, New Delhi.

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in

Moodle for details.

1. School offering the course	**Civil Engineering**
2. Course Code	**CEN446**
3. Course Title	**Advanced Reinforced Concrete Structures Design**
4. Credits (L: T:P:C:S)	**3:0:0:3**
5. Contact Hours (L: T:P:S)	**3:0:0**
6. Prerequisites (if any)	**None**
7. Course Basket	**Discipline Elective (BTCE)**

8. Course Summary

Course provides knowledge on advanced RCC elemental design details

9. Course Objectives

The course is designed to familiarize students with design concepts of reinforced structures like curved beams, retaining walls, water tanks and multi-storey frames.

10. Course Outcomes

Outcomes are designed to provide students with a strong foundation in the analysis of RCC structures, preparing them for more advanced topics in advanced reinforced concrete structure design. At the end of the course, student will be able to:

CO1: Explain the principle of yield line theory.

CO2: Develop competence in problem identification, formulation and solution for analysing concrete structures.

CO3: Analyse the different types of water tanks and retaining walls as per IS code.

CO4: Evaluate the different components of the building.

CO5: Design multi-storey framed structures.

11. Curriculum Content

Unit 1 Yield Line Theory **(6 hours)**

Introduction to yield line theory. The design concept of beams and slabs by yield line theory.

Unit 2 Design of Retaining Walls (8 hours)

General specifications, Forces acting on retaining walls, Stability consideration, Wall proportioning, Design of cantilever type retaining walls, Design of counterfort type retaining walls.

Unit 3 Design of Water Tanks (8 hours)

Types of water tanks, Designed of circular water tanks resting on the ground with rigid base and flexible base. Concept of underground water tanks, Design of overhead water tank and Intz type tank.

Unit-4 Design of Curved Beams (8 hours)

Introduction to curved beams, Design of curved RC beams. Analysis of domes and circular plates.

Unit- 5 Multi-storey Building Frames (9 hours)

Introduction to multi-storey building frames, Analysis of multi-storey frames, Method of substitute frames and analysis and design of plane frames.

12. Text book

1. Reinforced concrete design by N. Krishna Raju and R.N. Pranesh, New Age International Publishers, New Delhi, 2nd edition

2. Pillai, S. U., Menon, D., "Design of reinforced concrete structures"- Tata McGraw Hill publications, 4th Edition, 2022.

13. Reference Books

1. Sinha, S. N., "Reinforced Concrete Design", Tata McGraw Hill Publications, New Delhi 3rd edition, 2017.

2. IS 456: 2000, "Plain and Reinforced Concrete - Code of Practice", 4th Revision, BIS, New Delhi.

3. SP 16: 2019 "Design Aid for RC to IS: 456-1978", BIS, New Delhi.

4. SP 34: "Handbook on Concrete Reinforcement and Detailing", BIS, New Delhi.

5. "Advance R.C.C. Design (R.C.C. Volume-II) "S.S. Bhavikatti, New Age Publishers, 3rd edition, 2016.

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details

1.Department offering the course	**Civil Engineering**
2.Course Code	**CEN447**
3.Course Title	**Smart Materials and Composites**
4.Credits (L:T:P:C)	**3:0:0:3**
5.Contact Hours (L:T:P)	**3 0 0**
6.Prerequisites (if any)	**None**
7.Course Basket	**Discipline Elective (BTCE with specialization in**

8. Course Summary: The students will able to apply the knowledge of basics of sensors and its engineering application

9. Course Objectives: To study various types of smart materials used in engineering application

10. Course Outcomes:

CO1: Remember various smart materials and its importance in engineering application

CO2: Understand various processing technics of smart materials

CO3: Applying knowledge of the use of smart materials as sensors

11. Curriculum Content: Unit 1: Smart Materials (8 HRS)

Characteristics of metals, polymers and ceramics. Introduction to smart materials. Classification of smart materials, Components of a smart System, Applications of smart material

Piezoelectric materials, Electro strictive Materials, Magnetostrictive materials, Magnetoelectric materials, Magnetorheological fluids, Electrorheological fluids, Shape Memory materials

Unit 2: Processing of Smart Materials (6 HRS)

Semiconductors and their processing, Metals and metallization techniques, Ceramics and their processing, Polymers and their synthesis, UV radiation curing of polymers

Unit 3: Sensors (8 HRS)

Introduction, Conductometric sensors, Capacitive sensors, Piezoelectric sensors, Magnetostrictive sensors, Piezoresistive sensors, Optical sensors, Resonant sensors, semiconductor-based sensors, Acoustic sensors, polymerize sensors, Carbon nanotube sensors

Unit-4: Actuators (8 HRS)

Introduction, Electrostatic transducers, Electromagnetic transducers, Electrodynamic transducers, Piezoelectric transducers, Electro-strictive transducers, Magneto-strictive transducers, Electro thermal actuators, Comparison of actuation, Applications

12. Text Books

1. Smart Material Systems and MEMS: Design and Development Methodologies, V. K. Varadan, K. J. Vinoy, S. Gopalakrishnan, John Wiley and Sons, England, 2006.
2. Smart Structures and Materials, Brain Culshaw, Artech House, London, 1996.
3. Smart Materials and Structures, Mukesh V. Gandhi, Brian S. Thompson, , Springer, May-1992

13. References

1. Smart Structures: Analysis and Design, A. V. Srinivasan, Cambridge University Press, Cambridge, New York, 2001.
2. Smart Structures, P. Gauenzi, Wiley, 2009
3. Piezoelectric Sensorics: Force, Strain, Pressure, Acceleration and Acoustic Emission Sensors, Materials and Amplifiers, G. Gautschi, Springer, Berlin, New York, 2002.
4. Analysis and Performance of Fiber Composites, B. D. Agarwal and L. J. Broutman, John Wiley & Sons.

14. Teaching and Learning Strategy

Following strategies shall be considered.

1. Site visit
2. Group projects

1. Department offering the course	**Civil Engineering**
2. Course Code	**CEN448**
3. Course Title	**Coastal and Off-shore Geotechnology**
4. Credits (L:T:P:C)	**3:0:0:3**
5. Contact Hours (L:T:P)	**3:0:0**
6. Prerequisites (if any)	**None**
7. Course Basket	**Discipline Elective (BTCE with**

8. **Course Summary:** The students will able to apply the knowledge of Offshore foundation systems.

9. **Course Objective**: Students are expected to understand the importance of Identification of key challenges of offshore engineering design and off-shore ground improvement techniques.

10. Course Outcomes:

On successful completion of the course, students will be able to achieve the following:

CO1: Understanding the different types of marine foundations.

CO2: Applying suitable Geotechnical investigations for marine deposits.

CO3: Analyse loads on offshore structures and select the appropriate foundation.

11. Curriculum Content

Unit 1: **Introduction** **[6 Hours]**

Identify and describe key challenges of offshore engineering design; describe the aspects of the marine environment that feed into offshore engineering design

Unit 2: **Offshore Site-Investigation** **[6 Hours]**

Describe the main components of an offshore site investigation; Interpret selected geotechnical site investigation data.

Unit 3: **Offshore Foundation Systems** **[6 Hours]**

Identify the main types of offshore foundation systems and describe the drivers during foundation design, Perform selected foundation design techniques.

Unit-4: **Offshore Foundation Design** **[6 Hours]**

Off-shore ground improvement technics, identify key aspects of geotechnical offshore pipeline design, determine the loads acting on the off-shore structures**.**

12. Text Books

1. Advanced Marine Structures, Srinivasan Chandrasekaran, CRC Press, 2015.
2. Offshore structures, Design, Construction, and Maintenance, Md. El-Reedy, 2012, 1st Edition.

13. Reference Books

1. Offshore Pipelines, Gou B., Song S., Chacko J. and Ghalambor A., GPP Publishers, 2006.
2. Handbook of Offshore Engineering, Hakrabarti S.K., Elsevier, 2005.
3. Construction of Marine and Offshore Structures, Ben C. Gerwick, CRC Press, 1999, 1st Edition.

14. Teaching and Learning Strategy

Following strategies shall be used.

a) Validating theories through numerical analysis
b) Collaborative study
c) Flipped class

w.e.f. Academic Year 2024-25

1.Department offering the course	**Civil Engineering**
2.Course Code	**CEN449**
3.Course Title	**Soil Reinforcement**
4.Credits	**3:0:0:3**
5.Contact Hours (L:T:P)	**3:0:0**
6.Prerequisites (if any)	**None**
7.Course Basket	**Discipline Elective (BTCE with specialization in**

8. Course Summary: To understand the basic concept of soil reinforcement and reinforced soil wall. Some of the important topics which will be learned during the course: Different Types of Geosynthetics and their Applications; Testing on Geotextiles; Soil Reinforcement Interaction; Reinforced Soil Walls; Field Application of Reinforced Earth. Upon successful completion of the course, students should be able to apply fundamentals of soil reinforcement in the analysis, design, and construction of civil engineering projects.

9. Course Objectives: The objectives of this course are to understand the basic concept of soil reinforcement, reinforced wall and reinforced soil slopes.

10. Course Outcomes:

CO1: Understand the different types of reinforced materials used for soil improvement

CO2: Apply functions and applications of different geosynthetic materials

CO3: Analyse the behaviour of reinforcement with soil in Reinforced Earth Structures

11. Curriculum Content:

Unit 1: Introduction [6 Hours]

Basic Introduction to the Elements of Ground Engineering, Characteristics of Reinforcing Materials. Different Types of Geosynthetics and their Applications. Types of Polymers and the Manufacture of Geosynthetics.

Unit 2: Functions of Reinforcement [6 Hours]

Definitions, Functions, Properties, and Applications of Different Geosynthetic Materials. Testing on Geotextiles, Environmental Efforts, Ageing and Weathering. Soft Ground Improvement Using Geosynthetics- Accelerated Consolidation, Encased Granular Columns, Vacuum Consolidation.

Unit 3: Reinforced Earth [4 Hours]

Definition of Reinforced and Advantages of Reinforced Earth. Soil Reinforcement Interaction. Behaviour of Reinforced Earth Walls

Unit-4: Design of Reinforced wall [6 Hours]

Basis of Wall Design, the Coulomb Force Method, the Rankine Force Methods, Internal and External Stability Condition. Field Application of Reinforced Earth, Randomly Reinforced Earth and Analysis of Reinforced Soils, Testing of Soil Reinforcements

12.Text Books

1. Almeida, Marcio and Marques, M.E.S. (2013) Design and Performance of Embankments on Very Soft Soils, CEC Press, London, U.K.
2. BS8006 (2010) Code of Practice for Strengthened/reinforced soils and other fills, British Standards Institution, U.K, Vols 1 & 2.
3. Federal Highway Administration Guidelines for Mechanically Stabilised Earth Walls and Reinforced Soil Slopes, Design and Construction Guidelines, Report No. FHWA-NHI-00-0043 (2001) & FHWA-NHI-10-024 (2009), Washington, D.C.

13.References

1. Hausmann, M.R. (1976) Engineering principles of ground modification, McGraw-Hill Publishing Co., New York, N.Y. USA
2. Koerner, R.M. (2012) Designing with Geosynthetics, Vols. 1&2, 6th Edition, Xlibris Corporation, USA.
3. Sanjay Kumar Shukla and Jian Hua Yin (2006). Fundamentals of Geosynthetic Engineering, Taylor and Francis.

14. Teaching and Learning Strategy

Following strategies shall be used.

1. Collaborative study

2. Field visit
3. Project based learning

1.	**Department offering the course**	**Civil Engineering**
2.	**Course Code**	**CEN451**
3.	**Course Title**	**Soil Dynamics**
4.	**Credits**	**3:0:0:3**
5.	**Contact Hours (L:T:P)**	**3:0:0**
6.	**Prerequisites (if any)**	**None**
7.	**Course Basket**	**Discipline Elective (BTCE)**

8. Course Summary: The course deals with the behaviour and properties/response of soil as a material which is subjected to various types of dynamic or cyclic time-dependent loadings and hence will be very useful to undergraduate students to prepare the background for further study in the area of Geotechnical Earthquake Engineering and various related research and field applications for earthquake resistant design and construction of geotechnical systems.

9. Course Objectives: To understand the wave propagation in soils, determine dynamic properties of soil for analysing and designing foundations subjected to vibratory loading.

10. Course Outcomes:

On completion of this course, the students will be able to

CO1. Understand the fundamentals of wave propagation in soil media.

CO2. Analyze the dynamic properties of soil.

CO3. Design foundations for centrifugal and reciprocating machines

11. Curriculum Content

Unit 1 **[8 Hours]**

Fundamentals of Vibration: Definitions, Simple harmonic motion, Response of SDOF systems of Free and Forced vibrations with and without viscous damping, Frequency dependent excitation, Systems under transient loads, Rayleigh's method of fundamental frequency, Logarithmic decrement, Determination of viscous damping, Transmissibility, Systems with Two and Multiple degrees of freedom, Vibration measuring instruments.

Unit 2 **[8 Hours]**

Wave Propagation and Dynamic Soil Properties: Propagation of seismic waves in soil deposits Attenuation of stress waves, Stress-strain behaviour of soils under cyclic loads, Strength of cyclically loaded soils, Dynamic soil properties – Laboratory and field testing techniques, Elastic constants of soils, Correlations for shear modulus and damping ratio in sand, gravels, clays and lightly cemented sand. Liquefaction of soils and its evaluation using simple methods.

Unit 3 **[8 Hours]**

Vibration Analyses: Types, General Requirements, Permissible amplitude, Allowable soil pressure, Modes of vibration of a rigid foundation block, Methods of analysis, Lumped Mass models, elastic half space method, elasto-dynamics, effect of footing shape on vibratory response, dynamic response of embedded block foundation, Vibration isolation.

Unit 4 **[6 Hours]**

Design of Machine Foundations: Analysis and design of block foundations for reciprocating engines, Dynamic analysis and design procedure for a hammer foundation, IS code of practice design procedure for foundations of reciprocating and impact type machines. Vibration isolation and absorption techniques.

Unit-5 **[6 Hours]**

Machine Foundations on Piles: Introduction, Analysis of piles under vertical vibrations, Analysis of piles under translation and rocking, Analysis of piles under torsion, Design procedure for a pile supported machine foundation.

12.Text Books:

1. Swami Saran – Soil Dynamics and Machine Foundation, Galgotia Publications Pvt. Ltd. (2010)
2. Prakash, S. – Soil Dynamics, McGraw Hill Book Company (1981)

13.References:

1. Prakash, S. and Puri, V. K. – Foundation for Machines: Analysis and Design, John Wiley & Sons, 1998.
2. Kameswara Rao, N. S. V. – Vibration Analysis and Foundation Dynamics, Wheeler Publication Ltd., 1998.
3. Das, B. M. & Ramana, G.V. – Principles of Soil Dynamics, 2nd Edition, CL Engineering Publishers, 2010.

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

1.Department offering the course	**Civil Engineering**
2.Course Code	**CEN452**
3.Course Title	**Soil Exploration**
4.Credits	**3:0:0:3**
5.Contact Hours (L:T:P)	**3:0:0**
6.Prerequisites (if any)	**None**
7.Course Basket	**Discipline Elective (BTCE with specialization in Smart Infrastructure and Sustainable City Planning, BTCE with specialization in Construction Planning and Management)/ Minor (Earth System and Technology)**

8. **Course Summary:** To understand the basics of soil exploration through different field tests. Some of the important topics which will be learned during the course: planning of exploration; boring and drilling techniques; sampling technique; in-situ soil investigations; instrumentation in soil engineering. Upon successful completion of the course, students should be able to apply fundamentals of soil exploration, soil sampling and instrumentation in construction of civil engineering projects.

9. Course Objectives: Students are expected to understand the importance of site investigation, planning of sub soil investigation, interpretation of investigated data to design suitable foundation system.

10. Course Outcomes:

CO1: Remember the subsurface investigation program for a given project

CO2: Apply the knowledge of different methods of exploration to select the appropriate method of boring for investigating real field condition

CO3: Analyze the knowledge of different sampling techniques to collect, store and transport soil samples from onshore and offshore to meet specified needs and to characterise the soil.

CO4: Checking appropriate field tests to arrive at required soil parameters for the design of geotechnical structures considering all the influential parameters

11. Curriculum Content:

Unit 1: PLANNING OF EXPLORATION AND GEOPHYSICAL METHODS [8 Hours]

Scope and objectives, planning of exploration program - methods of exploration - exploration for preliminary and detailed design, spacing and depth of bores, data presentation. - Geophysical exploration and interpretation - reflection, refraction and resistivity: Spectral analysis of surface waves (SASW), Multichannel Analysis of Surface Waves (MASW), cross hole – up hole - down hole methods.

Unit 2: EXPLORATION TECHNIQUES [6 Hours]

Methods of boring and drilling, non-displacement and displacement methods, drilling in difficult subsoil conditions, offshore drilling, limitations of various drilling techniques, stabilization of boreholes, bore logs.

Unit 3: SOIL SAMPLING [4 Hours]

Sampling Techniques – quality of samples – factors influencing sample quality - disturbed and undisturbed soil sampling advanced sampling techniques, offshore sampling, shallow penetration samplers, preservation and handling of samples.

Unit-4: FIELD TESTING IN SOIL EXPLORATION [6 Hours]

Field tests, penetration tests, Field vane shear, In situ shear and bore hole shear test, pressuremeter test, dilatometer test - plate load test–monotonic and cyclic; field permeability tests – block vibration test. Procedure, limitations, correction and data interpretation of all methods.

Unit-5: INSTRUMENTATION [6 Hours]

Instrumentation in soil engineering, functional components of data acquisition system - strain gauges, resistance and inductance type, load cells, earth pressure cells, settlement and heave gauges, pore pressure measurements - slope indicators, sensing units, case studies.

12.Text Books

1. Punmia, B. C., Jain, A. K., Jain, A. K., “Soil Mechanics and Foundations”, Laxmi publication Co. New Delhi, 16th edition, 2005.

2. Ranjan, G., Rao, A. S. R., “Basic and Applied Soil Mechanics”, New Age International (P) Ltd., New Delhi, 2nd Edition, 2005.

13.References

1. Hunt, R.E., Geotechnical Engineering Investigation Manual, McGraw Hill,1984.
2. Winterkorn, H.F. and Fang, H.Y., Foundation Engineering Hand Book, a Nostrand Reinhold 1994.
3. Alam Singh and Chowdhary, G.R., Soil Engineering in Theory and Practice, Volume-2, Geotechnical testing and instrumentation, CBS Publishers and Distributors, New Delhi, 2006.
4. Nair, R.J. and Wood, P.M., Pressuremeter Testing Methods and Interpretation, Butter- worths, 1987.
5. Dunnicliff, J., and Green, G.E., Geotechnical Instrumentation for Monitoring Field Performance, John Wiley, 1993.

14. Teaching and Learning Strategy

Following teaching strategy shall be considered:

- Field visit
- Collaborative study
- Flipped class

1.	**Department offering the course**	**Civil Engineering**
2.	**Course Code**	**CEN453**
3.	**Course Title**	**Fundamentals of Ground Improvement Methods**
4.	**Credits**	**3:0:0:3**
5.	**Contact Hours (L:T:P)**	**3:0:0**
6.	**Prerequisites (if any)**	**None**
7.	**Course Basket**	**Discipline Elective (BTCE)**

8. Course Objectives: The course aim is to identify basic deficiencies of various soil deposits, to decide various ways and means of improving the soil and implementing techniques of improvement.

9. Course Outcomes:

CO1: Solve the field problems related to problematic soils and solve the problems using the above ground improvement techniques

CO2: Design drainage, dewatering for the field problems

CO3: Design and construct reinforced earth retaining structures.

CO4: Design of Soil reinforcement techniques

10. Curriculum Content:

Unit 1: Introduction to Engineering Ground Modification [6 Hours]

Need and objectives, Identification of soil types, In situ and laboratory tests to characterize problematic soils; Mechanical, Hydraulic, Physico-chemical, Electrical, Thermal methods, etc. and their applications.

Unit 2: Mechanical Modification [6 Hours]

Principles of soil densification – Properties of Compacted soil, Compaction control tests, Specification of compaction requirements, Blasting Vibrocompaction, Dynamic Tamping and Compaction piles.

Unit 3: Hydraulic Modification [8 Hours]

Objectives and techniques, traditional dewatering methods and their choice, Design of dewatering system, Electro-osmosis, Filtration, Drainage and seepage control with Geosynthetics, Preloading and vertical drains, Electro-kinetic dewatering.

Unit-4: Physical and Chemical Modification [6 Hours]

Modification by admixtures, Shotcreting and Guniting Technology, Modification at depth by grouting, Crack Grouting and compaction grouting, Jet grouting, Thermal Modification, Ground freezing.

Unit-5: Modification by Inclusions and Confinement [6 Hours]

Soil reinforcement, reinforcement with strip, bar, mesh, sheet and grid reinforced soil. In-situ ground reinforcement, ground anchors, rock bolting and soil nailing.

11.Text Books

1. Hausmann, M. R. (1990) – Engineering Principles of Ground Modifications, McGraw Hill publications
2. Mosley – Ground Improvement

12.References

1. Koerner, R. M (1994) – Designing with Geosynthetics – Prentice Hall, New Jersey
2. Jones C. J. F. P. (1985) – Earth Reinforcement and soil structures – Butterworths, London.
3. Xianthakos, Abreimson and Bruce - Ground Control and Improvement

13. Teaching and Learning Strategy

Following teaching strategy shall be considered:

- Field visit
- Collaborative study

1.	**Department offering the course**	**Civil Engineering**
2.	**Course Code**	**CEN454**
3.	**Course Title**	**CSI SAP000- Structural Analysis Program**
4.	**Credits (L: T:P: C)**	**0:0:4:2**
5.	**Contact Hours (L: T:P)**	**0:0:4**
6.	**Prerequisites (if any)**	**None**
7.	**Course Basket**	**Skill Enhancement Course**

8. **Course Summary:** This syllabus is designed to provide students with a comprehensive understanding of how to use CSI SAP2000 for structural analysis and design, enabling them to solve complex engineering problems and prepare for real-world structural engineering applications.

9. **Course Objective:** The course is designed to provide B.Tech students with a fundamental understanding and hands-on experience in using CSI SAP2000, a powerful software for structural analysis and design. The course will cover basic and advanced topics in structural modeling, analysis, and design using SAP2000, along with its application to real-world engineering problems.

10. **Course Outcomes:** Upon successful completion of the course, students will be able to:

CO1: Understand and apply the principles of structural analysis in SAP2000.

CO2: Model and analyze different types of structures, including beams, frames, trusses, and multi-story buildings.

CO3: Conduct static and dynamic analyses for various load cases.

CO4: Interpret and validate results for structural behavior.

CO5: Perform basic design of structural elements like beams, columns, and slabs using the software.

11. **Curriculum Content**

Unit 1: Introduction to Structural Analysis and SAP2000 (8L)

Overview of Structural Engineering: Types of structures and analysis methods. Introduction to CSI SAP2000: Software installation, interface, and basic functionalities. Basics of Structural Modeling: Understanding grids, units, coordinate systems, and geometry creation. Working with Different Types of Structural Models: Frames, slabs, beams, and trusses.

Structural Modeling in SAP2000

Creation of Structural Models: Modeling simple 2D and 3D structures. Defining Structural Components: Beams, columns, joints, supports, and boundary conditions. Material Properties: Defining concrete, steel, and other materials in SAP2000. Section Properties: Assigning cross-sectional properties to structural elements (e.g., rectangular, I-sections, circular). Modeling Loads: Point loads, distributed loads, temperature effects, and live loads.

Unit 2: Static Structural Analysis (8L)

Introduction to Analysis Types: Linear static analysis, P-delta effects, and stability analysis. Defining Load Cases: Dead load, live load, wind load, seismic load, etc. Load Combinations: Understanding and applying load combinations based on relevant building codes. Performing Static Structural Analysis: Running the analysis and interpreting results (displacements, reactions, internal forces). Post-Processing: Extracting and visualizing results from SAP2000's graphical outputs and tables.

Unit 3: Dynamic Structural Analysis (8L)

Introduction to Dynamic Analysis: Theory of vibration, natural frequencies, and modes of vibration. Seismic Analysis: Response spectrum analysis and time history analysis. Earthquake Load Analysis: Applying seismic loads using IS 1893 or other relevant codes. Dynamic Load Cases: Defining load cases for dynamic analysis and interpreting results such as displacement and acceleration. Modal Analysis: Understanding mode shapes, frequencies, and their implications for structural behavior.

Unit 4: Structural Design in SAP2000 (8L)

Overview of Structural Design: Introduction to the design of beams, columns, and slabs. Design Codes: Familiarity with relevant design codes (IS 456, IS 3370, AISC, Eurocodes, etc.). Beam Design: Design of reinforced concrete and steel beams for bending, shear, and torsion. Column Design: Axial load, bending, and combined stress design of reinforced concrete and steel columns. Slab Design: Design of one-way and two-way slabs under various load conditions. Application of Design in SAP2000: Running the design check within SAP2000 and interpreting the design results.

Unit 5: Advanced Structural Analysis Techniques (8L)

Nonlinear Static and Dynamic Analysis: Basics of nonlinear analysis in SAP2000. Pushover Analysis: Introduction to pushover analysis for seismic design. Analysis of Complex Structures: Analyzing multi-story buildings, bridges, and other complex structures. Multi-Model Analysis: Working with hybrid models and analyzing complex systems (e.g., combined frame-slab models).

Case Studies and Applications

Real-Life Structural Analysis Examples: Application of SAP2000 to solve real-world structural engineering problems. Analysis of High-Rise Buildings: Structural modeling and design of high-rise buildings under wind and seismic loading. Bridges and Foundations: Modeling and analyzing bridge structures, foundations, and retaining walls. Industrial Structures: Application to industrial buildings and frames.

Final Project and Presentations

Project Assignment: Students will be required to work on a final project involving the analysis and design of a structure using SAP2000. Project Topics: Design and analysis of residential buildings, commercial buildings, bridges, or any relevant structure. Project Deliverables: SAP2000 model files, analysis results, design calculations, and final report. Presentation: Students will present their projects to the class and faculty, showcasing their understanding and analysis.

12. Textbook:

1. Structural Analysis and Design with SAP2000 by Prof. Dr. Amit Kumar, 1st Edition, 2016, AMAZON INDIA.

13. References:

1. Structural Analysis by R.C. Hibbeler, 11th Edition, July 2023, PEARSON.COM, Pearson, ISBN: 978-0138026394

2. Design of Reinforced Concrete Structures by N. Krishna Raju, 4th Edition, May 2016, CBS Publishers & Distributors, ISBN: 978-9385915369

3. SAP2000 Documentation and Tutorials (CSI), SAP2000 V24, 2023, Computers and Structures, Inc. (CSI)

4. Theory of Elasticity by Timoshenko and Goodier, 3rd Edition, published in 1970, McGraw-Hill, ISBN: 978-0070858551

14. Software Requirements

1. CSI SAP2000 (Version 20 or above)
2. MATLAB or Excel for data analysis (optional)

15. Teaching and learning Strategy

Lectures: Conceptual lessons covering the theory behind structural analysis, software features, and techniques.

Hands-on Sessions: Practical sessions using SAP2000 where students will model, analyze, and design structures under various loading conditions.

1. Department offering the course	**Civil Engineering**
2. Course Code	**CEN461**
3. Course Title	**Geodesy and GPS Surveying**
4. Credits (L:T:P:C)	**3:0:0:3**
5. Contact Hours (L:T:P)	**3:0:0**
6. Prerequisites (if any)	**None**
7. Course Basket	**Minor (Geoinformatics)**

8. Course Summary: With the knowledge of this subject student can get the concept of Real time monitoring.

9. Course Objectives: To understand the basics of geodesy and global positioning system which will help to further broaden one's background in the general field of geomatics engineering.

10. Course Outcomes:

CO1- Students will understand the basics of old and modern photographic systems

CO2- Students will understand aerial photography, the principles and measurement procedures, 3-D mapping, height estimation, flight planning etc.

CO3 They will be able to generate traditional, modern digital, and Satellite Navigational System surveying data using high end equipment and devices

CO4- They will be able to analyse such data using powerful computer systems. They will also learn the uses and limitations of such systems

11. Curriculum Content:

Unit-I **6L**

Introduction: Introduction to geodesy & its development Earth and its size & shape, Earth, and its motions- annual, spin, precession, nutation, polar motion

Unit II **6L**

Earth, its gravity field and its atmosphere: anomaly, gravity potential, geoid & deflection to vertical, physical properties, wave propagation through atmosphere temporal variations, gravitational field of the atmosphere

Unit III **8L**

Introduction to GPS: its components, Instruments & processing software GPS signals GPS data collection, Planning & Methods, Pseudo range and carrier phase; Parameter Estimations

Unit IV **8L**

Global Navigational Satellite System: Introduction, Satellite constellation, GPS signals and data, Geo-positioning – Basic Concepts. GPS, NAVSTAR, GLONASS, Indian Regional Navigational Satellite System (IRNSS), Control Segment, Space Segments, User Segment, GPS Positioning Types- Absolute Positioning, Differential positioning

Unit V **8L**

GPS Surveying Methods and Accuracy: Methods-Static & Rapid Static, Kinematic-Real Time Kinematic Survey- DGPS-GPS Data Processing and Accuracy, Factors Affecting GPS Accuracy, Reference Station- Selection of Reference Station, Reference Station Equipment: GPS receiver, GPS antenna. Radio and its types, Radio Antenna

12.Textbooks:

1. Bomford, G., “Geodesy”, Clarendon Press, Oxford.
2. Hoffmann-Wellenhoff, B., “GPS Theory & Practice”, Springer.
3. Leick, A., “GPS Satellite Surveying”, John Wiley.

13.Reference Books:

1. Torge, W., “Geodesy: An Introduction”, Walter de Gruyter, Berlin.
2. Vanicek, Peter and Krakiwsky, E.J., “Geodesy: The Concepts”, Elsevier

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

1. Department offering the course	**Civil Engineering**
2. Course Code	**CEN462**
3. Course Title	**Basics of Photogrammetry**
4. Credits (L:T:P:C)	**3:0:0:3**
5. Contact Hours (L:T:P)	**3:0:0**
6. Prerequisites (if any)	**None**
7. Course Basket	**Minor (Geoinformatics)**

8. Course Summary: Basics of Photogrammetry covers the entire concepts of Aerial photography, Parallax, Stereoscope etc. To introduce basics and concepts of optics, Aerial photography acquisition and mapping from Aerial photographs.

9. Course Objectives: The "Basics of Photogrammetry" course offers essential insights into aerial photography, parallax, and stereoscope usage. Designed to build a solid understanding of optics, it covers the acquisition of aerial photographs and mapping techniques. Through practical applications and theoretical knowledge, students will learn to analyze and interpret aerial images, equipping them for impactful roles in surveying, cartography, and GIS. Enhance your expertise and contribute meaningfully to engineering and planning with this valuable opportunity.

10. Course Outcomes:

CO1- Photographic process and characteristics of tools used in photogrammetry.
CO2- Concepts of stereoscopy and geometry of various types of photographs
CO3- The process of planning photogrammetric operations
CO4- The use of stereo plotters in map preparation and orthophotomap generation

11. Curriculum Content:

UNIT I: Photogrammetry: 8L

Introduction, basic definitions, terrestrial photogrammetry, photo theodolite, horizontal and vertical angles from terrestrial photographs, horizontal position of a point from photographic

measurements, elevation of points by photographic measurements, determination of focal length.

UNIT II: Aerial Photogrammetry: 8L

advantages, vertical, tilted and oblique photographs, geometry of vertical photographs, scale of vertical photograph over flat and variable terrain, ground coordinates, computation of length of a line, computation of flying height, relief displacement, overlaps, flight planning, computation of required number of photographs for a given area, ground control in photogrammetry

UNIT III: Stereoscopy: 8L

Basics of stereoscopy, stereoscopes, uses, Binocular and Stereoscopic vision, Conditions for Stereovision, parallax. Basic elements in photographic interpretation, Height determination from stereo pairs - Parallax Equation, Ground Control

UNIT IV: Scale and Co-ordinate system: 8L

Scale, Geometry and Ground Coverage of Aerial Photographs, Area calculation & Flight Planning, Co-ordinate Systems used in Photogrammetry, Relief distortion and Tilt distortions, Rectification, Ortho Rectification, Height determination from single photograph, Plan metric map compilation, Digital Elevation Model (DEM), Digital ortho-photos.

UNIT V: Principles of digital photogrammetry: 8L

Hardware & software requirements, Image, measurement, Orientation procedure, Epipolar geometry, Aero triangulation, Block adjustment, Mosaics of DTM & ortho images.

12.Textbooks:

1. Paul. R Wolf., Bon A. DeWitt," Elements of Photogrammetry with Application in GIS" McGraw Hill International Book Co., 3rd Edition, 2000
2. E.M. Mikhail, J.S. Bethel, J.C. McGlone, "Introduction to Modern Photogrammetry", Wiley Publisher, 2001

13.Reference Books:

1. Gollfried Konecny, Geo information: Remote Sensing, Photogrammetry and Geographical Information Systems, CRC Press, 1st Edition, 2002.

2. Moffitt, F.H. and Mikhail, E.M., “Photogrammetry”, 3rd Ed., Harper and Row Publisher.
3. Luhmann, T., Robson, S., Kyle, S. and Beohm, J., “Close Range Photogrammetry and 3D Imaging”, Gruyter Inc.

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

1. Department offering the course	**Civil Engineering**
2. Course Code	**CEN463**
3. Course Title	**Thermal, Microwave and Hyperspectral Remote Sensing**
4. Credits (L:T:P:C)	**3:0:0:3**
5. Contact Hours (L:T:P)	**3:0:0**
6. Prerequisites (if any)	**None**
7. Course Basket	**Minor (Geoinformatics)**

8. Course Summary: This course focuses on understanding and analyzing thermal, microwave, and hyperspectral remote sensing data for engineering applications.

9. Course Objectives: Thermal, Microwave and Hyperspectral Remote Sensing covers the understanding of all three types of remote sensing. To provide enhanced knowledge on the use of thermal, microwave and Hyperspectral remote sensing data and their analysis for various engineering and other applications.

10. Course Outcomes:

CO1- Comprehend the basics of thermal, hyperspectral, microwave, LIDAR and UAV remote sensing.

CO2- Process and interpret thermal, hyper spectral, microwave, LIDAR datasets.

CO3- Utilize skills obtained for different applications of thermal, hyper spectral, microwave, LIDAR remote sensing.

11. Curriculum Content:

Unit 1 Introduction: 8L

Brief review of thermal and microwave remote sensing, their utility, merit and demerits. Introduction to spectral characteristics of remote sensing data. Optical radiation models. Summary of Visible to Shortwave region models. Thermal sensors and their characteristics.

Unit 2 Thermal Remote Sensing: 8L

Thermal infrared region models. Interpretation of thermal images day and night images. Emissivity consideration. Thermal inertia considerations. Factors affecting Analysis of thermal images. Estimation of land surface temperature from thermal images. Applications of thermal remote sensing.

Unit 3 Microwave Remote Sensing: 8L

Introduction to Microwave Remote Sensing Active and Passive Systems, Platforms and Sensors. Passive Microwave Systems Background, Mathematical formulation for microwave radiation and simulation, Measurement and analysis of Brightness Temperature, Applications in various fields- Oceanography and Meteorology. Active Microwave Systems: Basic principles of Radar, Radar Equation, Resolution, Range, Phase and Angular measurements, Microwave Scattering and its measurement, Relationships between Scene and Sensor parameters, Imaging systems, RAR and SAR. SAR Imagery—their characteristics and interpretation. Applications of microwave remote sensing.

Unit 4 SAR Interferometry: 8L

SAR Interferometry for DEM generation. Differential SAR Interferometry for surface displacement studies. Applications in land subsidence, landslide movements, glacier movements etc. Polarimetry in Radar Remote Sensing. Basic equations. Propagation of waves and wave polarization. HH, VV, HV and VH polarization data and their applications.

Unit 5 Hyperspectral Remote Sensing: 8L

Principles of Hyperspectral Remote Sensing, Spectral Cube, Airborne and space borne hyperspectral sensors. Smile effect and correct, instrument calibration geometric and spectral calibration, continuum removal, red edge and blue shift concepts Spectral mixing theory, waveform characterization, spectral mapping methods spectral feature filtering (SFF), Linear Spectral Unmixing (LSU), Mixture Tuned Matched Filtering (MTMF). Spectral Angle Mapper (SAM).

12.Textbooks:

1. Henderson, F.M. and Anthony, J.L., “Principles and Applications of Imaging Radar”, Manual of Remote Sensing, Vol.2. John Wiley.
2. Manual of Remote Sensing, Vol. 1 to 5, American Society of Photogrammetry and Remote Sensing.

13.Reference Books:

1. Schowengerdt, R. A., “Remote Sensing Models and Methods in Image Processing”, Academic Press.
2. Matzler C., “Thermal Microwave Radiation: Application for Remote Sensing”, Institute of Electrical Engineers (IEE).
3. Chang, Chein, I., “Hyperspectral Data Processing”, John Wiley and Sons.

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

1.	**Department offering the course**	**Civil Engineering**
2.	**Course Code**	**CEN464**
3.	**Course Title**	**Analytical and Digital Photogrammetry**
4.	**Credits (L:T:P:C)**	**3:0:0:3**
5.	**Contact Hours (L:T:P)**	**3:0:0**
6.	**Prerequisites (if any)**	**None**
7.	**Course Basket**	**Minor (Geoinformatics)**

8. **Course Summary:** Analytical and Digital Photogrammetry covers the understanding of various properties of analytical and digital photogrammetry and also of triangulation.

9. **Course Objectives:** Analytical and Digital Photogrammetry provides a thorough understanding of the essential properties of both analytical and digital photogrammetry, including triangulation. This course equips students with knowledge of photogrammetric sensors, orientation, geometric properties, and error correction. Students will analyze key outputs like maps, Digital Elevation Models (DEMs), and orthophotos, exploring their applications in cartography, GIS, and civil engineering. By completing this course, students will develop a practical skill set that integrates theoretical knowledge with real-world applications in photogrammetry.

10. **Course Outcomes:**

CO1- Introduction to photogrammetry & remote sensing Photogrammetric sensors & systems
CO2- Students will understand Photogrammetric orientation, geometric properties, system error and correction
CO3- Students will able to analyses Photogrammetric products: maps, DEMs orthophotos, Aerial surveying and planning, quality aspect
CO4- Students will understand Digital Images and digital matching techniques, Photogrammetry applications in cartography, GIS and civil engineering

11. **Curriculum Content:**

Unit-I Introduction: 8L

Historical development from conventional to analytical and digital photogrammetry. Applications of analytical and digital photogrammetry. Coordinate systems, condition equations, orthogonal transformation matrices and methods of constructions, Approximate orthogonal matrix, measurement of image coordinates from hard copy and soft copy, instruments

Unit II Digital image and their properties: 8L

Direct and indirect methods of acquisition of digital images- CCD, Digitizers and photogrammetric scanners, comparative merits, storage and compression of digital imagery, loss of data and image quality, corrections to observed image coordinates

Unit III Analytical Photogrammetry: 8L

Analytical orientation, relative, absolute and exterior orientation methods, Analytical plotter and its functioning, automatic image matching techniques- signal based and feature based matching, comparative merits and demerits

Unit IV Digital Photogrammetry: 8L

Digital correlation, least square matching, multipoint matching etc., Model formation using digital stereo pairs, Automatic generation of DEM, Digital orthophotos. Digital photogrammetric system- Potential, Capabilities and characteristics features, Design consideration, Add-on devices

Unit V Triangulation: 8L

Analytical aerial triangulation, Independent model triangulation, strip and block triangulation and adjustment, bundle block adjustment, various applications

12.Textbooks:

1. Ghosh, Sanjib K., “Analytical Photogrammetry”, Concept Publishing Co.
2. “Manual of Photogrammetry”, American Society of Photogrammetry

13.Reference Books:

1. Linder, Wilfried, “ Digital Photogrammetry”, Springer.
2. Egals, Yves and Kasser, Michel, “Digital Photogrammetry”, Taylor and Francis.

14.Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

1.	**Department offering the course**	**Civil Engineering**
2.	**Course Code**	**CEN465**
3.	**Course Title**	**Advanced Digital Image Processing**
4.	**Credits (L:T:P:C)**	**3:0:0:3**
5.	**Contact Hours (L:T:P)**	**3:0:0**
6.	**Prerequisites (if any)**	**None**
7.	**Course Basket**	**Minor (Geoinformatics)**

8. **Course Summary:** Advanced Digital Image Processing covers the various filtering techniques with knowledge of Digital Elevation Modelling.

9. **Course Objectives:** Advanced Digital Image Processing delves into powerful filtering techniques while providing a comprehensive understanding of Digital Elevation Modeling (DEM). This course equips you with essential skills in image enhancement and noise reduction, enabling you to significantly improve image quality. Furthermore, you'll explore the intricate process of creating and manipulating digital elevation models, highlighting their critical role in geographic information systems (GIS) and remote sensing applications.

10. **Course Outcomes:**

CO1- To develop a knowledge base and comprehensive set of related skills in image processing.
CO2- To put together a diverse collection of techniques to create a working application system.
CO3- To develop project management skills through a structured design and reporting process.

11. Curriculum Content:

Unit1 Introduction: 8L

Various types of images: PAN, Multispectral, hyperspectral and high resolution images, feature and intensity based image registration of images, open source image processing software and image data

Unit 2 Filtering techniques: 8L

Advanced spatial filtering techniques- spatial and frequency domain (e.g. Fourier, wavelets), texture images, image compression, pixel and sub pixel level target detection and classification, data fusion methods and application

Unit 3 DEM: 8L

DEM generation from stereo- satellite images, CARTOSAT DEM, SRTM DEM, ASTER DEM, parameter extraction

Unit 4 Modelling: 8L

Empirical modelling of biophysical parameters from multi and hyperspectral remote sensing data, 3D visualization of data, ANN, Fuzzy logic, Object based classification from satellite images

Unit 5 Applications: 8L

Applications of multi and hyperspectral remote sensing data in water resources, forestry, earth sciences, resource management and planning military target detection

12.Textbooks:

1. Ghosh, Sanjib K., "Analytical Photogrammetry", Concept Publishing Co.
2. "Manual of Photogrammetry", American Society of Photogrammetry

13.Reference Books:

1. Linder, Wilfried, " Digital Photogrammetry", Springer.
2. Egals, Yves and Kasser, Michel, "Digital Photogrammetry", Taylor and Francis.

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

1. Department offering the course	**Civil Engineering**
2. Course Code	**CEN466**
3. Course Title	**Modelling and Analysis of Geo-Spatial Data**
4. Credits (L:T:P:C)	**3:0:0:3**
5. Contact Hours (L:T:P)	**3:0:0**
6. Prerequisites (if any)	**None**
7. Course Basket	**Minor (Geoinformatics)**

8. Course Summary: Modelling and Analysis of Geo-Spatial Data covers the knowledge of coordinate transformation, error in data and finally the interpretation process.

9. Course Objectives: Modelling and Analysis of Geo-Spatial Data equips students with essential expertise in coordinate transformation, data error analysis, and interpretation methodologies. This course not only enhances your understanding of geospatial information but also empowers you to analyze and interpret data effectively, positioning you for success in the rapidly evolving field of geospatial technology.

10. Course Outcomes:

CO1- Understand the main methods for storing and encoding geospatial information in computer systems
CO2- Understand the basics of relational databases and SQL
CO3- Understand the principal spatial data types and be familiar with a variety of methods of spatial analysis as applicable to each.
CO4- Be able to implement these principles using the ORACLE RDBMS and ArcGIS.
CO5- Be able to undertake individual and group practical work, and write assignments within the specified parameters and to a professional standard

11. Curriculum Content:

Unit 1 Types of Geo-Spatial Data: 8L

Ratio, Categorical and Ordinal Data, Spatial and Non spatial Data, Vector and Raster data, Primary and secondary data, standardization of weights, Analytical Hierarchical process (AHP), Spatial decision support system

Unit 2 Coordinate transformations and Measurements and Analysis: 8L

2-D, conformal, Affine, projective coordinate transformation, 3-D conformal coordinate transformation, Map models and map projection systems. Sample versus population, graphical representation of geo-spatial data, measures of central tendency- mean, median, mode. Mean vector, measure of variation in data- variance covariance and correlation matrices

Unit 3 Error in Geo-spatial data and error modelling: 8L

Error Sources, Types of Errors-Gross, Systematic and Random Errors. Precision, Accuracy and Uncertainty. Errors in Geospatial data and measurements Propagation of Random Errors. Principles of Least Squares. Observation Equations. Systematic Formulation of the Normal Equations. Using Matrices to Form the Normal Equations. Least Squares Solution of Nonlinear Systems. Least Squares Fit of Points to a Line or Curve. Concept of Adjustment of Errors. Least Squares Adjustment Using Conditional Equations and Observation Equations

Unit 4 Confidence Intervals and Statistical Testing: 8L

Sampling Distributions. Sampling Schemes and Sample Sizes. Confidence Interval for the Mean: t Statistic. Confidence Interval for a Population Variance. Confidence Interval for the Ratio of Two Population Variances. Hypothesis Testing. Uses of Statistical Testing in Geo-Spatial Data Processing.

Unit 5 Uncertainty Modelling of Geo-Spatial Data: 8L

Uncertainties in various Geo-Spatial Data, Fuzzy set, Monte Carlo Simulations. Error Ellipse for Uncertainty Quantification

12.Textbooks:

1. Bossler, J. D., “Manual of Geospatial science and Technology”, Taylor and Francis
2. Freund, J.E., “Mathematical statistics”, Prentice Hall of India

13.Reference Books:

1. Law, A. M. and Kelton, W. D., “Simulation, Modeling and Analysis”, Tata McGraw Hill.
2. Mikhail, Edward M. and Gracie, Gordon, “Analysis and Adjustment of Survey Measurements”, Van Nostrand Reinhold.

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

1.	**Department offering the course**	**Civil Engineering**
2.	**Course Code**	**CEN467**
3.	**Course Title**	**Application of Data Analytics and Machine Learning tools**
4.	**Credits (L:T:P:C)**	**3:0:2:4**
5.	**Contact Hours (L:T:P)**	**3:0:2**
6.	**Prerequisites (if any)**	**None**
7.	**Course Basket**	**Minor (Geoinformatics)/ Minor (Earth System and Technology)**

8. Course Objective:

The objective of the course is to teach the students about various Multi-Criteria Decision-Making techniques, focusing on data management, data clustering, and gain knowledge on conducting surveys and data analytics

9. Course Outcome

At the end of the course, the student can:

CO1. Understand the concepts of fuzzy logic and Artificial Neural Network

CO2. Analyze Multi Criteria Decision Making Methods.

CO3. Understand big data characteristics and Applications.

CO4. Interpret various clustering techniques and classifications

10. Curriculum Content

Unit 1: Statistical Methods for Data Analysis 8L

Factors Influencing Selection of Statistical Methods, Type and distribution of the data, Concept of Parametric and Nonparametric Methods, Selection between Parametric and Nonparametric Methods Statistical Methods to Compare the Proportions, Various statistical methods

Unit 2: Multi-Criteria Decision-Making Methods 8L

Attribute weights, foundations, concepts, definitions, steps of MCDM, Analytical Hierarchical Process, Frequency Ratio Method, Weight of Evidence, Modified Information Value, Index of Entropy, Logistic regression

Unit 3: Introduction to Big-Data **8L**

Evolution of Big data - Best Practices for Big data Analytics - Big data characteristics - Validating - The Promotion of the Value of Big Data - Big Data Use Cases- Characteristics of Big Data Applications - Perception and Quantification of Value -Understanding Big Data Storage – A General Overview of High-Performance Architecture.

Unit 4: Introduction to Machine Learning **8L**

Concepts of machine learning, machine learning versus Deep learning, machine learning versus neural network, process of machine learning, machine learning methods, common machine learning algorithms, random forest (RF), decision tree (DT), k-nearest neighbor (kNN), support vector machine (SVM), Bayesian network (BN), Multilayer Perceptron (MLP), and deep learning models (DL)

Unit 5: Clustering and Classification **8L**

Advanced Analytical Theory and Methods: Overview of Clustering - K-means - Use Cases - Overview of the Method - Determining the Number of Clusters - Diagnostics - Reasons to choose and Cautions. Classification: Decision Trees - Overview of a Decision Tree - The General Algorithm - Decision Tree Algorithms - Evaluating a Decision Tree - Decision Trees in R – Naïve Bayes - Bayes‘ Theorem - Naïve Bayes Classifier.

11. Text Books:

a. John K. Taylor and Cheryl Cihon; Statistical Methods for Data Analysis, 2nd Edition, Chapman and Hall/CRC; 2nd edition (30 June 2020); Chapman and Hall/CRC, 978-0367578435

b. Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, John D. Kelleher, Brian Mac Namee and Aoife D’Arcy; The MIT Press; Illustrated edition (24 July 2015), 978-0262029445.

Reference Books:

a. Machine Learning for Beginners: Learn to Build Machine Learning Systems Using Python; Harsh Bhasin, 978-9389845426

b. Machine Learning for Absolute Beginners: A Plain English Introduction (Second Edition) by Oliver Theobald, 2nd Edition, Scatterplot Press; 2nd edition (June 21, 2017)

c. Machine Learning For Dummies by John Paul Mueller and Luca Massaron; For Dummies; 1st edition (May 11, 2016)

d. Data Mining: Practical Machine Learning Tools and Techniques" by Ian H. Witten, Eibe Frank, and Mark A. Hall, Morgan Kaufmann; 3rd edition (January 20, 2011)

12. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

1.	**Department offering the course**	**Civil Engineering**
2.	**Course Code**	**CEN468**
3.	**Course Title**	**Mini Projects**
4.	**Credits (L:T:P:C)**	**0:0:8:4**
5.	**Contact Hours (L:T:P)**	**0:0:8**
6.	**Prerequisites (if any)**	**None**
7.	**Course Basket**	**Minor (Geoinformatics)**

8. **Course Summary:** Mini projects in Remote Sensing and GIS courses can teach students how to use remote sensing and GIS to solve research problems.

9. **Course Objectives:** Mini projects in Remote Sensing and GIS courses can involve topics like image classification, machine learning, and enhancing satellite images. The goal of these courses is to teach students how to use remote sensing and GIS to solve real-time problems and research problems.

10. Course Outcomes:

CO1: Understand how to use remote sensing data and GIS techniques in various fields
CO2: Understand the application of remote sensing and GIS in solving research problems
CO3: Understand how to use remote sensing and GIS to enhance service delivery in areas like Disaster management, various Civil Engineering Projects, and many more.

11. **Course Curriculum:**

Not Defined. Depending on the project requirement

12. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

1.	**Department offering the course**	**Civil Engineering**
2.	**Course Code**	**CEN471**
3.	**Course Title**	**Structural Geology**
4.	**Credits (L:T:P:C)**	**2:0:2:3**
5.	**Contact Hours (L:T:P)**	**2:0:2**
6.	**Prerequisites (if any)**	**None**
7.	**Course Basket**	**Minor (Earth System and Technology)**

8. Course Summary: Structural Geology provides a comprehensive understanding of the deformation processes that shape the Earth's crust, including folding, faulting, and fracturing. Through theoretical study, laboratory exercises, and fieldwork, students gain insights into the formation and significance of geological structures.

9. Course Objectives: The primary objective of Structural Geology is to equip students with the knowledge and skills to recognize, interpret, and analyze geological structures. By understanding the processes behind these structures, students can unravel the Earth's dynamic history, assess geological hazards, and contribute to various fields such as resource exploration, engineering, and environmental management.

10. Course Outcomes:

On completion of this course, the students will be able to

C.O1-. Understand Weathering process
C.O2- Explain Rock behavior and Cartography
C.O3- Identify the importance of Rock Structure and analysis
C.O4- Analyze Shear zones in Rocks

11. Curriculum Content:

Unit 1 Weathering and Erosion 8L

Devi's cycle, Exogenous and endogenous processes shaping the earth. Transportation and deposition; Geological work of running water, wind, glaciers, seas and ground water; Diastrophism; Earthquakes and volcanoes, Introduction to Plate Tectonics

Unit 2 Behavior of rock 8L

Strength and Behavior of Rocks, Stress and Strain in rocks. Concept of Rock deformation & Tectonics. Forms of igneous intrusions - dyke, sill and batholith. Effects of folds and fractures on strata/ore bodies and their importance in exploration activities.

Unit 3 Cartography and Deformed Structures 8L

Interpretation of topographic maps; Attitude of planar and linear structures; Effects of topography on outcrops. Unconformities, folds, faults and joints - their nomenclature, classification and recognition. Principles of stereographic projection.

Unit 4 Principles of Structural Analysis 8L

Interference patterns in superposed folding and structural geometry in superposed folding. Behavior of lineations in superposed deformations. Use of foliations and lineations in tectonic analysis. Methods of constructing profiles of folds: Convolute and evolute methods, Concentric-arc method, Kink-style construction, Dip-isogon method, Down-plunge projection method

Unit 5 Shear Zones and their characteristics 8L

Analysis of shear zones: Different types, Shear zone rocks, Shear sense indictors. Balanced cross-sections of thrust-belts. Applications of balanced cross-sections. Analysis of fractures: Lineament-Array analysis and its significance for regional exploration Programme, Joint array Analysis and its significance, Fault-array Analysis.

11.Text Books:

1. "Structural Geology" by Haakon Fossen (2nd Edition, Publisher: Cambridge University Press, Year of Publication: 2016)
2. "Structural Geology of Rocks and Regions" by George H. Davis, Stephen J. Reynolds, and Chuck Kluth (3rd Edition, Publisher: Wiley, Year of Publication: 2011)
3. "Introduction to Structural Geology" by Patrice F. Rey and James R. Boles (Publisher: Wiley-Blackwell, Year of Publication: 2008)

4. "Principles of Structural Geology" by John Suppe (Publisher: Pearson, Year of Publication: 1985)
5. "Structural Geology" by Robert J. Twiss and Eldridge M. Moores (Publisher: W. H. Freeman, Year of Publication: 1992)

12.Reference Books:

1. "Analysis of Geological Structures" by Neville J. Price (3rd Edition, Publisher: Cambridge University Press, Year of Publication: 2019)
2. "Faulting and Magmatism at Mid-Ocean Ridges" edited by John M. Sinton, Larry M. Parson, and John A. Christie (Publisher: Springer, Year of Publication: 1991)
3. "Tectonics" by Eldridge M. Moores and Robert J. Twiss (Publisher: W. H. Freeman, Year of Publication: 1995)
4. "Brittle Deformation of Solid and Structures" by John G. Ramsay and Martin I. Huber (Publisher: McGraw-Hill, Year of Publication: 1983)
5. "Field Geology of High-Grade Gneiss Terrains" by Desmond Fitzgerald, Paul B. O'Sullivan, and Robert D. Dallmeyer (Publisher: Wiley, Year of Publication: 1991)

13. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

14. List of Experiments

1. Preparation of structural maps
2. Identification of folded structure in structural maps
3. Identification of faulted layers in structural maps
4. Field excursion

1.	**Department offering the course**	**Civil Engineering**
2.	**Course Code**	**CEN472**
3.	**Course Title**	**Ocean System Technology and Modeling**
4.	**Credits (L:T:P:C)**	**3:0:0:3**
5.	**Contact Hours (L:T:P)**	**3:0:0**
6.	**Prerequisites (if any)**	**None**
7.	**Course Basket**	**Minor (Earth System and Technology)**

8. Curriculum Content

Unit 1 General Introduction to Oceanography

Major expeditions, Ocean Floor Topography and terminology- Continental Shelf, Continental Slope, Continental Margin, Continental Rise, Submarine Canyons, Mid oceanic Ridges, Trenches, Abyssal Plains

Unit 2 Ocean Waves and Tides

Definitions and terms, wave theories, classifications; progressive waves, shallow water waves, seismic sea waves (Tsunami), wind waves, stationary waves, sea and swell, deep and shallow water waves, storm surges, Beaufort scale, spilling and breaking waves, Tides and tide generating forces, type of tides, tide currents, rip currents.

Unit 3 Physical and Chemical Properties of Sea Water

Salinity and chlorinity; temperature; thermal properties of sea water; density and stability, conductivity, viscosity, heat budget, colligative and other properties of sea water, residence time of constituents in sea water, properties of sea ice, transmission of sound, absorption of radiation. Constancy of its composition and factors affecting the composition, major and minor constituents, trace elements - artificial sea water - dissolved gases in sea water, CO2 system, dissolved Oxygen and Oxygen profile, Nutrients in the Ocean, their cycles and factors influencing their distribution: Nitrogen, phosphorus, silicate, manganese.

Unit 4 Ocean Currents

Definitions, direct and indirect forces acting on sea waters, surface currents, Coriolis effect, Ekman spirals, geostrophic currents, upwelling, sinking, circulation, El-Nino, La-Nina, significance of major ocean currents of the world measurement of currents.

Unit V Circulation of Water Masses

Formation and classification of water masses, General distribution of temperature, salinity and density, Identification of water masses, Salinity and temperature of surface layer (SST),

SSS,T-S diagram, water masses of Indian Oceans, Estuaries and estuarine circulation, Thermo haline circulation.

1.	**Department offering the course**	**Civil Engineering**
2.	**Course Code**	**CEN473**
3.	**Course Title**	**Plate Tectonic Dynamics**
4.	**Credits (L:T:P:C)**	**3:0:0:3**
5.	**Contact Hours (L:T:P)**	**3:0:0**
6.	**Prerequisites (if any)**	**None**
7.	**Course Basket**	**Minor (Earth System and Technology)**

8. Course Summary: Plate Tectonic Dynamics explores the movement and interactions of Earth's lithospheric plates, driving forces behind phenomena like earthquakes, volcanic eruptions, and mountain formation. Through theoretical study and practical analysis, students examine the processes shaping the Earth's surface and its geological features

9. Course Objectives: The course aims to provide students with a deep understanding of plate tectonics, its mechanisms, and its consequences for the Earth's surface. By studying plate boundaries, mantle convection, and associated geological features, students gain insights into the dynamic nature of the Earth's lithosphere. The objective is to equip students with the knowledge and analytical skills to interpret geological data, model plate movements, and understand the implications of plate tectonics for natural hazards, resource distribution, and the evolution of the Earth's surface over time.

10. Course Outcomes:

On completion of this course, the students will be able to

CO1-. Understand the concepts of plate tectonics

CO2- Explain the details of plates and margin

CO3- Identify the process of Orogenesis

CO4- Analyze the concepts of Indian Plate configuration

11. Curriculum Content:

Unit 1 Concepts of Plate tectonics and its mechanism 8L

Earth’s interior constitution and concept of lithospheric plate. Composition, heat flow, pressure and gravity variation in earth, Oceanic and continental types of Earth’s crust, their composition, mineralogy and major structural features

Unit 2 Details of Plates 8L

Types of plates, type of plate margins, Euler’s pole, sense of displacements of plates, Creative Plate Margin: Composition, seismic structure, magmatic activities, gravity variation, isostatic balance and evolution

Unit 3 Detail concepts of Plate Margin 8L

Conservative Plate Margin: Transform and transcurrent faults and plate motions, seismicity, structure and evolution. Different structure associated with transpression and transtension environments, Destructive Plate Margins: Surface manifestations, geophysical and geological characteristics, sedimentological, metamorphic and magmatic characteristics, isostatic balance, gravity variation, thermal structure

Unit 4 Orogenesis 8L

Plate tectonics and mountain building processes, orogeny and epiorogeny, Fault plane solution, Concept of plate tectonics in mineralization and hydrocarbon exploration: Types of plate setting and basin formation, mineralization in different plate settings, Magmatism and metamorphism in plate tectonics: Different types of plate setting and igneous activities, Volcanoes and their products, metamorphism and its products in different plate boundaries

Unit 5 Indian Plate configuration and Neotectonism 8L

Indian Plate: Configuration and characters of Indian plate margins; Himalayan orogeny and tectonic models; Indian seismicity, Neotectonism: Identification of paleo and neotectonic features. Surficial expression of Neotectonism and its effect on geomorphology, Active fault mapping

12.Textbooks:

1. Kearey,P., Klepeis Vine, F. J., Global Tectonics. John Wiley & Sons Ltd. UK 2013
2. Condie, K.C., Plate Tectonics and Crustal Evolution, Butterworth-Heinemann 2003
3. Summerfield, M. A., Geomorphology and Global Tectonics. John Wiley & Sons Ltd. UK 2000

13.Reference Books:

1. Davies, G.F., "Dynamic Earth: Plates, Plumes and Mantle Convection", Cambridge 2000
2. Tomecek, S.M., Plate Tectonics, Chelsea House, New York 2009
3. Frisch, W.; Meschede, M., and Blakey, R. Plate Tectonics: Continental drift and mountain building. Springer 2011
4. The Solid Earth, An Introduction to Global Geophysics By C. M. R. Fowler, Connie May Fowler, Clarence Mary R. Fowler ‘Cambridge University Press, 2005

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

1.	**Department offering the course**	**Civil Engineering**
2.	**Course Code**	**CEN474**
3.	**Course Title**	**Geochemistry**
4.	**Credits (L:T:P:C)**	**3:0:0:3**
5.	**Contact Hours (L:T:P)**	**3:0:0**
6.	**Prerequisites (if any)**	**None**
7.	**Course Basket**	**Minor (Earth System and Technology)**

8. Course Summary: This subject includes the study of different ground water phenomenon.

9. Course Objectives: The main aim of this course is to introduce students to applications of chemical concepts to predict the outcome of geologic processes and use of chemical data to solve applied, real-world problems; orient students to the current status of numerous chemical analysis techniques commonly used in the field of geochemistry; provide students with opportunity to discuss about their research topics in terms of geochemistry.

10.Course Outcomes:

CO1: Understand geochemical concepts operating within various spheres in the dynamic earth system.

CO2: Chemical analysis various ore minerals and its applications to mining industries.

CO3: Analysis of various pollutants in various ecosystems.

CO4: Increase in the curiosity about events in the universe and its origin.

11.Curriculum Content

Unit 1 8L

Gibbs phase rule, one component system (water and sulphur), Goldschmidt's Mineralogical phase rule

Unit 2 8L

The states of matter, the crystalline state, principles of crystal structure, formation of crystal, lattice energy of crystals, radius ratio, coordination number, structure of Sodium Chloride, Cesium Chloride, Zinc Sulphide. Brief idea of radii of common ions in rock forming minerals. General rules of the three dimensional structure with the help of solid geometry

Unit 3 8L

Chemistry of carbon compounds, General characteristics of organic compounds, classification of organic compounds, homologous series, empirical and molecular formula of organic compound.

Unit 4 8L

Colloids-Definition, electrical, mechanical and optical properties of colloids, origin of charge, kinds of colloidal system, silica as chemical sediment, clay minerals as colloids

12.Text Books:

1. Brian Mason and C.B. Moore - Principles of Geochemistry
2. H.H. Read (ed.) - Rutley's Elements of Mineralogy

13.Reference Books:

1. Krauskopf - Introduction to Geochemistry
2. Rollinson, H.R., 1993. Using geochemical data: Evaluation, Presentation, and Interpretation. Longman.

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

1.	**Department offering the course**	**Civil Engineering**
2.	**Course Code**	**CEN475**
3.	**Course Title**	**Mini Projects**
4.	**Credits (L:T:P:C)**	**0:0:8:4**
5.	**Contact Hours (L:T:P)**	**0:0:8**
6.	**Prerequisites (if any)**	**None**
7.	**Course Basket**	**Minor (Earth System and Technology)**

8. **Course Summary:** Mini projects aim to prepare students with the skills, knowledge, and awareness necessary to address global environmental challenges and to contribute meaningfully to the field of Earth System Science.

9. **Course Objectives:** Mini projects in an Earth System Science (ESS) course provide a hands-on approach to understanding Earth's interconnected systems. They combine theory with real-world applications, encouraging students to analyze data, explore natural and human system interactions, and propose sustainable solutions to environmental challenges. Through these projects, students develop essential skills and appreciate the interdisciplinary nature of ESS.

10. Course Outcomes:

CO1: Understanding the interaction between climate systems and human activities in reference to various domains

CO2: Developing skills in data analysis and interpretation of large datasets.

CO3: Demonstrating the ability to model various trends related to climate change, Biodiversity, natural disaster, water quality management, and their societal implications.

11. **Course Curriculum:**

Not Defined. Depending on the project requirement

12. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.