Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. (Civil Engineering)

STUDY SCHEME 2024 B.TECH. (CIVIL ENGINEERING)

Sem	Theory/ Practical	Course Category	Course Code	Course Name	L	T	P	Credits	CA Marks	ESE Marks	Total Marks
3	T	ESC	ESCE101	Solid Mechanics	3	1	0	4	40	60	100
3	T/P	PCC	CCE101	Building Material and Testing	3	0	2	4	90	60	150
3	T/P	PCC	CCE102	Environmental Engineering - I	3	0	2	4	90	60	150
3	T/P	PCC	CCE103	Fluid Mechanics	3	1	2	5	90	60	150
3	T	BSC	BSCE101	Probability and Statistics	4	0	0	4	40	60	100
3	P	PR	SMCE101	Seminar and Technical Report Writing for Engineers	0	0	2	1	50	0	50
3	P	INT	TRCE101	Training-I	-	-	-	1	60	40	100
3	T	HMSC	HSMC103	Business Essentials for Engineers	2	0	0	2	40	60	100
3	T	MNC-AU	MCCE101	Environmental Sciences and Sustainability	2	0	0		50	0	50
3	T	MPD		Mentoring and Professional Development	1	0	0	-	-	-	-
4	T/P	PCC	CCE104	Transportation Engineering	3	0	2	4	90	60	150
4	T/P	PCC	CCE105	Surveying and Geomatics	3	0	2	4	90	60	150
4	T/P	PCC	CCE106	Environmental Engineering - II	3	0	2	4	90	60	150
4	T	PCC	CCE107	Hydraulic Engineering	3	0	0	3	40	60	100
4	T/P	PCC	CCE108	Structural Analysis - I	3	1	2	5	90	60	150
4	T	MPD	MPD102	Mentoring and Professional Development	0	0	1	1	100	0	100
4	T	MNC-AU	MC101	Indian Constitution	2	0	0		50	0	50
4	T	HMSC	HSMC104	Universal Human Values: Understanding Harmony	2	0	0	2	40	60	100
5	T	PCC	CCE109	Structural Design -I	3	1	0	4	40	60	100
5	T/P	PCC	CCE110	Geotechnical Engineering	3	0	2	4	90	60	150
5	T	PCC	CCE111	Structural Analysis-II	3	1	0	4	40	60	100
5	T	PCC	CCE112	Irrigation Engineering	4	0	0	4	40	60	100
5	T	PEC	ECE10x	Elective - I	4	0	0	4	40	60	100

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Sem	Theory/ Practical	Course Category	Course Code	Course Name	L	T	P	Credits	CA Marks	ESE Marks	Total Marks
5	P	INT	TRCE102	Training-II	-	-	-	1	60	40	100
5	T	PCC	CCE113	Construction Engineering and Project Management	3	0	0	3	40	60	100
5	T	MNC-AU	MC102	Essence of Indian Knowledge Tradition	2	0	0		50	0	50
5	P	ESC	ESCE102	Design Thinking	0	0	2	1	50	0	50
5	T	MPD		Mentoring and Professional Development	1	0	0	-	-	-	-
6	T/P	PCC	CCE114	Structural Design -II	3	1	2	5	90	60	150
6	T/P	PCC	CCE115	Foundation Engineering	3	1	2	5	90	60	150
6	T	PCC	CCE116	Estimation and Costing	3	0	0	3	40	60	100
6	T	PEC	ECE20x	Elective - II	4	0	0	4	40	60	100
6	T	PEC	ECE30x	Elective - III	4	0	0	4	40	60	100
6	P	PR	PRCE101	Minor Project	0	0	2	1	60	40	100
6	T	PR	FSCE101	Employability and Career Development	2	0	0	2	40	60	100
6	T	ESC	ESC106	Entrepreneurship and Startups	3	0	0	3	40	60	100
6	T	MNC	MC103	Disaster Management and Preparedness	2	0	0		50	0	50
6	T	MPD	MPD103	Mentoring and Professional Development	1	0	0	1	100	0	100
7	T	PEC	ECE40x	Elective-IV (Through MOOCs)	3	0	0	3	40	60	100
7	T	MOPEC	OCE40X	Open Elective - I	3	0	0	3	40	60	100
7	T	MOPEC	OCE40Y	Open Elective - II	3	0	0	3	40	60	100
7	T	MOPEC	OCE40Z	Open Elective - III	3	0	0	3	40	60	100
7	P	PR	PRCE102	Major Project	0	0	6	3	120	80	200
8	P	INT	TRCE4103	Industrial Training	0	0	24	12	450	150	600
8	T	MPD	MPD104	Mentoring and Professional Development	1	0	0	1	100	0	100

Program Elective Details

Elective - I		Elective – II		Elective – III	
Course Code	Course Name	Course Code	Course Name	Course Code	Course Name

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ECE101	Masonry Structures	ECE201	Seismic Design of RC buildings	ECE301	Bridge Engineering
ECE102	Numerical Methods in Civil Engineering	ECE202	Matrix methods of Structural Analysis	ECE302	Industrial Structures
ECE103	Repairs and Rehabilitation of Structures	ECE203	Pre-stressed Concrete	ECE303	Design of Timber structures
ECE104	Engineering Geology	ECE204	Reinforced Earth	ECE304	Design of Concrete Structures
ECE105	Ground Improvement Techniques	ECE205	Geometric Design of Highways	ECE305	Stability Analysis of Slopes
ECE106	Pavement Materials	ECE206	Building Infrastructures and Construction Practices	ECE306	Soil Dynamics
ECE107	Solid Waste Management	ECE207	Industrial Wastewater Management and Reuse	ECE307	Pavement Design
ECE108	Environmental Impact Assessment and Life Cycle Analysis	ECE208	Hydrology and Dams	ECE308	Air Pollution Control
ECE109	Environmental Risk Assessment	ECE209	Groundwater Hydrology and Recharge	ECE309	Environmental Remote Sensing and GIS
ECE110	Circular Economy and Resource Recovery			ECE310	Environmental Quality Modeling
				ECE311	Urban Hydrology and Hydraulics

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. (Civil Engineering)

Course Code: ESCE101
Course Title: Solid Mechanics

Programme: B.Tech.	**L:** 3, **T:**1, **P: 0**	**Credits:** 4
Semester: 3	**Theory/Practical:** Theory	**Teaching Hours:** 45(L)+15(T)+0(P)= 60 Hours
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical/Design problems in ESE: 80%		
Duration of End Semester Examination (ESE): 3 Hours		
Course Type: Core Course		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: Non-programmable Scientific Calculator

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Identify and apply material properties of solids in calculations and analysis
2	Summarize the different types of deformations and how they relate to stress and strain
3	Calculate stresses and strains in various structural elements under different loading scenarios
4	Draw shear force and bending moment diagrams
5	Apply different failure theories to predict failure
6	Interpret analysis results to draw meaningful conclusions specific to response of solids

CONTENT

Part A

Unit 1: **7(L) hrs**

Rigid and deformable solids – physical and strength properties; Concept of force – response of solids, stress-strain diagram of ductile and brittle materials; Principles of statics and equilibrium to analyze forces acting on solid bodies – reactions, shear force and bending moment, use of free body diagrams; Concept of strength and stiffness

Unit 2: **15(L) hrs**

Internal forces and deformations in solids – stress and strain; Constitutive relations – Hooke's law; Method of section for evaluating internal forces; Stress – normal and shear stress; Strain – normal and shear strains; Transformation of plane stress and strain, principal stresses and strains; Combined stress – use of Mohr's circle; Principle of superposition and its limitations; Failure under different stress states; Failure criteria to predict safe loads – Mohr-coulomb theory, maximum principal stress theory, Maximum shear tress theory.

Part B

Unit 3: **15(L) hrs**

Bending equation and applications; centroid and section modulus of various cross-sectional shapes including rectangular, circular, I/T shapes, channel, angle, flitched beam section; Bending and shear stress in different beams sections – computation and plotting

Unit 4: **8(L) hrs**

Understanding the phenomenon of buckling in columns, including Euler's formula; Analyzing stresses in thin-walled pressure vessels like cylinders and spheres; Torsion equation, applications to circular shafts – solid and hollow

Books

1. Statics and Mechanics of Materials by R.C. Hibbeler
2. Strength of Materials by S.P. Timoshenko
3. Strength of Materials by R.K. Rajput
4. Fundamentals of Solid Mechanics by M L Gambhir
5. Strength of Materials by R. Subramanian
6. Engineering Mechanics of Solids by E. P. Popov

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. (Civil Engineering)

Course Code: CCE101
Course Title: Building Material and Testing

Programme: B.Tech.	**L:** 3 **T:** 0 **P:** 2	**Credits:** 4
Semester: 3	**Theory/Practical:** Theory	**Teaching Hours:** 45(L) + 0(T) + 30(P)= 75 Hours
Total Max. Marks: 150	**Continuous Assessment (CA) Marks:** 90	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical/Design problems in ESE: 10%		
Duration of End Semester Examination (ESE):3 Hours		
Course Type: Core Course		

Prerequisites: NIL

Additional Material Allowed in ESE: Non-programmable Scientific Calculator

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Demonstrate the role of materials in building construction
2	Identify appropriate building material for construction
3	Select and apply suitable material testing procedures/techniques
4	Write technical Laboratory report
5	Interpret the test reports for selection of suitable material and compliance
6	Utilize the relevant information from the standards and guidelines

Contents

Part A

Unit 1: **(8L) hrs**

Material – definition, classifications (engineering, non-engineering and structural, non-structural), types (brittle, ductile, composites and cementitious materials, etc.); Desirable properties and specifications for building materials; Selection of appropriate materials during engineering design & construction.

Unit 2: **(14L) hrs**

Concrete, bricks, steel, stones, timber – Composition/ constituent materials, production, and applications; Material microstructure, load-deformation response, effect on the strength and other material properties like toughness, water absorption, permeability; Characteristics strength, determination and its reporting

Part B

Unit 3: **(10L) hrs**

Other materials – Paint, Varnish, Bitumen and asphaltic materials; Water-proofing materials; Geo-textiles; Carbon composites; types and uses; Selection of suitable material in building construction; Methods of application.

Unit 4: **(5L) hrs**

Quality control - Sampling, Acceptance criterion, Code of practice and guidelines for different building materials such as Cements; Aggregates; Admixtures; Concrete, Bricks, Steel, Timbers.

Unit 5: **(8L) hrs**

Different equipment, devices, and instruments to characterize the material response/ behavior; Current testing technology (displacement-controlled and load controlled) and its selection for capturing the response of the material; Documenting the experimental program, including the test procedures, collected data, method of interpretation and final results; Use of test data/ testing reports in the material selection for various civil engineering projects /construction

Part C

(To be conducted in laboratory as per the relevant BIS codes)

Tests on cement– Fineness, Consistency, Setting time, Soundness, Specific gravity, Compression strength
Tests on aggregates (fine and coarse) – Specific gravity, Bulk Density, Fineness Modulus, Moisture content, Water Absorption, Bulking of sand
Tests on concrete– Slump, Compressive strength (Cube and Cylinder), Split Tensile strength, Flexural strength, Abrasion resistance, and tests for self-compacting concrete
Tests on steel – Elongation, Yield strength, Ultimate strength, Impact strength, Weight
Test on timber – Flexural strength, Unit weight
Test on Bricks – Dimensions, Water absorption, Efflorescence, Crushing strength

Books

- Building Construction Handbook by Chudley & Greeno (2006), (6th ed.), R. Butterworth Heinemann
- Highway Materials and Pavement Testing by Khanna & Justo, Nem Chand & Bros
- Structural Materials by Singh H., Springer
- Mechanical Testing of Engineering Materials by Kyriakos Komvopoulos
- Mechanical Behavior of Materials by E.N. Dowling, Prentice Hall International Edition
- Concrete: Microstructure, Properties and Materials by Mehta, P K and Monteiro P J M, Tata McGraw Hill
- Properties of Concrete by A. M. Neville, Prentice Hall
- Concrete Technology by M. S. Shetty, S. Chand & Co.
- Concrete Technology by M. L. Gambhir, Tata McGraw Hill Publishers, New Delhi
- Concrete Technology by A. R. Santha Kumar, Oxford University Press, New Delhi
- Applicable BIS and IRC code of practice/ guidelines specific to the listed materials

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. (Civil Engineering)

Course Code: CCE102
Course Title: Environmental Engineering-I

Programme: B.Tech.	**L:** 3 **T:** 0 **P:** 2	**Credits:** 4
Semester: 3	**Theory/Practical:** Theory	**Teaching Hours:** 45(L) + 0(T) + 30(P) = 75 Hours
Total Max. Marks: 150	**Continuous Assessment (CA) Marks:** 90	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 40%		
Duration of End Semester Examination: 3 Hours		
Course Type: Core Course		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: Scientific Calculator

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Explain the significance of environmental engineering and the fundamentals of water quality, sources, and standards as per BIS and WHO.
2	Estimate and project future population and corresponding water demand using standard engineering forecasting methods.
3	Design the working of conveyance systems suitable for different water sources and terrain conditions.
4	Design various physico-chemical treatment processes involved in making water potable and components of a water distribution network.
5	Analyze water distribution networks using modern software and computational tools like EPANET and watergems.
6	Conduct experiments adopting standard procedures and characterize various water samples.

Contents

Part-A

Unit-1: Introduction to Environmental Engineering and Water Supply (8L) hrs
Importance of Environmental Engineering in Civil Engineering, Role of clean water in public health and sustainable development, Sources of water: Surface water and Groundwater, Water quality parameters and their significance (physical, chemical, biological), Water quality standards: BIS and WHO.

Unit-2: Water Demand and Population Forecasting (6L) hrs
Types of water demand: Domestic, Industrial, Commercial, Firefighting, etc., Factors affecting water demand, Methods of population forecasting, Per capita demand and design period.

Unit-3: Collection and Conveyance Systems (9L) hrs
Types of intake structures: River, canal, reservoir etc., Water conveyance: Gravity and pumping systems, Design of rising mains and transmission pipelines, Pipe materials and joints.

Part-B

Unit-4: Water Treatment Processes (9L) hrs

Objectives of water treatment, Treatment flowcharts for surface and groundwater, Design of treatment units: Screening, Aeration, Water softening, Sedimentation, Sedimentation aided with coagulation, Filtration (slow sand, rapid sand, mixed media filters), Disinfection, miscellaneous treatments.

Unit-5: Distribution Systems and Appurtenances (7L) hrs

Types of distribution systems: Gravity, Pumping, Combined, Distribution reservoirs, Methods of distribution: Layout, design, suitability, Appurtenances in distribution systems, Detection and prevention of water wastage in distribution system.

Unit-6: Design of Water Supply Systems using Modern Tools (6L) hrs

Introduction to design software: EPANET, WaterGEMS etc., Application of software in modeling and simulation of water distribution networks, Case studies using software (basic overview and demonstration-based learning), Role of GIS and remote sensing in water supply systems planning.

Laboratory Work

Experiment No.	Experiment Title
1	Determination of pH value of a water sample.
2	Determination of Turbidity of a water sample
3	Determination of Hardness - total, calcium and magnesium hardness of a water sample.
4	Determination of solids - total, dissolved and suspended solids of a water sample.
5	Determination of alkalinity of a water sample.
6	Determination of chlorides content of a water sample.
7	Determination of sulphates content of a water sample.
8	Determination of bacteriological quality of a water sample
9	Design/Analysis of water distribution networks using EPANET, Water Gems etc.

Text Books

1. S.K. Garg, “Environmental Engineering – Vol. I: Water Supply Engineering", Khanna Publishers.
2. B.C. Punmia, Ashok Jain, Arun Jain, "Water Supply Engineering", Laxmi Publications
3. Howard S. Peavy, Donald R. Rowe & George Tchobanoglous, “Environmental Engg.”, McGraw Hill.
4. P. Aarne Vesilind, Susan M. Morgan, "Introduction to Environmental Engineering", Cengage Learning.
5. Mackenzie L. Davis, “Water and Wastewater Engineering- Design Principles and Practice”-McGraw-Hill Education.
6. Viessman Jr, Hammer J. M, Perez, E.M, and Chadik, P. A, Water Supply and Pollution Control, PHI Learning.

Reference Books

1. Hammer, M.J. and Hammer, M.J. Jr., “Water and Wastewater Technology”, PHI Learning
2. “Manual on Water Supply and Treatment -1999”, Central Public Health and Environmental Engineering Organisation, Govt. of India.
3. American Water Works Association (AWWA), Principles and Practices of Water Supply Operations Series,” AWWA.
4. James Edzwald, “Water Quality and Treatment- A Handbook on Drinking Water”, American Water Works Association.
5. Bentley Systems, Thomas M Walski, “Advanced Water Distribution Modeling and Management,” Bentley Institute Press.
6. Standard Methods for the Examination of Water and Waste Water, American Public Health Association, American Water Works Association, Water Environment Federation, 2023.

Online Learning Materials

1. https://www.epa.gov/water-research/epanet accessed on 14/05/2025
2. https://education.bentley.com/LearningPaths/guided-learningpaths-310579 accessed on 14/05/2025
3. https://www.udemy.com/course/water-supply-system-design/ accessed on 14/05/2025
4. https://www.udemy.com/course/the-complete-course-in-water-and-wastewater-treatment/ accessed on 14/05/2025
5. https://www.edx.org/xseries/delft-university-of-technology-water-management accessed on 14/05/2025
6. https://www.youtube.com/playlist?list=PLlQdh3107nrtDcqv25wkUPcHITh8_kLGm accessed on 14/05/2025

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Water Supply Engineering	Prof. Manoj Kumar Tiwari	IIT Kharagpur	https://nptel.ac.in/courses/105105201 accessed on 14/05/2025
2	Introduction to Environmental Engineering and Science - Fundamental and Sustainability Concepts	Prof. Brajesh Kumar Dubey	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc25_ge17/preview? accessed on 14/05/2025
3	Water and Wastewater Engineering	Dr. P Bose	IIT Kanpur	https://nptel.ac.in/courses/105104102 accessed on 14/05/2025
4	Water Quality Management Practices	Prof. Gourav Dhar Bhowmick	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc25_ag12/preview accessed on 14/05/2025
5	Water and waste water treatment	Prof. Bhanu Prakash Vellanki	IIT Roorkee	https://onlinecourses.nptel.ac.in/noc25_ce63/preview accessed on 14/05/2025
6	Rural Water Resources Management	Prof. Pennan Chinnasamy	IIT Bombay	https://onlinecourses.nptel.ac.in/noc25_ge31/preview accessed on 14/05/2025
7	Water and Waste Water Engineering	Prof. C. Venkobachar, Prof. Ligy Philip, Prof. B.S. Murty	IIT Madras	https://nptel.ac.in/courses/105106119 accessed on 14/05/2025

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. (Civil Engineering)

Course Code: CCE103
Course Title: Fluid Mechanics

Programme: B.Tech.	**L:** 3 **T:**1 **P:**2	**Credits:** 5
Semester: 3	**Theory/Practical:** Theory	**Teaching Hours:** 45(L)+15(T)+30(P) = 90 Hours
Total Max. Marks: 150	**Continuous Assessment (CA) Marks:** 90	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 70%		
Duration of End Semester Examination (ESE): 3 Hours		
Course Type: Core Course		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: Scientific Calculator

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Define fundamental fluid properties, behavior, and terminology.
2	Calculate pressure in pipes, hydrostatic forces on various surfaces, and the stability of floating bodies.
3	Analyze various types of fluid flow and their characteristics.
4	Design pipe networks to meet specified hydraulic and operational requirements.
5	Apply dimensional analysis to derive relationships among fluid parameters.
6	Demonstrate the validity of fluid mechanics theorems and determine performance constants of hydraulic devices through experimentation.

Contents

Part-A

Unit-1 Basic concept and Definitions **5(L) hrs**

Distinction between a fluid and a solid; Density, Specific weight, Specific gravity, Kinematic and dynamic viscosity; variation of viscosity with temperature, Newton law of viscosity; vapour pressure, boiling point, cavitation; surface tension, capillarity, Bulk modulus of elasticity, compressibility.

Unit-2 Fluid statics **10(L) hrs**

Fluid Pressure: Pressure at a point, Pascals law, pressure variation with temperature, density and altitude. Piezometer, U-Tube Manometer, Single Column Manometer, U-Tube Differential Manometer, Micromanometers. pressure gauges, Hydrostatic pressure and force: horizontal, vertical and inclined surfaces. Buoyancy and stability of floating bodies.

Unit-3 Fluid kinematics **6(L) hrs**

Classification of fluid flow: steady and unsteady flow; uniform and non-uniform flow; laminar and turbulent flow; rotational and irrotational flow; compressible and incompressible flow; ideal and real fluid flow; one-, two- and three-dimensional flows; Stream line, path line, streak line and stream tube; stream function, velocity potential function. One-, two- and three -dimensional continuity equations in Cartesian coordinates

Part-B

Unit-4 Fluid dynamics **12(L) hrs**

Surface and body forces; Equations of motion - Euler's equation, Bernoulli's equation – derivation; Energy Principle; Practical applications of Bernoulli's equation, venturimeter, orifice meter and pitot tube; Momentum principle; Forces exerted by fluid flow on pipe bend; Vortex Flow – Free and Forced.

Unit -5-Dimensional Analysis and hydraulic similitude **6(L) hrs**

Definitions of Reynolds Number, Froude Number, Mach Number, Weber Number and Euler Number; Buckingham's π-Theorem, Or Dimensional homogeneity, Rayleigh method, Buckingham's Pi method and other methods. Dimensionless groups. Similitude, Model studies, Types of models. Application of dimensional analysis and model studies to fluid flow problem.

Unit-6 Flow through pipes **6(L) hrs**

Loss of head through pipes, Darcy-Wiesbatch equation, minor losses, total energy equation, hydraulic gradient line, Pipes in series, equivalent pipes, pipes in parallel, flow through laterals, flows in dead end pipes, siphon.

Part-C

Laboratory Work: To be conducted in fluid mechanics lab

Experiment No.	Experiment Title
1	To study of pressure measuring devices as piezometer, U-tube manometer, and pressure gauges.
2	To verify Bernoulli's Theorem.
3	To determine the meta centric height of a Floating Body under different condition.
4	To determine the coefficient of discharge of Venturimeter.
5	To determine the coefficient of discharge of Orifice Meter
6	To determine the coefficient of friction for different diameter pipes.
7	To estimate velocity of fluid in pipe using pitot tube.
8	To estimate the minor losses as energy loss in pipe bend.
9	To estimate the minor losses as energy loss in sudden contraction and sudden enlargement in pipe
10	To determine the coefficient of discharge on rectangular notches.
11	To determine the coefficient of discharge on V-notches
12	To verify Storke's law in laboratory.

Text Books

1. C.S.P. Ojha, R. Berndtsson and P. N. Chadramouli "Fluid Mechanics and Machinery", Oxford University Press, 2010
2. P M Modi and S M Seth, "Hydraulics and Fluid Mechanics", Standard Book House, 22nd edition, 2019.
3. K. Subramanya, "Theory and Applications of Fluid Mechanics", Tata McGraw Hill,3rd edition, 2013.
4. R.L. Daugherty, J.B. Franzini and E.J. Finnemore, "Fluid Mechanics with Engineering Applications" International Student Edition, Mc Graw Hill, 10th edition ,2001

Reference Books

Here are some popular textbooks for Fluid Mechanics in Civil Engineering:

1. Frank M. White "Fluid Mechanics": Tata McGraw-Hill, 9th edition, 2021
2. R. K. Bansal "Fluid Mechanics and Hydraulics", Laxmi Publications,11th edition, 2023.
3. Cengel and Cimbala "Fluid Mechanics", McGraw-Hill Education, 5th edition, 2024.
4. P. N. Modi, "Hydraulics and Fluid Mechanics", Standard Book House, 23rd edition, 2022.
5. N. S. Govinda Rao "Fluid Mechanics for Civil Engineers" BS Publishers & Distributors Pvt Ltd,12th edition, 2021.

Online Learning Materials

1. https://www.youtube.com/watch?v=JYPITI0t_wM
2. https://www.youtube.com/watch?v=oZMEWpR9Vbw
3. https://www.youtube.com/watch?v=QApXrTUwQ14
4. https://www.youtube.com/watch?v=KnZIGa1PmCg

5. https://www.youtube.com/watch?v=Ww6P-XSRNkE
6. https://www.youtube.com/watch?v=vOgDfS50w2s
7. https://www.youtube.com/watch?v=4oEdRWMWYug

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Fluid Mechanics	Dr TI Eldeho	IIT Bombay	https://nptel.ac.in/courses/105101082
2	Fluid Mechanics	Dr N Sahoo and Dr Subhashisa Dutta	IIT Guwahati	https://nptel.ac.in/courses/105103095
3	Fluid Mechanics	Dr Subashisa Dutta	IIT Guwahati	https://nptel.ac.in/courses/105103192
4	Environmental fluid mechanics	Prof. Chunendra K Sahu	IIT Kanpur	https://nptel.ac.in/courses/105104565

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B.Tech. (Civil Engineering)

Course Code: BSCE101
Course Title: Probability and Statistics

Programme: B.Tech.	**L:** 4 **T:**0 **P:** 0	**Credits:4**
Semester: 3	**Theory/Practical:** Theory	**Teaching Hours:** 60 Hours
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 95%		
Duration of End Semester Examination (ESE): 3 Hours		
Course Type: Core Course		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Summarize the fundamental concepts of probability, evaluate conditional probabilities and apply Bayes' Theorem in solving real-world problems.
2	Identify and classify discrete and continuous random variables, and compute their respective probability distributions.
3	Apply linearity of expectation and properties of variance in solving theoretical problems.
4	Evaluate different sampling techniques for testing small samples and making reliable inferences about a population
5	Apply the chi-square test to assess the goodness-of-fit and analyze the independence of attributes in categorical data.
6	Apply appropriate large sample tests to analyze statistical data.

Contents

Part-A

Unit-1 Probability Theory **9 (L) hrs**

Probability spaces, theorems of Probability: addition theorem, multiplication theorem on probability, conditional probability and independence of events, Law of total probability, Baye's theorem.

Unit-2 Random Variables **9 (L) hrs**

Random Variable: Discrete and continuous random variables, probability mass function, probability density function, distribution functions, exponential densities, Bivariate random variables: discrete and continuous. Joint and Marginal density functions, conditional distributions.

Unit-3 Expectation **5 (L) hrs**

Expectation of discrete and continuous random variables, properties of expectation, mean and variance using expectation.

Part-B

Unit-4 Test of Significance **12 (L) hrs**

Sampling theory: Null hypothesis and alternate hypothesis, critical value, critical region, region of acceptance, level of significance, Type I and type II errors. Small sample tests: t-test for single mean and for difference of means, F-test (Variance Ratio-test), Chi square test for Goodness of fit and independence of attributes.

Unit-5 Test of Significance for Large Samples **10 (L) hrs**

Large sample test for simple proportion, difference of proportion, simple mean, difference of means, simple

standard deviation and difference of standard deviation.

Text Books

1. B.S. Grewal, "Higher Engineering Mathematics", 36th Edition, Khanna Publishers, 2010.
2. R.K. Narula," Engineering Mathematics-III", First Edition, 2019, Sharma Publications.
3. S.C. Gupta, V.K. Kapoor, "Fundamentals of Mathematical Statistics (A Modern Approach)", Sultan Chand & Sons, 23, Darya Ganj, New Delhi-11 0002.

Reference Books

1. E. Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
2. R.K. Jain and S.R.K Iyenger, "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 2008.
3. B.V. Ramana, "Higher Engineering Mathematics", 11th Reprint, Tata McGraw Hill, New Delhi, 2010.

Online Learning Materials

1) **https://www.khanacademy.org/math/statistics-probability/analyzing-categorical-data**
2) **https://ndl.iitkgp.ac.in/ndl_he**

Supplementary NPTEL Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Introduction to probability and Statistics	Prof. G. Srinivasan	IIT Madras	https://nptel.ac.in/courses/111106112
2	Probability and Statistics	Prof. Somesh Kumar	IIT Kharagpur	https://archive.nptel.ac.in/courses/111/105/111105090/

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. (Civil Engineering)

Course Code: SMCE101

Course Title: Seminar and Technical Report Writing for Engineers

Programme: B.Tech.	**L:** 0**T:**0 **P:**2	**Credits:**1
Semester: 3	**Theory/Practical:** Theory	**Teaching Hours:** 30 Hours
Total Max. Marks: 50	**Continuous Assessment (CA) Marks:** 50	**End Semester Examination (ESE) Marks:** 0
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 0%		
Duration of End Semester Examination (ESE): 0		
Course Type: Core Course		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Articulate the key concepts of the seminar topic
2	Conduct necessary literature survey relevant to identified topic
3	Engage in thoughtful discussion and debate related to the seminar topic
4	Analyze arguments and perspectives coming during the seminar
5	Identify and utilize appropriate sources for research and further learning
6	Utilize the relevant information from the standards and guidelines

Contents

Part-A

This is an open-ended structured course in which the students will work on a problem/ topic to be given by faculty and will work under their supervision. The focus area of the seminar can be any topic from the civil engineering discipline. Each student will submit a structured report covering the introduction to the topic, details of literature survey done, outcome of the study, and references.

Focus area of the seminar report includes importance and relevance of the topic, organization of the content, planning the documentation – selection and use of appropriate diagrams, graphs, tables and equations; citing and referencing; references to diagrams, graphs, tables and equations proof reading; originality and plagiarism

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. (Civil Engineering)

Course Code: TRCE101
Course Title: Training -I

Programme: B.Tech.	**L: 0T:** 0 **P:**0	**Credits:** 1
Semester: 3	**Theory/Practical:** Practical	**Teaching Hours:** 60 Hours
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 60	**End Semester Examination (ESE) Marks:** 40
Minimum Percentage of Numerical / Design / Programming Problems in ESE: nil		
Duration of End Semester Examination (ESE): NIL		
Course Type:		

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Apply formatting to data using Excel's basic functions, cell references, and formatting tools.
2	Apply formulas and functions to perform calculations and automate data processing.
3	Interpret data using charts and conditional formatting to support decision-making.
4	Draw 2D engineering and architectural designs using fundamental AutoCAD tools and commands.
5	Modify technical drawings to reflect design changes and industry standards using AutoCAD features.
6	Organize drawing elements effectively using layers, blocks, and annotation tools for efficient drafting.

Contents

Part-A

Unit-1

Introduction to spreadsheet interface; data entry and formatting; sorting and filtering techniques; applying conditional formatting for data visualization; using built-in functions for basic analysis; creating and customizing charts; data validation; working with tables; printing.

Unit-2

Introduction to formulas and cell referencing; logical functions (IF, AND, OR); lookup functions (VLOOKUP, HLOOKUP, XLOOKUP); math functions (SUM, AVERAGE, COUNT, SUMIF, COUNTIF); text functions (LEFT, RIGHT, CONCATENATE); date/time functions.

Part-B

Unit-3

Introduction to CAD software: interface; setting units and limits; coordinate systems; drawing tools: line, arc, circle, rectangle, polyline, ellipse; object snaps and grid; modifying tools (erase, move, copy); text annotations: single-line and multi-line text.

Unit-4

Layer creation and management; layer properties and standards; dimensioning tools and styles; associative and aligned dimensions; hatch patterns and editing; block creation, insertion, and editing.

Reference Book:

1. "AutoCAD 2023 for Engineers & Designers" By Prof. Sham Tickoo, CADCIM Technologies (India-based publisher), ISBN: 9789393168536.
2. "Learning AutoCAD 2021 "By Sandeep Dogra, BPB Publications (New Delhi) ISBN: 9789389898307

3. "Engineering Drawing with AutoCAD" By Dhananjay A. Jolhe, Tata McGraw Hill Education (India), ISBN: 9780070149817.
4. "AutoCAD Training Guide" By Linkan Sagar, BPB Publications, ISBN: 9789386551991.
5. "Microsoft Excel 2021 Training Guide" By CA. Passu Gopalakrishnan, BPB Publications (New Delhi), ISBN: 9789391030453
6. "Excel Data Analysis: Your visual blueprint for analyzing data, charts, and PivotTables" By Wiley India, Jinjer Simon, ISBN: 9788126510984
7. "Learn Microsoft Excel 2021" By Ritu Arora, BPB Publications, ISBN: 9789389898604.
8. "Mastering MS Excel", By Harjit Singh, Kalyani Publishers (India),
9. "Microsoft Excel 2019 Bible (Indian Adaptation)", John Walkenbach, Wiley India, ISBN: 9788126577444

Online Learning materials.

1 https://youtu.be/2LumoE9KjoY?feature=shared,accessed on May 14, 2025

2 https://youtu.be/VtLXKU1PpRU?feature=shared, accessed on May 14, 2025

3 https://youtu.be/MrYdZiyfbXU?feature=shared,accessed on May 14, 2025

4 https://youtu.be/wbJcJCkBcMg?feature=shared,accessed on May 14, 2025

5 https://youtu.be/Vl0H-qTclOg?feature=shared,accessed on May 14, 2025

6 https://youtu.be/LgXzzu68j7M?feature=shared,, accessed on May 14, 2025

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. (Civil Engineering)

Course Code: MCCE101

Course Title: Environmental Sciences and Sustainability

Programme: B. Tech.	**L:** 2 **T:** 0 **P:** 0	**Credits:** Non-Credit Course
Semester: 3	**Theory/Practical:** Theory	**Teaching Hours:** 30
Total Max. Marks: 50	**Continuous Assessment (CA) Marks:** 50	**End Semester Examination (ESE) Marks:** Nil
Minimum Percentage of Numerical / Design / Programming Problems in ESE: Nil		
Duration of End Semester Examination (ESE): Nil		
Course Type: Mandatory Non-Credit Course		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Propose solutions to environmental problems related to resource use and management
2	Infer threats to global biodiversity, their implications and potential solutions.
3	Interpret local, regional and global environmental issues
4	Comprehend the sustainability concepts; understand the role and responsibility of engineers in sustainable development
5	Recognize the challenges posed by technology in achieving sustainable development
6	Apply sustainability concepts in construction practices, designs, product developments and processes across various engineering disciplines

Contents

Part-A

Unit-1: Natural Resources **6(L) hrs**

Renewable and non-renewable resources: natural resources and associated problems, use and over-utilization of surface and ground water, floods, drought, dam's benefits and problems, growing energy needs, use of alternate energy sources.

Unit-2: Ecosystem and Biodiversity **4(L) hrs**

Concept of an ecosystem, producers, consumers, decomposers, ecological succession, food chains, food webs and ecological pyramids, biodiversity at global, national and local level, India as a mega diversity nation, threats to biodiversity, conservation of biodiversity.

Unit-3: Environmental Pollution and Social Issues **6(L) hrs**

Air pollution, water pollution, soil pollution, noise pollution, water conservation, rain water harvesting, solid waste management, E-waste management, environmental ethics: issues and possible solutions, climate change-extreme weather conditions, National Action plan on Climate Change

Part-B

Unit-4: Introduction to Sustainability **3(L) hrs**

Need and concept of sustainability, social-environmental and economic sustainability concepts, sustainable development goals.

Unit-5: Technology and Sustainability **3(L) hrs**

Nexus between technology and sustainable development, challenges for sustainable development, multilateral environmental agreements and protocols - Clean Development Mechanism (CDM)

Unit-6: Sustainable Design **8(L) hrs**

Basic concepts of sustainable habitat, green buildings, green materials & waste material for construction, material selection for sustainable design, green building certification- GRIHA & IGBC certification for buildings, energy efficient building design- passive solar design technique, thermal storage, cooling strategies, high performance insulation. sustainable cities, sustainable transport.

Text Books

1. G. Tyler Miller, Scott E. Spoolman, "Environmental Science", 17th Edition, Brooks/Cole, 2024.
2. D. D. Mishra, "Fundamental concepts in Environmental Studies", 3rd edition, S Chand & Co Ltd, 2014.
3. A. Kaushik, C. P. Kaushik, "Perspectives in Environmental Studies", 6th edition, New Age International Publishers, 2018.
4. R. Rajagopalan, "Environmental Studies, Crisis to Cure" Oxford University Press, 2023.
5. D. Allen, D. R. Shonnard, "Sustainability Engineering: Concepts, Design and Case Studies", 1st edition, Pearson, 2011
6. B. A. Striebig, A. A. Ogundipe, M. Papadakis, "Engineering applications in sustainable design and development", International edition, CL Engineering, 2015.
7. M. S. Sodha, N. K. Bansal, "Solar Passive Building, Science and Design", 1st edition, Pergamon Press, 1986
8. C. J. Kibert, "Sustainable Construction: Green Building Design and Delivery", 5th edition, Wiley, 2022

Reference Books

1. W. P. Cunningham, M. A. Cunningham, "Principle of Environmental Science", 9th edition, McGraw Hill, 2019.
2. P. Meenakshi, "Elements of Environment Science & Engineering", 2nd edition, Prentice Hall India Learning Private Limited, 2012.
3. K. N. Duggal, "Elements of Environment Engineering", 3rd edition, S. Chand & Co. Ltd, 1996.
4. K. M. Mackenthun, "Basic Concepts in Environmental Management", 1st edition, CRC Press, 1999.
5. Ni bin Chang, "Systems Analysis for Sustainable Engineering: Theory and Applications", Illustrated edition, MacGraw Hill, 2010.
6. J. Twidell, T. Weir, "Renewable Energy Resources", 3rd edition, Routledge, 2015.
7. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System.

Online Learning Materials

1. https://www.youtube.com/watch?v=wNjIJaXaTkQ&t=1446s
2. https://www.youtube.com/watch?v=or-z0Q03pcY
3. https://www.youtube.com/watch?v=or-z0Q03pcY
4. https://www.youtube.com/watch?v=SHxAOoxhKTA
5. https://www.youtube.com/watch?v=B8lTtrjxn2s
6. https://www.youtube.com/watch?v=CA5gxp6rWfA
7. https://www.youtube.com/watch?v=nFBvLIfFFqI
8. https://www.youtube.com/watch?v=MWgyRNtp2Do
9. https://www.youtube.com/watch?v=80JP9SBKGv4
10. https://www.youtube.com/watch?v=kqHeD5yKtoM
11. https://www.youtube.com/watch?v=RoIpCJwX7-M
12. https://www.youtube.com/watch?v=yy3VK6OYBbU

13. https://www.youtube.com/watch?v=1b2VDJbvAtA

Supplementary SWAYAM Course

Sr. No	Course Name	Instructor	Host Institute	URL
1	Environmental Science	Prof. Sudha Goel and Prof. Shamik Chowdhary	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc24_hs160/preview
2	Environment and Development	Prof. Ngamjho Kipgen	IIT Guwahati	https://onlinecourses.nptel.ac.in/noc23_hs133/preview
3	Sustainable Engineering and Life Cycle Analysis	Prof. Brajesh Kr. Dubey	IIT Kharagpur	https://onlinecourses-archive.nptel.ac.in/noc18_ce08/preview
4	Introduction to Environmental Engineering and Science – Fundamental and Sustainability Concept	Prof. Brajesh Kr. Dubey	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc25_ge17/preview
5	Water, Society and Sustainability	Prof. Jenia Mukherjee	IIT Kharagpur	https://elearn.nptel.ac.in/shop/nptel/water-society-and-sustainability/?v=c86ee0d9d7ed
6	Basic Environmental Engineering and Pollution Abatement	Prof. P. Mondal	IIT Roorkee	https://onlinecourses.nptel.ac.in/noc24_ch53/preview
7	Sustainable Materials and Green Buildings	Prof. B. Bhattacharjee	IIT Delhi	https://onlinecourses.nptel.ac.in/noc19_ce40/preview

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. (Civil Engineering)

Course Code: CCE104

Course Title: Transportation Engineering

Programme: B.Tech.	**L:** 3 **T:**0 **P:**2	**Credits:** 4
Semester: 4	**Theory/Practical:** Theory	**Teaching Hours:** 45(L)+0(T)+30(P) = 75 Hours
Total Max. Marks: 150	**Continuous Assessment (CA) Marks:** 90	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 30%		
Duration of End Semester Examination (ESE): 3 Hours		
Course Type: Core Course		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: Scientific Calculator

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Design the geometric parameters of highways to ensure smooth and safe traffic flow.
2	Design traffic flow facilities and street furniture based on traffic characteristics.
3	Explain the fundamentals of railways and the classification of track systems.
4	Describe the components of a railway track and their required specifications.
5	Outline the importance and key elements of airport infrastructure.
6	Conduct laboratory and field tests on highway materials in accordance with relevant Indian Standards.

Contents

Part-A

Unit 1: Highway development and planning **10(L) hrs**

Classification of roads, road development in India, Current Road projects in India, highway cross section elements, sight distance, design of horizontal alignment.

Unit 2: Traffic engineering & control **8(L) hrs**

Traffic Characteristics, traffic engineering studies, traffic flow and capacity, traffic regulation and control, parking facilities, highway lighting.

Unit 3: Highway Materials **5(L) hrs**

Materials used in Highway Construction- Soil, Stone aggregates, bituminous binders, desirable properties, tests and specifications.

Part-B

Unit 4: Railway Engineering **6(L) hrs**

History of Railways, Development of Indian Railway, organization of Indian Railway. Railway Gauges: Definition, Gauges on World Railways, Choice of Gauge, Uniformity of Gauge, Loading Gauge, Construction Gauge.

Unit 5: Railway Track **9(L) hrs**

Requirements of a Good Track, Track Specifications, Detailed Cross-Section of Single/Double Track used in Indian Railways. Components of permanent way - Rails, Sleepers, Ballast, Track Fixtures & Fastenings, Coning of Wheels, Tilting of Rails, Adzing of Sleepers, Rail Joints, Creep of Rails.

Unit 6: Airport Engineering: Introduction **7(L) hrs**

Air Transport Scenario in India, Airport planning - Site selection, runway orientation, etc. Concept of Head Wind, Cross Wind, Wind Rose Diagram, Runway Configuration, Aircraft Parking System, Taxiway.

Part-C

Laboratory Work: To be conducted in Laboratory.

Experiment No.	Experiment Title
1	**Tests on Sub-grade Soil** 1. California Bearing Ratio
2	**Tests on Road Aggregates** 1. Crushing Value Test 2. Los Angles Abrasion Value Test 3. Impact Value Test 4. Shape Test (Flakiness and Elongation Index)
3	**Tests on Bituminous Materials and Mixes** 1. Penetration Test 2. Ductility Test 3. Softening Point Test 4. Flash & Fire Point Test 5. Bitumen Extraction
4	**Field Tests** 1. Study of Roughometer/Bump Indicator 2. Study of Benkelman Beam Method

Text/Reference Books:

1. S.K., Khanna, C.E.G Justo and A Veeraragavan, 'Highway Engineering', Revised 10th Edition, Nem Chand & Bros, 2017
2. L.R. Kadiyalai, ' Traffic Engineering and Transport Planning', Khanna Publishers, 9th edition 2024
3. C.A.O Flaherty, "Highway Engineering", Volume 2, Edward Arnold, London, 1986.
4. S.K Sharma "Principles, Practice & Design of Highway Engineering", S. Chand & Company Ltd., New Delhi, 1985.
5. C. Jotin Khisty, & B. Kent Lall, "Transportation Engineering: An Introduction", Pearson Education, 4th Edition (2017)
6. S.C. Rangwala, "Railway Engineering", Charotar Publishing House, 28th Edition (2020).
7. Satish Chandra & M.M. Agrawal, "Railway Engineering", Oxford University Press, 2nd Edition (2013).
8. S.K Khanna, M.G Arora, & S.S Jain, "Airport Planning and Design", Nem Chand & Bros., Roorkee, 6th Edition (2018)
9. Robert Horonjeff, & Francis X McKelvey, "Planning and Design of Airports", McGraw-Hill Education, 5th Edition (2010)
10. Partha Chakroborty, & Animesh Das, "Principles of Transportation Engineering", PHI Learning Pvt. Ltd.,2nd Edition (2005).
11. V.N. Vazirani, & M.S Joshi, "Transportation Engineering", Khanna Publishers, Updated reprints till 2020
12. Mannering, "Principles of Highway Engineering & Traffic Analysis", Wiley Publishers, New Delhi, 7th edition 2020.
13. Partha Chakraborty, ' Principles of Transportation Engineering, PHI Learning, 2nd edition, 2021.

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. (Civil Engineering)

Course Code: CCE105
Course Title: Surveying and Geomatics

Programme: B.Tech.	**L:** 3 **T:** 0 **P:** 2	**Credits:** 4
Semester: 4	**Theory/Practical:** Theory	**Teaching Hours:** 45(L)+0(T)+30(P) = 75 Hours
Total Max. Marks: 150	**Continuous Assessment (CA) Marks:** 90	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical /Design problems in ESE: 50%		
Duration of End Semester Examination (ESE): 3 Hours		
Course Type: Core Course		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: Non programmable Scientific Calculator

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Explain the concept, various methods and techniques of surveying.
2	Compute angles, distances and levels for a given area.
3	Apply the concept of tachometry survey in difficult and hilly terrain.
4	Select appropriate instruments for data collection and survey purpose.
5	Interpret the concepts related to GIS and GPS and retrieve the information from remotely sensed data and interpret the data for survey.
6	Implement various methods of surveying by using instruments in field.

Contents

Part-A

Unit-1 Introduction: 4 hrs
Principles, Survey stations, Survey lines- ranging, direct &indirect ranging.

Unit-2 Compass Surveying: 4 hrs
Bearing and its measurement with prismatic compass, calculation of angles from bearings, Local Attraction

Unit-3 Levelling: **4** hrs
Principles of levelling, booking and reducing levels; differential levelling, reciprocal levelling, profile levelling and cross sectioning. Digital and Auto Level, Errors in levelling.

Unit-4 Contouring: 4 hrs
Characteristics, methods, uses; areas and volumes

Unit-5 Plane Table Surveying: 4 hrs
Setting up the plane table and methods of plane tabling (Radiation and three-point problem only).

Unit-6 Theodolite Traversing: 4 hrs
Instruments, Measurement of horizontal and vertical angle; Balancing of Traverse

Part-B

Unit-7 Tachometry: 4 hrs
Definition, determination of tachometer constants and reduced level from tachometric observations.
Triangulation - network- Signals. Baseline corrections, Trigonometric leveling.

Unit-8 Curves: 3 hrs
Types of curves, Elements of simple and Transition curves

Unit-9 Modern Field Survey Systems: 6 hrs
Principle of Electronic Distance Measurement, Types of EDM instruments, Distomat, Total Station – Parts of a Total Station – Accessories – Advantages and Applications, Field Procedure for total station survey, Errors in Total Station Survey, Global Positioning Systems (GPS), Segments of GPS, Errors in GPS, Differential Global Positioning System (DGPS)

Unit-10 Photogrammetry Surveying: 4 hrs
Introduction, Basic concepts, flight planning; Stereoscopy, photographic mapping, mosaics, Ground control point

Unit-11 Remote Sensing: 4 hrs
Introduction – Electromagnetic Spectrum, interaction of electromagnetic radiation with the atmosphere and earth surface, remote sensing data acquisition: platforms and sensors.

Laboratory Work

Experiment No.	Experiment Title
1	Measurement of bearing and angles with compass, adjustment of traverse by graphical method.
2	Different methods of levelling, height of instrument, rise & fall methods.
3	Measurement of horizontal and vertical angle by theodolite.
4	Determination of tachometric constants and determination of reduced levels by tachometric observations.
5	Plane table survey, different methods of plotting, Three point problems.
6	Determination of height of an inaccessible object.
7	Setting out of circular curves in the field using different methods.
8	Plotting of traverse using the Total Station and GPS

Text Books

1. S.K. Duggal, Surveying Vol I & II, Tata McGraw Hill, 2019
2. B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain Surveying Vol. I & II, Laxmi Publications, 2016
3. R. A. Agor, Text Book of Advanced Surveying, Khanna Publishers, 1991
4. K.R. Arora, Surveying Volume I,II& III, Standard Book House. 2019
5. J. M. Anderson, E. M. Mikhail, Surveying: Theory and Practice (7th Edition), McGraw-Hill Education, 1998

Reference Books

1. James B. Campbell, Introduction to Geomatics, The Guilford Press, 2021
2. P. A. Longley, M. F. Goodchild, D. J. Maguire, D. W. Rhind, Geographic Information Systems and Science (4th Edition), Wiley, Year, 2015
3. C.L. Kochher, A Text Book of Surveying Vol. I & II, Dhanpat Rai Publishing Co., 2014
4. S. Ramamrutham., Plane and Geodetic Surveying, Dhanpat Rai Publishing Company, 2016
5. A.M Chandra., Plane Surveying, New Age International Publishers, 2015
6. A.M Chandra., Higher Surveying, New Age International Publishers, 2015
7. S.K Soni, Surveying Volume I & II, Katson Books, 2016

Online Learning Materials

1. Fundamentals of Surveying by S.K. Roy, https://civildatas.com/download/fundamentals-of-surveying-by-roy Accessed on 7-05-2025.
2. Surveying-Problem Solving with Theory and Objective Type Questions by Dr. A.M. Chandra https://civildatas.com/download/surveying-problem-solving-with-theory-and-objective-type-questions Accessed on 7-05-2025

Online Courses and Video Lectures:

1. Digital Land Surveying and Mapping by J.K. Ghosh, https://onlinecourses.nptel.ac.in/noc21_ce08/preview Accessed on 7-05-2025.
2. GPS Surveying by J.K. Ghosh https://onlinecourses.nptel.ac.in/noc20_ce51/preview Accessed on 7-05-2025

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. (Civil Engineering)

Course Code: CCE106
Course Title: Environmental Engineering-II

Programme: B.Tech.	**L:** 3 **T:** 0 **P:** 2	**Credits:** 4
Semester: 4	**Theory/Practical:** Theory	**Teaching Hours:** 45 (L) + 30 (P) = 75 Hours
Total Max. Marks: 150	**Continuous Assessment (CA) Marks:** 90	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 50%		
Duration of End Semester Examination (ESE): 3 Hours		
Course Type: Core Course		

Prerequisites (if any): CCE102

Additional Material Allowed in ESE: Scientific Calculator

On completion of the course, the student will have the ability to:

CO	Course Outcomes
1	evaluate the waste water characteristics and interpret their importance.
2	design the conveyance elements of wastewater collection systems.
3	plan and design components of wastewater treatment systems.
4	compare the efficacy of wastewater treatment technologies under different conditions.
5	analyze sewer networks using modern software and computational tools like OpenFlows Sewer, SewerGEMS etc.
6	conduct experiments adopting standard procedures and assess the quality of wastewater.

Contents

Part-A

Unit-1: Characteristics of wastewater **7(L) hrs**
Composition of domestic wastewater, sampling, physical, chemical and microbiological characteristics, biological decomposition, BOD and BOD kinetics, effluent disposal limits.

Unit-2: Sewerage system **10(L) hrs**
Systems of sewerage, estimation of dry weather and wet weather flow, flow variations, types of sewers, hydraulic design of sanitary sewers, materials for sewers, construction & maintenance of sewers, sewer appurtenances, wastewater pumping.

Unit-3: Primary treatment of wastewater **6(L) hrs**
Preliminary & Primary treatment: screening, grit chamber, floatation units, sedimentation tanks.

Part-B

Unit-4: Secondary treatment of wastewater **9(L) hrs**
Introduction to unit operations and processes, Secondary treatment units; activated sludge process, sequencing batch reactors, trickling filters, anaerobic filters, UASB, septic tank, sludge handling and disposal facilities

Unit-5: Natural and tertiary wastewater treatment systems **7(L) hrs**
Stabilization ponds, constructed wetland systems, soil aquifer treatment, soak pits, tertiary wastewater treatment for nutrient removal and disinfection, wastewater reuse.

Unit-6: Modern tools in sewerage system design **6(L) hrs**

Introduction to design software: SewerGEMS, OpenFlows Sewer, SewerCad etc., application of software in modeling and simulation of sewer networks.

Laboratory Work

Experiment No.	Experiment Title
1	Determination of pH value of a wastewater sample.
2	Determination of solids - total, dissolved and suspended solids of a wastewater sample.
3	Determination of Dissolved Oxygen DO of a water/wastewater sample
4	Determination of Biochemical Oxygen Demand (BOD) of a wastewater sample.
5	Determination of Chemical Oxygen Demand (COD) of a wastewater sample.
6	Determination of nutrients in wastewater (TKN, TN and TP).
7	Determination of heavy metals in a wastewater sample using Atomic Absorption Spectrometry.
8	Determination of bacteriological quality of a wastewater sample
9	Design/Analysis of sewer networks using SewerGems, OpenFlows Sewer etc.

Text Books:

1. Waste Water Engg. (Environmental Engg.-II), B. C. Punmia, Ashok Jain, Laxmi Publications, 2023, New Delhi
2. Environmental Engg. - A design Approach, Arcadio P. Sincero and Gregoria P. Sincero, Prentice Hall of India, New Delhi.
3. Environmental Engg., Howard S. Peavy, Donald R. Rowe & George Tchobanoglous, McGraw Hill, 2017, Indian Edition.
4. Sewage Disposal and Air Pollution Engg., S.K. Garg, Khanna Publishers, 2024, Delhi.

Reference Books

1. Wastewater Engineering: Treatment and Reuse, Metcalf & Eddy, McGraw Hill Education, 2017, 4th edition
2. Water and Wastewater Engineering: Design Principles and Practice, Mackenzie L. Davis, McGraw Hill Education, 2017,1st Edition
3. Introduction to Environmental Engineering and Science, G.B. Masters, Pearson, 2013, 3rd edition.
4. Wastewater Treatment- Concept and Design Approach, G. L. Karia, R. A. Christian, N. D. Jariwala, PHI Learning, 3rd edition.
5. Wastewater Treatment for Pollution Control and Reuse, Arceivala and Asolekar, Tata McGraw Hill, 2006, 3rd edition
6. Natural Wastewater Treatment Systems, R. W. Crites, E. J. Middlebrooks, R. K. Bastian, S. C. Reed, CRC Press, 2014, 2nd edition
7. Standard methods for the examination of water and wastewater, Washington: APHA AWWA, 2023, 24th edition
8. Manual on sewerage and sewage treatment, CPHEEO, 2013.

Online Learning Materials

1. https://www. studybwwt.online/ Accessed on June 02, 2025
2. https://freeebookpdf.download/docs/Biological%20Wastewater%20Treatment%202nd%20Edition-4953586 Accessed on June 02, 2025
3. https://www.classcentral.com/course/xuetangx-water-and-wastewater-treatment-engineering-physicochemical-technology-375920 Accessed on June 02, 2025

4. https://www.classcentral.com/course/udemy-the-complete-course-in-water-and wastewater-treatment-434558 Accessed on June 02, 2025

Supplementary SWAYAM Course

Sr. No	Course Name	Instructor	Host Institute	URL
1	Wastewater Treatment and Recycling	Prof. M. K. Tiwari	IIT Kharagpur	https://archive.nptel.ac.in/courses/105/105/105105178/
2	Wastewater Management	Prof. M.M. Ghangrekar	IIT Kharagpur	https://archive.nptel.ac.in/courses/105/105/105105048/
3	Water and Wastewater Treatment	Prof. Bhanu Prakash	IIT Roorkee	https://archive.nptel.ac.in/courses/105/107/105107207/
4	Water and Wastewater Engineering	Prof. C. Venkobachar	IIT Madras	https://archive.nptel.ac.in/courses/105/106/105106119/
5	Water and Wastewater Engineering	--	IIT Kanpur	https://archive.nptel.ac.in/courses/105/104/105104102/#
6	Biological process design for wastewater treatment	Prof. V.C. Srivastava	IIT Roorkee	https://archive.nptel.ac.in/courses/103/107/103107217/

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. (Civil Engineering)

Course Code: CCE107
Course Title: Hydraulic Engineering

Programme: B.Tech.	**L:** 3 **T:**0 **P:**0	**Credits:**3
Semester: 4	**Theory/Practical:** Theory	**Teaching Hours:** 45(L)+0(T)+0(P) = 45 Hours
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 90%		
Duration of End Semester Examination (ESE): 3 Hours		
Course Type: Core Course		

Prerequisites (if any): CCE-103

Additional Material Allowed in ESE: Scientific Calculator

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Determine flow parameters of laminar flow under varying boundary conditions, including drag force and fluid viscosity.
2	Estimate resisting forces in turbulent flow for both rough and smooth pipes.
3	Examine boundary layer friction and **its** solutions to minimize flow resistance and forces on moving bodies.
4	Design the most economical cross-section of an open channel based on fundamental concepts and definitions of open channel flow.
5	Analyze flow parameters under non-uniform flow conditions in open channels.
6	Analyze the elements and behavior of hydraulic jumps and surges.

Contents

Part-A

Unit-1 Laminar flow **2(L) hrs**

Laminar flow through: circular pipes, annulus and parallel plates. Stoke's law, Measurement of viscosity.

Unit-2 Turbulent Flow **13(L) hrs**

Reynolds experiment, Transition from laminar to turbulent flow. Definition of turbulence, scale and intensity, Causes of turbulence, instability, mechanism of turbulence and effect of turbulent flow in pipes. Reynolds stresses, Prandtl's mixing length theory, universal velocity distribution equation. Resistance to flow of fluid in smooth and rough pipes,

Unit-3 Boundary layer analysis **5(L) hrs**

Assumption and concept of boundary layer theory. Boundary-layer thickness, displacement, momentum & energy thickness, laminar and turbulent boundary layers on a flat plate; Laminar sub-layer, smooth and rough boundaries. Local and average friction coefficients. Separation and Control.

Part-B

Unit-4 Introduction to open channel **5(L) hrs**

Comparison between open channel flow and pipe flow, geometrical parameters of a channel, classification of open channels, classification of open channel flow, Velocity Distribution of channel section. Continuity Equation, Characteristics of uniform flow, Chezy's formula, Manning's formula. Factors affecting Manning's Roughness Coefficient "n". Most economical section of channel. Computation of Uniform flow, Normal depth.

Unit-5 Non uniform flow **15(L) hrs**

Specific energy, Specific energy curve, critical flow, discharge curve Specific force Specific depth, and Critical depth. Channel Transitions. Measurement of Discharge and Velocity –Broad Crested Weir. Gradually Varied Flow-Dynamic Equation of Gradually Varied Flow, Classification of channel bottom slopes, Classification of surface profile, Characteristics of surface profile. Computation of water surface profile Direct Step method.

Unit-6 Hydraulic Jump **5(L) hrs**

Theory of hydraulic jump, Elements and characteristics of hydraulic jump in a rectangular Channel, length and height of jump, location of jump, Types, applications and location of hydraulic jump. Energy dissipation and other uses, surge as a moving hydraulic jump. Positive and negative surges.

Text Books

1. Hydraulics and Fluid Mechanics, P.M. Modi and S.M. Seth, Standard Book House
2. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill.
3. Open channel Flow, K. Subramanya, Tata McGraw Hill.
4. Open Channel Hydraulics, Ven Te Chow, Tata McGraw Hill.

Reference Books

1. "Open Channel Flow" by F. M. Henderson, McGraw-Hill Education
2. "Open Channel Hydraulics" by R. H. French, John Wiley & Sons
3. "Fluid Mechanics and Open Channel Flow" by R. K. Bansal, Laxmi Publications
4. "Open Channel Flow: A Practical Approach" by J. R. French, CRC Press
5. "Hydraulics of Open Channel Flow" by P. N. Modi, Standard Book House

Online Learning Materials

1. "Fluid Mechanics-II" by Stanford University on Coursera: http://www.coursera.org/specializations/fluid-mechanics
2. "Fluid Mechanics-II" by MIT on edX: http://www.edx.org/course/fluid-mechanics
3. "Fluid Mechanics for Civil Engineers" by UC Berkeley on Coursera: http://www.coursera.org/specializations/fluid-mechanics-civil-engineering
   Fluid Mechanics Tutorial by Tutorials Point: http://www.tutorialspoint.com/fluid_mechanics/index.html
4. **5. Fluid Mechanics Guide by Engineering Toolbox**: http://www.engineeringtoolbox.com/fluid-mechanics-d_13.html

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Fluid Mechanics	Dr TI Eldeho	IIT Bombay	https://nptel.ac.in/courses/105101082
2	Fluid Mechanics	Dr N Sahoo and Dr Subhashisa Dutta	IIT Guwahati	https://nptel.ac.in/courses/105103095
3	Fluid Mechanics	Dr Subashisa Dutta	IIT Guwahati	https://nptel.ac.in/courses/105103192
4	Environmental fluid mechanics	Prof. Chunendra K Sahu	IIT Kanpur	https://nptel.ac.in/courses/105104565

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. (Civil Engineering)

Course Code: CCE108
Course Title: Structural Analysis -I

Programme: B.Tech.	**L:** 3 **T:**1 **P:**2	**Credits:**5
Semester: 4	**Theory/Practical:** Theory	**Teaching Hours:** 45(L)+15(T)+30(P) = 90 Hours
Total Max. Marks: 150	**Continuous Assessment (CA) Marks: 90**	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 80%		
Duration of End Semester Examination (ESE): 3 Hours		
Course Type: Core Course		

Prerequisites: ESCE101

Additional Material Allowed in ESE: Scientific Calculator

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Apply the concept of equilibrium in structural analysis.
2	Compute displacements of structures under loads using various methods and principles
3	Calculate internal forces within different structural forms, like trusses, beams, and frames
4	Plot bending moment and shear force diagram
5	Apply concept of influence lines to determine the maximum effect of moving loads
6	Interpret results to draw meaningful conclusions specific to engineering design

Contents

Part A

Unit 1: **3(L) hrs**

Load – types and their assessment; Type of supports, Concept and types of structures – cables, trusses, beams, arches, frames; Statical determinacy of a problem – identification of determinate and indeterminate structures based on degree of redundancy (*DoR*)

Unit 2: **18(L) hrs**

Beams, frames (determinate cases only) – Internal forces: axial force, shear force, bending moment; sign conventions; Shear force and bending moment diagrams for cantilever, simply supported and overhang beams/ frames subjected to point loads, uniformly distributed loads, uniformly varying loads, moments or their combination, the point of contra flexure and its significance; Displacements – deflection, rotation; computation using different methods – Direct integration method, Moment area method, Conjugate method, Energy methods

Part B

Unit 3: **12(L) hrs**

Cables – General cable theorem, shape, elastic stretch of cable, maximum tension in cable and back-stays, pressure on supporting towers; Trusses (determinate cases only) – computation of forces (using Method of joint, Method of section, Tension coefficient method) and displacements (using Energy method)

Unit 4: **12(L) hrs**

Concept and applications of influence line diagram (determinate cases only); rolling loads – Bending moment and shear force diagrams due to single and multiple concentrated rolling loads, uniformly distributed moving

loads; Equivalent UDL and applications; Muller Breslau principle; Plotting influence lines for beams, bar force in trusses and portal frames; calculation of the maximum and absolute maximum shear force and bending moment; Concept of envelopes.

Part C

(To be conducted in laboratory)

Test on beams – Measurement of rotations and deflections for simple beams and fixed end beams; Determination of the Flexural Rigidity; Verification of Clark-Maxwell's theorem; verification of the Moment-area theorems; Unsymmetrical bending of a cantilever beam; Curved beams

Test on Arches – Verification of Clark-Maxwell's theorem for two and three hinged arches; Calculation of support reactions; Plotting influence line diagrams

Test on Columns – Behavior of columns and struts with different end conditions.

Test on Trusses – Verification of Clark-Maxwell's theorem; Deflection of a statically determinate truss; Computation of forces in redundant truss joint;

Plotting influence line diagrams for joint reactions – Simple and continuous beams; Arches

Books

- Elementary Structural Analysis by Norris Wilber
- Basic Structural Analysis by C S Reddy
- Intermediate structural analysis by C K Wang
- Indeterminate structural analysis by J. Sterling Kinney Addison
- Structural Analysis by Devdas Menon
- Analysis of Structures by Vazirani &Ratwani
- Theory of structures by B.C. Punima
- Laboratory Manual on Structural Mechanics by Harvinder Singh
- Structural Analysis Lab by Lakshman Singh

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. (Civil Engineering)

Course Code: CCE109
Course Title: Structural Design – I

Programme: B.Tech.	**L:** 3 **T:**1 **P:**0	**Credits:** 4
Semester:	**Theory/Practical:** Theory	**Teaching Hours:** 45(L)+15(T)+0(P) = 60 Hours
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 80%		
Duration of End Semester Examination (ESE): 3 Hours		
Course Type: Core Course		

Prerequisites: Solid Mechanics **(**ESCE101), Structural Analysis (CCE109)

Additional Material Allowed in ESE: IS 456, SP 16, SP 34

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Interpret the structural behavior of RC members and relate it to the codal design provisions.
2	Develop factored load combinations and design actions for RC structural members
3	Design RC elements for flexure, shear and torsion and verify serviceability requirements
4	Analyze one-way and two-way slab systems including stairs and determine reinforcement based on bending, shear and deflection criteria.
5	Select appropriate reinforcement arrangements for RC columns subjected to axial load and combined bending using IS 456 and SP-16 guidelines
6	Prepare reinforcement detailing drawings and bar bending schedules for beams, slabs, columns and isolated footings in accordance with SP-34

Contents

Part A

Unit 1: **10 (L) hrs**

Concrete as structural material – properties and behavior; Stress-strain response of concrete and steel; Design philosophy and assumptions – Working Stress Method, Ultimate load method, Limit State Method; Limit states – collapse and serviceability, Partial safety factors for materials and loads; Characteristic strength; Design requirements – strength, serviceability, durability, robustness, integrity, restoration.

Unit 2: **13 (L) Hrs**

Beams: Stress block and computation of section neutral-axis, moment of resistance; Concept of balanced section, under- and over-reinforced sections; design of rectangular beams – Singly and doubly reinforced sections, – strength (flexural, shear, torsion), serviceability (deflection, crack width) and durability (selection of materials); Detailing of reinforcement – curtailment, anchorage, cover, spacing rules.

Part B

Unit 3: **10 (L) Hrs**

Slab and Stairs: Functions and types; Load assessment; design and detailing of wall / rigid beam supported one-way, two way rectangular slabs – Shear check, deflection check; Design and detailing of longitudinally and transversely supported stairs

Unit 4: **12 (L) Hrs**

Columns and footings: Classification – short/long columns; Effective length of columns and end conditions; Minimum eccentricity and its importance; Design of short axially loaded columns (tied and spiral) – axial, uniaxial and biaxial load conditions, Use of interaction diagrams / SP-16 charts; Detailing of column reinforcement – Longitudinal reinforcement limits, Lateral ties, pitch, and cover, Lap splices and anchorage; Design and detailing of isolated footings – One-way shear, Two-way (punching) shear, Development length and anchorage.

Text Books

- A.K. Jain (2015). Reinforced Concrete Limit State Design, Standard Publications
- Krishna Raju, N. (2018). Reinforced concrete design (3rd ed.). CBS Publishers.
- Gambhir, M. L. (2013). Fundamentals of reinforced concrete design. PHI Learning Pvt. Ltd.
- Punmia, B. C., Jain, A. K., & Jain, A. K. (2016). Reinforced concrete structures (Vols. 1 & 2). Laxmi Publications.
- Nilson, A. H., Darwin, D., & Dolan, C. W. (2010). Design of concrete structures (14th ed.). McGraw Hill.

Reference/ Standards and Guidelines

- Pillai, S. U., & Menon, D. (2017). Reinforced Concrete Design (3rd ed.). Tata McGraw Hill Education.
- Park, R., & Paulay, T. (1975). Reinforced concrete structures. John Wiley & Sons.
- MacGregor, J. G., & Wight, J. K. (2012). Reinforced concrete: Mechanics and design (6th ed.). Pearson.
- Varghese, P.C. (2007). Limit State Design of Reinforced Concrete, Prentice Hall of India
- Jack C. McCormac (2013). Design of Reinforced Concrete, John Wiley & Sons
- IS 456:2000: Code of Practice for Plain and Reinforced Concrete
- SP 16: Design Aid for Reinforced Concrete to IS 456.
- SP 34: Handbook on Concrete Reinforcement and Detailing

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. (Civil Engineering)

Course Code: CCE110
Course Title: Geotechnical Engineering

Programme: B.Tech.	**L:** 3 **T:** 0 **P:** 2	**Credits:** 4
Semester: 5	**Theory/Practical:** Theory/Practical	**Teaching Hours:** 45(L)+0(T)+30(P) = 75 hours
Total Max. Marks: 150	**Continuous Assessment (CA) Marks:** 90	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 70%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core		

Prerequisites: Nil

Additional Material Allowed in ESE:

On completion of the course, the student will have the ability to:

CO	Course Outcomes
1.	Classify soils based on origin, formation and phase relationships.
2.	Describe index and consistency properties of soils.
3.	Evaluate engineering behavior of soils through compaction characteristics.
4.	Analyze the fundamentals of permeability and shear strength parameters of soils.
5.	Compute consolidation characteristics and settlement of soil deposits using theoretical relationships.
6.	Apply standard laboratory and field-testing procedures to determine soil index and engineering properties.

Contents

Part-A

Unit -1 Introduction to Soil Formation and Phase Relationships 8 (L) hrs

Types of soils and their formation, Definitions: soil mechanics, soil engineering, rock mechanics, geotechnical engineering. Scope of geotechnical engineering. Index relationships: void ratio, porosity, degree of saturation, moisture content, unit weight and specific gravity etc. Relationship between volume- weight, voids ratio- moisture content, unit weight- percent air voids, moisture content- specific gravity etc. Determination of water content, specific gravity and unit weight (laboratory and field methods).

Unit-2 Index Properties and Soil Classification 7 (L) hrs

Plasticity and consistency of soils. Atterberg's limits: liquid limit, plastic limit and shrinkage limits. Plasticity, liquidity and consistency indices. Flow index, toughness index, activity and sensitivity. Determination of Atterberg's limits. Indian Standard Soil Classification System (ISCS). Field identification and engineering characteristics of soil groups.

Unit-3 Compaction of Soils 6 (L) hrs

Theory and mechanism of compaction, laboratory determination of optimum moisture content and maximum dry density, concept of optimum moisture content and zero Air Void Line. Compaction of soil in field, compaction specifications and field control.

Part-B

Unit-4 Permeability, Seepage and Effective Stress 8 (L) hrs

Darcy's law and determination of coefficient of permeability. Laboratory method: constant-head method, falling-head method. Permeability of stratified soil, Factors influencing permeability. Seepage through soil and flow nets, graphical method to plot flow nets. Effective stress principle, nature of effective stress, effect of water table. Fluctuations of effective stress, effective stress in soils saturated by capillary action, seepage pressure and quick sand condition.

Unit -5 Consolidation and Settlement of Soil **8(L)hrs**

Introduction to consolidation, comparison between compaction and consolidation, initial, primary & secondary consolidation, spring analogy for primary consolidation, interpretation of consolidation test results, One – dimensional Terzaghi's theory of consolidation, computation of consolidation settlement and secondary compression.

Unit -6 Shear Strength of soil **8(L) hrs**

Mohr circle and its characteristics, principal planes, relation between major and minor principal stresses, Mohr-Coulomb theory, types of shear tests: direct shear test, merits of direct shear test, triaxial compression tests (UU, CU and CD tests), pore pressure measurement, computation of shear strength parameters: unconfined compression test, vane shear test.

Part-C

Laboratory Work:

1. Determination of natural moisture content (oven drying).
2. Determination of specific gravity of soil solids (pycnometer).
3. Determination of Grain size analysis (sieve analysis) and determination of Cu and Cc.
4. Determination of Atterberg's limits: Liquid limit and plastic limit.
5. Determination of In-situ density by core cutter method.
6. Determination of In-situ density by sand replacement method.
7. Determination of Standard Proctor compaction test (OMC and MDD).
8. Determination of relative density of sand.
9. Determination of Unconfined compression test (cohesive soil).
10. Determination of Direct shear test (cohesionless soil).
11. Determination of Permeability test — constant head method.
12. Demonstration of geotechnical equipment: augers, samplers, rapid moisture meter, Proctor needle.
13. Preparation of consolidated laboratory report of index and engineering properties of soil.

Text Books:

1. Arora K.R., "Soil Mechanics & Foundation Engineering", Standard Publishers Distributors, New Delhi, 7th Edition, 2018.
2. Gopal Ranjan & A.S.R. Rao, "Basic and Applied Soil Mechanics", New Age International Publishers, New Delhi, 2011.
3. Venkatramaiah C., "Geotechnical Engineering", Universities Press / New Age International, Hyderabad/New Delhi, 5th Edition, 2020.
4. Braja M. Das, "Principles of Geotechnical Engineering", Cengage Learning (Inc./India), 10th Edition, 2020.
5. Lambe T.W. & Whitman R.V., "Soil Mechanics", Wiley-Interscience, 1st/2nd Edition, 1969.
6. Holtz, Kovacs & Sheahan, "An Introduction to Geotechnical Engineering", Pearson Education, Latest available edition 2013.

Reference Books:

1. K.K. Gupta, "Soil Mechanics & Foundation Engineering", Khanna Publishers / Nem Chand & Bros, latest edition 2012.
2. Purushothama Raj, "Soil Mechanics and Foundations Engineering", Pearson Education India, 2nd Edition, 2013.
3. Murthy V.N.S., "Textbook of Soil Mechanics and Foundation Engineering", CBS Publishers & Distributors, New Delhi, 2014.
4. Terzaghi Karl, Peck R.B. & Mesri, G. "Soil Mechanics in Engineering Practice", John Wiley & Sons, 3rd Edition, 1996.
5. Coduto D.P., "Geotechnical Engineering – Principles & Practices", Prentice Hall / Pearson, 2010.
6. Carthy D.F., "Essentials of Soil Mechanics and Foundations: Basic Geotechnics", Pearson / Prentice Hall,

2006.
7. Manuals
8. Shamsher Prakash, Jain P.K., Arora K.R., "Engineering soil testing", Nem Chand & Bros., Roorkee, India, 3rd Edition — 1992
9. Sharma R. K., "A Laboratory Manual on Soil Mechanics: Testing and Interpretation, I. K. International Publishing House Pvt. Ltd., New Delhi, India, - 2016

Supplementary SWAYAM Courses

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Soil Mechanics/ Geotechnical Engineering-I	Dilip Kumar Baidya	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc24_ce95/preview
2	Geotechnical Engineering - I	D. N. Singh	IIT Bombay	https://onlinecourses.nptel.ac.in/noc24_ce18/preview
3	Geotechnical Engineering-II Foundation Engineering	Dilip Kumar Baidya	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc24_ce89/preview
4	Geotechnical Engineering Laboratory	J. N. Mandal	IIT Bombay	https://onlinecourses.nptel.ac.in/noc25_ce99/preview

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. (Civil Engineering)

Course Code: CCE109
Course Title: Structural Analysis – II

Programme: B.Tech.	**L:** 3 **T:**1 **P:**0	**Credits:**4
Semester:	**Theory/Practical:** Theory	**Teaching Hours:** 45(L)+15(T)+0(P) = 60 Hours
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 80%		
Duration of End Semester Examination (ESE): 3 Hours		
Course Type: Core Course		

Prerequisites: Solid Mechanics **(**ESCE101), Structural Analysis - I (CCE109)

Additional Material Allowed in ESE:

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Distinguish statically determinate and indeterminate structural systems.
2	Analyze the beams and trusses using the Classical Methods of analysis.
3	Compute reactive forces in the beams, pin-jointed and rigid jointed frames.
4	Develop and apply the approximate methods of analysis for framed structures.
5	Predict the structural response under different types of loading, support displacements and temperature changes.
6	Draw influence lines to decide the critical forces and sections while designing.

Contents

Part A

Unit 1: **12 (L) hrs**

Indeterminacy in structural systems – concept and applications, Static and kinematic indeterminacies, Conditions of equilibrium, compatibility of displacements, stress-strain relationships; Solution of simultaneous algebraic equations. Analysis using Classical Methods – Method of consistent deformations for beams, pinned and rigid jointed frames; Effects of support settlement and lack of fit; Three-moment theorem; Fixed-end moments – member loading, sinking of supports, temperature.

Unit 2: **10 (L) Hrs**

Arches – Concept, types and applications; Computation of radial shear, axial forces, moments in linear, circular, segmental and parabolic arches.

Part B

Unit 3: **15 (L) Hrs**

Analysis using Conventional Methods – Slope Deflection Method; Moment Distribution Method; Rotation Contribution method (*Kani*'s method); Selection of suitable method; plotting of reaction diagrams

Unit 4: **8 (L) Hrs**

Approximate Methods – Portal method, Cantilever method, Substitute frame method; Analysis of beams and frames using influence line diagram.

Text Books

1. Basic structural analysis - C.S. Reddy Tata McGraw-Hill
2. Intermediate structural analysis - C. K. Wang. McGraw Hill
3. Indeterminate structural Educational Publishers analysis - J. Sterling
4. Theory of structures - B.C. Punima, Laxmi Publications
5. Structural Analysis, vol 2, Devdas Menon, Narosa Publishers.

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. (Civil Engineering)

Course Code: CCE112
Course Title: Irrigation Engineering

Programme: B.Tech.	**L:4 T: 0 P: 0**	**Credits:** 4
Semester: 5	**Theory/Practical:** Theory	**Teaching Hours:** 60(L) + 0(T) + 0(P) = 60 Hours
Total Max. Marks: 100	**Continuous Assessment (CA) Marks**: 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 70%		
Duration of End Semester Examination: 3 Hours		
Course Type: Core Course		

Prerequisites:
Additional Material Allowed in ESE: Khosla's curve, Blench curve, Montague curve
Course Outcomes (COs)
After successful completion of the course, students will be able to:

CO#	Course Outcomes (COs)
1.	**Explain** basic concepts of irrigation, crop water requirements, duty, delta, and base period.
2.	**Apply** Kennedy's and Lacey's theories for the design of irrigation canals.
3.	**Analyze** the functions and components of diversion headworks and silt control devices.
4.	**Evaluate** seepage in hydraulic structures using Bligh's, Lane's, and Khosla's theories.
5.	**Design** irrigation structures such as weirs, regulators, and canal falls.
6.	**Assess** suitable cross-drainage works and canal outlets for irrigation systems.

Contents

PART-A

Unit I: Introduction **6 (L) hrs**
Importance of Irrigation Engineering, purposes of Irrigation, objectives of Irrigation, Benefits of Irrigation, techniques of irrigation, water requirements of crops, factors affecting water requirement, consumptive use of water, water depth or delta, Duty of water and Base Period.

UNIT II: Canal irrigation **7(L)hrs**
Classifications of canals, canal alignment, Inundation canals, Silt theories-Kennedy's theory, Lacey's theory, Drawbacks in Kennedy's & Lacey's theories, comparison of Lacey's and Kennedy's theories, Design of unlined canals based on Kennedy & Lacey's theories, design of lined canals, and methods of providing drainage behind lining.

UNIT III: Diversion headwork: **4 (L) hrs**
Functions and investigations of a diversion head work: component of a diversion head work and their design considerations, silt control devices.

Unit IV: Theories of Seepage **10 (L) hrs**
Seepage force and exit gradient, assumptions and salient features of Bligh's Creep theory, Limitations of Bligh's Creep theory, salient features of Lane's weighted Creep theory and Khosla's theory, Comparison of Bligh's Creep theory and Khosla's theory, Determination of uplift pressures and floor thickness.

Part B

Unit V: Design of Weirs **8(L) hrs**
Weirs versus barrage, types of weirs, main components of weir, causes of failure of weir and design considerations with respect to surface flow, hydraulic jump and seepage flow and Design of weir.

UNIT VI: Canal Regulators and falls **12 (L) hrs**
Offtake alignment, cross-regulators – their functions and design, Distributary head regulators-their functions and design, Necessity and location, types of falls and their description, selection of type of falls, Design of Sarda type fall, straight glacis fall, energy dissipation devices and canal escape.

Unit VII: Cross-Drainage works: 8 (L) hrs

Definitions, choice of type, Hydraulic design consideration, Aqueducts their types and design, siphon aqueducts – their types and design considerations, super passages, canal siphons and level crossing.

VIII: Canal Out-lets: 5 (L) hrs

Essential requirements, classifications, criteria for outlet behaviours: flexibility, proportionality, sensitivity, sensitiveness, etc. Details and design of non-modular, semi-modular and modular outlets.

Text Books:

1. S. K Garg, "Irrigation Engineering & Hydraulic Structure", Khanna Publishers, 2025
2. K. R. Arora, "Irrigation Waterpower and Water Resources Engineering", Standard Publishers Distributors, 2026
3. B. C. Punmia, B.B.L. Pande, Ashok K.R. Jain, Arun K.R. Jain, "Irrigation & Water Power Engineering", 16th Edition, Laxmi Publications (P) Ltd., New Delhi, 2021
4. P.N. Modi, "Irrigation Water Resources and Water Power Engineering", Standard Book House, 9th Edition, 2020
5. L W Mays, "Water Resources Engineering", Wiley, 2010
6. Hunter R, "applied hydraulics in engineering", Dover publication, 2005

Reference Books

1. Houk Ivan E., "Irrigation Engineering Volume – I & II", John Wiley; 2nd Printing Stated L.C. 51-12519 Edition (1962)
2. G.L.Asawa, "Irrigation and Water Resources Engineering", New Age International Publishers, 2025.
3. Varshney R.S., "Concrete dams", 2nd Edition, Oxford and IBH Pub.Co.in, New Delhi, 1982.
4. Varshney R.S., S. C. Gupta & R.L. Gupta, "Theory and Design of Hydraulic structures", Nemchand and Brothers, 1992.
5. Satyanarayana Murthy C, "Water Resources Engineering", 1st Edition, New Age International Pvt. Ltd. Publishers, 1997.

Supplementary SWAYAM Course

Sr. No	Course Name	Instructor	Host Institute	URL
1	Irrigation and drainage	Damodhara Rao Mailapalli	IIT, Kharagpur	https://nptel.ac.in/courses/126105010
2	Water resources engineering	Pranab K. Mohapatra &. Rajesh Srivastava	IIT, Kanpur	https://nptel.ac.in/courses/105104103
3	Micro irrigation engineering	Kamlesh Narayan Tiwari	IIT, Kharagpur	https://nptel.ac.in/courses/126105019

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. (Civil Engineering)

Course Code: CCE113

Course Title: Construction Engineering and Project Management

Programme: B.Tech.	**L:** 3 T: 0 P:0	**Credits:**3
Semester: 5	**Theory/Practical:** Theory	**Teaching Hours:** 45(L)+0(T)+0(P) = 45 Hours
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 60%		
Duration of End Semester Examination (ESE): 3 Hours		
Course Type: Core Course		

Prerequisites: Nil

Additional Material Allowed in ESE: Nil

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Describe the stages and types of construction projects.
2	Apply appropriate construction methods and equipment for site operations.
3	Prepare construction site layouts and resource schedules.
4	Analyze project schedules using CPM and PERT techniques.
5	Evaluate project performance using monitoring and cost control methods.
6	Develop safety management measures for construction sites.

Contents

Part A

Unit 1: 6 (L) hrs

Introduction to Construction Engineering: Introduction to construction industry and types of construction projects such as buildings, highways, bridges and infrastructure works. Stages involved in execution of construction projects from planning and design to construction, completion and handover.

Unit 2: 17 (L) hrs

Project Management: Project planning process including development of work breakdown structure. Project scheduling using network techniques including Critical Path Method (CPM) and Program Evaluation and Review Technique (PERT), determination of critical path, floats and project duration. Updating and monitoring of project schedules and progress control in construction projects. Communication and coordination in construction projects.

Project Monitoring and Control: Project monitoring and control techniques including progress measurement, identification of delays and corrective control measures, causes of project delays and remedial measures, cost control and time-cost relationship in construction projects.

Introduction of relevant open-source software(s).

Part B

Unit 3: 11 (L) hrs

Construction Methods: Construction equipment used for earthwork, concreting, material handling and lifting operations. Formwork and scaffolding systems: erection and removal procedures. Modern construction techniques: precast and prefabricated construction, transportation and erection of precast elements, mechanized construction practices and quality control during construction operations.

Unit 4: 11 (L) hrs

Planning and Organizing Construction Site and Resources: Construction site planning and layout including enabling structures, site organization and documentation at site. Resource scheduling techniques including bar charts and line of balance method, resource constraints and conflicts, resource aggregation, allocation, smoothing and levelling.

Textbooks

1. Srinath L.S., PERT and CPM - Principles and Applications. East West Press, 2001
2. Punmia B.C. and Khandelwal K.K. Project Planning and Control with PERT and CPM. 4th edition, Laxmi Publications Private Limited, 2016.

3. P. S. Gahlot and B. M. Dhir (2015). Construction Planning and Management. New Age International Publishers, New Delhi.
4. K. K. Chitkara (2014). Construction Project Management: Planning, Scheduling and Controlling. Tata McGraw Hill, New Delhi.
5. Kumar Neeraj Jha (2015). Construction Project Management: Theory and Practice. Pearson Education, India.
6. Chris Hendrickson and Tung Au (2008). Project Management for Construction. Prentice Hall.
7. K. K. Chitkara (International edition reference). Construction Project Management. McGraw Hill.

Reference Books

1. Sengupta and Guha (2012). Construction Management and Planning. Tata McGraw Hill, New Delhi.
2. S. C. Sharma (2011). Construction Management. Khanna Publishers, New Delhi.
3. K. K. Chitkara (2013). Construction Technology and Management. Tata McGraw Hill.
4. Jimmie W. Hinze (2011). Construction Planning and Scheduling. Pearson Education.
5. Donald S. Barrie and Boyd C. Paulson (1992). Professional Construction Management. McGraw Hill.
6. Sidney M. Levy (2018). Project Management in Construction. McGraw Hill Education.
7. R. L. Peurifoy, Clifford Schexnayder and Aviad Shapira (2018). Construction Planning, Equipment and Methods. McGraw Hill Education.
8. CPWD Works Manual: 2019, Central Public Works Department, Government of India.

SWAYAM / NPTEL Online Courses

Course Title	Instructor	Institute	Course Link
Project Planning and Control	Koshy Varghese	IIT Madras	https://onlinecourses.nptel.ac.in/noc22_ce59
Project Management	Ramesh Anbanandam	IIT Roorkee	https://onlinecourses.nptel.ac.in/noc24_mg01/preview
Principles of Construction Management	Sudhir Misra	IIT Kanpur	https://onlinecourses.nptel.ac.in/noc22_ce56

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. (Civil Engineering)

Course Code: ECE101
Course Title: Masonry Structures

Programme: B.Tech.	**L:** 4 **T:**0 **P:**0	**Credits:**4
Semester: 5	**Theory/Practical:** Theory	**Teaching Hours:** 60(L)+0(T)+0(P) = 60 Hours
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 80%		
Duration of End Semester Examination (ESE): 3 Hours		
Course Type: Program Elective		

Prerequisites: Solid Mechanics **(**ESCE101), Structural Analysis - I (CCE109)

Additional Material Allowed in ESE:

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Identify and classify masonry units, mortar types, and their properties.
2	Compute strength parameters of masonry materials using standard test methods.
3	Analyze unreinforced masonry walls under axial, flexural, and shear loads.
4	Design load-bearing masonry walls and piers as per BIS provisions.
5	Design reinforced masonry elements (lintels, beams, piers) with proper detailing.
6	Evaluate masonry buildings for stability, durability, and seismic performance.

Contents

Part A

Unit 1: **10 (L) hrs**

Masonry Materials and Construction Practice: Introduction to masonry structures: scope, applications, advantages and limitations; Types of masonry – brick masonry, stone masonry, concrete block masonry, AAC block masonry; Masonry units – properties, classification, strength, water absorption, durability; Mortar and grout – types, mix proportions, selection criteria, workability and curing; Bonds in masonry – English bond, Flemish bond and other common bonds; Workmanship and site practices – joint thickness, curing, quality control; Testing of bricks, blocks and mortar as per BIS standards.

Unit 2: **18 (L) Hrs**

Unreinforced Masonry: Stress-strain characteristics of masonry; Strength of masonry in compression, shear and flexure; Failure modes of masonry walls and piers; Permissible stresses and design philosophy as per IS 1905; Design of load-bearing walls under axial load; Slenderness effects and stability of masonry walls; Design of masonry walls under combined axial load and bending; Design of masonry piers.

Part B

Unit 3: **15 (L) Hrs**

Reinforced Masonry: Concept and necessity of reinforced masonry; Reinforcement materials, bond and anchorage requirements; Reinforced masonry beams and lintels – analysis and design; Reinforced masonry columns – design considerations; Design of masonry around openings – jambs, sills and lintels; Design of arches, corbels and parapets; Detailing practices for reinforced masonry elements; Construction guidelines and quality control for reinforced masonry

Unit 4: **15 (L) Hrs**

Seismic Design, Durability and Retrofitting: Behavior of masonry under wind and earthquake loads; Seismic vulnerability of unreinforced masonry structures; Earthquake-resistant masonry construction practices; Strengthening measures: bands, vertical reinforcement, confinement as per IS 4326; Cracks in masonry – causes, classification and prevention; Durability issues – dampness, efflorescence, Sulphate attack and corrosion; Repair techniques – stitching, grouting, re-pointing, jacketing; Retrofitting and rehabilitation of masonry buildings.

Books

1. Arya A. S. (2015), Brick and Reinforced Brick Structures, Standard Publishers
2. Dayaratnam, P. (2017), Brick and Reinforced Brick Structures, Oxford & IBH
3. Curtin, W.G. (2015), Design of Reinforced and Prestressed Masonry, Thomas Telford Ltd.
4. Hendry, A.W. (1998), Structural masonry, Macmillan Education Ltd.
5. Sinha, B. P., and, Davis, S. R. (1997), Design of Masonry structures, E & F N Spon

Standards & Code documents

1. IS 1905 (2003). Code of practice for structural use of unreinforced masonry
2. IS 2212 (1991). Code of practice for brickwork
3. IS 1077 (1992). Common burnt clay building bricks – Specification
4. IS 2185 (1) (2005). Concrete masonry units – Specification (IS 2185 Part 1). BIS.
5. IS 3495 (1-4) (1992). Methods of tests for burnt clay building bricks
6. IS 2250 (1982). Code of practice for preparation and use of masonry mortars
7. IS 4326 (1993). Earthquake resistant design and construction of buildings – Code of practice
8. SP 20 (1991). Handbook on masonry design and construction

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. (Civil Engineering)

Course Code: ECE102
Course Title: Numerical Methods in Civil Engineering

Programme: B.Tech.	**L:** 4 **T:**0 **P:**0	**Credits:**4
Semester: 5	**Theory/Practical:** Theory	**Teaching Hours:** 60(L)+0(T)+0(P) = 60 Hours
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 80%		
Duration of End Semester Examination (ESE): 3 Hours		
Course Type: Program Elective		

Prerequisites: Nil

Additional Material Allowed in ESE:

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Explain error sources, accuracy, convergence and stability in numerical computations.
2	Solve non-linear equations using standard numerical root-finding techniques.
3	Solve systems of linear algebraic equations using direct and iterative numerical methods
4	Apply interpolation and curve fitting techniques for civil engineering data analysis
5	Compute numerical differentiation and integration for engineering functions and datasets
6	Solve ordinary differential equations using numerical methods for civil engineering applications.

Contents

Part A

Unit 1: **15 (L) hrs**

Fundamentals of Numerical Computation and Errors: Introduction to numerical methods and their importance in civil engineering; Types of errors: truncation error, round-off error, absolute and relative error; Significant digits and error propagation; Convergence, stability and computational efficiency; Solution of linear and non-linear equations – Bisection method, Regula-Falsi method, Newton-Raphson method, Secant method; Applications in civil engineering (settlement equation, flow equation, structural equilibrium) .

Unit 2: **15 (L) Hrs**

System of Linear Equations and Matrix Methods: Formation of simultaneous linear equations from civil engineering systems; Direct methods – Gauss elimination method, Gauss-Jordan method, Iterative methods – Jacobi method, Gauss-Seidel method; Convergence criteria of iterative methods; Eigen values and eigenvectors; Applications in vibration problems, structural analysis.

Part B

Unit 3: **15 (L) Hrs**

Interpolation, Curve Fitting and Numerical Differentiation: Interpolation concepts and applications; Newton's forward and backward interpolation; Lagrange interpolation; Divided difference interpolation; Curve fitting using least squares method – Linear regression, Polynomial regression; Numerical differentiation – Forward difference, backward difference and central difference; Civil engineering applications: traffic flow modeling, load-deflection curve fitting, rainfall-runoff data analysis

Unit 4: **15 (L) Hrs**

Numerical Integration and Solution of Differential Equations: Numerical integration – Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule; Ordinary differential equations – Euler method, , Runge-Kutta method (2nd and 4th order); Finite difference method (introduction); Solution of boundary value problems (basic approach); Applications – beam deflection problems, seepage analysis, population modeling, reservoir routing

Books

1. Grewal B. S. (2012). Numerical Methods in Engineering and Science, Khanna Publishers
2. S.S. Sastry (2012). Introductory Methods of Numerical Analysis, PHI Learning
3. Akai T J (1994). Applied Numerical methods for Engineers, John Wiley & Sons New York
4. Chapra, S. C., & Canale, R. P. (2015). Numerical methods for engineers (7th ed.). McGraw Hill Education.
5. Kreyszig, E. (2011). Advanced engineering mathematics (10th ed.). Wiley.
6. Jain, M. K., Iyengar, S. R. K., & Jain, R. K. (2012). Numerical methods for scientific and engineering computation (6th ed.). New Age International.
7. Gerald, C. F., & Wheatley, P. O. (2004). Applied numerical analysis (7th ed.). Pearson Education.
8. Burden, R. L., & Faires, J. D. (2011). Numerical analysis (9th ed.). Brooks/Cole.
9. Rajasekaran, S. (2005). Numerical methods in engineering and science. S. Chand Publishing.
10. Hoffman, J. D. (2001). Numerical methods for engineers and scientists (2nd ed.). CRC Press.
11. Rao, S. S. (2011). Applied numerical methods for engineers and scientists. Prentice Hall

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. (Civil Engineering)

Course Code: ECE103
Course Title: Repairs & Rehabilitation of Structures

Programme: B.Tech.	**L:** 4 **T:**0 **P:**0	**Credits:**4
Semester: 5	**Theory/Practical:** Theory	**Teaching Hours:** 60(L)+0(T)+0(P) = 60 Hours
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 80%		
Duration of End Semester Examination (ESE): 3 Hours		
Course Type: Program Elective		

Prerequisites: Nil

Additional Material Allowed in ESE:

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Identify causes and types of distress in RC and steel structures.
2	Apply inspection and testing techniques to evaluate structural condition and damage level
3	Interpret NDT results and prepare structural condition assessment reports.
4	Select suitable repair materials and methods for different structural defects
5	Design strengthening and retrofitting measures for RC and masonry structural elements
6	Develop repair and rehabilitation plans considering durability, safety, cost and quality control

Contents

Part A

Unit 1: **15 (L) hrs**

Introduction and Causes of Deterioration: Need for repair, rehabilitation and retrofitting of structures; Distinction between repair, rehabilitation, strengthening and retrofitting; Performance requirements: strength, serviceability and durability; Causes of distress in structures – Poor design and detailing, Faulty construction practices, Overloading and change of usage, Environmental effects and aging, Foundation settlement and soil issues, Chemical attack (Sulphate, chloride, carbonation); Types of cracks in concrete and masonry structures; Corrosion of reinforcement – causes, mechanism and effects; Structural health monitoring .

Unit 2: **15 (L) Hrs**

Inspection, Testing and Condition Assessment: Preliminary inspection and detailed investigation procedures; Visual inspection: mapping cracks, deflection, spalling, leakage; Non-Destructive Testing (NDT) – Rebound hammer test, Ultrasonic Pulse Velocity (UPV) test, Half-cell potential test, Cover meter test, Core cutting and compressive strength evaluation; Destructive and semi-destructive tests; Assessment of load carrying capacity of existing structures; Condition rating systems and damage classification; Preparation of inspection report and repair proposal; Introduction to BIS guidelines and structural audit

Part B

Unit 3: **15 (L) Hrs**

Repair Materials and Repair Techniques: Repair materials - Cementitious repair mortars, Polymer modified mortars, Epoxy resins and bonding agents, Grouts and injection materials, FRP materials, Surface preparation and curing practices; Concrete repair methods – Patch repair and jacketing, Crack repair: routing, sealing and epoxy injection, Recasting and micro-concreting, Shotcrete, Grouting for void filling; Corrosion control methods

– Cathodic protection Corrosion inhibitors, Re-alkalization and chloride extraction; Waterproofing and leakage treatment, Repair of masonry structures: stitching, re-pointing, underpinning

Unit 4: **15 (L) Hrs**

Strengthening, Retrofitting and Rehabilitation Strategies: Strengthening of RC members: beams, columns, slabs; Jacketing methods – RC jacketing, Steel jacketing, FRP wrapping and laminates; Strengthening of foundations – underpinning and soil improvement; Seismic retrofitting concepts and techniques –bands, vertical reinforcement, confinement; Rehabilitation of bridges and industrial structures (case studies); Repair of fire-damaged and earthquake-damaged structures; service life extension and maintenance planning; Case studies of major rehabilitation projects

Standards and Code documents

1. IS 15988 (2013). Guidelines for repair, strengthening and rehabilitation of concrete buildings
2. IS 13935 (2016). Evaluation, repair and seismic strengthening of masonry buildings

Books

1. Varghese, P. C. (2015). Maintenance, repair and rehabilitation and minor works of buildings. PHI Learning Pvt. Ltd.
2. Jain, A. K. (2016). Maintenance and repairs of buildings. CBS Publishers.
3. Shetty, M. S. (2013). Concrete technology: Theory and practice. S. Chand Publishing.
4. Bungey, J. H., Millard, S. G., & Grantham, M. G. (2006). Testing of concrete in structures (4th ed.). Taylor & Francis.
5. Allen, R. T. L., & Edwards, S. C. (1987). Repair of concrete structures. Blackie Academic & Professional.
6. Emmons, P. H. (1994). Concrete repair and maintenance illustrated. R.S. Means Company

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. (Civil Engineering)

Subject Code: ECE104

Subject Name: Engineering Geology

Programme: B.Tech.	**L:** 4 **T:**0 **P:**0	**Credits:**4
Semester: 5	**Theory/Practical:** Theory	**Teaching Hours:** 60(L)+0(T)+0(P) = 60 Hours
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 0%		
Duration of End Semester Examination (ESE): 3 Hours		
Course Type: Program Elective		

Additional Material Allowed in ESE: NIL

On Completion of the course, the student will have the ability to:

CO	Course Outcomes
1.	Describe the role of Engineering Geology and weathering processes in civil engineering works.
2.	Identify and classify minerals and rocks for engineering applications including RQD assessment.
3.	Analyze geological structures and their impact on civil engineering projects.
4.	Apply laboratory tests to determine engineering properties of rocks.
5.	Analyze strength and stress–strain behavior of rocks under different conditions.
6.	Evaluate in-situ testing methods for determining rock mass properties.

Detailed Contents:

Part-A

Unit 1 **12 (L) hrs**

Rocks & Minerals: Importance of Engineering Geology applied to Civil Engineering Practices. Weathering, definition, types and effect. Geological works of rivers, wind, glaciers as agents of erosion, transportation and deposition Minerals, their identification, igneous, sedimentary & metamorphic rocks. Classification of rocks for engineering purposes. Rock quality designation (RQD).

Unit 2 **18 (L) hrs**

Structural & Engineering Geology: Brief idea about stratification, apparent dip, true dip, strike and in conformities. Folds, faults & joints: definition, classification relation to engineering operations. Geological considerations in the Engineering Projects like tunnels, highways, foundation, dams, reservoirs.

Part B

Unit 3 **15 (L) hrs**

Engineering properties of rocks and laboratory measurement: Uniaxial compression test, tensile tests, permeability test, shear tests, size and shape of specimen rate of testing. Confining pressure, stress strain curves of typical rocks. Strength of intact and fissured rocks, effect of anisotropy, effect of saturation and temperature.

Unit 4 **15 (L) hrs**

In-situ determination of Engineering Properties of Rock masses: Necessity of in-situ tests, uniaxial load tests in tunnels and open excavations, cable tests, flat jack test, shear test, pressure tunnel test. Simple methods of

determining in situ stresses, bore hole test.

Text Books:

1. Verma, B.P., Rock Mechanics for Engineers, Khanna Publishers, New Delhi. 2021.
2. Arora, D.S., Engineering Geology, Mohindra Capital Publishers, 2000.
3. Singh, Parbin, Engineering Geology, 8th Edition S.K. Kataria & Sons, 2023.

Reference Books:

1. Goodman, Richard E., Introduction to Rock Mechanics, Wiley Publishers, 2018.
2. Farmar, I.W., Engineering Behaviour of rocks, Kluwer Academic Publishers, 2011
3. Jaeger C., Rock Mechanics and Engineering, Cambridge University Press, 2009.
4. Kesavvalu, Engineering Geology, MacMillan India, 2009.
5. Harvey, J.C., Geology for Geotechnical Engineers, Cambridge University Press, 1982.

Online Learning Materials

S No.	Course Name	Instructor	Host Institute	URL
1	Engineering Geology|	R. K. Dubey	IIT(ISM) Dhanbad	https://onlinecourses.nptel.ac.in/noc25_ce129/preview
2	Earth Sciences for Civil Engineering Part - I & II |	Javed N. Malik	IIT Kanpur	https://onlinecourses.nptel.ac.in/noc22_ce86/preview

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. (Civil Engineering)

Course Code: ECE105

Course Title: Ground Improvement Techniques

Programme: B.Tech.	**L:** 4 **T:**0 **P:**0	**Credits:**4
Semester: 5	**Theory/Practical:** Theory	**Teaching Hours:** 60(L)+0(T)+0(P) = 60 Hours
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 10%		
Duration of End Semester Examination (ESE): 3 Hours		
Course Type: Program Elective		

Prerequisites: Nil

Additional Material Allowed in ESE: Scientific Calculator

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Assess the need for ground improvement and classify different types of problematic soils.
2	Describe the principles for improvement techniques without addition of materials, including dynamic compaction.
3	Apply appropriate ground improvement methods without material addition based on various considerations.
4	Analyze soil improvement techniques with addition of materials with respect to performance and field suitability.
5	Evaluate the effectiveness and limitations of reinforcement-based ground improvement systems.
6	Develop ground improvement solutions for practical geotechnical problems using suitable techniques supported by case studies and design considerations.

Contents

Part-A

Unit-1 Introduction **3(L) hrs**

Need for Ground Improvement, Different types of problematic soils, Emerging trends in ground Improvement, Shallow and deep compaction requirements, Principles and methods of soil compaction.

Unit-2 Soil improvement without addition of materials **20(L) hrs**

Dynamic compaction equipment used - application to granular soils - cohesive soils, depth of improvement, environmental considerations, compaction using vibratory probes, vibro techniques vibro equipment, vibro compaction and replacement process, control of verification of vibro techniques, vibro systems and liquefaction, soil improvement by thermal treatment, preloading techniques, surface compaction.

Part-B

Unit-3 Introduction to soil improvement with the addition of materials **20(L) hrs**

Stabilization of soft clay or silt with lime, bearing capacity of lime treated soils, settlement of lime treated soils, improvement in slope stability, chemical grouting, commonly used chemicals, grouting systems, grouting operations and applications, introduction to compaction grouting, application and limitations, jet grouting, jet grouting process, geometry and properties of treated soils, applications, sand - stone columns.

Unit-4 Soil improvement using reinforcing elements **15(L) hrs**

Introduction to reinforced earth, load transfer mechanism and strength development, anchored earth nailing reticulated micro piles, soil dowels, soil anchors, reinforced earth retaining walls, behaviors of soils on reinforcing with geotextiles, effect on strength, bearing capacity, compaction and permeability, design aspects, slopes, clay embankments, retaining walls, pavements.

Case Studies **3(L) hrs**

Case studies of ground improvement techniques projects.

Text Books

1. P. Purushothama Raj "Ground Improvement Techniques" Laxmi Publications; New Delhi, 2016
2. B.C. Chattopadhyay and J. Maity, Ground Control and Improvement Techniques, Peedot, Howrah, 2011
3. S. K. Gulhati and M. Datta, "Geotechnical Engineering", Tata McGraw Hill, 2005
4. M. R. Hausmann, "Engineering Principles of Ground Modification", McGraw-Hill 1990

Reference Books

1. R. M. Korner, Design with Geosynthetics, Prentice Hall, New Jersy, 3rd Edition 2002
2. Jewell R.A., Text Book on Soil Reinforcement with Geotextiles, CIRIA Special Publication, Thomas Telford,1996
3. Moseley, Text Book on Ground Improvement, Blackie Academic Professional, Chapman & Hall, 1993
4. Manfired R. Hausmann, Engineering Principles of Ground Modification, McGraw-Hill Pub, Co., 1990
5. Bureau of Indian Standards, Selection of ground improvement techniques for foundation in weak soils? guidelines, Bureau of Indian Standards, New Delhi, 1992
6. G. V. Rao and G. V. S. Rao, Text Book on Engineering with Geotextiles, Tata McGraw Hill 1990

Online Learning Materials

S No.	Course Name	Instructor	Host Institute	URL
1	Ground Improvement Techniques	G L Sivakumar Babu	IISc Bangalore	https://nptel.ac.in/courses/105108075
2	Ground Improvement	Dilip Kumar Baidya	IIT Kharagpur	https://nptel.ac.in/courses/105105210

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. (Civil Engineering)

Course Code: ECE106

Course Title: Pavement Materials

Programme: B.Tech.	L: 4 T: 0 P: 0	Credits: 4
Semester: 5	Theory/Practical: Theory	Teaching Hours: 60(L)+0(T)+0(P) = 60 hrs
Total Max. Marks: 100	Continuous Assessment (CA) Marks: 40	End Semester Examination (ESE) Marks: 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 10%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Program Elective		

Prerequisites: Transportation Engineering

Additional Material Allowed in ESE: Scientific Calculator

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Examine the subgrade soil properties as per need of pavement.
2	Evaluate quality and suitability of road aggregates through standard physical and mechanical tests.
3	Determine the properties of bitumen for pavement works based on location and traffic.
4	Design and control bituminous paving mixes using Marshall Stability Method
5	Assess the properties of cement concrete paving mixes according to IRC specifications.
6	Appraise the applications and benefits of modern pavement materials

Contents

Part-A

Unit-1 Subgrade Soil Characterization **14(L) hrs**

Introcduction and significance of subgrade soil in road construction. suitability of different types of soil for construction of embankment and other pavement layers, Laboratory and field compaction of soil, equipment for field compaction of soil, field compaction control, Index and Engineering properties of subgrade soils, determination of subgrade soil strength using CBR test (soaked and un-soaked) and Resilient Modulus (M_R).

Unit-2 Road Aggregates **12(L) hrs**

Introduction, sources and types, desirable properties (physical and mechanical), Tests on aggregates- crushing test, impact test, shape test (flakiness and elongation), abrasion test, specific gravity & water absorption test and their suitability for road construction as per BIS.

Unit-3 Bituminous Materials **12(L) hrs**

Bituminous Materials for Paving – Classification; Properties, Grading System; Test - Specific gravity, Penetration, Softening Point, Ductility, Elastic recovery, Flash point, viscosity test as per BIS.

Part-B

Unit-4 Bituminous Paving Mixes **10(L) hrs**

Bituminous Mix Components (aggregate gradation, binder, filler materials), requirements of bituminous mixes, design of bituminous mix (Bituminous Concrete only) using Marshall Stability Test, construction aspects-hot mix plant operations, transportation, laying and rolling, quality control.

Unit -5 Cement Concrete Paving Mixes **10(L) hrs**

Introduction, Constituents and requirements, Physical, plastic and structural properties of concrete, overview of tests on cement concrete, use of additives in cement concrete, IRC specifications, joint filler and sealer – requirements and functioning,

Unit -6 Modern Pavement Materials **2(L) hrs**

Introduction, uses and applications of modern pavement materials such as Polymer Modified Bitumen (PMB), Crumb Rubber Modified Bitumen (CRMB), Warm Mix Asphalt (WMA), Plastic waste modified bitumen.

Text Books:

1. Khanna S.K. and Justo, C. E. G. `Highway Engineering', Nem Chand and Bros.,2000.
2. Principles and Practice of Highway Engineering, L. R. Kadiyali and N. B. Lal, Khanna, 2007.
3. Atkins, N. Harold, Highway Materials, Soils and Concretes, Fourth Edition, 2002, Prentice-Hall.
4. Kerbs Robert D. and Richard D. Walker, Highway Materials, McGraw-Hill, 1971.

Reference Books/Codes:

1. MoRTH 'Specifications for Roads and Bridges Works'- Indian Roads Congress
2. "Bituminous materials in Road Construction"- HMSO Publication.
3. R Srinivasa Kumar, Highway Engineering, Universities Press.
4. Read, J. And Whiteoak, D., "The Shell Bitumen Handbook", Fifth edition, Shell Bitumen, Thomas Telford Publishing, London 2003

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Pavement Materials	Nikhil Saboo	IIT Roorkee	https://swayam.gov.in/nd1_noc22_ce93/preview
2	Mechanical Characterization of Bituminous Materials	Nikhil Saboo	IIT Roorkee	https://swayam.gov.in/nd1_noc21_ce14/preview
3	Analysis and Design of Bituminous Pavements	J. Murali Krishnan	IIT Madras	https://swayam.gov.in/nd1_noc23_ce49/preview
4	Pavement Construction Technology	Rajan Choudhary	IIT Guwahati	https://onlinecourses.nptel.ac.in/noc25_ce75/preview

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. (Civil Engineering)

Course Code: ECE107
Course Title: Solid Waste Management

Programme: B.Tech.	**L:** 4 **T:** 0 **P:** 0	**Credits:** 4
Semester: 5	**Theory/Practical:** Theory	**Teaching Hours:** 60(L)+0(T)+0(P) = 60 hrs
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 30%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Program Elective		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: Scientific Calculator

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	analyze the types, sources, composition and characteristics of solid wastes, and their impacts on public health and the environment.
2	evaluate the functional elements of an integrated solid waste management system.
3	design appropriate methods for quantification and characterization of solid wastes to support selection of suitable collection, processing and disposal options.
4	compare various solid waste processing and treatment technologies based on process principles, products and environmental considerations.
5	assess the design and operational features of sanitary landfills.
6	interpret key legal and regulatory provisions related to waste management rules in India for informed solid waste system planning.

Contents

Part-A

Unit-1 Introduction to Waste Management **10 (L) hrs**

Definition and classification of solid wastes (municipal, industrial, biomedical, hazardous, e waste, construction and demolition waste, agricultural and inert wastes); Sources and generation of solid waste in urban and rural areas; Factors affecting per capita waste generation; Public health and environmental impacts of improper waste handling, nuisance potential; Concept and principles of integrated solid waste management (ISWM) and life cycle thinking.

Unit-2 Characterization and Quantification **12 (L) hrs**

Types and composition of solid wastes in Indian cities and small towns; Physical characteristics – density, particle size distribution, moisture content, void ratio, field capacity; Chemical characteristics – proximate and ultimate analysis, calorific value, organic and nutrient content, biodegradability; Biological characteristics and their relevance to processing and treatment; Methods for measurement and estimation of waste generation –Laboratory methods for characterization.

Unit-3 Collection, Storage and Transportation of Wastes **8 (L) hrs**

On-site storage of solid waste – objectives, design considerations and requirements; Types of storage containers and their sizing, materials and colour-coding for source segregation; Concept and practice of segregation at source – wet/dry waste, recyclables, hazardous household waste, e-waste, sanitary waste; Transfer stations; Occupational health and safety issues in storage, collection and transport.

Part-B

Unit-4 Solid Waste Processing and Treatment **10 (L) hrs**

Objectives of processing and treatment prior to final disposal; Mechanical processing operations – sorting, segregation, shredding, baling, compaction, size reduction and densification; Biological conversion technologies; Process parameters and design considerations for composting and bio-methanation, Thermal conversion technologies – Energy recovery options from waste – waste to energy plants; Preprocessing of wastes.

Unit-5 Sanitary Landfills **12(L) hrs**

Role of sanitary landfills in integrated solid waste management; Difference between open dumping and sanitary landfilling; Site selection criteria, Components of a sanitary landfill – liners, leachate collection and removal system, gas collection and control system, daily/intermediate/final cover systems, drainage and storm water management; Design principles –Leachate generation, characteristics and treatment/disposal options; Landfill gas generation, composition, hazards, flaring and energy recovery options; Closure and post closure care.

Unit-6 Legal Requirements **8(L) hrs**

Overview of policy and regulatory framework for solid waste management in India; Solid Waste Management Rules, 2016 and subsequent amendments – scope, applicability and key provisions; Overview of allied rules: Plastic Waste Management Rules, E-Waste Management Rules, Bio-Medical Waste Management Rules, Hazardous and Other Wastes Rules, Construction and Demolition Waste Management Rules; Environmental standards and guidelines for compost, RDF, waste-to-energy plants and landfills; Public participation, grievance redressal and enforcement; Emerging concepts such as extended producer responsibility (EPR), circular economy and sustainable procurement in the context of solid waste management.

Text Books

1. Pichtel, J., Waste Management Practices – Municipal, Hazardous and Industrial, 2nd Edition, CRC Press, 2014.
2. Vesilind, P.A., Solid Waste Engineering, 2nd Edition, Thomson Learning Inc, 2002.
3. Tchobanoglous, G., Vigil, S.A. and Theisen, H., Integrated Solid Waste Management: Engineering Principles and Management Issues, McGraw Hill, 1993.
4. Howard S. Peavy, Donald R. Rowe & George Tchobanoglous, "Environmental Engg.", McGraw Hill, Reprint Edition 2017.
5. CPHEEO, Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India, 2026.
6. Ramesha Chandrappa, Diganta Bhusan Das - Solid Waste Management, Principles and Practice, Springer, 2016.

Reference Books

1. Frank Kreith, George Tchobanoglous - Handbook of Solid Waste Management, 2nd Edition, McGraw Hill, 2002.
2. Vesilind, P.A., Solid Waste Processing and Resource Recovery, Humana Press, 1990.
3. LaGrega M.D., Buckingham P.L. and Evans J.C., Hazardous Waste Management, Waveland Pr Inc., Reissue Edition, 2010.
4. Ramachandra, T.V. and Bachamanda, S., Environmental Management: Textbook for Municipal Solid Waste Management, Capital Publishing / IISc Bangalore supported material, 2007.
5. Sharma, S. and Shah, K., Municipal Solid Waste Management in Indian Cities, Concept Publishing Company, New Delhi, 2006.
6. United Nations Environment Programme (UNEP), Solid Waste Management, Volume I: Assessing the Situation, UN Habitat/UNEP Technical Report, 2010.

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL

1	Municipal Solid Waste Management	Ajay Kalamdhad	IIT Guwahati	https://onlinecourses.nptel.ac.in/noc24_ce77/preview (or https://nptel.ac.in/courses/105103205) – accessed on 24-02-2026
2	Municipal Solid Waste Management	T. V. Ramachandra	IISc Bangalore	https://nptel.ac.in/courses/120108005 – accessed on 24-02-2026
3	Integrated Waste Management for a Smart City	Brajesh Kumar Dubey	IIT Kharagpur	https://nptel.ac.in/courses/105105160 or preview: https://onlinecourses.nptel.ac.in/noc25_ce122/preview – accessed on 24-02-2026
4	Solid and Hazardous Waste Management	Indumathi Nambi	IIT Madras	https://nptel.ac.in/courses/105106056 – accessed on 24-02-2026

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. (Civil Engineering)

Course Code: ECE108

Course Title: Environmental Impact Assessment and Life Cycle Analysis

Programme: B.Tech.	**L: 4 T:0 P: 0**	**Credits:** 4
Semester: 5	**Theory/Practical:** Theory	**Teaching Hours: 60 (L) + 0 (T) + 0 (P) = 60 Hours**
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 0%		
Duration of End Semester Examination: 3 Hours		
Course Type: Program Elective		

Prerequisites: NIL

Course Outcomes (COs)

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

CO#	Course Outcomes (COs)
1.	Describe the concepts and legal framework of Environmental Impact Assessment.
2.	Analyze and evaluate the potential environmental impacts of developmental projects.
3.	Apply various impact assessment methodologies and risk assessment techniques.
4.	Explain the principles and stages of Life Cycle Analysis.
5.	Perform basic LCA calculations and interpret LCA results for sustainable decision-making.
6.	Compare EIA and LCA approaches for environmental management and sustainability planning.

Contents

PART-A

Unit I: Introduction to Environmental Impact Assessment EIA 8 (L) hrs

Definition, need, and scope of EIA, Evolution of EIA – Global and Indian perspective, Environmental components: Air, water, land, noise, socio-economic aspects, Environmental management principles.

Unit II: EIA Process and Methodologies 10 (L) hrs

Screening and Scoping, Baseline data collection, Impact identification and prediction methods: Checklists, Matrices (e.g., Leopold Matrix), Network method, Overlay method (GIS based), Environmental Risk Assessment, Public participation and public hearing, Environmental Management Plan (EMP).

Unit III: Environmental Legislation and Case Studies 12(L) hrs

Role of agencies like Ministry of Environment, Forest and Climate Change (MoEFCC), Overview of Environmental Protection Act (India)EIA Notification (latest amendments), Role of State Pollution Control Boards, Environmental clearance process, Case studies of industrial, mining, infrastructure projects, post-project monitoring and auditing.

PART-B

Unit IV: Introduction to Life Cycle Analysis (LCA) 10 (L) hrs

Definition and concept of LCA, Historical development of LCA, Framework of LCA according to International Organization for Standardization (ISO 14040 series), Goal and scope definition, Functional unit and system boundaries.

Unit V: Life Cycle Inventory (LCI) and Impact Assessment 9 (L) hrs

Life Cycle Inventory analysis, Data collection and validation, Life Cycle Impact Assessment (LCIA), Impact categories: Global warming, Acidification, Eutrophication, Ozone depletion Resource depletion, Interpretation of LCA results.

Unit VI: Applications of LCA and Integration with EIA 11 (L) hrs

Product comparison and eco-labelling, Carbon footprint and water footprint, Sustainable product design, Circular economy concepts, Comparison of EIA vs LCA, Industrial case studies, Software tools for LCA (e.g., openLCA, Brightway2 – overview).

Text Books

1. Canter, L. W. “Environmental Impact Assessment”. McGraw-Hill, 1996.

2. Glasson, J., Therivel, R., & Chadwick, A. "Introduction to Environmental Impact Assessment". Routledge, 2013.
3. Hauschild, Rosenbaum & Olsen. "Life Cycle Assessment: Theory and Practice". Springer, 2018.
4. Baumann, H., & Tillman, A.-M. "The Hitch Hiker's Guide to LCA". Student litteratur, 2004.
5. Curran, M. A. "Life Cycle Assessment: Principles and Practice". United States EPA / SETAC, 2015.

Reference Books/ Standards:

1. Hanna, K. S. (Ed.). Routledge Handbook of Environmental Impact Assessment. Routledge, 2016
2. Hauschild, M. Z., & Huijbregts, M. A. J. Life Cycle Impact Assessment. Springer, 2015
3. Jolliet, O., Saade-Sbeih, M., Shaked, S., Jolliet, A., & Crettaz, P. Environmental Life Cycle Assessment. CRC Press, 2015
4. Muthu, S. S. (Ed.). Life Cycle Sustainability Assessment. Springer, 2015

Supplementary SWAYAM Course

Sr. No	Course Name	Instructor	Host Institute / Platform	URL
1	Environmental Impact Assessment	Prof. Harshit Sosan Lakra	IIT Roorkee	https://nptel.ac.in/courses/124107160
2.	Sustainable Engineering and Life Cycle Analysis	Prof. Brajesh Kr. Dubey	IIT Kharagpur (NPTEL)	https://nptel.ac.in/courses/105105157

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. (Civil Engineering)

Course Code: ECE109

Course Title: Environmental Risk Assessment

Programme: B. Tech.	**L: 4 T:** 0 **P:** 0	**Credits:** 4
Semester: 5	**Theory/Practical:** Theory	**Teaching Hours:** 60 (L) + 0 (T) + 0 (P) = 60 Hours
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:**40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 20%		
Duration of End Semester Examination (ESE): 03 Hours		
Course Type: Programme Elective		

Prerequisites: NIL

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO	Course Outcomes
1	**Interpret** the fundamental concepts of environmental toxicology,
2	**Analyze routes of exposure** and toxicity testing methods in environmental systems,
3	Identify environmental hazards and assess risks,
4	**Apply quantitative risk assessment tools** for probabilistic exposure assessment,
5	**Perform risk analysis using frequency modelling techniques,**
6	Formulate risk management strategies.

Contents

Part-A

Unit-1 Environmental Toxicology 15 (L) hrs

Historical context and importance of environmental toxicology, environmental contaminants, classification and types, fate of contaminants in environmental media, bioaccumulation, and bioavailability in multiphase systems, dose-response relationship and toxicity testing, hazard and risk; routes of exposure, oral route, dermal route, inhalation route, distribution, elimination, absorption, and bioavailability.

Unit-2 Environmental Risk 15 (L) hrs

Basic concepts of environmental risk and definitions; hazard identification procedures; environmental risk zonation, consequence analysis and modelling (discharge models, dispersion models, fire and explosion models, effect models etc), application of statistical and Monte Carlo simulations and other techniques for probabilistic exposure assessment; microbial risk assessment - risk characterization, uncertainty and sensitivity analysis.

Part-B

Unit-3 Risk Analysis 13 (L) hrs

Estimation of incident frequencies from historical data, frequency modelling techniques e.g., Fault tree analysis (FTA) and Event tree analysis (ETA), case studies, human factors in risk analysis, calculation and presentation of risk (individual risk, societal risk),

Unit-4 Risk Management 17 (L) hrs

Risk communication and perception, risk management strategies and mitigation techniques, environmental management plans and occupational health and safety, cost-benefit analysis, risk management rules, regulations and

conventions, case studies on environmental risk assessment, industrial pollution, hazardous waste sites and water contamination incidents.

Text Books

1. T. W. Simon, "Environmental Risk Assessment: A Toxicological Approach", CRC Press, 2019.
2. E. Hodgson, "A Textbook of Modern Toxicology", John Wiley & Sons, 2010.
3. A. W. Hayes, C. L. Kruger, "Principles and Methods of Toxicology", CRC Press, Taylor and Francis, 2014.
4. D. M. Cocarta, "Environmental Risk Assessment", Bentham Science Publishers Pt. Ltd. 2023.

Reference Books

1. M. H. Dong, "Introduction to Environmental Toxicology", Create Space Publishers, 2018.
2. M. Rausand, "Risk Assessment: Theory, Methods and Applications", Wiley, 2020.
3. C. H. Walker, R. M. Sibly, S. P. Hopkin, and D. B. Peakall, "Principles of Ecotoxicology", CRC Press, 2005.
4. M. C. Newman and M. A. Unger, "Fundamentals of Ecotoxicology: The Science of Pollution", Lewis Publishers, 2020.
5. R. Wilson and E.A.C. Crouch, "Risk-Benefit Analysis", Harvard University Press, 2001.

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Certificate Course in Environmental Sustainability	M. Rajesh	IGNOU, New Delhi	https://onlinecourses.swayam2.ac.in/e-learning/preview/nou26_ag07
2	Climate and Environmental Protection	B S Balaji	JNU, New Delhi	https://onlinecourses.swayam2.ac.in/e-learning/preview/ugc26_ge08
3	Basic Environmental Engineering and Pollution Abatement	P. Mondal	IIT Roorkee	https://onlinecourses.nptel.ac.in/ noc24_ch53/preview
4	Environment and Development	Ngamjho Kipgen	IIT Guwahati	https://onlinecourses.nptel.ac.in/ noc23_hs133/preview

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. (Civil Engineering)

Course Code: ECE110
Course Title: Circular Economy and Resource Recovery

Programme: B.Tech.	**L:** 4 **T:** 0 **P:** 0	**Credits: 4**
Semester: 5th	**Theory/Practical:** Theory	**Teaching Hours:** 60 (L) = 60 Hours
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 0 %		
Duration of End Semester Examination: 3 Hours		
Course Type: Program Elective		

Prerequisites: NIL
Additional Material Allowed in ESE: None
On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Evaluate five mega trends involving climate, development, ecology, economy, and technology and their linkages with energy and resources.
2	Identify routes of circular economy in personal, family, community, and institutional settings.
3	Practice principles and methods of circular economy and design resource-efficient.
4	Plan on transforming waste into valuable resource through circular economy principles.
5	Analyze the environmental and economic sustainability.
6	Design recovery systems, understand circular economy principles, and assess regulatory frameworks for waste management.

Part-A

UNIT 1- Circular economy

Concept and definitions; Closed loop ecosystems; Systems thinking; Benefits to environment, economy and society, Sustainable procurement; Ecodesign; Industrial and territorial ecology; Economics of functionality; Responsible consumption; Extending the duration of use; Recycling
6(L) Hrs

UNIT 2- Steps for transition towards a circular economy

Large-scale transition to non-polluting sources of energy; Durable products requiring less materials and energy; Incentivization of recycling, re-use, and repair; Replacement of hazardous materials with safer alternatives, Micro-level: Firm-level engineering and managerial level;
Meso-level: Industrial ecology, Industrial symbiosis, Eco-clusters, Eco-industrial parks; Macro level: General policies, Plans, Green and sustainable entrepreneurship
16(L)Hrs

UNIT 3- Challenges in implementing circular economy

Achievability and desirability; Disrupting consumer's convenience; Local regulations versus the circular economy concept; Lack of infrastructure for waste treatment; Lack of recycling technology; Poor business model plan
8(L) Hrs

Part-B

UNIT 4- Introduction to Waste Management & Circular Economy

Concepts of waste, generation rates, and classification (municipal, hazardous, biomedical, e-waste), Principles of the 6R framework (Reduce, Reuse, Repair, Refurbish, Repurpose, Recycle), Regulatory frameworks: Waste Management Rules (e.g., Plastic, E-waste) 10(L)Hrs

UNIT 5- Collection, Characterization, and Processing

Characterization of municipal solid waste and hazardous waste, Methods for collection, transfer, transport and storage, Separation and processing techniques. 5(L) Hrs

UNIT 6 - Resource Recovery & Sustainable development

Biological Treatment: Composting and anaerobic digestion for organic waste, Energy-from-Waste (Waste-to-Energy): Pyrolysis, incineration, and thermal treatment, Recycling: Material recovery, e-waste recycling, and reuse strategies. Sustainable Development & Management: Circular business models and economic, environmental, and social aspects of waste, Entrepreneurship in waste environment. 15(L) Hrs

Text Books

1. Purva Tavri, "Indian circular economy in action", Routledge Publishers, 2026
2. Shalini Goyal Bhalla, "Circular Economy:(Re) Emerging Movement", Invincible Publishers, 2021
3. Stahel, W.R. and MacArthur, E, "The Circular Economy: A User's Guide", Routledge, NY, USA, 2019
4. Lacy, P. and Rutqvist, J, "Waste to Wealth: The Circular Economy Advantage", London: Palgrave Macmillan, 2015

Reference Books

1. Crocker, R., Saint, C., Chen, G. and Tong, Y. eds., "Unmaking Waste in Production and Consumption: Towards the Circular Economy", Emerald Publishing Limited, 2018
2. Delchet-Cochet, K. ed., "Circular Economy: From Waste Reduction to Value Creation", John Wiley & Sons, 2020
3. Frodermann, L., "Exploratory Study on Circular Economy Approaches", Springer, 2018
4. Ghosh, S.K., Samanta, S., Hirani, H. and da Silva, C.R.V. eds., "Effective Waste Management and Circular Economy: Legislative Framework and Strategies", CRC Press, 2022

Swayam NPTEL courses

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Linear to circular economy	Shalini Goyal Bhalla	ICCE New Delhi	https://onlinecourses.swayam2.ac.in/e-learning/preview/aic21_ge19
2	Circular Economy for sustainable buildings	Iyer Vijay Laxmi Kasinath	school of planning and architecture, Vijayawada	https://onlinecourses.swayam2.ac.in/e-learning/preview/aic21_ge19

3	Waste Management	G. Janardhanan	NIT, Chennai	https://onlinecourses.swayam2.ac.in/e-learning/preview/ntr25_ed53
4	Plastic Waste Management	Brajesh Kumar Dubey	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc24_ce25/preview

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. (Civil Engineering)

Course Code: ESCE102

Course Title: Design Thinking

Programme: B. Tech.	**L: 0 T:** 0 **P:** 2	**Credits:** 1
Semester: 5	**Theory/Practical:** Theory	**Teaching Hours:** 0 (L) + 0 (T) + 30 (P) = 30 Hours
Total Max. Marks: 50	**Continuous Assessment (CA) Marks:** 50	**End Semester Examination (ESE) Marks:** 0
Minimum Percentage of Numerical / Design / Programming Problems in ESE:		
Duration of End Semester Examination (ESE): nil		
Course Type: core course		

Course Outcomes

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

CO	Course Outcomes
1	Identify field-based problem specific to civil engineering.
2	Prepare problem statements based on need-analysis.
3	Develop concept solutions using brainstorming tools.
4	Create prototypes using the decision matrix.
5	Validate and improve prototype through testing and feedback.
6	Prepare design solution report.

Detailed Syllabus

Unit 1:

Concept of design thinking*:* Difference between conventional design and design thinking; Design Thinking stages – Observe, Define, Ideate, Prototype, Test, Improve (repeat), Field Observation and Problem Identification: Methods of identifying real problems – observation walks, site surveys, photo documentation, basic measurements and sketches.

Deliverable: Short write-up: one civil engineering problem observed in daily life; Problem logbook with photographs, sketches, and notes.

Unit 2:

Empathy Tools and Root-cause Analysis: Stakeholder identification in civil projects such as users, residents, workers, engineers, contractors, authorities etc.; Stakeholder mapping tools – influence-interest matrix, stakeholder network diagram; Empathy tools – interview method, survey questionnaire preparation; empathy mapping, persona building, Identifying user pain points and expectations.

Root cause analysis tools – Fishbone diagram, 5-Why technique; Writing a final problem statement with constraints – cost constraints, safety constraints, site constraints; time constraints, environmental constraints; Framing "How Might We (HMW)" statements

Deliverable: Problem Statement, 5-Why report, HMW statement.

Unit 3:

Ideation and Concept Generation: Divergent and convergent thinking; Brainstorming principles; Ideation techniques – mind mapping, SCAMPER technique, Crazy-8 sketching, morphological chart; Concept screening and selection – feasibility analysis, decision matrix (weighted scoring)

Prototyping and Visualization: sketch, layout, mock-up, scaled model, digital prototype (AutoCAD / SketchUp / AI tools/ Canva)

Deliverable: Solution ideas, Concept selection matrix and Prototype (physical/digital).

Unit 4:

Testing, Validation and Iteration: Testing methods in design thinking – user feedback testing, peer review testing, expert review, Recording feedback systematically; Iteration and improvement; Final design freeze and justification – cost feasibility, safety improvement, sustainability impact, ease of implementation

Deliverable: Feedback sheet and final design justification.

Suggested Themes (but not limited to)

- *Campus drainage redesign to prevent waterlogging*
- *Pedestrian safety improvement near gate/road*
- *Low-cost rainwater harvesting for hostel*
- *Dust control and noise reduction plan for construction sites*
- *Traffic circulation redesign near parking area*
- *Sustainable pavement block design using recycled waste*
- *Waste segregation and collection redesign for campus*
- *Temporary site safety arrangement*
- *many other….*

Reference:

1. Christian Muller-Roterberg, “Handbook of Design Thinking”, 2018
2. Eli Woolery, “Design Thinking Handbook” Invision Pub, 2019
3. Nigel Cross, “Design Thinking” Max Answell “Mastering Design Thinking”, 2019
4. Karl T. Ulrich, Steven D. Eppinger and Maria C Yang, “Product Design and Development”, McGraw Hill, 7ed, 2020
5. George e Dieter, Linda C Schmidt, “Engineering Design”, Mc Graw Hill, 4ed, 2009

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. (Civil Engineering)

Course Code: CCE114
Course Title: Structural Design – II

Programme: B.Tech.	**L:** 3 **T:**1 **P:** 2	**Credits:** 5
Semester:	**Theory/Practical:** Theory	**Teaching Hours:** 45(L)+15(T)+30(P) = 90 Hours
Total Max. Marks: 150	**Continuous Assessment (CA) Marks:** 90	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 80%		
Duration of End Semester Examination (ESE): 3 Hours		
Course Type: Core Course		

Prerequisites: Solid Mechanics **(**ESCE101), Structural Analysis – I (CCE109)

Additional Material Allowed in ESE: IS 800, steel table

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Select suitable connection type for ensuring the identified load path.
2	Assess the design loading for roof and floor systems as per relevant IS codes
3	Apply IS 800 limit state design philosophy for steel member design
4	Analyze and design steel roofing and flooring systems.
5	Proportion and design structural columns and footing base
6	Prepare structural drawings including detailing of joints, gusset plates, and base plates

Contents

Part A

Unit 1: **11 (L) hrs**

Connections: Introduction to connections, types and functions; design of riveted, bolted and welded connections – axially and eccentrically loaded joints, simple connection of bracket plates to columns, beam-to-beam and beam-to-column connections; design of framed, un-stiffened and stiffened seat connections; Connection detailing; Fabrication drawing basics.

Unit 2: **12 (L) Hrs**

Roofing system: Imposed loads on flat and sloping roofs, wind loads on sloping roofs and vertical cladding including effect of degree permeability and wind drag; Analysis of pin-jointed trusses under various loading cases, computation of design forces; design and detailing of various members and supports; Truss layout and member schedule.

Part B

Unit 3: **11 (L) Hrs**

Flooring system: Concept and types of floor system, main components – main and secondary beams; design of simply supported beams – rolled steel sections, fabricated sections; Design of laterally supported vs unsupported beams – Shear check, deflection check; Design of beam connections

Unit 4: **11 (L) Hrs**

Columns and bases: Design of columns under axial loads using single or multiple rolled steel sections, design of lacing, battens, and columns subjected to axial load and bending; design of Gusseted base; Column base plate detailing.

Part – C

Use of software (s) for problems of structural design

Text Books

- Duggal, S. K. (2018). Design of steel structures (3rd ed.). McGraw Hill Education India.
- Bansal, R. K. (2019). Design of steel structures. Laxmi Publications.
- Ramchandra, & Gehlot, V. (2017). Design of steel structures (Vols. 1 & 2). Scientific Publishers.
- Sharma, S. K. (2014). Design of steel structures. S. Chand Publishing.
- Salmon, C. G., Johnson, J. E., & Malhas, F. A. (2009). Steel structures: Design and behavior (5th ed.). Pearson.
- Segui, W. T. (2013). Steel design (5th ed.). Cengage Learning.
- McCormac, J. C., & Csernak, S. F. (2015). Structural steel design (5th ed.). Pearson.

Reference/ Standards and Guidelines

1. IS 800 (2007). General construction in steel – Code of practice
2. IS 875 Parts 1–5 (1987). Code of practice for design loads (other than earthquake) for buildings and structures

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. (Civil Engineering)

Course Code: CCE115

Course Title: Foundation Engineering

Programme: B.Tech.	L: 3 T: 1 P: 2	Credits: 4
Semester: 5	Theory/Practical: Theory	Teaching Hours:45(L)+15(T)+30(P)=90 hrs
Total Max. Marks: 150	Continuous Assessment (CA) Marks: 90	End Semester Examination (ESE) Marks: 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 70%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core Course		

Prerequisites: Nil

Additional Material Allowed in ESE: Scientific Calculator

On completion of the course, the student will have the ability to:

CO	Course Outcomes
1.	Evaluate various soil investigation techniques for the design of foundations.
2.	Analyze the settlement of substructures for cohesive and non-cohesive soils.
3.	Predict the soil failure by understanding its criteria.
4.	Apply the knowledge of soil bearing capacity for the design of shallow foundation.
5.	Evaluate earth pressure for the lateral stability of retaining wall.
6.	Demonstrate numerical analysis for slope stability, foundation behaviour and earth-retaining structures.

Contents

Part-A

Unit -1 Sub Soil Exploration and Sampling 10(L) hrs

Objectives and scope of soil investigation for new and existing structures. Depth and spacing of exploration for different structures. Methods of soil exploration: trial pits, borings, penetration tests and geophysical methods (seismic and resistivity). Types of soil samples and sampling disturbance. Samplers: open drive sampler, stationary piston sampler, rotary sampler. Borehole logging and interpretation. Standard Penetration Test (SPT) and its applications.

Unit-2 Bearing Capacity and Settlement of Shallow Foundation 13 (L) hrs

Type of shallow foundations, Definition of ultimate bearing capacity, safe bearing capacity and allowable bearing capacity. Rankine's analysis and Terzaghi's analysis, Types of failures, Factors affecting bearing capacity, B.I.S recommendations for shape, depth and inclination factors. Plate Load test and Standard Penetration Test, 2:1 method of load distribution, Types and causes of settlement of structures, Computation of immediate and consolidation settlement, basics of raft and floating foundation.

Part-B

Unit -3 Earth Pressure 10(L) hrs

Earth Pressure Terms and symbols used for a retaining wall, Rankine states of plastic equilibrium, Rankine's theory for active and passive earth pressure for Cohesionless backfill with surcharge and fully submerged case. Cohesive backfill condition, Coulomb's method for cohesion less backfill, Merits and demerits of Ranking and Coulomb's theories, Culmann's graphical construction method (without surcharge load).

Unit-4 Deep Foundation 12 (L) hrs

Types of deep foundation, Necessity and uses of piles, Classification of piles, Types of pile driving hammers & their

comparison, Use of Engineering News Formula and Hiley's Formula for determination of allowable load, Limitations of pile driving formulae, Cyclic Pile Load Test, Determination of point resistance and frictional resistance of a single pile by Static formulas, Piles in Clay, Pile in sand, Spacing of piles in a group, Factors affecting load carrying capacity of a pile group, Efficiency of pile group, Bearing capacity of a pile group in clay by block failure and individual action approach, Calculation of settlement of pile group in clay, Settlement of pile groups in sand, Negative skin friction, Advantages and disadvantages of open box and pneumatic caissons, Essential part of a pneumatic caisson, Components of a well foundation, Conditions for stability of a well, Forces acting on a well foundation, Computation of scour depth.

Part-C

(To be conducted in software/ computational Laboratory using: PLAXIS 2D / 3D and Geo 5)

1. Stability analysis of reinforced earthen slope.
2. Parametric study of reinforcement length, spacing and placement on bearing capacity ratio for slope.
3. Bearing capacity of spread footing under concentric and eccentric loading.
4. Axial load capacity of single pile in homogeneous and layered soil.
5. Earth pressure and stability analysis of sheet pile.
6. Earth pressure and stability analysis of retaining wall.
7. Soil stability analysis using micropiles.
8. Soil stability analysis of nailed slope.

Text Books:

1. Arora K.R., Standard Publishers Distributors, New Delhi, **7th Edition, 2019.**
2. Punmia B.C., Punmia, Jain A. K., Laxmi Publications (P) Ltd., New Delhi, **16th Edition, 2017.**
3. Venkatramaiah C., New Age International Publishers, New Delhi, **6th Edition, 2018.**
4. Braja M. D.**,** Principles of Foundation Engineering, Cengage Learning, **9th Edition, 2019.**
5. Coduto D. P., Foundation Design, Pearson Education, **3rd Edition, 2011.**
6. Shamsher Prakash, Sharma H.D., Analysis and Design of Foundations and Retaining Structures, Gulf Publishing Company, **1988.**

Reference Books

1. Garg S.K., Pile Foundations in Engineering Practice, Khanna Publishers, New Delhi, **6th Edition, 2015**.
2. Gupta K.K., Soil Mechanics and Foundation Engineering, Khanna Publishers, New Delhi, **Latest Revised Edition, 2014.**
3. Vinayagam H.S., Foundation Engineering Handbook, McGraw Hill Education (India), Edition **2012.**
4. Terzaghi Karl, Ralph B., Gholamreza Mesri, Soil Mechanics in Engineering Practice, John Wiley & Sons, **3rd Edition, 1996.**
5. Terzaghi Karl, Theoretical Soil Mechanics, John Wiley & Sons, **1943 (Reprint 2009).**
6. Shamsher Prakash, Sharma H. D., Analysis and Design of Foundations and Retaining Structures, Gulf Publishing Company, **1988.**

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Foundation Engineering	Kousik Deb	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc25_ce120/preview

2	Geotechnical Engineering-II / Foundation Engineering	Dilip Kumar Baidya	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc21_ce01/preview
3	Advanced Foundation Engineering	Kousik Deb	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc21_ce33/preview

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. (Civil Engineering)

Course Code: CCE116

Course Title: Estimation & Costing

Programme: B.Tech.	**L:** 3	**Credits:**3
Semester: 6	**Theory/Practical:** Theory	**Teaching Hours:** 45(L)+0(T)+0(P) = 45 Hours
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 80%		
Duration of End Semester Examination (ESE): 3 Hours		
Course Type: Core Course		

Prerequisites: NIL

Additional Material Allowed in ESE: Scientific Calculator, CSR 2020, IS 1200

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Explain and apply methods of estimation to calculate quantities and cost of civil engineering works.
2	Prepare detailed estimates for buildings, roads, and public health engineering works using standard procedures.
3	Develop specifications and perform rate analysis for common construction works.
4	Explain and implement contract, tendering, and billing procedures in construction projects.
5	Apply accounting and arbitration procedures related to public works contracts.
6	Apply appropriate valuation methods for buildings and properties.

Contents

Part A

Unit 1: Estimates and Specifications **9 (L) hrs**

Estimates: Method of building estimates, types of estimations, types of plans: site plan, line plan, index plan, layout plan; plinth area, floor area, carpet area. Technical Terms including technical sanction, administrative approval, contingencies, work charged establishment, prime cost, tools & plants provision, lump sum items, overhead cost, supervision charges.

Specifications: Principles of general and detailed specifications; Purpose and writing detailed specifications for different classes of building and Civil engineering works (earthwork, concrete, Masonry, plastering, finishes etc.)

Unit 2: Detailed Estimation and Rate Analysis **13 (L) hrs**

Quantity Estimate: Preparation of estimates for buildings, roads, earthwork, R.C.C. works, sloped roof, roof trusses, masonry platforms, masonry water tank. Preparation of estimates for public health engineering works including sanitary and water supply works.

Analysis of Rates and costing: For earthwork, brickwork, concrete work, damp proof course, stone masonry, plastering, pointing, doors and windows, whitewashing, painting, varnishing, centering and shuttering, and road works.

Part B

Unit 3: Contracts, Tender Procedures and Billing **9 (L) hrs**

Contracts, Tender: Classification of contracts (item-rate, lumpsum, percentage, cost-plus), contract document/agreement; Tenders, tender form, tender notice, tender document, submission and opening of tenders, earnest money, security deposit, retention money, prequalification of contractors, provisions related to extra and deviation items, variation orders, escalation clauses, penalties and liquidated damages, termination of contract, insurance and risk coverage, completion certificate, defect liability period.

Billing and Payment Procedures: Execution and billing procedures including classification of works, work orders, measurement book, muster roll, piece work agreement. Preparation of running account bills, interim, final payments.

Unit 4: Accounts, Arbitration and Valuation **14 (L) hrs**

Accounts: P.W.D. accounts and accounting procedures including cash transactions, receipt of money, cash book,

temporary advance, imprest account, stock records, works expenditure, materials accounting and basic accounting procedures related to public works.

Arbitration and settlement of disputes including causes of disputes in construction contracts, role and appointment of arbitrator, arbitration agreement provisions, power and duties of arbitrator, arbitration procedures, conduct of hearings, submission of claims and counter claims, arbitral award and enforcement of award under provisions of Arbitration Act applicable to construction contracts**.**

Valuation: Valuation of buildings and properties including purposes of valuation, methods of valuation, capitalized value, rental method, cost method, depreciation, sinking fund, salvage value and determination of standard rent.

Textbooks

1. Dutta, B. N. (2026). *Estimating and Costing in Civil Engineering*. UBS Publishers and Distributors, New Delhi.
2. Chakraborti, M. (2010). *Estimating, Costing, Specifications and Valuation in Civil Engineering*. CBS Publishers and Distributors, New Delhi.
3. Rangwala, S. C. (2016). *Estimating and Costing in Civil Engineering*. Charotar Publishing House, Anand, India.
4. Dagostino, F. R., and Feigenbaum, L. (2015). *Estimating in Building Construction*. Pearson Education, Boston.
5. Levy, S. M. (2017). *Construction Estimating Using Excel*. McGraw Hill Education, New York.
6. Hinze, J. (2011). *Construction Contracts*. McGraw Hill Education, New York.

Reference/ Standards/ Guidelines

1. Birdie, G. S. (2013). *Estimating and Costing in Civil Engineering*. Dhanpat Rai Publications, New Delhi.
2. Rangwala, S. C. (2015). *Valuation of Real Properties*. Charotar Publishing House, Anand, India.
3. Chitkara, K. K. (2014). *Construction Project Management and Contracts*. Tata McGraw Hill Education, New Delhi.
4. Mislick, G. K., and Nussbaum, D. A. (2015). *Cost Estimation: Methods and Tools*. Wiley, Hoboken, New Jersey.
5. Peterson, S. J. (2012). *Construction Estimating Using Excel* (2nd ed.). Pearson Education, Upper Saddle River, New Jersey.
6. Holm, L., and Schaufelberger, J. E. (2021). *Construction Cost Estimating*. Routledge, Taylor and Francis Group, New York.
7. Bureau of Indian Standards IS 1200 (Part 1): 1992 – Methods of Measurement of Building and Civil Engineering Works.
8. Bureau of Indian Standards IS 456: 2000 – Plain and Reinforced Concrete Code of Practice (relevant for quantity estimation of RCC works).
9. Bureau of Indian Standards National Building Code of India (NBC): 2016, Bureau of Indian Standards.
10. CPWD Analysis of Rates: 2021, Central Public Works Department, Government of India

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. (Civil Engineering)

Course Code: ECE201
Course Title: Seismic Design of RC buildings

Programme: B.Tech.	**L:** 4 **T:**0 **P:**0	**Credits:**4
Semester: 6	**Theory/Practical:** Theory	**Teaching Hours:** 60(L)+0(T)+0(P) = 60 Hours
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 80%		
Duration of End Semester Examination (ESE): 3 Hours		
Course Type: Program Elective		

Prerequisites: Nil

Additional Material Allowed in ESE:

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Explain fundamental earthquake engineering concepts and seismic behavior of structures
2	Compute seismic forces and response parameters using IS 1893 provisions
3	Analyze RC buildings for earthquake loads using equivalent static and response spectrum methods
4	Design RC structural components for seismic load combinations as per BIS codes
5	Apply ductile detailing provisions of IS 13920 for beams, columns, joints and shear walls
6	Evaluate seismic performance of RC buildings and recommend earthquake-resistant construction measures

Contents

Part A

Unit 1: **15 (L) hrs**

Fundamentals of Earthquake Engineering: Introduction to earthquakes – causes, seismic waves and earthquake terminology; Seismology basics – magnitude, intensity, seismic zoning and seismographs; Ground motion characteristics – acceleration, velocity, displacement, response spectrum; Earthquake effects on structures and common modes of failure; Structural performance objectives – serviceability, life safety and collapse prevention; Introduction to seismic hazard and risk concepts; Indian seismic zoning and importance factor concept; Introduction to BIS seismic design philosophy (IS 1893) .

Unit 2: **15 (L) Hrs**

Structural Dynamics and Seismic Response of Buildings: Dynamic behavior of structures – free vibration, forced vibration; Single Degree of Freedom systems under dynamic loading; Damping, natural frequency, resonance and response amplification; Multi Degree of Freedom systems (concept only); Seismic demand and response spectrum method; Equivalent static method vs dynamic method; Torsional effects in buildings; Vertical and plan irregularities in RC buildings; Storey drift and displacement checks.

Part B

Unit 3: **15 (L) Hrs**

Seismic Analysis and Design of RC Buildings: Seismic design philosophy – strength, stiffness and ductility; Base shear calculation as per IS 1893; Distribution of lateral forces along height; Load combinations for seismic design; Analysis methods for RC buildings – Equivalent Static Analysis; Response Spectrum Analysis; Design of RC

structural elements under seismic loads – Beams, columns, slabs and shear walls; Beam-column joint behavior; Design of RC frames with ductile detailing requirements

Unit 4: 15 (L) Hrs

Ductile Detailing, and Earthquake Resistant Construction: Ductility and energy dissipation mechanisms; Ductile detailing provisions as per IS 13920 – Detailing of beams, Detailing of columns, Beam-column joint detailing, Confinement reinforcement, Lap splice and anchorage rules; Design principles of shear walls: location, configuration and behavior; Detailing of shear walls and boundary elements; Seismic design of staircases, infill walls and non-structural components (concept only); Foundation considerations in seismic design

Standards and Code documents

1. IS 456 (2000): Plain and reinforced concrete – Code of practice Bureau of Indian Standards.
2. IS 13920 (2016): Ductile detailing of reinforced concrete structures subjected to seismic forces
3. IS 1983 Part-1 (2025): Criteria for earthquake resistant design of structures
4. IS 875, Parts 1–5 (1987). Code of practice for design loads (other than earthquake) for buildings and structures
5. IS 13828 (1995). Earthquake resistant design and construction of buildings – Code of practice

Books

1. Duggal, S. K. (2017). Earthquake resistant design of structures (2nd ed.). Oxford University Press.
2. Agarwal, P., and Shrikhande, M. (2010). Earthquake resistant design of structures. PHI Learning Pvt. Ltd.
3. Jain, A. K. (2016). Earthquake resistant design of structures. Nem Chand & Bros.
4. Chopra, A. K. (2017). Dynamics of structures: Theory and applications to earthquake engineering (5th ed.). Pearson.
5. Clough, R. W., & Penzien, J. (2003). Dynamics of structures (3rd ed.). Computers & Structures Inc.
6. Paulay, T., & Priestley, M. J. N. (1992). Seismic design of reinforced concrete and masonry buildings. John Wiley & Sons.

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. (Civil Engineering)

Course Code: ECE202
Course Title: Matrix methods of Structural Analysis

Programme: B.Tech.	**L:** 4 **T:**0 **P:**0	**Credits:**4
Semester: 6	**Theory/Practical:** Theory	**Teaching Hours:** 60(L)+0(T)+0(P) = 60 Hours
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 80%		
Duration of End Semester Examination (ESE): 3 Hours		
Course Type: Program Elective		

Prerequisites: Nil

Additional Material Allowed in ESE:

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Apply matrix algebra concepts to represent structural equilibrium and compatibility conditions
2	Formulate element flexibility matrices and analysis of indeterminate structures
3	Derive stiffness matrices for truss, beam and frame elements in local and global coordinates
4	Assemble global stiffness matrices and apply boundary conditions for structural systems
5	Solve for nodal displacements, member forces and reactions using matrix stiffness method
6	Interpret computational results and apply matrix methods for truss and frame analysis problems

Contents

Part A

Unit 1: **12 (L) hrs**

Fundamentals of Matrix Algebra: Introduction to matrix methods in structural analysis and their significance; Review of matrix algebra – addition, multiplication, transpose, determinant, inverse; Solution of simultaneous linear equations using matrix approach; Coordinate transformation and rotation matrices; Degrees of freedom (DoF), restraints and structural idealization; Concept of stiffness, flexibility and equilibrium; Element connectivity and numbering of nodes and DoFs; Introduction to structural system matrices and assembly concept

Unit 2: **18 (L) Hrs**

Flexibility Method/ Force Method: Review of classical force method and redundant; Compatibility and equilibrium conditions; Flexibility matrix and its physical significance; Formation of element flexibility matrix for – truss element, Beam element; Assembly of flexibility matrix, Solution of statically indeterminate structures using matrix flexibility method; Applications to continuous beams and simple plane frames; Computation of member forces and support reactions.

Part B

Unit 3: **16(L) Hrs**

Stiffness Method/ Displacement Method: Concept of stiffness matrix and displacement method formulation; Element stiffness matrix derivation for – Truss element, Beam element, Plane frame element; Transformation of local stiffness matrix to global coordinates; Assembly of global stiffness matrix; Application of boundary conditions and load vectors; Solution procedure for nodal

displacements, member end forces and reactions; Analysis of plane trusses and continuous beams using matrix stiffness method

Unit 4: **16 (L) Hrs**

Advanced Applications: Analysis of plane frames using stiffness method; Support settlements and temperature effects in matrix formulation; Influence of member loads and equivalent nodal loads; Introduction to banded matrices and computational efficiency; Brief introduction to finite element formulation concept (relation with stiffness method); Introduction to structural analysis software workflow; Comparison of flexibility method and stiffness method

Books

1. Jain, A. K. (2013). Advanced structural analysis. Nem Chand & Bros.
2. S. S. Bhavikatti, S. S. (2014). Structural analysis (Vol. 2). Vikas Publishing.
3. Menon, D. (2008). Advanced structural analysis. Narosa Publications
4. Gere, J. M., & Weaver, W. (1990). Matrix analysis of framed structures (3rd ed.). CBS Publishers & Distributors.
5. Kassimali, A. (2011). Matrix analysis of structures (2nd ed.). Cengage Learning.
6. Hibbeler, R. C. (2017). Structural analysis (10th ed.). Pearson Education.
7. C. S. Reddy, C. S. (2010). Basic structural analysis. Tata McGraw Hill. (Includes matrix methods concepts)
8. McGuire, W., Gallagher, R. H., & Ziemian, R. D. (2000). Matrix structural analysis (2nd ed.). Wiley.

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. (Civil Engineering)

Course Code: ECE203
Course Title: Pre-stressed Concrete

Programme: B.Tech.	**L:** 4 **T:**0 **P:**0	**Credits:**4
Semester: 6	**Theory/Practical:** Theory	**Teaching Hours:** 60(L)+0(T)+0(P) = 60 Hours
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 80%		
Duration of End Semester Examination (ESE): 3 Hours		
Course Type: Program Elective		

Prerequisites: Structural Design – I

Additional Material Allowed in ESE: IS 1343

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Explain the principles, methods and applications of prestressed concrete structures
2	Compute stresses in prestressed members under different loading conditions
3	Estimate prestress losses and determine effective prestressing force as per IS 1343
4	Design prestressed concrete beams for flexure under service and ultimate limit states
5	Design prestressed concrete members for shear, bond and anchorage zone requirements
6	Apply detailing and construction guidelines for pre-tensioned and post-tensioned systems

Contents

Part A

Unit 1: 12 (L) hrs

Introduction to Prestressing and Materials: Concept of prestressing and need for prestressed concrete; Advantages, limitations and applications of prestressed concrete; Types of prestressing: pre-tensioning and post-tensioning; Materials for prestressing – High strength concrete, Prestressing steel (wires, strands, tendons); Mechanical properties and stress-strain behavior of prestressing steel; Anchorage systems, ducts and grouting; Basic terminology: prestress force, eccentricity, tendon profile, kern distance; Introduction to BIS code provisions (IS 1343).

Unit 2: 18 (L) Hrs

Analysis of Stresses in Prestressed Concrete Members: Stress distribution in prestressed concrete under – Prestress only, Prestress + dead load, Prestress + dead load + live load; Concepts of kern zone and pressure line; Load balancing method; Analysis of simply supported prestressed rectangular and flanged sections; Concept of concordant cable profile; Deflection of prestressed members; Introduction to serviceability requirements.

Part B

Unit 3: 16(L) Hrs

Losses of Prestress and Design for Flexure: Losses of prestress – Elastic shortening, Creep of concrete, Shrinkage of concrete, Relaxation of steel, Friction loss (post-tensioning), Anchorage slip loss; Estimation of total losses as per IS 1343; Design for flexure – Limit state of serviceability, Limit state of collapse (flexure); Ultimate moment capacity of prestressed sections; Design of simply supported PSC beams (rectangular and T-section); Partial prestressing and concept of load factor.

Unit 4: **16 (L) Hrs**

Design for Shear, Bond, Anchorage and Structural Applications: Shear resistance of prestressed concrete members; Design for shear as per IS 1343; Design of end blocks and anchorage zone; Bond and transmission length in pre-tensioned members; Design of post-tensioned members with curved tendons; Composite construction with prestressed members; Prestressed concrete slabs, bridges and girders (case studies); Detailing requirements – tendon profile, spacing, cover, ducts, grouting; Construction procedure, quality control and site practices; Introduction to durability considerations in PSC structures.

Standards and Code documents

1. IS 1343 (2012): Indian Standard Code of Practice: Prestressed Concrete

Books

1. Pandit, G. S., & Gupta, S. P. (2012). Prestressed concrete. CBS Publishers & Distributors.
2. Dayaratnam, P. (2013). Prestressed concrete structures. Oxford & IBH Publishing.
3. Rajagopalan, N. (1990). Prestressed concrete. Narosa Publishing House.
4. Varghese, P. C. (2008). Prestressed concrete. PHI Learning Pvt. Ltd.
5. Lin, T. Y. et al (2010). Design of Pre-stressed Concrete Structures, Wiley India Private Limited
6. Nilson, A. H. (1987). Design of Pre-stressed Concrete, John Wiley and Sons Ltd
7. Magnel, G. G. (1954). Prestressed Concrete, Cement & Concrete Assn
8. Krishna Raju, N. (2006). Prestressed concrete, Tata McGraw Hill Education
9. Natarajan, V. (1983). Fundamentals of Prestressed Concrete, B.I. Publications
10. Lin, T. Y., & Burns, N. H. (2010). Design of prestressed concrete structures (3rd ed.). Wiley India Private Limited

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. (Civil Engineering)

Course Code: ECE204
Course Title: Reinforced Earth

Programme: B.Tech.	**L:** 4 **T:**0 **P:**0	**Credits:**4
Semester: 6	**Theory/Practical:** Theory	**Teaching Hours:** 60(L)+0(T)+0(P) = 60 Hours
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 50%		
Duration of End Semester Examination (ESE): 3 Hours		
Course Type: Program Elective Course		

Prerequisites (if any): CCE110, CCE114

Additional Material Allowed in ESE: Scientific Calculator

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Describe the fundamental concepts and mechanisms of reinforced earth.
2	Compare different types of geosynthetics and reinforced earth systems for based different parameters.
3	Design reinforced earth structures using standard design principles and procedures.
4	Analyze soil nailing techniques, and differentiate them from reinforced soil systems
5	Suggest the use of fibre-reinforced soil system for field conditions and performance requirements.
6	Assess the requirement for projects and recommend appropriate reinforcement solutions.

Contents

Part-A

Unit-1 Introduction **3(L) hrs**

Introduction, General, basic mechanism of reinforced earth, Soil or fill-material, reinforcement bars, Metallic strips, Metallic grids, Facing Elements, concrete panel facing etc.

Unit-2 Reinforced Earth & Geosynthetics **15(L) hrs**

Introduction, Historical background, Principles of reinforced earth, Effect of reinforcement of soil, Mechanism of reinforced earth, Anchors, Tiebacks, Economic advantage of reinforced earth structure over similar structures, Geosynthetics: Introduction and overview, Historical developments, Recent developments, Classification based on materials, Geosynthetics – geotextiles, geogrids, geomembranes, geocomposites, geonets and other products, Properties of geosynthetics

Unit-3 Design of RE Structures **18(L) hrs**

Design of Reinforced Structures - slopes, foundation, retaining walls and embankments

Part-B

Unit-4 Soil Nailing Techniques **15(L) hrs**

Introduction, Advantages & limitations of soil nailing techniques, comparison of soil nailing with reinforced soil, methods of soil nailing - construction sequence components of system, design aspects.

Unit-5 Fibre Reinforced Soil **5(L) hrs**

General, soil stabilization, reinforced soil, soil nailing, texsol, ply soil, comparison of ply soil with reinforced soil and soil nailing, types of fibers – synthetic fibers, natural fibers, plant roots, direction of placements

Case Studies **4(L) hrs**

Case studies of Reinforced Earth projects.

Text Books:

1. Robert M. Koerner, Designing with Geosynthetics, Prentice Hall – 1989
2. G.V Rao & GVS Suryanarayana Raju, Engineering with Geosynthetics, Tata Mc Graw Hill Publishing Co. New Delhi
3. Korener, Construction & Geotechnical Methods in Foundation Engineering, McGraw Hill
4. Shukla, S.K. and Yin, J.H. Fundamental of Geosynthetic Engineering, Taylor & Francis
5. Swamisaran, Reinforced Soil and its Engineering Application, New Age Publication
6. Gulati, S.K. and Datta, M., Geotechnical Engineering, TMH

Supplementary Swayam Course

S No.	Course Name	Instructor	Host Institute	URL
1	Geosynthetics and Reinforced Soil Structures	K. Rajagopal	Andhra University	Geosynthetics And Reinforced Soil Structures - Course

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. (Civil Engineering)

Course Code: ECE205
Course Title: Geometric Design of Highways

Programme: B.Tech.	**L:** 4 **T:** 0 **P:** 0	**Credits:** 4
Semester: 6	**Theory/Practical:** Theory	**Teaching Hours:** 60(L)+0(T)+0(P) = 60 hrs
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 70%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Elective Course		

Prerequisites: Transportation Engineering

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Identify the all elements of Geometric design of different roads and factors affecting.
2	Access the required parameters of different elements of road geometry as per latest Indian Standard and estimated traffic.
3	find the various elements required for horizontal alignment confirming Indian Standards.
4	Design vertical alignment based on present terrain and traffic as per Indian Standards.
5	Design the intersections and parking facilities based on traffic condition and site condition.
6	Select appropriate traffic management techniques for the safe and smooth flow of traffic.

Contents

Part- A

Unit I: Fundamentals of Geometric Design of Road 10 (L) hrs

Introduction to Highway Engineering, Importance and objectives of highway geometric design, Principles of highway alignment, Classification of roads (Rural and Urban), Highway cross-sectional elements, Design controls and criteria. Design speed and factors affecting it.

Unit 2: Highway Cross-Sectional Elements 10 (L) hrs

Carriageway width, Shoulders and formation width, Camber and its types, Krebs and footpaths, Side slopes, Median and traffic separators, Right of way (ROW)

Unit 3: Sight Distance and Horizontal Alignment 10 (L) hrs

Types of sight distance: Stopping Sight Distance (SSD), Overtaking Sight Distance (OSD), Intermediate Sight Distance (ISD), Headlight Sight Distance, Factors affecting sight distance, Horizontal curves: Simple circular curve, Super-elevation, Extra widening, Transition curves, Design of horizontal alignment

Part-2

Unit 4: Vertical Alignment and Advanced Geometric Design 10 (L) hrs

Vertical Alignment- Gradients: Types (Ruling, Limiting, Exceptional, Minimum). Grade compensation. Vertical curves: Summit curves, Valley curves, Design of vertical curves, Critical length of grade,

Unit 5: Intersection Design and Traffic Engineering Aspects 10 (L) hrs

Types of intersections: At-grade intersections, Grade-separated intersections, Rotary intersections, Channelization, Traffic islands, Design considerations for intersections, Parking facilities

Unit 6: Traffic Engineering and Highway Management 10 (L) hrs

Traffic characteristics: Traffic volume, Speed studies, Traffic density and flow, Traffic surveys: Classified volume count, Speed and delay studies, Origin and destination studies.

Traffic control devices: Traffic signs, Road markings, Traffic signals

Road safety measures, Highway capacity and Level of Service (LOS), Traffic management systems, Introduction to Intelligent Transportation Systems (ITS)

Text Books:

1. Kadiyali, L. R. (2023). *Highway Engineering*. Khanna Publishers.
2. Khanna, S. K., Justo, C. E. G., & Veeraragavan, A. (2024). *Highway Engineering*. Nem Chand & Bros.
3. Singh, G. (2022). *Highway Engineering*. Standard Publishers Distributors.
4. Goel, A. K. (2024). *Highway Engineering*. Kataria & Sons.

Reference Books:

1 Srinivasa Kumar, R. (2018). *Introduction to Traffic Engineering*. Universities Press (India) Pvt. Ltd.

2 Sharma, S. K. (2015). *Principles, Practice and Design of Highway Engineering*. Schand Publishing.

3 Das, S. K., & Choudhury, C. (2017). *Principles of Transportation Engineering*.

4 Garber, N. J., & Hoel, L. A. (2019). *Traffic and Highway Engineering* (Edition). Cengage Learning.

5 Mannering F. L., Kilareski, W. P., & Washburn, S. S. (2020). *Principles of Highway Engineering and Traffic Analysis*. (Edition). Wiley.

Supplementary SWAYAM Course

S No.	Course Name	Instructor	Host Institute	URL
1	NOC: Geometric Design of Highways	Rajat Rastogi	IIT Roorkee	https://nptel.ac.in/courses/105107220
2	Traffic Engineering & Management	Tom V. Mathew	IIT Bombay	https://nptel.ac.in/courses/105101008
3	NOC: Traffic Engineering	Bhargab Maitra	IIT Kharagpur	https://nptel.ac.in/courses/105105215

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. (Civil Engineering)

Course Code: ECE206
Course Title: Building Infrastructures and Construction Practices

Programme: B.Tech.	**L:** 4 **T:**0 **P:**0	**Credits:**4
Semester: 6	**Theory/Practical:** Theory	**Teaching Hours:** 60(L)+0(T)+0(P) = 60 Hours
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 10%		
Duration of End Semester Examination (ESE): 3 Hours		
Course Type: Program Elective Course		

Prerequisites (if any): nil

Additional Material Allowed in ESE: Scientific Calculator

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Explain the principles of site selection, building orientation, and planning of residential buildings.
2	Interpret general building requirements for lightening and ventilation in building.
3	Analyze fire protection requirements in buildings and fire safety measures.
4	Plan vertical transportation systems based on essential construction requirements and standards.
5	Evaluate prefabrication systems in residential buildings with respect to different parameters.
6	Classify and assess miscellaneous structural systems and building services.

Contents

Part-A

Unit-1 Orientation and Planning: 8 (L) hrs
Selection of site, Orientation of building, Design of residential buildings with particular reference to grouping and circulation.

Unit-2 General building requirements 12(L) hrs
Open spaces in and around buildings for lighting and ventilation, Minimum sizes and height of roofs, Rat and Termite proofing of buildings, Lightning protection of buildings.

Unit-3 Fire protection of buildings 10(L) hrs
Important considerations in fire protection, Fire resisting, Properties of common building materials, Fire safety and exit requirements

Part-B

Unit-4 Vertical transportation in buildings 8(L) hrs
Essential requirements and details of construction of stairs, lifts escalators and ramps.

Unit-5 Prefabrication systems in residential buildings: 8(L) hrs
Planning and modules and sizes of components in prefabrication, Testing of components, Manufacturing and erection guide lines.

Unit-6 Miscellaneous structures: 14(L) hrs

Shell structures, Domes, Folded plate structures, Skeletal and space frame structures, Grain storage structures, Earthquake resistant structures. Building services: Lighting and Ventilation, Electrical installation, Air-conditioning and heating, Acoustics and Sound insulation, Plumbing services.

Text Books:

1. National building code of India, BIS 2005.
2. Arora and Bindra, Building construction, Dhanpat rai & Sons, 2012.
3. Hand book of Housing Statistics, NBO 2003.

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. (Civil Engineering)

Course Code: ECE207

Course Title: Industrial Wastewater Management and Reuse

Programme: B. Tech.	**L: 4 T:** 0 **P:** 0	**Credits:** 4
Semester: 6	**Theory/Practical:** Theory	**Teaching Hours:** 60 (L) + 0 (T) + 0 (P) = 60 Hours
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:**40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: NIL		
Duration of End Semester Examination (ESE): 03 Hours		
Course Type: Programme Elective		

Prerequisites: Environmental Engineering - II

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO	Course Outcomes
1	Analyze the characteristics of industrial wastewater,
2	Summarize the processes involved and wastewater generated in the various industries,
3	Explain the effects of disposal of industrial wastewater,
4	Choose waste minimizing techniques for industries,
5	Identify treatment options for handling industrial wastewater,
6	Recommend the effective reuse of treated industrial wastewater.

Contents

Part-A

Unit-1 Introduction **10 (L) hrs**

Physical, chemical, biological properties of industrial wastewater, difference between industrial & municipal wastewaters, effects of disposal of industrial effluents in sewers and natural water bodies.

Unit-2 Industrial Wastewater Characterization **20 (L) hrs**

Characteristics and composition of wastewater and manufacturing processes of industries like sugar, food processing industries, steel, and petroleum refineries, textiles, tanneries, dairy industry, atomic energy plants and other mineral processing industries, Indian standards for industrial wastewater discharge, zero liquid discharge.

Part-B

Unit-3 Pre and Primary Treatment **08 (L) hrs**

Necessity of pretreatment, equalization, proportioning, neutralization, oil separation, waste reduction, volume reduction, strength reduction.

Unit-4 Wastewater Treatment Methods **17 (L) hrs**

Nitrification and de-nitrification, phosphorous removal, heavy metal removal, membrane separation processes, air stripping and absorption processes, biological wastewater treatment methods, sludge treatment, reuse and disposal treated wastewater.

Unit – 5 Common Effluent Treatment Plant **5 (L) hrs**

Location, operation and maintenance problems, economical aspects.

Text Books

1. W. W. Eckenfelder, "Industrial Water Pollution Control", McGraw Hill, 2000.
2. A. D. Patwardhan, "Industrial Waste water Treatment", Prentice Hall of India, New Delhi, 2008.
3. N. L. Nemerrow, "Theories and practices of Industrial Waste Engineering", Addison-Wesley Publishing Company, 2007.
4. C.F. Gurnham, "Principles of Industrial Waste Engineering", Public Health Service Publications, 1955.

Reference Books

1. Metcalf & Eddy, "Wastewater Engineering: Treatment and Reuse", Tata McGraw Hill, 2017
2. M. N. Rao and A. K. Dutta, "Waste Water Treatment", Oxford and IBH Publishers, 2020.
3. M. J. Hammer, Mark J. Hammer, Jr., "Water & Wastewater Technology", Prentice Hall of India, 2018.
4. A. K. Pain and S. Hazra, "Industrial Ecology: concepts and practices", ICFAI University Press, 2008.
5. Harry and Freeman, "Industrial Pollution Prevention Handbook", McGraw Hill, 1994.
6. N. L. Nemerrow, "Theories and practices of Industrial Waste Engineering. Addison-Wesley Publishing Company, 1963.

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Industrial Wastewater Treatment	Prof. Alok Sinha, Prof. S K Gupta	IIT Dhanbad	https://onlinecourses.nptel.ac.in/noc26_ce40/preview
2	Wastewater Treatment and Recycling	Prof. M. K. Tiwari	IIT Kharagpur	https://archive.nptel.ac.in/courses/105/105/105105178/
3	Wastewater Management	Prof. M. M. Ghangrekar	IIT Kharagpur	https://archive.nptel.ac.in/courses/105/105/105105048/
4	Water and Wastewater Treatment	Prof. Bhanu Prakash	IIT Roorkee	https://archive.nptel.ac.in/courses/105/107/105107207/

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. (Civil Engineering)

Course Code: ECE208
Course Title: Hydrology and Dams

Programme: B.Tech.	**L:3 T:0 P: 0**	**Credits**: 4
Semester: 6	**Theory/Practical:** Theory	**Teaching Hours: 60L) + 0(T) + 0(P) = 60Hours**
Total Max. Marks: 100	**Continuous Assessment (CA) Marks: 40**	**End Semester Examination (ESE) Marks: 60**
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 60%		
Duration of End Semester Examination: 3 Hours		
Course Type: Elective		

Prerequisites: NIL
Additional Material Allowed in ESE: Scientific Calculator
Course Outcomes (COs)
After successful completion of the course, students will be able to:

CO#	Course Outcomes (COs)
1.	explain the interaction among various processes in the hydrologic cycle
2.	compute mean precipitation and its relationships with other parameters.
3.	estimate evaporation, infiltration, and other precipitation losses using standard methods.
4.	analyze hydrographs and unit hydrographs to determine runoff.
5.	calculate crop water requirements and plan appropriate method of applying water.
6.	explain various components of diversion headworks, canal distribution system and Gravity dams.

Contents

PART-A

Unit I: precipitation **10 (L)hrs**
Hydrologic Cycle, Water-Budget Equation, Applications in Engineering, Sources of Data.
Forms of Precipitation, Characteristics of Precipitation in India, Measurement of Precipitation, Rain Gauge Network, Mean Precipitation over an Area, Depth Area-Duration Relationships, Maximum Intensity/Duration-Frequency Relationship, Probable Maximum Precipitation (PMP).

Unit II: Abstractions from precipitation **7 (L) hrs**
Evaporation process, analytical methods of evaporation estimation, reservoir evaporation and methods for its reduction, evapotranspiration, interception, depression storage, infiltration, infiltration capacity, measurement of infiltration, modelling of infiltration capacity and infiltration indices.

UNIT III: Runoff **8 (L) hrs**
Hydrograph, Factors Affecting Runoff, Base Flow Separation, Effective Rainfall, Unit Hydrograph, S-curve hydrograph, Snyder's synthetic unit hydrograph.

PART-B

Unit IV: Gravity Dam **5 (L) hrs**
Forces on gravity dams, causes of failure, stress analysis, elementary and practical profile, economic height of dam , Advantages of gated spillways, Discharge characteristics of spillways.

Unit V: Arch and Buttress Dams **7 (L) hrs**
Classification of arch dam- constant radius, constant angle and variable radius, Cylinder theory, Expression relating central angle and Cross-Sectional area of arch. Types of buttress dams, Advantages of buttress dams

Unit VI: Earth Dams **8 (L) hrs**
Components of earth dams and their functions, Phreatic line determination by analytical and graphical methods

Text Books

1. K Subramanya, "Engineering Hydrology", Mc-Graw Hill, 2024

2. K N Muthreja, "Applied Hydrology", Tata Mc-Graw Hill, 1998
3. S. K Garg, "Irrigation Engineering & Hydraulic Structure", Khanna Publishers, 2025
4. L W Mays, "Water Resources Engineering", Wiley, 2010
5. P JReddy, "Hydrology", Laxmi publication, 2018
6. C S P Ojha, R Berndtsson and P Bhunya, "Engineering Hydrology", Oxford, 2008

Reference Books

1. Rajesh Srivastava and Ashu Jain, "Engineering hydrology", Mc-Graw Hill,2017
2. Vijay P Singh, "Elementary hydrology", Prentice Hall (USA), 1992
3. Goyal, M., K. "Engineering Hydrology", PHI Learning Private Limited 2016)
4. Srivastava, R., and, Jain, A. "Engineering Hydrology", McGraw Hill Education 2017.
5. Maity, R. "Statistical Methods in Hydrology and Hydroclimatology", Springer, 2018
6. Patra, K. C. "Hydrology and Water Resources Engineering", Narosa Publishing House, 2008

Supplementary SWAYAM Course

Sr. No	Course Name	Instructor	Host Institute / Platform	URL
1	Water Resources Engineering	Dr. Pranab K Mohapatra & Prof. Rajesh Srivastava	IIT Kanpur	https://nptel.ac.in/courses/105104103
2	Surface water hydrology	Prof. Rajib Maity	IIT Kharagpur	https://nptel.ac.in/courses/105105214
3	Advanced Hydrology	Dr Subhankar Karmakar	IIT Bombay	https://nptel.ac.in/courses/105101002
4	Advanced Hydrology	Dr Ashu jain	IIT Kanpur	https://nptel.ac.in/courses/105104029

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. (Civil Engineering)

Course Code: ECE209

Course Title: Groundwater Hydrology and Recharge

Programme: B.Tech.	**L:** 4 **T:0 P: 0**	**Credits: 4**
Semester: 6	**Theory/Practical:** Theory	**Teaching Hours: 60(L) + 0(T) + 0(P) = 60Hours**
Total Max. Marks: 100	**Continuous Assessment (CA) Marks: 40**	**End Semester Examination (ESE) Marks: 60**
Minimum Percentage of Numerical / Design / Programming Problems in ESE:		
Duration of End Semester Examination: 3 Hours		
Course Type: Elective-		

Prerequisites: NIL

Additional Material Allowed in ESE: Scientific Calculator

Course Outcomes (COs)

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

CO#	Course Outcomes (COs)
1.	explain groundwater occurrence, movement, and flow principles including Darcy's law.
2.	apply groundwater flow equations to analyze steady and unsteady aquifer conditions.
3.	analyze groundwater level fluctuations under environmental influences.
4.	evaluate groundwater transport using the advection–dispersion equations
5.	design suitable artificial recharge systems for aquifers.
6.	assess groundwater management and recharge strategies.

Contents

PART-A

Unit I:Introduction **11(L) hrs**

Introduction: Role of groundwater in the hydrologic cycle, problems and perspectives. Occurrence and movement of groundwater, hydrogeology of aquifers, Darcy's law, general flow equations. Groundwater Hydraulics: steady and unsteady radial flows in aquifers.

Unit II: Groundwater levels and environmental influences **6(L) hrs**

Time variations of levels, Fluctuations due to evapotranspiration, meteorological phenomenon, urbanization, earthquakes, global climate change.

Unit III: Groundwater Transport Process **12(L) hrs**

Hydrodynamic dispersion - occurrence of dispersion phenomena, coefficient of dispersion - Aquifer advection dispersion equation and parameters - initial and boundary conditions - method of solutions, solution of advection dispersion equation

PART-B

Unit IV: Artificial recharging of groundwater **14(L)hrs**

Recharge techniques, recharge rates, design, operation and maintenance of surface recharge systems and recharge well systems, groundwater mounding, stormwater infiltration basin mound development, clogging, recharge and groundwater models, induced recharge.

Unit V: Groundwater Management **8(L) hrs**

Dynamic equilibrium in natural aquifers, groundwater budgets, management potential of aquifers, safe yield, seepage from surface water, and stream-aquifer interaction.

Unit VI: Ancillary sources for Groundwater Recharge **9(L)hrs**

Wastewater recharge for reuse, soil aquifer treatment systems, transport and degradation of organic compounds, chemical reactions and particle transport during aquifer transport, microorganisms and microbiology, public health issues, aquifer storage and recovery wells, Case studies of artificial recharge.

Text Books

1. Todd D.K., Mays L.W., "Groundwater Hydrology", Wiley 2021.
2. Raghunath H.M., "Ground Water", New Age International Publishers 2024
3. Schwarz F., Zhang H., "Fundamentals of Ground Water", Wiley 2024
4. Fitts C., "Groundwater Science", Academic Press 2023

Reference Books

1. Mohammad Karamouz, Azadeh Ahmadi, Masih Akhbari, "Groundwater Hydrology: Engineering, Planning, and Management", CRC Press 2020
2. Mays L. W., "Hydraulic Design Handbook", McGraw Hill 2004
3. Artificial Recharge of groundwater, European Commission, EC project ENV4-CT95- 0071 2001
4. Bear J., "Hydraulics of Groundwater", Dover Publications 2007

Supplementary SWAYAM Course

Sr. No	Course Name	Instructor	Host Institute / Platform	URL
1	Ground water hydrology and management	Pennan Chinnasamy	IIT Bombay	https://nptel.ac.in/courses/105101214
2	Groundwater engineering	Arun K saraf	IIT Roorkee	https://nptel.ac.in/courses/105107473
3	Sustainable groundwater management	Elango Lakshmanan	IIT Madras	https://nptel.ac.in/courses/105106694
4	Availability and management of groundwater resources	Prof. Prasson Kumar Singh	IIT-ISM Dhanbad	https://nptel.ac.in/courses/105105219

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. (Civil Engineering)

Course Code: ECE301
Course Title: Bridge Engineering

Programme: B.Tech.	**L:** 4 **T:**0 **P:**0	**Credits:**4
Semester: 6	**Theory/Practical:** Theory	**Teaching Hours:** 60(L)+0(T)+0(P) = 60 Hours
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 80%		
Duration of End Semester Examination (ESE): 3 Hours		
Course Type: Program Elective		

Prerequisites: Structural Design – I

Additional Material Allowed in ESE:

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Classify bridges and identify key components and their functions
2	Compute bridge loads and load combinations as per IRC provisions
3	Analyze bridge deck systems using influence lines and load distribution methods
4	Design RCC slab bridges and T-beam bridges for highway loading conditions
5	Apply prestressed concrete bridge concepts and design requirements for PSC bridge elements
6	Evaluate bridge substructures, construction methods, inspection procedures and rehabilitation measures

Contents

Part A

Unit 1: **12 (L) hrs**

Introduction: Introduction to bridge engineering: need, scope and importance; Classification of bridges- Based on function (road, rail, pedestrian), Based on material (RCC, PSC, steel, composite, masonry), Based on structural form (slab, beam, truss, arch, cable-stayed, suspension); Selection of bridge type based on span, site and economy; Bridge components – Superstructure (deck slab, girders, cross girders, bearings), Substructure (abutments, piers, wing walls), Foundations (shallow and deep); Deck systems: RCC deck, PSC deck, orthotropic steel deck (intro); Bearings: elastomeric, rocker, roller, pot bearings (basic concept); Expansion joints and drainage provisions; Introduction to bridge design philosophy and codal provisions (IRC).

Unit 2: **18 (L) Hrs**

Analysis of Bridge Deck Systems: Bridge loads as per IRC – Dead load and superimposed dead load, Live load (IRC Class A, Class 70R/40T), Impact factor, Wind load, braking force and centrifugal force, Temperature effects, shrinkage and creep, Earthquake loads; Load combinations and design philosophy (limit state method); Influence line diagrams (ILD) for bridge analysis; Analysis of simply supported slab bridges; Courbon's method for load distribution in girder bridges; Introduction to grillage analogy method; Design forces for deck slab and girders.

Part B

Unit 3: **15(L) Hrs**

Design of RCC and PSC Bridges: Design of RCC slab bridges – One-way slab bridge, Two-way slab bridge; Design of T-beam and girder bridges – Longitudinal girder design, Cross girder design, Deck

slab design; PSC bridges – Need and advantages of prestressing in bridges; PSC I-girder and box girder concepts; Basics of tendon profile and prestress losses; Bearings and expansion joints design considerations; Detailing requirements for RCC/PSC bridges as per IRC provisions.

Unit 4: 15 (L) Hrs

Substructure, Construction, Maintenance and Rehabilitation: Design considerations for bridge substructures – Abutments and piers; Wing walls and return walls; Foundations for bridges – Spread foundations, Pile foundations and well foundations; Scour depth estimation and river training works (basic concept); Construction methods (introduction)– Cast-in-situ and precast construction, Segmental construction, Launching of girders and deck construction methods; Bridge inspection and maintenance – Common defects and deterioration mechanisms, Repair and rehabilitation of bridges – strengthening, retrofitting and load rating; Case studies of bridge failures and lessons learned.

Standards and Code documents

1. IRC:5 – Standard Specifications and Code of Practice for Road Bridges, Section I: General Features of Design
2. IRC:6 – Loads and Stresses
3. IRC:21 – Cement Concrete (Plain & Reinforced)
4. IRC:22 – Prestressed Concrete
5. IRC:24 – Steel Bridges
6. IRC:78 – Foundations and Substructure Design
7. IRC:83 (Part I, II, III) – Bearings
   Part I – Metallic Bearings
   Part II – Elastomeric Bearings
   Part III – POT/PTFE Bearings
8. IRC:89 – Hydraulic Design of Bridges
9. IRC:112 – Concrete Road Bridges (Limit State Design)
10. IRC:SP:13 – Guidelines for River Training and Protection Works
11. IRC:SP:114 – Seismic Design of Road Bridges
12. IRC:SP:47 – Quality Control in Bridge Construction
13. IRC:SP:35 – Inspection and Maintenance of Bridges
14. IRC:SP:40 – Guidelines for Stone Masonry Bridges
15. IRC:SP:64 – Guidelines for Segmental Construction
16. IRC:SP:65 – Guidelines for RCC Box Culverts
17. IRC:SP:70 – Precast Concrete in Bridges

Books

1. Nagarajan, P. (2020). Design of concrete bridges: As per latest IRC codes. Wiley India.
2. Ponnuswamy, S. (2025). Bridge engineering (2nd ed.). McGraw Hill Education India.
3. Jagadeesh, T. R., & Jayaram, M. A. (2013). Design of bridge structures (2nd ed.). PHI Learning Pvt. Ltd.
4. Raina, V. K. (1996). Concrete bridge practice: Analysis, design and economics. Tata McGraw Hill.
5. Victor, D. J. (2004). Essentials of bridge engineering. Oxford & IBH Publishing.
6. Ramamurtham, K. K. (2013). Elements of bridge engineering. S. Chand Publishing.
7. Chen, W.F., & Duan, L. (2014). Bridge engineering handbook (2nd ed.). CRC Press.

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. (Civil Engineering)

Course Code: ECE302
Course Title: Industrial Structures

Programme: B.Tech.	**L:** 4 **T:**0 **P:**0	**Credits:**4
Semester: 6	**Theory/Practical:** Theory	**Teaching Hours:** 60(L)+0(T)+0(P) = 60 Hours
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 80%		
Duration of End Semester Examination (ESE): 3 Hours		
Course Type: Program Elective		

Prerequisites: Structural Design – I

Additional Material Allowed in ESE:

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Explain functional requirements, planning aspects and structural systems used in industrial buildings
2	Compute industrial loads including crane loads, wind loads and relevant load combinations
3	Analyze and design steel roof trusses, purlin and bracing systems for industrial sheds
4	Design gantry girders considering bending, shear, buckling and serviceability requirements
5	Design industrial frames, columns, base plates and connections for steel industrial structures
6	Evaluate special industrial structures (chimneys, silos, bunkers, tanks)

Contents

Part A

Unit 1: **12 (L) hrs**

Planning of Industrial Structures: Introduction to industrial structures: scope, importance and classification; Types of industrial buildings: single-storey, multi-storey, heavy and light industries; Functional requirements and planning considerations – Plant layout and structural grid planning, Equipment placement and foundation requirements, Selection of structural systems – portal frames, trusses, braced frames; Industrial building components – roof system, columns, bracings, cladding, crane system; Loadings – dead, live, wind, seismic and impact loads.

Unit 2: **18 (L) Hrs**

Design of Roof Systems: Loads on industrial buildings – Roof live loads, Crane loads and dynamic effects, Wind load on industrial sheds, Seismic effects on industrial frames, Temperature loads and equipment loads; Load combinations as per BIS codes; Design of roof trusses – Types of trusses (any one from Pratt, Howe, Warren, Fink), Determination of truss forces; Design of tension and compression members; Design of purlins and sag rods; Design of roof bracing and column bracing systems; Connections in steel industrial structures.

Part B

Unit 3: **15(L) Hrs**

Design of Gantry Girders and Industrial Frames: Introduction to cranes and gantry systems; Types of cranes – EOT cranes, gantry cranes; Crane loads – vertical wheel loads, lateral surge loads, impact factor; Design of gantry girders – Bending moment and shear force calculation; Lateral torsional

buckling considerations; Web buckling and stiffener design; Design of industrial steel columns and portal frames; Design of base plates and column foundation.

Unit 4: **15 (L) Hrs**

Special Industrial Structures: Chimneys – Types (RCC, steel) and basic design requirements; Wind load effects and stability checks; Bunkers and silos – Classification and material storage behavior; Janssen's theory (without derivation); Design considerations for wall pressure and hopper bottom; Water tanks and industrial tanks.

Books

1. Duggal, S. K. (2018). Design of steel structures (3rd ed.). McGraw Hill Education India.
2. Bansal, R. K. (2019). Design of steel structures. Laxmi Publications.
3. Ramchandra, & Gehlot, V. (2017). Design of steel structures (Vols. 1 & 2). Scientific Publishers.
4. Sharma, S. K. (2014). Design of steel structures. S. Chand Publishing.
5. Salmon, C. G., Johnson, J. E., & Malhas, F. A. (2009). Steel structures: Design and behavior (5th ed.). Pearson.
6. Segui, W. T. (2013). Steel design (5th ed.). Cengage Learning.
7. McCormac, J. C., & Csernak, S. F. (2015). Structural steel design (5th ed.). Pearson.

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. (Civil Engineering)

Course Code: ECE303
Course Title: Design of Timber Structures

Programme: B.Tech.	**L:** 4 **T:**0 **P:**0	**Credits:**4
Semester: 6	**Theory/Practical:** Theory	**Teaching Hours:** 60(L)+0(T)+0(P) = 60 Hours
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 80%		
Duration of End Semester Examination (ESE): 3 Hours		
Course Type: Program Elective		

Prerequisites: Structural Design – I

Additional Material Allowed in ESE:

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Identify the physical and mechanical properties of structural timber
2	Recognize defects, seasoning methods, and preservation techniques of timber
3	Design timber beams subjected to bending and shear
4	Design timber compression members considering buckling
5	Design timber connections using common fasteners
6	Analyze and design basic timber roof and truss systems

Contents

Part A

Unit 1: **12 (L) hrs**

Timber as Structural Material: Introduction to timber as an engineering material; Growth and structure of wood; Physical and mechanical properties of timber; Classification of timber; Advantages and limitations of timber structures.

Unit 2: **12 (L) Hrs**

Defects, Seasoning and Preservation: Natural defects in timber; Defects due to seasoning and conversion; Methods of seasoning; Preservation techniques; Durability and fire resistance of timber.

Part B

Unit 3: **18 (L) Hrs**

Design of Timber Members: Design principles and allowable stresses in timber; Design of timber beams for bending, shear and deflection; Built-up beams; Design of timber columns and compression members; Buckling and slenderness effects.

Unit 4: **18 (L) Hrs**

Timber Connections and Roof Systems: Types of timber joints and connections – Nailed, bolted and screwed connections; Timber connectors and metal plate fasteners; Types of timber roof trusses; Design of simple timber trusses; purlins and rafters.

Books

1. Ramchandra, & Gehlot, V. (2014). Design of timber structures. Scientific Publishers.
2. Bhavikatti, S. S. (2019). Design of steel and timber structures. I. K. International Publishing House.
3. McCormac, J. C., & Nelson, J. K. (2015). Structural design of wood (7th ed.). Wiley.
4. Duggal, S. K. (2017). Building materials (4th ed.). New Age International Publishers

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. (Civil Engineering)

Course Code: ECE304
Course Title: Design of Concrete Structures

Programme: B.Tech.	**L:** 4 **T:**0 **P:**0	**Credits:**4
Semester: 6	**Theory/Practical:** Theory	**Teaching Hours:** 60(L)+0(T)+0(P) = 60 Hours
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 80%		
Duration of End Semester Examination (ESE): 3 Hours		
Course Type: Program Elective		

Prerequisites: Structural Design – I

Additional Material Allowed in ESE:

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Explain the behavior and design principles of reinforced concrete structures
2	Select and Design different types of RC combined foundations
3	Design RC retaining walls such as cantilever and counterfort retaining walls
4	Design reinforced concrete water tanks used for liquid storage
5	Analyze and design flat slab systems in reinforced concrete building
6	Analyze and design curved beams in reinforced concrete structures

Contents

Part A

Unit 1: **15 (L) hrs**

Foundations – Types of reinforced concrete foundations; Structural behavior, load transfer; Selection, proportioning and design of combined footings – Rectangular, Trapezoidal, Strap; Design principles of raft, Pile foundations; Reinforcement detailing.

Unit 2: **15 (L) Hrs**

Retaining Walls – Earth pressure theories; Structural behavior, Stability requirements of retaining walls; Design of reinforced concrete cantilever retaining walls; Design of counterfort retaining walls; Checks for sliding, overturning and bearing capacity; Reinforcement detailing.

Part B

Unit 3: **15(L) Hrs**

Water Tanks – Introduction to liquid retaining structures; Design requirements for water retaining structures; Design of ground supported, underground and overhead circular and rectangular reinforced concrete water tanks; Crack control and serviceability requirements as per relevant codes.

Unit 4: **15 (L) Hrs**

Flat Slabs and Curved Beams – Concept and advantages of flat slab systems; Components of flat slabs; Analysis and design using the direct design method; Reinforcement detailing; Behavior and analysis of curved beams; Design considerations for reinforced concrete curved beams.

Books

1. Pillai, S. U., & Menon, D. (2017). Reinforced concrete design. McGraw Hill Education.
2. Bansal, R. K. (2019). Reinforced concrete design. Laxmi Publications.
3. Krishna Raju, N. (2018). Design of reinforced concrete structures. CBS Publishers.
4. Hulse, R., & Mosley, W. (2016). Reinforced concrete design by example. CRC Press

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. (Civil Engineering)

Course Code: ECE305
Course Title: Stability Analysis of Slopes

Programme: B.Tech.	**L: 4**, **T:0**, **P: 0**	**Credits:** 4
Semester: 6	**Theory/Practical:** Theory	**Teaching Hours:** 60(L)+0(T)+0(P)= 60 Hours
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical/Design problems in ESE: 75%		
Duration of End Semester Examination (ESE): 3 Hours		
Course Type: Program Elective		

Prerequisites (if any): Geotechnical Engineering, Foundation Engineering
Additional Material Allowed in ESE: Non-programmable Scientific Calculator

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Classify different types of slopes and failure modes and explain the causes of slope failure
2	Calculate the factor of safety of infinite slopes and simple soil slopes under dry and submerged conditions using appropriate analytical expressions.
3	Determine the stability of finite slopes using Limit Equilibrium Methods
4	Evaluate the stability of slopes under real life situations including rainfall infiltration, rapid drawdown, unsaturated soil behavior, and rock slope failure modes.
5	Design appropriate slope stabilization measures for given field conditions to achieve the required factor of safety.
6	Select suitable instrumentation, monitoring systems, and warning devices for slope safety assessment and long-term performance monitoring.

CONTENT

Part A

Unit 1: **12(L) hrs**

Fundamentals of Slope Stability – Types of slopes and failure modes, Causes of slope failure, Shear strength of soils (Mohr–Coulomb theory), Infinite slope analysis, Factor of Safety concept, Mass analysis and wedge methods, Taylor's Stability Number.

Unit 2: **20(L) hrs**

Limit Equilibrium Methods – Ordinary Method of Slices (Fellenius Method), Friction circle method, Bishop's Simplified Method, Janbu's Method, Morgenstern–Price Method (conceptual), Layered soil stability, Rapid drawdown analysis, Stability of earth dams.

Part B

Unit 3: **12(L) hrs**

Real Life Situations - Rainfall-induced failures, unsaturated soil slopes, Seepage and pore water pressure effects, Rock slope stability (plane, wedge, toppling failures), Case studies.

Unit 4: **16(L) hrs**

Slope Stabilization & Design – Drainage measures, Retaining structures, Soil nailing, Geosynthetics, Vegetative stabilization, Shotcreting, Rock bolting and anchoring, Instrumentation and monitoring, Integrated design examples and review, Warning devices and maintenance of slopes.

Books

1. Braja M. Das – Principles of Geotechnical Engineering (Cengage Learning)
2. Karl Terzaghi, Ralph B. Peck & Gholamreza Mesri – Soil Mechanics in Engineering Practice (Wiley)
3. V.N.S. Murthy – Geotechnical Engineering: Soil Mechanics and Foundation Engineering

4. Evert Hoek & Jonathan Bray – Rock Slope Engineering
5. Duncan C. Wyllie - Rock Slope Engineering, 5th Edition, Civil Applications
6. Chowdhary R and Chowdhary I. - Geotechnical Slope Analysis, CRC Press

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Geotechnical Engineering II Foundation Engineering	Prof. Dilip Kumar Baidya	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc26_ce50/preview
2	Rock Engineering	Prof. Priti Maheshwari	IIT Roorkee	https://onlinecourses.nptel.ac.in/noc26_ce77/preview
3	Geosynthetics And Reinforced Soil Structures	Prof. K.Rajagopal	Andhra University	https://onlinecourses.nptel.ac.in/noc26_ce60/preview

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. (Civil Engineering)

Course Code: ECE306
Course Title: Soil Dynamics

Programme: B.Tech.	**L: 4**, **T:0**, **P: 0**	**Credits:** 4
Semester: 6	**Theory/Practical:** Theory	**Teaching Hours:** 60(L)+15(T)+0(P)= 60 Hours
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical/Design problems in ESE: 80%		
Duration of End Semester Examination (ESE): 3 Hours		
Course Type: Programme Elective		

Prerequisites (if any): Geotechnical Engineering, Foundation Engineering

Additional Material Allowed in ESE: Non-programmable Scientific Calculator

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Explain the fundamental concepts of soil dynamics including types of dynamic loads and vibration characteristics of soil systems.
2	Apply the theory of vibrations to analyze the response of single degree of freedom systems under free and forced vibrations with and without damping.
3	Describe the mechanism of wave propagation in soils and identify different types of seismic waves and their characteristics.
4	Evaluate dynamic soil properties using laboratory and field-testing methods.
5	Analyze the vibration response of machine foundations and understand the design criteria for safe foundation performance.
6	Assess soil behavior during earthquakes including ground response and liquefaction potential and recommend suitable ground improvement measures.

CONTENT

Part A

Unit 1: 12(L) hrs

Fundamentals of Soil Dynamics and Vibrations – Introduction to soil dynamics and its importance in geotechnical engineering; types of dynamic loads: machine loads, traffic loads, impact loads, earthquake loads. Basic definitions: degree of freedom, natural frequency, damping, resonance. Types of vibrations: free and forced vibrations; Single degree of freedom system - Equation of motion for un-damped and damped systems.

Unit 2: 18(L) hrs

Dynamic Soil Properties – Theory of wave propagation in elastic media; Types of waves in soils: Compression (P) waves, Shear (S) waves, Surface waves (Rayleigh and Love waves), Wave velocities and their determination, Attenuation of stress waves in soil. Dynamic soil properties: Shear modulus, Dynamic modulus of elasticity, damping ratio, Poisson's ratio, Factors affecting dynamic soil properties. Laboratory tests: Resonant column test, cyclic triaxial test, cyclic simple shear test. Field tests: Standard penetration test (SPT) correlations, Cross-hole and down-hole tests, Seismic refraction methods.

Part B

Unit 3: 14(L) hrs

Machine Foundations – Types of machine foundations, Modes of vibration of foundations, Vertical vibration of foundations, Horizontal vibration of foundations, Rocking vibration, Torsional vibration, Design criteria for machine foundations, Vibration isolation techniques

Unit 4: 16(L) hrs

Soil Dynamics in Earthquake Engineering – Basics of earthquakes and seismic waves, Earthquake parameters: magnitude, intensity, frequency content, Ground response analysis, Liquefaction of soils: mechanism, factors affecting liquefaction, Evaluation of liquefaction potential, Methods of ground improvement against liquefaction, Seismic design considerations in geotechnical engineering

Books

1. Swami Saran, *"Soil Dynamics and Machine Foundations",* Galgotia Publications Pvt. Ltd., New Delhi, 2nd Edition, (1999).
2. Braja M. Das and G. V. Ramana, *"Principles of Soil Dynamics",* Cengage Learning, 2nd Edition, (2011).
3. Shamsher Prakash and V. K. Puri, *"Foundations for Machines: Analysis and Design",* John Wiley & Sons, 1st Edition, (1988).

Reference Books

1. Robert W. Day, *"Geotechnical Earthquake Engineering Handbook",* McGraw-Hill, 1st Edition, (2007).
2. Steven L. Kramer, *"Geotechnical Earthquake Engineering",* Prentice Hall / Pearson Education, 1st Edition, (1996).
3. Kenji Ishihara, *"Soil Behaviour in Earthquake Geotechnics",* Oxford University Press, 1st Edition, (1996).
4. Bharat Bhushan Prasad, *"Fundamentals of Soil Dynamics and Earthquake Engineering",* PHI Learning Pvt. Ltd., New Delhi, 1st Edition, (2005).
5. V. N. S. Murthy, *"Soil Mechanics and Foundation Engineering",* CBS Publishers & Distributors, New Delhi, 1st Edition, (2009).

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Soil Dynamics	Deepankar Choudhury	IIT Bombay	https://nptel.ac.in/courses/105101005
2	Soil Dynamics	S. Mittal	IIT Roorkee	https://nptel.ac.in/courses/105107066
3	Soil Dynamics	Paramita Bhattacharya	IIT Kharagpur	https://nptel.ac.in/courses/105105221
4	Geotechnical Earthquake Engineering	Deepankar Choudhury	IIT Bombay	https://nptel.ac.in/courses/105101134
5	Geotechnical Earthquake Engineering	Gali Madhavi Latha	IISc Bangalore	https://nptel.ac.in/courses/105108074

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. (Civil Engineering)

Course Code: ECE307
Course Title: Pavement Design

Programme: B.Tech.	L: 4 T: 0 P: 0	Credits: 4
Semester: 6	Theory/Practical: Theory	Teaching Hours: 60(L)+0(T)+0(P) = 60 hrs
Total Max. Marks: 100	Continuous Assessment (CA) Marks: 40	End Semester Examination (ESE) Marks: 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 70%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Elective Course		

Prerequisites: Transportation Engineering

Additional Material Allowed in ESE: Scientific Calculator, IRC 37, IRC 58, IRC 81

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Identify the different types of pavement and factors affecting their design.
2	Design the flexible pavement using different methods and as per latest Indian Standard.
3	Design the bitumen mix for surface and binder course as per IRC and MORTH specifications.
4	Design the rigid pavement confirming latest Indian Road Congress Standard.
5	Design an overlay by evaluating the existing strength of pavement as per IRC specification.
6	Illustrate the use of new technology in pavements.

Contents

Part-A

Unit-1 Introduction **5(L) hrs**

Types of pavement structure, Functions of pavement components, Factors affecting pavement design, Design wheel load, ESWL and Strength characteristics of pavement materials. Comparison of flexible and rigid pavements.

Unit-2 Design of Flexible Pavement **15(L) hrs**

General design considerations, Methods for design of flexible pavements – Burmister two-layer theory, Group Index Method, Triaxial Test Method, C-R value Method, McLeod's Method, Indian Roads Congress Method as per IRC 37-2018. Analysis of stress and strain using IITPAVE.

Unit-3 Bitumen Mix Design **11(L) hrs**

Mix Design Approaches, Design Gradation of Bitumen Mix, Marshall Method of Bituminous Mix Design, Volumetric Analysis of Bitumen Mix.

Part-B

Unit-4 Rigid Pavement Design **16(L) hrs**

Design factors, Westergaard's stress analysis, load stress, temperature stress, Design based on fatigue behavior of concrete, IRC-58 design method – Fatigue concept, Design of joints, Design of dowel bar, Design of tie bar.

Unit -5 Design of Overlays **8(L) hrs**

Definition, types of overlays, design of Overlay over flexible pavement using IRC 81, White topping – Conventional, thin and Ultra-thin white topping as per IRC SP-76.

Unit -6 Introduction to New Technology **5(L) hrs**

Recycle aggregate pavement as per IRC:120 (RAP), Road Rehabilitation Techniques-Cold in place Recycling (CIR), Hot in Place Recycling (HIPR), Stone matrix asphalt as per IRC SP-79, Interlocking /Concrete Block Pavement.

Text Books:

1. S K Khanna, C E G Justo, and A Veeraragavan, Highway Engineering, Nem Chand & Brothers.
2. L.R.Kadiyali and Dr.N.B.Lal, Principles and Practices of Highway Engineering, Khanna publishers
3. Saxena,S. C., "Highway and Traffic Engineering", CBS Publishers & Distributors.
4. Huang, Y.H. Pavement Analysis and Design, Pearson Prentice Hall, New Jersey, USA, 2004.

Reference Books:

1. Yoder & wit zorac , Principles of pavement design, John Wiley & Sons.
2. Subha Rao, Principles of Pavement Design.
3. R Srinivasa Kumar, Pavement Design, University Press.
4. Relevant recent IRC 31 : 2018, IRC 58 : 2015, IRC 81 : 1997, IRC 120 : 2015, IRC SP-79:2023, IRC 63 : 2018, IRC SP 76 : 2024, IRC 17127 : 2019.

Supplementary SWAYAM Course

S No.	Course Name	Instructor	Host Institute	URL
1	Analysis and Design of Bituminous Pavements	Prof. J. Murali Krishnan	IIT Madras	Link
2	Pavement Design and Maintenance	Industry Experts/ NITTTR	NITTTR Chennai	Link
3	Pavement Construction Technology	Prof. Animesh Das	IIT Guwahati	Link
4	Pavement Materials (Under Pavement Engineering)	Prof. Nikhil Saboo	IIT Roorkee	Link
5	Transportation Engineering - II	Prof. Rajat Rastogi	IIT Roorkee	Link

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. (Civil Engineering)

Course Code: ECE308

Course Title: Air Pollution Control

Programme: B. Tech.	**L: 4 T:** 0 **P:** 0	**Credits:** 4
Semester: 6	**Theory/Practical:** Theory	**Teaching Hours:** 60 (L) + 0 (T) + 0 (P) = 60 Hours
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:**40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 40%		
Duration of End Semester Examination (ESE): 03 Hours		
Course Type: Programme Elective		

Prerequisites: NIL

Additional Material Allowed in ESE: Pasquill Stability Table and Curves

On completion of the course, the student will have the ability to:

CO	Course Outcomes
1	Identify various sources of air pollution and their effects on human health and environment,
2	Develop the energy balance and plume behaviour for different atmospheric stability conditions,
3	Determine the sampling techniques for air quality monitoring,
4	Analyze the indoor and outdoor air quality.
5	Interpret various techniques used to control particulate matter and gaseous pollutants and
6	Explain the implementation of physicochemical and biological air pollution control technologies.

Contents

Part-A

Unit-1 Introduction to air pollution **10 (L) hrs**

Air pollution and sources of air pollution, sources, classification, properties, reaction and effect of air pollutants, global and regional air pollution problems (smoke, smog, acid rain, ozone layer disturbance, greenhouse effect, desertification, drought) and their harmful effect, effect of air pollution on human health, vegetation and property.

Unit-2 Dynamics of Atmosphere **20 (L) hrs**

Energy balance of atmosphere, various reasons for its imbalance and its effects, meteorological aspects, scales of motion, wind and wind roses, temperature measurement, environmental and adiabatic lapse rates, derivations of DALR, WALR and ELR, stability, atmospheric factors influencing stability, mixing height, plume behavior and effective height of stack, temperature inversions, fronts.

Part-B

Unit-3 Air Sampling and Modelling **17 (L) hrs**

Transport, transformation and deposition of air contaminants, air sampling (Ambient and stack sampling), concept of air sampling, stages involved in air sampling & pollution measurement methods, ambient air quality and emission standards, air quality index, sub index, indoor air pollution, its causes, effects and

control measures, WHO standards for indoor air quality, Air quality modeling, need, objective and categories of air quality model, - Gaussian model and equation,

Unit-4 Air Pollution Control System **13 (L) hrs**

Settling chambers, cyclone separation, wet collectors, fabric filters, electrostatic precipitators, removal of gaseous pollutants by adsorption, absorption, reaction and other methods, bio-scrubbers, bio-filters.

Text Books

1. H. S. Peavy, D. R. Rowe & G. Tchobanoglous, "Environmental Engineering.", International Edition, McGraw Hill, 2017.
2. H.C. Perkins, "Air Pollution", McGraw-Hill, 2019.
3. M. Khare, "Air Pollution - Monitoring; Modelling; Health and Control", In Tech Publishers, 2012.
4. M. Rao and H. V. N. Rao, "Air Pollution", Tata McGraw Hill, 2017.
5. N. Noelde, "Air Pollution Control Engineering", McGraw Hill, Boston, 2000.

Reference Books

1. D. A. Vallero, "Fundamentals of Air Pollution", Academic Press, 2025.
2. T. J. Lyons and W. D. Scott, "Principles of Air-Pollution Meteorology", CBS Publishers, 2001.
3. R. A. Wadden and P. A. Scheff, "Indoor Air Pollution: Characterization, Prediction, Control", Wiley, New York, 1983.
4. R. D. Griffin, "Principles of Air Quality Management", CRC Press, Boca Raton, USA, 2020.
5. D. A. Vallero, "Environmental Contaminants: Assessment and Control", Academic Press, Elsevier, 2010.

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Air Pollution and Control	Prof. Bhola Ram Gurjar	IIT, Roorkee	https://onlinecourses.nptel.ac.in/noc26_ce74/preview
2	Environmental Air Pollution	Prof. Mukesh Khare	IIT, Delhi	https://nptel.ac.in/courses/105102089
3	Fundamentals of Air Pollution	Prof. Kirpa Ram	Banaras Hindu University	https://onlinecourses.swayam2.ac.in/e-learning/preview/ini26_es02
4	Environmental Pollution and Human Health	Dr. Javid A. Parray	Government Degree College Tangdar, University of Kashmir	https://onlinecourses.swayam2.ac.in/e-learning/preview/cec26_es02
5	Climate and environmental protection	Prof. B S Balaji	JNU, New Delhi	https://onlinecourses.swayam2.ac.in/e-learning/preview/ugc26_ge08

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. (Civil Engineering)

Course Code: ECE309

Course Title: Environmental Remote Sensing and GIS

Programme: B.Tech.	**L:** 4 **T: 0 P: 0**	**Credits:** 4
Semester: 6	**Theory/Practical:** Theory	**Teaching Hours: 60 (L) + 0(T) + 0(P) = 60 Hours**
Total Max. Marks: 100	**Continuous Assessment (CA) Marks: 40**	**End Semester Examination (ESE) Marks: 60**
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 30%		
Duration of End Semester Examination: 3 Hours		
Course Type: Elective		

Prerequisites: NIL

Additional Material Allowed in ESE: Scientific Calculator

Course Outcomes (COs)

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

CO#	Course Outcomes (COs)
1.	analyze the basic components of GIS.
2.	apply basic principles of remote sensing for resource mapping and evaluation,
3.	develop geospatial database of water resources and environmental engineering systems
4.	enact GIS models for planning environmental engineering systems
5.	formulate GIS models for studies in urban environmental setting
6.	conceptualize a GIS project

Contents

PART-A

Unit I: Introduction **10 (L) hrs**

Concepts of Remote Sensing, Energy sources and radiation principles, Energy interactions in the atmosphere, Spectral reflectance of earth surface features, GIS concepts, Data models and analysis, modelling real world features, data conversion, metadata.

Unit II: GIS Project Planning **6 (L) hrs**

Understanding the requirements, Phases of planning, Specifications and procedures for analysis of projects and design projects.

Unit III: Applications in Water and Land resources **14 (L) hrs**

Water Resources: Identification of suitable sites for artificial recharge structures, drainage, performance evaluation of irrigation systems, flood and drought monitoring and impact assessment, watershed development & sustainable planning using RS & GIS, Water quality monitoring and modelling.

Land Resources: Soil survey and land evaluation, land use/land cover mapping and planning, case studies on mapping of wastelands and waterlogged areas of India using

PART-B

Unit IV: Applications in Ecology and Forestry **8 (L) hrs**

Ecology and Forestry: Ecosystem analysis, monitoring of forest fires, Forest evapo-transpiration assessment, mapping of forest cover, RS based forest management plans, focus on Mangrove forests and wetlands.

Unit V: Applications in Air and Water Pollution **10 (L) hrs**

Air pollution – detection & identification of pollution, Sources of water – water quality mapping and monitoring, environmental impact assessment.

Unit VII: Applications in Geological and Urban Studies **12 (L) hrs**

Geological Applications: RS and GIS in ground water studies, mineral/oil exploration, air borne geophysical surveys Urban Studies: Spatial analysis of urban sprawl, impact of urbanization on vegetation and water bodies, urban heat islands condition assessment, urban road infrastructure development assessment, GIS based urban land use change detection

Text Books

1. Barrett, “Introduction of Environmental Remote Sensing”, Chapman and Hall, New York, USA (1992).

2. Engman, "Remote Sensing in Hydrology", Chapman and Hall, New York, USA (1991).
3. Siegel, "Remote Sensing in Geology" John Wiley, Inc, New York, USA (1980).
4. Schultz, G. A. and Engman, E.T., "Remote Sensing in Hydrology and Water Management", Springer-Verlag, 2000.
5. Burrough P.A., "Principles of GIS for Land Resources Assessment", Oxford Science Publications (1998).

Reference:

1. Chang K.T., "Introduction to Geographic Information Systems", Tata McGraw Hill, New Delhi (2001).
2. Lillesand, T.M. and Kiefer, R.W., Remote Sensing and image Interpretation, John Wiley and Sons, 2008
3. Patania, F., Gagliano, A., Nocera, F., & Galesi, A. The application of GIS to air quality analysis in Enna City (Italy). *WIT Transactions on Ecology and the Environment*, *123*, 75-86.
4. Becker M. W. (2006): Potential for Satellite Remote Sensing of Ground Water. *GROUND WATER*, Vol. 44, No. 2. pp: 306 – 311

Supplementary SWAYAM Course

Sr. No	Course Name	Instructor	Host Institute / Platform	URL
1	Remote Sensing and GIS	Prof. Rishikesh Bharti	IIT Guwahati	https://onlinecourses.nptel.ac.in/noc25_ce108/preview
2	Remote Sensing	Dr. D. Nagesh Kumar	IISc Bangalore	https://nptel.ac.in/courses/105108077

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. (Civil Engineering)

Course Code: ECE310
Course Title: Environmental Quality Modeling

Programme: B.Tech.	**L:** 4 **T:** 0 **P:** 0	**Credits:** 4
Semester:	**Theory/Practical:** Theory	**Teaching Hours:** 60(L)+0(T)+0(P) = 60 hrs
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 30%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Elective Course		

Prerequisites (if any): Environmental Engineering- I (CCE102) & Environmental Engineering – II (CCE 106)

Additional Material Allowed in ESE: Scientific Calculator

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	develop various environmental models to assess pollution levels and environmental quality.
2	analyze water quality parameters in various water bodies.
3	classify conventional water quality models for rivers, lakes, and groundwater systems.
4	identify air quality simulation models and atmospheric dispersion techniques.
5	evaluate the components and parameters of air pollution meteorology and their effects on pollutant dispersion and receptor modeling.
6	demonstrate proficiency in using air quality forecast models and validate model predictions.

Contents

Part-A

Unit-1 Introduction to Environmental Modeling **12 (L) hrs**

Definition and types of models (causal and statistical models); Characteristics of environmental models; Steps in model development; Importance and uses of environmental models; Model evaluation and application; Conservation of mass and mass balance principles; Calibration and verification of models.

Unit-2 Water Quality Modeling - Surface Water Systems **10 (L) hrs**

Water quality modeling fundamentals; Transport phenomena – advection, diffusion, and dispersion; Simple transport models; Modeling of lakes and reservoirs (stratified systems); Rivers and streams modeling; Modeling of common water quality parameters: Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Temperature, Suspended Solids, Algae, Nutrients (Nitrogen and Phosphorus), Coliforms, and Toxic substances.

Unit-3 Water Quality Modeling - Groundwater and Model Applications **8 (L) hrs**

Groundwater quality modeling; Mass transport of solutes; Degradation of organic compounds; Prediction of groundwater contaminant movement; Seawater intrusion – basic concepts and modeling; Validation and use of water quality models: DO-BOD models, Solute transport models, Nutrients and eutrophication models, Toxic substances and sediments models; Conventional water quality modeling software: QUAL2E, QUAL2K, BASINS, and WASP7.

Part-B

Unit-4 Air Quality Modeling - Fundamentals and Meteorology **8 (L) hrs**

Basic components of air quality simulation models; Parameters of air pollution meteorology: wind speed, wind direction, atmospheric stability, temperature inversions, mixing height; Steady-state and non-steady-state meteorological modeling; Grid meteorological modeling; Atmospheric stability classification: Pasquill's stability classes; Lapse rate and plume behavior patterns (looping, coning, fanning, fumigation, trapping).

Unit-5 Dispersion Modeling Techniques **12(L) hrs**

Dispersion modeling principles; Receptor modeling and source-oriented modeling techniques; Gaussian plume

model: derivation and assumptions; Modifications of Gaussian plume equation for different conditions; Point source, line source, and area source models; Multiple source modeling; Fixed box models and diffusion models; Long-term average concentration calculations; Multiple cell models.

Unit-6 Air Quality Model Applications and Validation **10(L) hrs**

Uses of air quality models in environmental management and regulatory applications; Model performance evaluation; Validation of air quality models with field data; Air pollution forecast models; Short-term and long-term impact assessment; Modeling for non-reactive and reactive pollutants; Advanced air quality modeling systems: AERMOD, CALPUFF, CMAQ; Case studies and real-world applications.

Text Books

1. Smith J. and Smith, P., Environmental Modeling: An Introduction, Oxford University Press, 2011.
2. Chapra, S.C., Surface Water Quality Modeling, Waveland Press, 2008.
3. Deaton, M.L. and Winebrake, J.J., Environmental Modeling: Fate and Transport of Pollutants in Water, Air, and Soil, John Wiley & Sons, 1996.
4. Khare, M., Air Pollution: Monitoring, Modeling, Health and Control, InTech Publishers, 2012.
5. Brebbia, C.A., Power, H. and Tirabassi, T., Air Pollution V: Modeling, Monitoring and Management, WIT Press, 1997.
6. Manivanan, R., Water Quality Modeling: Rivers, Streams and Estuaries, New India Publishing Agency, 2008.

Reference Books/Standards

1. Palmer, M.D., Water Quality Modeling: A Guide to Effective Practice, World Bank Technical Paper No. 485, World Bank Publications, 2001.
2. IS 2296:1992 - Indian Standard for Tolerance Limits for Industrial Effluents Discharged into Inland Surface Waters, Bureau of Indian Standards (BIS).
3. EPA Standards - United States Environmental Protection Agency (US EPA) National Ambient Air Quality Standards (NAAQS) and Water Quality Criteria Documents.
4. WHO Guidelines - World Health Organization (WHO) Air Quality Guidelines and Guidelines for Drinking-water Quality.
5. CPCB Guidelines - Central Pollution Control Board (CPCB) National Ambient Air Quality Standards and Water Quality Criteria, Government of India.
6. Standard Methods for the Examination of Water and Waste Water, American Public Health Association, American Water Works Association, Water Environment Federation, 2023.

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Environmental Quality Monitoring & Analysis	Prof. Ravi Krishna R	IIT Madras	nptel.ac.in/courses/103106162 – accessed on 24-02-2026
2	Air Pollution and Control	Prof. Bhola Ram Gurjar	IIT Roorkee	https://onlinecourses.nptel.ac.in/noc26_ce74/preview – accessed on 24-02-2026
3	Environmental Air Pollution	Prof. Mukesh Sharma	IIT Kanpur	https://nptel.ac.in/courses/105104099 – accessed on 24-02-2026
4	Water and Wastewater Engineering	Prof. C. Venkobachar, Prof. Ligy Philip, Prof. B.S. Murty	IIT Madras	https://nptel.ac.in/courses/105106119 – accessed on 24-02-2026

5	Fundamentals of Environmental Pollution and Control	Prof. Jayanta Bhattacharya	IIT Kharagpur	https://nptel.ac.in/courses/123105001 – accessed on 24-02-2026

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. (Civil Engineering)

Course Code: ECE311
Course Title: Urban Hydrology and Hydraulics

Programme: B.Tech.	**L: 4 T:0 P: 0**	**Credits:** 4
Semester: 6	**Theory/Practical:** Theory	**Teaching Hours:** 60(L) + 0(L) + 0(P) = 60Hours
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 40%		
Duration of End Semester Examination: 3 Hours		
Course Type: Elective-		

Prerequisites: NIL
Additional Material Allowed in ESE: Scientific Calculator
Course Outcomes (COs)
After successful completion of the course, students will be able to:

CO#	Course Outcomes (COs)
1.	explain hydrological and urban water cycle processes.
2.	apply rainfall data to develop IDF curves and estimate design storm parameters.
3.	estimate peak runoff using standard methods.
4.	examine open-channel and flow routing methods in urban watersheds.
5.	design stormwater drainage and pumping systems.
6.	develop sustainable urban stormwater management solutions.

Contents

PART-A

Unit I: Introduction **8(L) hrs**
Hydrological cycle: functions, thermodynamic characteristics, human disturbance; Urban water cycle: Characteristics, Conventional and towards a new paradigm

Unit II: Surface water hydrology13(L) hrs
Rainfall measurement, analysis, IDF curves, Probabilistic methods, Design rainfall, design return period and design storm duration and depth; Runoff volume and peak estimation: Time of concentration, runoff coefficient, soil conservation service method, rational method, time area method, unit hydrograph method; Rainfall-runoff process simulation; Storm water management model (SWMM).

Unit III: Open-Channel flow in urban watersheds **12 (L) hrs**
Open-Channel Hydraulics: States of Open-Channel flow, open-channel flow equations, steady gradually varied flow, Normal flow; Overland Flow: Kinematic-wave model, overland flow on impervious surfaces and pervious surfaces; Channel Flow: Muskingum method, Muskingum-Cunge method.

PART-B

Unit IV: Stormwater Drainage Structures 8(L) hrs
Drainage of street pavements: Design considerations, flow in gutters, pavement drainage inlets; Storm sewer systems: Hydraulics, design discharge, sizing of storm sewers, hydraulic grade line, design considerations for hilly terrain; Culverts: Inlet and outlet control flow, sizing.

Unit V: Stormwater pumping10(L) hrs
Planning of pump station: Location, sump well, storage reservoir; Design of pumping station: Type of pump stations, choice of pump type, wet pit, design capacity of storage tank, pump characteristics curve, pump main, net positive suction head; Stormwater storage ponds: Detention ponds, site selection, design, pond routing.

Unit VI:Stormwater managementpractices9 (L) hrs
Sand filters, Wetlands, Filter Strips, Water Sensitive Urban Design, Low Impact Development Design, Decentralized systems of urban stormwater drainage.

Text Books

1 Chow V.T., Maidment D.R. and Mays L.W.," Applied Hydrology", Tata McGraw Hill, 2016.
2. Wang X.C. and Fu G.," Water-Wise Cities and Sustainable Water Systems: Concepts, Technologies, and Applications", IWA Publishing, 2021.
3. Ojha, Berndtsson, Bhunya, "Engineering Hydrology", Oxford, 2008.
4. Chwen J. and Guo Y., "Urban Hydrology and Hydraulic Design", Water Resources Publication, 2006.
5. Viessman, W., and Lewis, G.L. "Introduction to Hydrology", Fifth Edition, PHI Learning Private Limited, New Delhi.2003
6. Subramanya, K, "Engineering Hydrology", Fourth Edition, McGraw Hill Education (India) Private Limited, New Delhi.2024

Reference Books

1. Kan A. O. and Houghtalen R. J., "Urban Hydrology, Hydraulics, and Stormwater Quality: Engineering Applications and Computer Modeling", Wiley India Pvt. Ltd., 2013
2. Gribbin J. E, "Introduction to Hydraulics and Hydrology: With Applications For Stormwater Management", Cengage Learning, 2014.
3. Manual on "Stormwater Drainage Systems", Vol.-1, CPHEEO, Ministry of Housing and Urban Affairs, Govt. of India, 2019.
4. V T Chow, "Open channel flow", McGraw Hill, 2010

Supplementary SWAYAM Course

Sr. No	Course Name	Instructor	Host Institute / Platform	URL
1	Hydraulic engineering	Mohammad Saud Afzal	IIT Kharagpur	https://nptel.ac.in/courses/105105203
2	Computational hydraulics	M. S. Mohan Kumar	IISC Bangalore	https://nptel.ac.in/courses/105108125
3	Hydrological measurements and analysis of data	Sharad Kumar Jain	IIT Roorkee	https://nptel.ac.in/courses/105107129

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. (Civil Engineering)

Course Code: MC103
Course Title: Disaster Management and Preparedness

Programme: B.Tech.	**L:** 2 **T:** 0 **P:** 0	**Credits:** 0
Semester: 6th	**Theory/Practical:** Theory	**Teaching Hours:** 30(L)+0(T)+0(P) = 30hrs
Total Max. Marks: 50	**Continuous Assessment (CA) Marks:** 50	**End Semester Examination (ESE) Marks:** Nil
Minimum Percentage of Numerical / Design / Programming Problems in ESE: Nil		
Duration of End Semester Examination (ESE): Nil		
Course Type: Mandatory Course (Non-Credit)		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Explain the fundamental concepts of disaster management, including hazards, vulnerabilities, risks, capacities, impacts, prevention, and mitigation strategies.
2	Classify the various natural and human-induced disasters for preparing the hazard and vulnerability profile of India.
3	Assess the environmental, social, economic, health, and demographic impacts of disasters to perform basic vulnerability and risk assessment for disaster-prone areas.
4	Apply the principles of the disaster management cycle for effective disaster risk reduction.
5	Describe the role of modern technologies in disaster prediction, monitoring, and management.
6	Demonstrate awareness of disaster management practices for various stakeholders in building resilient and sustainable communities.

Contents

Part-A

Unit I: Introduction to Disaster Management (2 Hours)

Concepts and definitions of disaster, hazard, vulnerability, emergency and risk; severity, frequency and exposure of hazards; capacity, resilience and impacts of disasters; principles of prevention, preparedness and mitigation for reducing disaster risks

Unit-II: Classification of Disasters (6 Hours)

Classification of disasters: natural disasters including floods, droughts, cyclones, earthquakes, tsunamis, landslides, volcanic eruptions, coastal erosion, soil erosion and forest fires; human-induced disasters such as industrial accidents, chemical spills, nuclear and radiological emergencies, transportation accidents, urban flooding and terrorist activities; hazard and vulnerability profile of India with special emphasis on mountain regions, coastal areas and ecologically fragile zones

Unit-III: Disaster Impacts and Risk Assessment (8 Hours)

Environmental, physical, social, ecological, economic and political impacts of disasters; health and psychosocial consequences; demographic considerations including gender, age and special-needs groups; global and national disaster trends; climate change and urban disasters; concepts of vulnerability analysis, risk assessment and risk mapping; stages of disaster recovery and associated challenges.

Part-B

Unit-IV: Disaster Risk Reduction and Management (7 Hours)

Disaster management cycle and its phases including prevention, mitigation, preparedness, response, relief, recovery and rehabilitation; structural and non-structural mitigation measures; risk analysis, vulnerability and capacity assessment; early warning systems; post-disaster environmental response including water supply, sanitation, food safety, waste management, disease control, communication and security; emergency medical and public health services; reconstruction and rehabilitation; capacity building and gender-sensitive approaches; roles and responsibilities of government agencies, local institutions, communities, NGOs, media and insurance sector; disaster management policies, legislation and program in India with reference to the National Disaster Management Authority.

Unit-V: Application of Science and Technology in Disaster Management (4 Hours)

Role of Geographic Information System (GIS), Remote Sensing, Global Positioning System (GPS), Internet of Things (IoT), Artificial Intelligence (AI), drones and mobile applications in disaster prediction, monitoring and management; disaster communication systems and dissemination of early warning information; knowledge-based expert systems and risk-time charts; influence of developmental projects, land-use changes and urbanization on vulnerability; Sustainable Development Goals (SDGs), disaster resilience, reconstruction and resilient development strategies.

Unit-VI: Accessibility and Inclusive Disaster Management (3 Hours)

Accessibility in disaster preparedness, mitigation, response and reconstruction; inclusive emergency planning and evacuation measures; emergency services and communication systems for persons with disabilities and vulnerable populations; universal accessibility and resilient community development for achieving inclusive and sustainable disaster management.

Text Books/ Reference:

1. S.C. Sharma, Disaster Management, Khanna Publishing House, 2022.
2. http://ndma.gov.in (Home page of National Disaster Management Authority)
3. http://www.ndmindia.nic.in (National Disaster Management in India, Ministry of Home Affairs).
4. Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.
5. Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication.
6. Singh Jagbir, Disaster Management – Future Challenges & Opportunities, I.K. International Publishing House.
7. Ghosh G.K., 2006, Disaster Management, APH Publishing Corporation.
8. Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June 2003
9. Inter-Agency Standing Committee (IASC) (Feb. 2007). IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings. Geneva: IASC.