Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

DEPARTMENT OF CIVIL ENGINEERING

CURRICULUM & SYLLABUS

(Specialization: Computer Aided Infrastructure Engineering and Honors: Infrastructure Engineering)

(Regulations –VTR UGE-2021)

VISION AND MISSION OF THE INSTITUTE

Vision:

To create, translate and share frontiers of knowledge embedded with wisdom and innovation for a positive transformation of emerging society.

Mission:

To nurture excellence in teaching, learning, creativity and research; translate knowledge into practice; foster multidisciplinary research across science, medicine, engineering, technology and humanities; incubate entrepreneurship; instill integrity and honour; inculcate scholarly leadership towards global competence and growth beyond self in a serene, inclusive and free academic environment.

VISION AND MISSION OF THE DEPARTMENT

Vision:

To impart knowledge and excellence in Civil Engineering with global perspectives to the student community and to make them ethically strong engineers to build the nation.

Mission:

M1: To produce Civil Engineers of high calibre with advanced technical skills and ethical values to serve the society and the nation.

M2: To make the department as a centre of excellence in the field of Civil Engineering and allied research activities.

M3: To provide knowledge base and consultancy services to the community in all areas of Civil Engineering

M4: To promote innovative ideas which original thinking in the minds of budding Engineers to face the future challenges.

DEPARTMENT OF CIVIL ENGINEERING
B. TECH - CIVIL ENGINEERING
Programme Educational Objectives

- Provide Engineering design solutions for the real world problems in Structural, Environmental, Geotechnical, Water Resources, Remote Sensing and Transportation Engineering.
- Succeed and excel in their chosen professional practice/research and pursue higher education in the field of Civil Engineering in reputed Institutions in India/Abroad.
- Make ethical decisions and demonstrate a commitment to the profession and society.
- Acquire a position that values adaptability and innovation in their profession.
- Demonstrate leadership, both in their chosen profession and in other social responsibilities.

DEPARTMENT OF CIVIL ENGINEERING
POs & PSOs of B. TECH – CIVIL ENGINEERING

PO 1 Engineering Knowledge

Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems

PO 2 Problem Analysis

Identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences

PO 3 Design/ Development of Solutions

Design solutions for complex engineering problems and design system components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations

PO 4 Conduct investigations of complex problems

using research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions

PO 5 Modern Tool Usage

Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

PO 6 The Engineer and Society

Apply reasoning informed by contextual knowledge to assess social, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.

PO 7 Environment and Sustainability

Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development

PO 8 Ethics

Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

PO 9 Individual and Team Work

Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings

PO 10 Communication

Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions

PO 11 Project Management and Finance

Demonstrate knowledge and understanding of engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

PO 12 Life-long Learning

Recognize the need for and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change

Specialization: Computer Aided Infrastructure Engineering

Specialization: Computer Aided Infrastructure Engineering (18 Credits)				
S.No	**Course Code**	**Course Name**	**Credits**	**Prerequisite**
1	10212CE126	Earth Science for Special Infrastructure	3	Foundation Engineering
2	10212CE127	Composite Materials for Construction	3	NIL
3	10212CE128	Industrial Structures	3	• Design of RC Elements • Design of Steel Structures
4	10212CE129	Tall Buildings	3	NIL
5	10212CE130	Design of Bridges	3	Design of RC Elements
6	10212CE131	Tunnel Engineering	3	Soil Mechanics
7	10212CE132	Urban Water Resources Management	3	NIL
8	10212CE133	Advanced Sanitation System for Modern infrastructure Engineering	3	NIL
9	10212CE134	RS & GIS application in infrastructure planning	3	NIL
10	10212CE135	Internet of Things for Civil Engineering	3	NIL

10212CE126	EARTH SCIENCE FOR SPECIAL INFRASTRUCTURE	L	T	P	C
		3	0	0	3

Course Category / Type: Specialized Course / Theory

A. Preamble:

- To introduce the students about the origin and composition of Earth.
- To impart basic knowledge of Rock Engineering.
- To expose the students to construction of dams, reservoirs and tunnels
- To introduce the concept of land reclamation to students.

B. Prerequisite:

- 10211CE201- Foundation Engineering

C. Link to other Courses:

- Nil

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Understand Earth's composition and Plate Tectonics.	K2
CO2	Understand the description, occurrence and properties of minerals and geophysical methods.	K2
CO3	Know the geological parameters in dam and reservoir constructions	K3
CO4	Know the geological parameters in tunnel constructions	K3
CO5	Understand the different earth factors that causes failures to structures	K3

E. Correlation of COs with POs

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M						M					L		
CO2	M			M	M		M					L		
CO3	M	M	H		M	M		L				L		
CO4	M	M	H		M	M		L				M		
CO5	M		H			M	M	L			M	M		

F . Course Content:

UNIT I INTRODUCTION TO EARTH SCIENCE 9

Origin of Earth and its composition, Surface Features, Interior of the Earth, Deformation, Tectonics, Seismology, Plate Tectonics and Geodynamics. Relevance of Geology in Engineering. Crystallographic systems – physical properties, behavior and engineering significance of minerals

UNIT II PETROLOGY, STRUCTURAL GEOLOGY AND GEOPHYSICAL METHOD 9

Classification of rocks, Distinction between igneous, sedimentary and metamorphic rocks, Engineering properties, description and occurrence of rocks. Outcrop-stratification-dip and strike, Folds, Faults & Joints. Geological investigations. Geophysical methods – Seismic and electrical methods for subsurface investigations. Bore Log Report.

UNIT III GEOLOGICAL REQUIREMENTS FOR DAMS AND RESERVOIRS 9

Dams and Reservoirs- its types. Site Selection and Geotechnical requirements. Geotechnical Inestigations. Rock Engineering. Forces acting on dams. Slope stability modeling. Failures of Dams and reservoirs. Case Studies

UNIT IV GEOLOGICAL REQUIREMENTS FOR TUNNELS 9

Geological Profile - Site Exploration- Tools and Methods. Soft Ground and Rock tunneling- Tunneling- Tunnel Boring Machines, Soil Stabilization- Rock anchors and grouts. Modeling of tunnels. Ground Movement Monitoring Systems. Safety Measures. Case Studies

UNIT V FAILURES IN INFRASTRUCTURES DUE TO EARTH CONDITIONS 9

Failures due to soil strength, water permeation, ground movement, vibrations, chemical actions, contaminant reaction, natural calamities. Construction on Reclaimed site. Reclaimation and rehabilitation. Case Studies.

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. Varghese, P.C., Engineering Geology for Civil Engineering Prentice Hall of India Learning Private Limited, New Delhi, 2012.
2. Siddiqui, I. H. (2009). Dams and Reservoirs: Planning and Engineering. Pakistan: Oxford University Press.
3. Hemphill, G. B. (2012). Practical Tunnel Construction. United States: Wiley.
4. Fox, H. (1998). Land Reclamation: Achieving Sustainable Benefits. Netherlands: Taylor & Francis.
5. Tripathi, R. S. (2009). Alkali land reclamation. India: Mittal Publications.

b) References:

1. Blyth F.G.H. and de Freitas M.H., Geology for Engineers, Edward Arnold, London,2010.
2. Wahlstrom, E. (2012). Dams, Dam Foundations, and Reservoir Sites. Netherlands: Elsevier Science.
3. Metje, N., Stark, A., Chapman, D. N. (2017). Introduction to Tunnel Construction. United States: CRC Press.
4. Land Reclamation and Restoration Strategies for Sustainable Development: Geospatial Technology Based Approach. (2021). Netherlands: Elsevier Science.

c) Online Resources:

1. https://nptel.ac.in/courses/105/105/105105106/
2. https://www.youtube.com/watch?v=bDwow2-WzHo
3. https://nptel.ac.in/courses/105/105/105105212/
4. https://nptel.ac.in/courses/105/107/105107181/
5. http://ismenvis.nic.in/Database/Land_Reclamation_7512.aspx
6. https://www.taylorfrancis.com/chapters/edit/10.1201/b17500-109/case-study-land-reclamation ecological-restoration-mine-liu-xu-zhao-ji

10212CE127	COMPOSITE MATERIALS FOR CONSTRUCTION	L	T	P	C
		3	0	0	3

Course Category / Type: Specialized Course/ Theory

A. Preamble:

Students undergoing this course are expected to understand the composite construction related materials, properties, manufacturing / fabricating processes, and uses.

B. Prerequisite:

- NIL

C. Link to other Courses:

- NIL

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Understand concepts and classification of composite material.	K2
CO2	Understand basic constituent materials in composites.	K2
CO3	Understand strength and failure theories of composites.	K2
CO4	Understand the design and manufacturing processes of composites.	K2
CO5	Understand the applications of composite materials.	K2

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		L	M	M									L	
CO2		M	M	M	M								L	
CO3			M	M	M		M				M		L	
CO4			M	M	M		H				M		L	
CO5				M	M		H				M		L	

F. Course Content:

UNIT I INTRODUCTION 9

Historical development - Concept of Composite materials - Types of composites - Classification based on Matrix Material - Classification based on reinforcement - Advantages and limitations of Composites.

UNIT II BASIC CONSTITUENT MATERIALS IN COMPOSITES 9

Reinforcements and Matrices for various types of composites – Fiber and Reinforcement Materials - Matrix Materials - Fiber reinforced Polymer (FRP) Laminated composites

UNIT III STRENGTH AND FAILURE THEORIES 9

Strength of Laminates - Failure Mechanics of Composites – Macro mechanical Failure Theories - Comparison of Failure Theories

UNIT IV DESIGN CONCEPTS AND MANUFACTURING PROCESSES 9

Structural Component Design process - Laminate Analysis - Composite Codes & Standards - Fabrication and Manufacturing Techniques - Hand Lay-up – Processing - Forming Structural Shapes - Structural Modelling of composite material – Overview of Finite element analysis software - SAP2000.

UNITV SPECIAL TOPICS AND APPLICATIONS 9

Testing of Composites - Joining of composites - Environmental Effects on composites - Recycling of Composites - Applications of FRP Composites - Strengthening Techniques.

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. Cahn R.W. - Material Science and Technology – Vol 13 – Composites, VCH, West Germany, 1994
2. Callister, W.D Jr., Adapted by Balasubramaniam R, Materials Science and Engineering, An introduction, John Wiley & Sons, NY, Indian edition, 2007.

b) References:

1. Chawla K.K., Composite Materials, 2013.
2. Lubin.G, Hand Book of Composite Materials, 2013.

Online Resources:

1. https://nptel.ac.in/courses/112104229
2. https://nptel.ac.in/courses/105108124

10212CE128	INDUSTRIAL STRUCTURES	L	T	P	C
		3	0	0	3

Course Category: Specialized Courses/ Theory

A. Preamble:

- To learn the layout, functional aspects and design of steel and R.C structures used in industries.

B. Pre-Requisites:

- 10211CE105 - Design of Reinforced Concrete Elements
- 10211CE107 – Design of Steel Structures

C. Link to other courses:

- 10211CE105 - Design of Reinforced Concrete Elements
- 10211CE107 – Design of Steel Structures
- 10212CE103 – Prefabricated Structures

D. Course outcomes:

Upon the successful completion of the course, learners will be able to

COs	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Develop knowledge on general requirements and planning of industrial structures.	K2
CO2	Describe the functional requirements of industrial structures.	K2
CO3	Analyze and Design the steel industrial structural components.	K3
CO4	Analyze and Design the Reinforced Concrete industrial structural components.	K3
CO5	Explain the concepts and process of Prefabrication in industrial structures.	K2

E. Correlation of COs with POs

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	H	L		L		L	L							
CO2	M	M		L		L	M	L						
CO3	M		H	M		M					L	M	M	
CO4	M		H	M	L	M					L	M	L	
CO5	M					L	L					L		

F. Course Content:

UNIT I PLANNING REQUIREMENTS 9

Classification of industries and industrial structures – General requirements of various industries – Planning and layout of buildings and components – site selection.

UNIT II FUNCTIONAL REQUIREMENTS 9

Lighting – Natural and artificial – protection from the sun – sky light - Services - wiring fixtures, cable and pipe bridges – Electrical installations - Ventilation and fire protection, ventilation & air – conditioning, fire escapes and, chutes, fire alarms, extinguishers and hydrants - Guidelines as per factories act.

UNIT III DESIGN OF STEEL STRUCTURES 9

Industrial roofs – Crane girders – pre-engineered and Mills buildings – Bunkers and Silos – Chimney – Cold form structures.

UNIT IV DESIGN OF R.C. STRUCTURES 9

Corbels, Brackets and Nibs - Silos and bunkers –Chimney - Principles of folded plates and shell roofs – usage of software tools.

UNIT V PREFABRICATED STRUCTURES 9

Principles of prefabrication – Prestressed precast roof trusses - Components of single-storey industrial sheds with crane gantry systems- storage - transportation - handling in yard - site and erection.

TOTAL: 45 PERIODS

G. Learning Resources:

1. TEXT BOOKS:

1. Ramamrutham.S., "Design of Reinforced Concrete Structures", DhanpatRaiPublishingcCompany,2016.
2. Varghese P.C., "Limit State Design of Reinforced Concrete", Prentice Hall of India Eastern Economy Editions, 2nd Edition,2009.
3. Bhavikatti.S.S., "Design of Steel Structures by Limit State Method as Per IS: 800-2007", I.K. International Publishing House Pvt. Ltd., 5th Edition,2017.
4. Bachmann, H. and Steinle, A. "Precast Concrete Structures", Ernst & Sohn, Berlin, 2011.

b) References:

1. Henn W. "Buildings for Industry", Vol. I and II, London Hill Books,1995.
2. SP32-1986, Handbook on Functional Requirements of Industrial buildings, Bureau of Indian Standards,1990.
3. Koncz.J., "Manual of Precast Construction", Vol. I and II, Bauverlay GMBH, 2nd Revised Edition, 1976.

10212CE129	TALL BUILDINGS	L	T	P	C
		2	2	0	3

Course Category / Type: Specialized Course / Theory

A. Preamble:

- To understand the concept of analysis and design of tall structures, loading techniques in tall buildings.

B. Prerequisite:

- Nil

C. Link to other Courses:

- Basics of Dynamics and Aseismic Design of Structures.

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Understand different design philosophies and loadings.	K2
CO2	Describe the Behavior of various structural systems.	K2
CO3	Study the Model and analyses the forces, drift, and twist.	K3
CO4	Apply the different structural components with various sectional shapes.	K3
CO5	Apply the overall buckling analysis of tall buildings with P-Delta analysis.	K3

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	M										L	L	
CO2	M	M		L								L	L	
CO3	M	M		L			L					M	M	
CO4	M	M	H	L			L					M	L	
CO5	M	M	H	L			L					M	M	

F. Course Content:

UNIT I LOADING AND DESIGN PHILOSOPHIES 6+6

Loading- Types - Equivalent lateral force, modal analysis - combination of loading – Static and Dynamic approach – Design philosophy – Working stress method - limit state method – Temperature effects and fire.

UNIT II BEHAVIOUR OF STRUCTURAL SYSTEMS 6+6

Factors affecting growth, height and structural form. High rise behavior, Rigid frames, braced frames, In filled frames, shear walls, coupled shear walls, wall-frames, tubulars, cores, outrigger - braced and hybrid mega systems.

UNIT III ANALYSIS AND DESIGN 6+6

Modeling for approximate analysis, Accurate analysis and reduction techniques, Analysis of buildings as total structural system considering overall integrity and major subsystem interaction,

Analysis for member forces, drift and twist - Computerized three-dimensional analysis.

UNIT IV STRUCTURAL COMPONENTS & ITS CONNECTIONS 6+6

Sectional shapes, properties and resisting capacity, design, deflection, cracking, prestressing, shear flow, Design for differential movement, creep and shrinkage effects, temperature effects and fire resistance.

UNIT V VORTEX SHEDDING TO BE ADDED 6+6

Overall buckling analysis of frames, wall-frames, Approximate methods, second order effects of gravity of loading, P-Delta analysis, simultaneous first-order and P-Delta analysis, Translational, Torsional instability, out of plumb effects, stiffness of member in stability, effect of foundation rotation.

TOTAL: 30+30 =60 PERIODS

G. Learning Resources:

a) Text Books:

1. Bryan Stafford Smith and Alex Coull, Tall Building Structures, Analysis and Design, John Wiley and Sons, Inc., 2011.
2. Taranath B.S, Structural Analysis and Design of Tall Buildings: Steel and Composite Construction, McGraw Hill, 2011.
3. Mark Sarkisian, Designing Tall Buildings: Structure as Architecture, Routledge, 2011.

b) References:

1. Lin T.Y. and Burry D.Stotes, Structural Concepts and Systems for Architects and Engineers, John Wiley, 1994.
2. Lynn S.Beedle, Advances in Tall Buildings, CBS Publishers and Distributors, Delhi,1996.

c) Online Resources:

1.https://onlinecourses.nptel.ac.in/noc22_ar01/preview
2. https://nptel.ac.in/courses/124/105/124105015/

10212CE130	DESIGN OF BRIDGES	L	T	P	C
		2	2	0	3

Course Category / Type: Specialized Course / Theory

A. Preamble:

Students undergoing this course are expected**:**

- To impart fundamental knowledge on bridge design and conceptual knowledge on bridge maintenance.
- To design and study the design principles of bridge superstructures, substructures and bearings according to the code of practice concerned.

B. Prerequisite:

- 10211CE105- Design of RC Elements

C. Link to other Courses:

- NIL

D. Course Outcomes:

Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Illustrate the essentials of bridge engineering.	K2
CO2	Design the short span bridges and demonstration of software used in bridge structures.	K3
CO3	Design the principles of long span bridges.	K3
CO4	Design the prestressed concrete bridges.	K3
CO5	Apply the different types of bearings, substructures used in bridges and fundamentals of bridge maintenance.	K3

E. Correlation of COs with POs:

COs	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	L		M			L	L	L				M	M	
CO2	M		H		M	M	L	L				M	M	
CO3	M		H			M	L	L				M	M	
CO4	M		H			M	L	L				M	M	
CO5			M			L	L	L				M	M	

F. Course Content:

UNIT I INTRODUCTION 6+6

Historical background of bridges and types - Bridge aesthetics and proportioning - Selection of bridge site - Review of applicable design codes - Loads on bridges and force distribution – IRC Specifications for Road Bridges, Standards live loads, other forces on bridges - General design considerations- Bridge geometry - Classification of Bridges - Suitability of different types of bridges for various spans - Economical span of a typical bridge - Bridge Hydrology - Determination of design discharge, linear water way, economical span, location of piers and abutments, afflux and scour depth.

UNIT II DESIGN OF SHORT SPAN BRIDGES 6+6

Pigeaud's method for computation of slab moments - Courbon's method for computation of moments in girders - Design of simply supported single span solid slab bridge - Tee beam bridge-Design of short span bridges using software techniques (Demonstration).

UNIT III DESIGN PRINCIPLES OF LONG SPAN BRIDGES 6+6

Continuous bridge – Arch Bridge – Box girder bridge decks- Box culverts- Cantilever bridge.

UNIT IV DESIGN OF PRESTRESSED CONCRETE BRIDGES 6+6

Advantages of prestressed concrete slab and girder bridges -Suitable spans – Design of slab and beam cross sections for given bending moment, shear, prestressing force and eccentricity.

UNIT V BEARINGS, SUBSTRUCTURES AND MAINTENANCE 6+6

Purposes of Bearings - Importance of Bearings - Free and Fixed Bearings - Types of Bearings –Design principles of bearings- Bed Blocks - Piers - Abutments - Wing walls - Setting out for Piers and Abutments - Materials for substructures - Types of bridge foundations - Bridge failures - Case studies - Maintenance of bridges - Detailed Inspection - Routine Inspection.

TOTAL: 30+30= 60 PERIODS

G. Learning Resources:

a) Text Books:

1. Ponnuswamy S, Bridge Engineering, Tata McGraw-Hill, 2017.
2. KrishnaRaju N, Design of Bridges, Oxford and IBH, 2019.

b) References:

1. Johnson VictorD, Essentials of Bridge Engineering, Oxford & IBH, 2007.
2. Jagadeesh T.R and Jayaram M.A, Design of Bridge Structures, Prentice Hall of India Pvt Ltd., 2004.
3. Raina V.K, Concrete Bridge Practice, Tata McGraw Hill Publishing Company, New Delhi, 1994.
4. KrishnaRaju N, Structural Design and Drawing: Reinforced Concrete and Steel, University Press (India) Pvt Limited, 2010.

c) Online Resources:

1. https://nptel.ac.in/courses/105/105/105105165/

d) IS Codes:

1. IS: 456-2006, Code of Practice for Plain and Reinforced Concrete, BIS,New Delhi, 2008.
2. IS: 1343-1980, IS Code of Practice for Prestressed Concrete, BIS, NewDelhi, 1980.
3. IRC:6-2014, Standard Specifications and Code of Practice for Road Bridges, Section II - Loads and Stresses (Fifth Revision), 2014.
4. IRC:18-2000, Design Criteria for Prestressed Concrete Road Bridges(Post-Tensioned concrete) (Third Revision), 2000.
5. IRC:21-2000, Standard Specifications and Code of Practice for Road Bridges, Section III - Cement Concrete (Plain and Reinforced) (Third Revision), 2000.
6. IRC:22-2010, Standard Specifications and Code of Practice for RoadBridges, Indian Road Congress, New Delhi, 2011.
7. IRC:24-2010, Standard Specifications and Code of Practice for Road Bridges, Steel Road Bridges (Limit State Method) Third Revision, 2010.
8. IRC:82 (Part 2) - Part IX-1987, Standard Specifications and Code ofPractice for Road Bridges, Elastomeric Bearings, IRC, 1987.
9. IRC:82 (Part 1) - section IX-1999, "Standard Specifications and Code ofPractice for Road Bridges, Metallic Bearings, IRC, 1999.
10. IRC:83-1999(Part-I), Standard Specifications and Code of Practice for Road Bridges, Section IX - Bearings, Part I Metallic Bearings (First Revision), 1999.
11. IRC:83-1987(Part II), Standard Specifications and Code of Practice for Road Bridges, Section IX - Bearings, Part II: Elastomeric Bearings.
12. IRC:112-2011,Code of Practice for Concrete Road Bridges, Indian RoadCongress, New Delhi, 2011.

10212CE131	**Tunnel Engineering**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Category / Type: Specialized Course / Theory

A. Preamble:

- The course deals with tunneling that is a very efficient solution for public transport as well as other underground transport systems. This course provides basic concepts of rock mechanics and properties of rocks and the failure criterion of rocks.

B. Prerequisite:

- 10211CE202 – Soil Mechanics

C. Link to other Courses:

- 10212CE112 – Ground Improvement Techniques

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	**Course Outcomes**	**Bloom's Taxonomy level**
CO1	Understand the need of utilization of Underground Space for various applications.	K2
CO2	Interpretation of geo-engineering investigations for rock/soil.	K2
CO3	Decide appropriate location, size, shape and alignment.	K2
CO4	Compare various types and purpose of tunnels.	K3
CO5	To develop the plan for infrastructure for transport.	K3

E. Correlation of COs with POs:

Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	M	L			L	M	L						L	
CO2	M	H		M	L		L						L	
CO3	L	L	H		L	M	L				L		L	
CO4	L	L			H	H	H				L		L	
CO5	L	L			H	H	H	L					L	

F. Course Content:

UNIT I INTRODUCTION TO UNDERGROUND SPACE APPLICATION 9

Natural caves, archeological caves and their construction, tunnels for road, rail and hydropower. Need for Underground Space: Congestion driven needs for development of infrastructure for transport, water, power supply, and vehicle movement in cities, storage of materials. Engineering Utilities: Hydropower tunnels and caverns, underground storage for LPG, LNG, Crude and its products.

UNIT II GEOENGINEERING INVESTIGATION FOR ROCK MASS CHARACTERIZATION 9

Topographical and geological survey, auguring, drilling, soil and rock sampling and testing, preparing sub-surface geological cross section, geo radar use and data analysis for shallow tunnels, geophysical investigations to prove deeper sub-surface features, Physical-mechanical properties and collection of rock mechanical data, stability analysis and identification of failure.

UNIT III PLANING AND GEOEMTRICAL DESIGN OF TUNNEL 9

Determination of appropriate location, size, shape and alignment - Assessment of behavior of tunneling media - deformation modulus and support pressure measurement, instrumentation and monitoring of rock-mass performance, earthquake effects on tunnels.Planning and Design of tunnels in soft ground: lining type, short term and long-term behavior, subsidence, instrumentation and monitoring.

UNIT IV TUNNELING METHODS 9

Types and purpose of tunnels; factors affecting choice of excavation technique - Methods - soft ground tunneling, hard rock tunneling, hallow tunneling, deep tunneling; Tunnel Boring Machine - Cuttability / boreability assessment, performance prediction in tunneling with machine selection methodology. Shield Tunneling: advantages - classification; different types of shield tunneling techniques - factors affecting selection of a shield; slurry shield, earth pressure balance shield, slime shields. Top down and bottom up approach in tunneling.

UNIT V TUNNEL INFRASTRUCTURE FOR TRAFFIC 9

Underground ring roads in mega cities - Submerged and floating tunnels. Traffic surveillance and control system (TSCS) in tunnels: Traffic control signs, signals, Lighting systems and fixtures in tunnels: specifications, maintenance, emergency lighting. Metro Tunneling case studies.

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. Introduction to Tunnel Construction David Chapman, Nicole Metje and Alfred Stark, Spon Press.
2. Handbook of Tunnel Engineering Volume I: Structures and Methods B. Maidl, M. Thewes, U. Maidl, Ernst &Sohn Publishers.

b) References:

1. Underground infrastructures _ planning, design, and construction (2012, Elsevier)
2. Rock Mechanics Design in Mining and Tunneling by Z.T. Bieniawski.

c) Online Resources:

1. https://nptel.ac.in/courses/105/105/105105212/.

10212CE132	URBAN WATER RESOURCES MANAGEMENT	L	T	P	C
		3	0	0	3

Course Category / Type: Specialized Course / Theory

A. Preamble:

- The student is exposed to the use the urban storm water models for better storm water management. Students also exposed for the preparation of urban storm water master plan and different types of operation and maintenance.

B. Prerequisite:

- Nil

C. Link to other Courses:

- Project

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Explain various functional elements of urban ecosystem.	K2
CO2	Calculate urban runoff, compute supply and demand of water, and draw hydrograph.	K2
CO3	Explain the flood management types of flood.	K2
CO4	Illustrate the Measures of urban drainage and flood control benefits.	K2
CO5	Assess the operation and maintenance needs of urban water systems.	K2

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L	H				M	M							L
CO2	L		M				L	H						
CO3	L					M	H							
CO4	L		H		M			H						M
CO5	L				M		H							

F. Course Content:

UNIT I INTRODUCTION 9

Water in the urban eco-system – Urban Water Resources – Major problems – Hydrological processes relevant to urban storm drainage– Types of storm water management – Storm water policies – Terms of integrated urban water management.

UNIT II WATER RESOURCES SOFTWARES AND MODELS 9

Types of models – Physically and unit hydrograph based **(INFIL 3.0)** – Computer aided urban surface runoff models **(ANNIE)** – Management models for flow rate and volume control rate – Urban Climate Change: rainfall-runoff process and the implications of different climate change scenarios –Master plan for river side development in urban areas.

UNIT III URBAN HYDRAULIC DESIGN 9

Storm water management practices – Storm / Flood management: Overview and challenges to urban areas – Modeling concept – Types of storage – Computer aided hydraulic analysis and design **guidelines (HSPF 12.4) –** Flow and storage capacity of urban components – Types of urban floods: Fluvial, Coastal, Pluvial, Flash flood – Master plan for urban storm water management.

UNIT IV URBAN WATER MANAGEMENT 9

Planning and organizational aspects – Inter dependency of planning and implementation of goals and measures – Socio – economics financial aspects – Potential costs and benefit measures – Utilization of minor and major water resources for power generation - Measures of urban drainage and flood control benefits – Master plan for effective urban water user.

UNIT V OPERATION & MAINTENANCE AS GROUND WATER RECHARGE 9

Operation and maintenance in urban water system – Complexity of operations and need for diagnostic analysis – Maintenance management System – Inventories and conditions assessment – Social awareness and involvement.Regular and irregular supply, unaccounted-for water and leakage, water demand management - Rainwater harvesting and maintenance.

TOTAL = 45 PERIODS

G. Learning Resources:

a) Text Books:

1. Geiger, W.F., Marsalek, F., and Zuidena, F.C., (Ed), manual on drainage in urbanized areas – Vol.1 and Vol.II, UNESCO, 1987.
2. Hengeveld, H. and C. De Voch.t (Ed)., Role of Water in Urban Ecology, 1982.

b) References:

1. Martin, P. Wanelista and Yousef, A. Yousef., Storm Water Management, John Wiley and sons, 1993.
2. Neil S. Grigg., Urban Water Infrastructure Planning, Management and Operations, John Wiley and Sons, 1986.
3. Overtens D.E. and Meadows M.E., Storm Water Modelling, Academic Press, New York, 1976.

C)Online Resources:

1. https://nptel.ac.in/courses/105/108/105108081/
2. https://nptel.ac.in/courses/105/105/105105201/
3. https://nptel.ac.in/courses/105/105/105105110/

10212CE133	ADVANCED SANITATION SYSTEM FOR MODERN INFRASTRUCTURE ENGINEERING	L	T	P	C
		3	0	0	3

Course Category: Specialized Course/ Theory

A. Preamble:

- To introduce about the need of sanitation infrastructure, to impart knowledge and create awareness about industrial sanitation and hygiene and to identify potential of wastewater for recycle and reuse

B. Pre-Requisites:

- Nil

C. Link to other courses:

- NIL

D. Course outcomes:

Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Understand the principles of sanitation and wastewater treatment systems.	K2
CO2	Classify the various sewage management systems and estimation of storm water drainage.	K2
CO3	Illustrate the urban sectors sanitation systems and their disposal methods.	K2
CO4	Illustrate the sanitation improvement schemes for rural areas.	K2
CO5	Understand the concept of industrial sanitation and their hygiene systems.	K2

E. Correlation of COs with POs

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	H					M	M						L	
CO2	L				L	H	L					M	L	
CO3	H				H	M	H						L	
CO4	H				H	H	H						L	
CO5	H				H	H	H					M	L	

F. Course Content:

UNIT I SANITATION SYSTEM 9

Sanitary engineering, stages of sanitary engineering project, objectives, effects of sewage on environment, sewerage system, principles of sanitation/sewage treatment, sanitary projects, project drawing, wastewater management, planning for sewerage systems.

UNIT II SEWAGE MANAGEMENT 9

Quantity estimation of sewage, sources of sanitary sewage, dry weather flow, evaluation of sewage discharge, quantity estimation of storm water, factors affecting the quantity of storm water, storm hyetographs, ground water recharge, computation the storm water loads and sewer overflow by Sewer GEMS software.

UNIT III REFUSE SANITATION 9

Refuse characteristics in urban areas – conditions and factors affecting collection, quantity and conveyance of solid waste – disposal methods – incineration – design of incinerators sanitary landfill, leachate management – composting – waste recycling – biogas and gobar gas plants.

UNIT IV RURAL SANITATION 9

Introduction to rural sanitation- Community and sanitary latrines - Planning of wastewater collection system in rural areas- treatment and disposal of wastewater - compact and simple wastewater treatment units and systems in rural areas- stabilization ponds - septic tanks - Imhoff tank- soak pits- low-cost excreta disposal systems- effluent disposal.

UNIT V INDUSTRIAL SANITATION 9

Occupational hazards – housekeeping – cleanliness and maintenance and comfort- industrial plant sanitation – case studies.

TOTAL: 45 PERIODS

G. Learning Resources:

a) TEXT BOOKS:

1. Victor Ehalers& Earnest W Steel, ―Municipal and Rural sanitation. Mcgraw-hill Education,2009.

2. Bhatia H. S., Text book on Environmental Pollution and Control, Galgotia Publication Pvt. Ltd., New Delhi,2003.

3. Adelaide M. Lusambili, Environmental Sanitation and Gender Among the Urban Poor, Vdm Verlag,2008.

4. Juuti, P., Tapio S. K., and Vuorinen H., Environmental History of Water: Global Views on Community Water Supply and Sanitation, IWA Publishing (Intl Water Assoc), 2007

b) References:

1. Salveto J.A., ―Environmental Sanitation, John Wiely,2006.

2. Dhameja S.K., ―Environmental Engineering & Management,2004

3. Vivek Pandey, Dwivedi A. K, Dr. Rekha Nair, Dr. Sama Jain, Environmental Engineering & Disaster Management, Neelkanth Publishers,2010

10212CE134	RS & GIS APPLICATION IN INFRASTRUCTURE PLANNING	L	T	P	C
		3	0	0	3

Course Category / Type: Specialized Course / Theory

A. Preamble:

- To understand various concepts of infrastructure planning and management.
- Aims to equip students aiming at Infrastructure planning and management, with sufficient theoretical and practical knowledge so as to make them Industry-aligned.
- To understand broadly cover planning, design, analysis and management frameworks for infrastructure systems from various disciplines such as construction, transportation, environment and others.
- The primary focus of this course will be to encourage relevant research in this interdisciplinary area.

B. Prerequisite:

- Nil

C. Link to other Courses:

- Nil

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Understand the basic principles of RS and GIS in infrastructure development.	K2
CO2	Discuss the importance of RS & GIS in Agriculture resources.	K2
CO3	Discuss the concepts RS & GIS in literacy, health and animal husbandry resources.	K2
CO4	Understand the concept of RS & GIS in infrastructural resources.	K2
CO5	Summarize the concepts of RS & GIS in industrial resources.	K2

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L			M	L		M					L	L	
CO2	M			M	H		M		L			L	L	
CO3	M			M	H		M		L			L	L	
CO4	L			M	H	L	M		L			L	L	
CO5	M			M	H	M	M		L			L	L	

F. Course Content:

UNIT I BASIC PRINCIPLES 9

Types and branches of infrastructure / physical resources - Current status of data holding departments - Current data types and formats - issues - need for Geoinformatics for infrastructure development - possible data formats and data structure - data collection mechanisms - Embedded systems.

UNIT II TRANSPORTATION AND INFRASTRUCTURE PLANNING 9

Site specific GIS: Housing development, parks and social facilities planning - Utility Planning and Asset Management - Urban and regional transportation corridors - wholesale and retail trade interactions – commuting - Classification of traffic - Optimum route and plans / shortest path – Alignment planning - Traffic and flow management - Accident analysis - case studies.

UNIT III URBAN PLANNING AND MAPPING 9

Importance and types, Urban and regional planning, GIS data modeling for urban design, Urban infrastructure, Urban site selection for urban development, Site suitability analysis for utilities and civic amenities, Urban mapping: physical structure and composition of urban areas, urbanization process, growth trend, problems of urbanization, urban sprawl and associated problems.

UNIT IV RS & GIS IN INFRASTRUCTURAL RESOURCES 9

Data formats, data collection, data structure, database creation and data mining models in infrastructural resources - Housing sectors - Transport sectors - Urban sectors - Electricity sectors -Energy sectors - Communication sectors.

UNIT V CURRENT TRENDS 9

Urban growth modeling - Expert systems in planning - 3D city models - ALTM - Land use Transportation interaction models - Intelligent transportation systems - case studies.

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. MaikNetzband, William Stefanov, Charles Redman (Eds.) Applied remote sensing for urban planning, governance and sustainability, Springer, 2007.
2. P.Partheeban and C.Kanmalai Williams (Coordinators), Proceedings of Advanced Training Programme on Applications of GIS, GPS and Remote Sensing in Urban Infrastructure Planning and Management, SCITECH publications (India) Pvt Ltd., Chennai and Hyderabad. 2004.
3. Pham HuyGiao, Mai TrongNhuan, van der Meer, F.D., Tong DuyThanh, Tran Nghi, and Nguyen Hong Minh (eds.) Proceedings of the international workshops : Towards systematic and innovative geotechnical geoenvironmental, geological and geophysical contributions for a sustainable infrastructure development of Vietnam Vietnam National University Publishing House, 2004.

b) References:

1. Committee on Review of Geographic Information Systems Research and Applications at HUD: Current Programs and Future Prospects, GIS for Housing and Urban Development, Board on Earth Sciences and Resources, 2003.

c) Online Resources:

1. https://nptel.ac.in/courses/105/102/105102015/
2. https://nptel.ac.in/courses/105/103/105103193/
3. https://nptel.ac.in/courses/105/107/105107155/

10212CE135	INTERNET OF THINGS FOR CIVIL ENGINEERING	L	T	P	C
		3	0	0	3

Course Category / Type: Specialized Course / Theory

A. Preamble:
This course aims to make the students to get the understanding of various computer and internet based technological applications in the field of Civil Engineering.

B. Prerequisite:
- Nil

C. Link to other Courses:
- Minor Project
- Major Project

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Explain the knowledge about cities aided with smart technologies	K2
CO2	Outline the fundamental aspects of internet of things (IoT)	K2
CO3	Illustrate the elements of IoT in building automation	K2
CO4	Demonstrate the technological features of healthier built environment	K2
CO5	Compare the various sensor systems for the assessment of structural health	K2

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M				H	M	H					H	M	
CO2	M				H							H	M	
CO3	M				H	M	H					H	M	
CO4	M				H	M	H					H	M	
CO5	M				H	M	H					H	M	

F. Course Content:

UNIT I INTRODUCTION 9

History of smart cities - Indian Smart City Mission, guiding principles – Key outcomes to define a smart city – Characteristics of smart cities – IoT based solutions for smart cities: smart grid, smart home, smart transport, smart healthcare – Overview of Indian smart cities – Scope of internet of things in civil engineering domains.

UNIT II ELEMENTS OF INTERNET OF THINGS (IoT) 9

Introduction - Definition and characteristic of IoT – Physical design of IoT: things in IoT, protocols – Logical design of IoT: functional blocks, communication models - IoT enabling technologies: WSN, cloud computing, big data analytics, embedded systems.

UNIT III BUILDING AUTOMATION 9

IoT enabled buildings – Home sensors: motion sensor, physical sensor, chemical sensor, leak/moisture detection sensor, remote sensor, biosensor, O_2-CO_2 sensor – Protocols for IoT home devices – Cloud architecture for IoT based homes – In house energy monitoring systems and devices.

UNIT IV BUILT ENVIRONMENT 9

History of human health vs-built environment – Factors affecting human health in built environment – Variable of indoor environmental quality – Technologies for healthy buildings: sensors, devices and equipment – Futuristic technologies for indoor human health – Case studies.

UNIT V STRUCTURAL HEALTH MONITORING 9

Structural health monitoring (SHM) systems for buildings - Common sensors for civil infrastructures – Piezoelectric transducers, fibre optic sensors, acoustic emission sensors, Micro-electro-mechanical-systems, corrosion assessing sensors and vision based robotic sensing for SHM applications – SHM systems for bridges, dams, roads and rail roads, landslides and underwater structures.

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. M. L. Wang, J. P. Lynch and H. Sohn, Sensor Technologies for Civil Infrastructures (Vol I&II) Elsevier & Woodhead Publication, 2014.
2. Making a City Smart: Learnings from the Smart City Mission – A workbook for decision makers, Smart Cities Mission – Ministry of Housing and Urban Affairs, Government of India, 2021.
3. PradeepTomar, GurjitKaur, Green and Smart Technologies for Smart Cities, CRC Press, 2020.
4. Fadi Al-Turjman, Intelligence in IoT enabled smart cities, CRC Press, 2019.

b) References:

1. ArshdeepBagha, Vijay Madisetti, Internet of Things: A Hands-on approach, Universities Press, 2015.
2. Ming Hu, Smart Technologies and design for healthy built environments, Springer, 2021.

Honors: Infrastructure Engineering

Honors: Infrastructure Engineering (18 Credits)				
S.No	**Course Code**	**Course Name**	**Credits**	**Prerequisite**
1	10212CE136	Cartography	3	NIL
2	10212CE137	Industrial Infrastructures	3	NIL
3	10212CE138	Bridge Engineering	3	Design of RC Elements
4	10212CE139	Urban Transportation Planning	3	NIL
5	10212CE140	Smart Structures and its Applications	3	NIL
6	10212CE141	Disaster Management and Mitigation	3	NIL

10212CE136	CARTOGRAPHY	L	T	P	C
		3	0	0	3

Course Category / Type: Honors course / Theory

A. Preamble:

- To introduce Cartography as science and technology of Map Making.
- The course also introduces its connections with Communication Science, Computer technology and IT.
- To outline the Cartography as a creative art.

B. Prerequisite:

- NIL

C. Link to other Courses:

- NIL

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Acquire knowledge about basics map and map formation with allied terminology	K2
CO2	Acquire knowledge about abstraction of earth and map projection	K3
CO3	Understanding the map compilation and design of map creation	K3
CO4	Understanding the selection of colour spectrum and choropleth maps to facilitate map layout	K3
CO5	Apply the flow mapping and terrain visualization by understanding projection and Projection Properties	K3

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1					H	L	L		L			M		
CO2					H	L	L		M			H		
CO3					H	M	M		M			H		
CO4					H	H	L		L			M		
CO5					H	M	M		M			L		

F. Course Content:

UNIT I INTRODUCTION TO GRAPHIC COMMUNICATOR 9

Maps, their functions and use – Definition of Cartography – Types of Maps – Terminology - other cartographic products – map making steps – surveying and mapping – Role of IT and computers, RS, GIS and GPS – Concepts of sphere, ellipsoid and geoid – latitudes, longitudes and graticules – Map Scales and Contents – accuracy and errors- History of Cartography – Mapping organizations in India.

UNIT II ABSTRATION OF EARTH AND MAP PROJECTION 9

Map projections – shape, distance, area and direction properties – role of aspect, development surface, secant and light source / view points – Perspective and Mathematical projections – Indian maps and projections – Map co-ordinate systems – UTM and UPS references – Common Projections and selections– projections for hemispheres and the world maps

UNIT III MAP COMPILATION AND DESIGN 9

Base map concepts – scanning and digitization – planimetric, topographic and thematic information – sample and census surveys – attribute data tables – Elements of a map – Map Layout principles – Map Design fundamentals – symbols and conventional signs – graded and ungraded symbols – color theory – colours and patterns in symbolization – map lettering.

UNIT IV COLOUR AND CHOROPLETH MAPS 9

Introduction to colour and choropleth-Colour Overview-Specifying Colours- Types of colour schemes. Visual perception constraints. Data Standardization - Making Choropleth Maps-Making Sense of Maps-Colour and Data.

UNIT V FLOW MAPPING AND TERRAIN VISUALIZATION 9

Overview-Modelling Earth- Geographic Coordinate Systems- Projecting the Earth-Characteristics of Projections-Projection Properties-Choosing a Projection-Popular Projections and Coordinate System-Flow Mapping. Visualizing a Landscape-Oblique Views-Physical Models-Vertical Views-Building Terrain Layers-Terrain as a Basemap-Terrain through Scale.

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. Anson R.W. and Ormeling F.J. “Basic Cartography for students and Technicians”. Vol.I, II and III, Elsevier Applied Science Publishers, 3rd Edition, 2004.
2. Arthur, H. Robinson et al, “Elements of Cartography”, 7th Edition, John Wiley and Sons, 2004.

b) References:

1. John Campbell, “Introductory Cartography”, Wm.C. Brown Publishers, 3rd Edition, 2004.
2. Menno Jan Kraak&FerjanOrmeling, “Cartography Visualization of Geospatial Data”, 2nd Edition, Pearson Education, 2004.
3. Martin Dodge, MarrsMcderby& Martin Turner, John wiley&srena “Geographic Visualization”, west sin sex, England, 2008.
4. Robert B McMaster, fritz C Kessler, Hugh H Howard “Thematic Cartography and Geo visualization” 3rd edition by Terry A slocum, Prentice Hall, 2008.

c) Online Resources:

1. https://www.e-education.psu.edu/geog486/syllabus
2. https://nptel.ac.in/courses/105/102/105102015/

10212CE137	INDUSTRIAL INFRASTRUCTURES	L	T	P	C
		3	0	0	3

Course Category / Type: Honors course / Theory

A. Preamble:

- On completion of this course student will be able to plan industrial structures for functional requirements.
- To understand and explain concepts of infrastructure, private involvement in infrastructure, challenges to successful infrastructure planning and implementation, strategies for successful infrastructure project implementation
- Prepare environmental management plan and mitigation measures by considering environmental aspects, impacts and potential hazards respectively for any project

B. Prerequisite:

- Nil

C. Link to other Courses:

- Nil

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Understand the general principles and standards of industrial infrastructures.	K2
CO2	Understand the concepts and design of industrial structural components.	K3
CO3	Describe the strategies for successful Infrastructure Project implementation.	K2
CO4	Able to plan and implement of industrial infrastructure projects.	K2
CO5	Describe the legal requirements of environmental impact assessment and socio- economic impact for projects.	K2

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M		M				M	L					M	H
CO2	L		M				M	M					M	H
CO3	M						M	L					M	H
CO4						M	M	M					M	H
CO5					L	H	M	M					M	H

F. Course Content:

UNIT I GENERAL 8

Specific equipment's for industries like Engineering - Textile, Chemical etc., - Site layout and external facilities classification of industries minimum standards internal calculation – Materials – Works.

UNIT II DESIGN REQUIREMENTS FOR INDUSTRIES 10

Lighting - Natural and artificial - protection from the sun - sky light - Ventilation and fire protection - extinguishers and hydrants - principles - design of girder

UNIT III BASIC CONCEPTS RELATED TO INFRASTRUCTURE 9

Introduction to Infrastructure - an overview of the Power Sector in India - Water Supply and Sanitation Sector - Urban Infrastructure- Rural Infrastructure - Governments Role in Infrastructure Implementation.

UNIT IV INFRASTRUCTURE PLANNING AND IMPLEMENTATION 9

Mapping and Facing the Landscape of Risks in Industries infrastructure Projects - Economic and Demand Risks - The Case study for Political Risks – Socio Environmental Risks - Cultural Risks in International Infrastructure Projects - Legal and Contractual Issues in Infrastructure - Challenges in Construction and Maintenance of Infrastructure.

UNIT V ENVIRONMENTAL IMPACT ASSESSMENT FOR INFRASTRUCTURE 9

Tools, impact on air, water, soil & Noise - Role of Biodiversity impact Assessment - E I A Report Preparation - Impact of Environment on Health - Developing framework for Health impact analysis - Tools and techniques - Case studies.

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. Chitkara, K.K. "Construction Project Management: Planning, Scheduling and Control", Tata McGraw-Hill Publishing Company, New Delhi, 1998.
2. Choudhury S, "Project Management", McGraw-Hill Publishing Company, New Delhi, 1988.
3. Jurgen Axel Adam, KatharriaHausmann, Frank Juttner, Klauss Daniel, Industrial Buildings: A Design Manual, Birkhauser Publishers, 2004.
4. A. S. Goodman and M. Hastak, Infrastructure planning handbook: Planning, engineering, and economics, McGraw-Hill, New York, 2006.
5. J. Parkin and D. Sharma, Infrastructure planning, Thomas Telford, London, 1999.

b) References:

1. Harold Kerzner – Project Management – systems approach to planning, scheduling & controlling – 7th edition, John wiley& sons, Canada.

2. Srinivasulu P and Vaidyanathan.C, Handbook of Machine Foundations, Tata McGraw Hill, 1976.
3. C. D. Reese and J. V. Eidson, Handbook of OSHA construction safety and health, 2nd ed., CRC Press, Boca Raton, 2006.

c) Online Resources:

1. https://nptel.ac.in/courses/112/107/112107292
2. https://onlinecourses.nptel.ac.in/noc20_mg28/preview
3. https://onlinecourses.nptel.ac.in/noc22_ce20/preview

10212CE138	BRIDGE ENGINEERING	L	T	P	C
		2	2	0	3

Course Category / Type: Honors course / Theory

A. Preamble:

Students undergoing this course are expected**:**

- To impart fundamental knowledge on bridge design and conceptual knowledge on bridge maintenance.
- To design methodologies of bridge superstructures, substructures and bearings according to the code of practice concerned.

B. Prerequisite:

- 10211CE105 - Design of RC Elements

C. Link to other Courses:

- NIL

D. Course Outcomes:

Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Illustrate the essentials of bridge engineering.	K2
CO2	Design the bridge superstructure.	K3
CO3	Design the prestressed concrete slab and girder bridges.	K3
CO4	Apply the design principles for different types of bearings and substructures used in bridges.	K3
CO5	Illustrate the bridge maintenance and analyze the various case studies on bridges.	K2

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						L						M	M	
CO2	M		H			M		M		H		M	M	
CO3	M		H			M		M		H		M	M	
CO4	M		H			M		M		H		M	M	
CO5						L						M	M	

F. Course Content:

UNIT I INTRODUCTION 6+6

Historical background of bridges and types - Bridge aesthetics and proportioning - Selection of bridge site - Review of applicable design codes - Loads on bridges and force distribution - IRC Specifications for Road Bridges, Standards live loads, other forces on bridges - General design considerations - Bridge geometry - Classification of Bridges - Suitability of different types of bridges for various spans - Economical span of a typical bridge - Bridge Hydrology - Determination of design discharge, linear water way, economical span, location of piers and abutments, afflux and scour depth.

UNIT II REINFORCED CONCRETE BRIDGE COMPONENTS 6+6

Pigeaud's method for computation of slab moments - Courbon's method for computation of moments in girders - Design of simply supported single span solid slab bridge - Tee beam bridge.

UNIT III PRESTRESSED CONCRETE BRIDGE COMPONENTS 6+6

Advantages of prestressed concrete slab and girder bridges - Suitable spans - Design of slab and beam cross sections for given bending moment, shear, prestresing force and eccentricity.

UNIT IV BEARINGS AND SUBSTRUCTURES 6+6

Purposes of Bearings - Importance of Bearings - Types of Bearings - Free and Fixed Bearings - Bed Blocks - Design principles of bearings - Piers - Abutments - Wing walls - Setting out for Piers and Abutments - Materials for substructures - Design principles of piers and abutments for different types - Types of bridge foundations - Design principles of foundations.

UNIT V BRIDGE MAINTENANCE 6+6

Bridge failures - Case studies - Maintenance of bridges - Detailed Inspection - Routine Inspection - Posting of Bridges - Assessment of Existing bridges - Rebuilding Bridges - Retrofitting and Rehabilitation of bridges - Case studies.

TOTAL: 30+30 = 60 PERIODS

G. Learning Resources:

a) Text Books:

1. Ponnuswamy S, Bridge Engineering, Tata McGraw-Hill, 2017.
2. KrishnaRaju N, Design of Bridges, Oxford and IBH, 2019.

b) References:

1. Johnson Victor D, Essentials of Bridge Engineering, Oxford & IBH, 2007.
2. Jagadeesh T.R and Jayaram M.A, Design of Bridge Structures, Prentice Hall of India Pvt Ltd., 2004.
3. Raina V.K, Concrete Bridge Practice, Tata McGraw Hill Publishing Company, New Delhi, 1994.
4. KrishnaRaju N, Structural Design and Drawing: Reinforced Concrete and Steel, University Press (India) Pvt Limited, 2010.

c) Online Resources:

1. https://nptel.ac.in/courses/105/105/105105165/

d) IS Codes:

1. IS: 456-2006, Code of Practice for Plain and Reinforced Concrete, BIS, New Delhi, 2008.
2. IS: 1343-1980, IS Code of Practice for Prestressed Concrete, BIS, New Delhi, 1980.
3. IRC:6-2014, Standard Specifications and Code of Practice for Road Bridges, Section II - Loads and Stresses (Fifth Revision), 2014.
4. IRC:18-2000, Design Criteria for Prestressed Concrete Road Bridges (Post-Tensioned concrete) (Third Revision), 2000.
5. IRC:21-2000, Standard Specifications and Code of Practice for Road Bridges, Section III - Cement Concrete (Plain and Reinforced) (Third Revision), 2000.
6. IRC:22-2010, Standard Specifications and Code of Practice for Road Bridges, Indian Road Congress, New Delhi, 2011.
7. IRC:24-2010, Standard Specifications and Code of Practice for Road Bridges, Steel Road Bridges (Limit State Method) Third Revision, 2010.
8. IRC:82 (Part 2) - Part IX-1987, Standard Specifications and Code of Practice for Road Bridges, Elastomeric Bearings, IRC, 1987.
9. IRC:82 (Part 1) - section IX-1999, "Standard Specifications and Code of Practice for Road Bridges, Metallic Bearings, IRC, 1999.
10. IRC:83-1999(Part-I), Standard Specifications and Code of Practice for Road Bridges, Section IX - Bearings, Part I Metallic Bearings (First Revision), 1999.
11. IRC:83-1987(Part II), Standard Specifications and Code of Practice for Road Bridges, Section IX - Bearings, Part II: Elastomeric Bearings.
12. IRC:112-2011, Code of Practice for Concrete Road Bridges, Indian Road Congress, New Delhi, 2011.

10212CE139	URBAN TRANSPORTATION PLANNING	L	T	P	C
		3	0	0	3

Course Category: Honor Courses / Theory

A. Preamble:

Students undergoing this course are expected to gain knowledge on the understanding of urban transportation problems from planners' perspectives.

B. Prerequisite:

- NIL

C. Link to other Courses:

- 10211CE106 - Transportation Engineering

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Gather the conceptual aspects of urban transportation planning	K2
CO2	Infer the transportation modelling techniques	K2
CO3	Extend the transportation analysis techniques and methods	K2
CO4	Gather the methods and models of traffic survey	K2
CO5	Express the urban structure and goods movement	K2

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						L	L							L
CO2	M			M	L	L	L							L
CO3	M			H	L	L	L							L
CO4	L			H	M	L								L
CO5					L									L

F. Course Content:

UNIT I INTRODUCTION TO URBAN TRANSPORT PLANNING 9

Urbanization, Urban Class Groups, Transportation Problems and Identification, Impacts of Transportation, Urban Transport System Planning Process, Modeling Techniques In Planning. Urban Mass Transportation Systems-Types, Capacity. Coordination - Types.

UNIT II DATA COLLECTION AND INVENTORIES 9

Collection of data – Organisation of surveys and Analysis, Study Area, Zoning, Types and Sources of Data, Road Side Interviews, Home Interview Surveys, Commercial Vehicle Surveys, Sampling Techniques, Expansion Factors, Accuracy Checks, Use of Secondary Sources, Economic data – Income – Population – Employment – Vehicle Owner Ship.

UNIT III TRIP GENERATION 9

UTPS Approach, Trip Generation Analysis: Zonal Models, Category Analysis, Household Models, Trip Attraction models, Commercial Trip Rates; Trip Distribution by Growth Factor Methods.

UNIT IV TRIP DISTRIBUTION 9

Gravity Models, Opportunity Models, Time Function Iteration Models. Travel demand modeling: gravity model, opportunity models, Desire line diagram. Modal split analysis.

UNIT V TRAFFIC ASSIGNMENT 9

Diversion Curves; Basic Elements of Transport Networks, Coding, Route Properties, Path Building Criteria, Skimming Tree, All-or-Nothing Assignment, Capacity Restraint Techniques, Reallocation of Assigned Volumes, Equilibrium Assignment. Introduction to land use planning models, land use and transportation interaction.

TOTAL: 45 Periods

G. Learning Resources

a) Text Books:

1. Kadiyali, L.R., Traffic Engineering & Transport Planning, Khanna Publishers, New Delhi.
2. Hutchinson, B.G.(1974).Principles of Urban Transport Systems Planning. McGraw Hill Book Company, New York.

b) References:

1. George Godwin; Traffic, Transportation and Urban Planning; Pitmen Press, Great Britain, 1981.
2. AdibKanafani. (1983). Transportation Demand Analysis. McGraw Hill Series in Transportation, Berkeley.
3. John W.Dickey.(1975). Metropolitan Transportation Planning. McGraw Hill Book Company, New York.
4. Papacostas, C.S., and Prevedouros,P.D.(2002). Transportation Engineering and Planning. 3rd Edition, Prentice - Hall of India Pvt Ltd., 318-436.
5. Salter, R J., Highway Traffic Analysis and Design, ELBS.

c) Online Resources

1. https://nptel.ac.in/courses/105/106/105106058/
2. https://nptel.ac.in/courses/124/105/124105016/

10212CE140	SMART STRUCTURES AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

Course Category / Type: Honors Course / Theory

A. Preamble:

Students undergoing this course are expected

- To understand the functions of smart structures like sensors, actuators and signal processing systems.

B. Prerequisite:

- Nil

C. Link to other Courses:

- **Nil**

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Understand the smart materials and structures	K2
CO2	Understand application of instrumentation	K2
CO3	Articulate structural assessment using sensors	K3
CO4	Demonstrate actuator techniques	K3
CO5	Understand the working mechanism of vibrators and Biomitics	K3

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L		L		L	L			L			H	M	
CO2	L	L	M		M	M			M			H	M	
CO3	L		M		M	M			M			H	M	
CO4	L		M		M	M			M			H	M	
CO5	L		M		M	M			M			H	M	

F. Course Content:

UNIT I INTRODUCTION 9

Introduction to Smart Materials and Structures Instrumented structures functions and response – Sensing systems – Self - diagnosis – Signal processing consideration Actuation systems and effectors.

UNIT II MEASURING TECHNIQUES 9

Strain Measuring Techniques using Electrical strain gauges, Types – Resistance Capacitance – Inductance – Wheatstone bridges – Pressure transducers – Load cells- Temperature Compensation, Strain Rosettes

UNIT III SENSORS 9

Sensing Technology, Types of Sensors, Physical Measurement using Piezo Electric Strain measurement – Inductively Read Transducers – The LVDT – Fiber optic Techniques Chemical and Bio-Chemical sensing in structural Assessment – Absorptive chemical sensors – Spectroscopes – Fibre Optic Chemical Sensing Systems and Distributed measurement.

UNIT IV ACTUATORS 9

Actuator Techniques-Actuator and actuator materials Piezoelectric and Electrostrictive Material – Magnetostrictive Material – Shape Memory Alloys – Electro-rheological Fluids Electromagnetic actuation – Role of actuators and Actuator Materials

UNIT V VIBRATION ABSORBERS AND BIOMIMETICS 9

Parallel damped vibration absorber, Gyroscopic vibration absorber, Active vibration, absorber, Applications. Characteristics of natural structures, Concepts of Biomimetic structural design, Biomimetic sensing, Challenges and opportunities for Biomimetics

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. Brain Culshaw., Smart Structures and Materials, Artech House Publishers, Boston-2004.
2. Sadhu Singh., Experimental Stress Analysis, Khanna Publishers (2009).
3. Srinath L.S., Experimental Stress Analysis, Tata McGraw-Hill, 1998.
4. Srinivasan,A.V., and Michael McFarland.D., Smart Structures – Analysis and Design, Cambridge University Press, 2001.

b) References:

1. Dally J. W and Riley W. F., Experimental Stress Analysis, Tata McGraw-Hill, 1998.
2. Hetyeni M., Hand Book of Experimental Stress Analysis, John Wiley and Sons Inc., New York 1972.

c) Online Resources:

1. https://nptel.ac.in/courses/107/104/107104076/

10212CE141	DISASTER MANAGEMENT AND MITIGATION	L	T	P	C
		3	0	0	3

Course Category: Honors Courses / Theory

A. Preamble:

- The course is intended to provide the basic concept in the dimensions of disasters caused by natural and environmental hazards induced by human activities with emphasis on disaster preparedness, response and recovery.

B. Pre-Requisites:

- Nil

C. Link to other courses:

- NIL

D. Course outcomes:

Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Understanding the basic concept of disaster management cycle.	K2
CO2	Classify the various natural and manmade disasters	K2
CO3	Illustrate the insight about disaster preparedness for prevention.	K2
CO4	Illustrate the drought hazards and its impact of disasters, globally and in India.	K2
CO5	Understanding the concept of mitigation and measures to be taken at different stages of disaster management	K2

E. Correlation of COs with POs

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	L					M	M					L		
CO2	L				L	H	L					L		
CO3	M				H	M	H					L		
CO4	M				H	H	H					L		
CO5	H				H	H	H					L		

F. Course Content:

UNIT I DEFINITION AND UNDERSTANDING OF DISASTERS 9

Understanding the concepts and definitions of disaster, hazard, vulnerability, risk, importance, dimensions & scope of disaster management, disaster management cycle.

UNIT II TYPES OF DISASTER 9

Natural hazards and Disasters - Man induced hazards & Disasters - Natural Hazards - Planetary Hazards / Disasters - Extra Planetary Hazards / disasters - Planetary Hazards - Endogenous Hazards - Exogenous Hazards

UNIT III EARTHQUAKE 9

Volcanic eruption - Earthquakes - landslides - Volcanic Hazards / Disasters - Causes and distribution of Volcanoes - Hazardous effects of volcanic eruptions - Environmental impacts of volcanic eruptions - Earthquake Hazards / disasters - Causes of Earthquakes - Distribution of earthquakes - Hazardous effects of - earthquakes - Earthquake Hazards in India - Human adjustment, perception & mitigation of earthquake

UNIT IV CYCLONES 9

Tropical cyclones & Local storms - Floods - Droughts - Cold waves - Heal waves - Flood hazards India - Flood control measures - Drought hazards in India - Drought control measures - Extra Planetary Hazards / Disasters - man induced Hazards / Disasters - Physical hazards / Disasters - Soil erosion - Chemical hazards / disasters - Biological hazards / disasters

UNIT V MITIGATION AND AWARENESS PROGRAM ON DISASTER MANAGEMENT 9

Basic principles of disasters management - Disaster Management cycle - Disaster management policy,National and State Bodies for Disaster Management, Early Warming Systems,building design andconstruction in highly seismic zones, retrofitting of buildings. Training and drills for disaster preparedness, Awareness generation program, national guidelines and plans on disaster management, national disaster response force (NDRF); Usages of GIS and Remote sensing techniques in disaster management

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. Disaster Management Guidelines, GOI-UND Disaster Risk Program (2009-2012)
2. Damon, P. Copola, (2006) Introduction to International Disaster Management, Butterworth Heineman.
3. Gupta A.K., Niar S.S and Chatterjee S. (2013) Disaster management and Risk Reduction, Role of Environmental Knowledge, Narosa Publishing House, Delhi.

b) References:

1. Murthy D.B.N. (2012) Disaster Management, Deep and Deep Publication PVT.Ltd. New Delhi.
2. Modh S. (2010) Managing Natural Disasters, Mac Millan publishers India LTD

c) Online Resources:

1. https://nptel.ac.in/courses/105/104/105104183