The National Institute of Engineering

(An Autonomous Institution under Visvesvaraya Technological University, Belagavi)
Recognised by AICTE, New Delhi, Grant-in-Aid by Government of Karnataka,
Accredited by NAAC, New Delhi

BLOWN UP SYLLABUS

2023-24

III Year B.E. (2021 admitted batch)

Department of Civil Engineering

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TABLE OF SCHEME AND EXAMINATION FOR V & VI SEMESTER (2021 admitted batch)

V Semester												
Sl. No	**Course Code**	**Course Title**	**Category**	**Teaching Department**	**Teaching Hours / Week**				**Examination**			**Credits**
					Theory Lecture	**Tutorial**	**Practical/ Drawing**	**Self-study Component**				
					L	**T**	**P**	**S**	**CIE Marks**	**SEE Marks**	**Total Marks**	
1	21CV5C01	RC Design and Drawing	PC	CIV	3	0	2	0	50	50	100	4
2	21CV5C02	Engineering Economics and Construction Management			3	0	0	0	50	50	100	3
3	21CV5C03	Fundamentals of Geotechnical Engineering			3	2	0	0	50	50	100	4
4	21CV5C04	Highway Engineering			3	0	2	0	50	50	100	4
5	21CV5L01	Computer Application Laboratory			0	0	2	0	50	50	100	1
6	21CV5L02	Geotechnical Engineering Laboratory			0	0	2	0	50	50	100	1
7	21CV5OXX	Open Elective 1	OE	CIV	3	0	0	0	50	50	100	3
8	21CV5A01	Research Methodology & IPR	AEC	CIV	2	0	0	0	50	50	100	2
9	21HS5C01	Physical Education/Yoga & NSS	MC	PE	--	--	--	--	50	0	50	0
TOTAL												**22**

VI Semester												
Sl. No	**Course Code**	**Course Title**	**Category**	**Teaching Department**	**Teaching Hours / Week**				**Examination**			**Credits**
					Theory Lecture	**Tutorial**	**Practical/ Drawing**	**Self-study Component**				
					L	**T**	**P**	**S**	**CIE Marks**	**SEE Marks**	**Total Marks**	
1	21CV6C01	Quantity Surveying and Estimation	PC	CIV	3	0	0	0	50	50	100	3
2	21CV6C02	Design and Drawing of Steel Structures			3	0	2	0	50	50	100	4
3	21CV6C03	Hydrology and Irrigation Engineering			3	2	0	0	50	50	100	4
4	21CV6L01	Concrete Laboratory			0	0	2	0	50	50	100	1
5	21CV6L02	Design and Drawing of Bridges			1	0	2	0	50	50	100	2
6	21CV6OXX	Open Elective 2	OE		3	0	0	0	50	50	100	3
7	21CV6P01	Minor Project/Survey Camp	PI	CIV	0	0	4	0	50	50	100	2
8	21CV6A01	AEC 5 - Drawing of Irrigation Structures	AEC		0	0	2	0	50	50	100	1
9	21HS6C01	Environment Studies	HSC	CIV	2	0	0	0	50	0	50	0
10	21HS6C02	Physical Education/Yoga & NSS	MC	PE	--	--	--	--	50	0	50	0
11	21CV6I01	Summer Internship 2	PI	CIV	Completed during IV/V Sem Vacation				50	0	50	2
TOTAL												**22**

List of Open Electives

(Offered by Department of Civil Engineering to other branch students)

V Semester		
Sl. No	**Course Code**	**Course Title**
1	21CV5O01	Solar Engineering
2	21CV5O02	Occupational Safety & Health Hazards
3	21CV5O03	Unmanned Aerial Vehicles
4	21CV5O04	Water Resource Management
5	21CV5O05	Finite Element Method
6	21CV5O06	Road Safety
VI Semester		
Sl. No	**Course Code**	**Course Title**
1	21CV6O01	Geoinformatics and Coding
2	21CV6O02	Occupational Safety & Health Hazards
3	21CV6O03	Space Technology and Applications
4	21CV6O04	Biomaterials
5	21CV6O05	Composite Materials
6	21CV6O06	Disaster Management and Mitigation

DEPARTMENT OF CIVIL ENIGNEERING

VISION

- The Department will be an internationally recognized centre for value based learning, research and consultancy in Civil Engineering and will produce competent Civil Engineers having commitment to national development.

MISSION

- To impart high quality Civil Engineering education through competent faculty, modern labs and facilities.
- To engage in R & D activities and to provide state–of–the–art consultancy services addressing Civil Engineering challenges of the society.
- To nurture social purpose in Civil Engineers through collaborations**.**

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

Civil Engineering graduates are expected to attain the following program educational objectives (PEOs) 3-5 years after graduation. Our graduates will be professionals who will be able to

PEO1: Deliver competent services in the field of Civil Engg., with a knowledge of the principles of engineering and the theories of science that underlie them.

PEO2: Continue their professional development, nurture research attitude, and life-long learning with scientific temperament.

PEO3: Exercise leadership quality and professional integrity, with a commitment to the societal needs and sustainable development.

PROGRAMME SPECIFIC OUTCOMES (PSO)

Graduates from the Department of Civil Engineering will have ability to:

1. Apply basic knowledge of Science & Engineering, and analyze complex Engineering problems to arrive at appropriate solutions in the field's of Civil Engineering;
2. Design & develop sustainable engineering systems by applying state of art tools and techniques, to meet specific needs;
3. Work in a team, as a member or as a leader, with good understanding of finance, management, cultural, societal and legal issues and flair for life long learning.

PROGRAMME OUTCOMES (PO)

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

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.

6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

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.

11. **Project management and finance**: Demonstrate knowledge and understanding of the 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.

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.

DETAILED SYLLABUS

V SEMESTER

Code: 21CV5C01 **Course: RC Design and Drawing**
Credits: 4 **L:T:P 3:0:2**
SEE+SET: 125 marks (reduced to 50 marks) **CIE: 50 marks**
SEE Hours: 3 **Max. Marks:100**

Prerequisites if any	-NA-
Learning objectives	1. Identify, formulate, and solve engineering problems of RC elements subjected to different kinds of loading. 2. Follow a procedural knowledge in designing various structural RC elements. 3. Impart the usage of codes for strength, serviceability, and durability.

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Recognize the design philosophy and basic principles of reinforced concrete structures	Understand
CO2	Analyze and design RC elements for flexure, shear and compressive forces	Evaluate
CO3	Create Reinforced concrete structural drawings of different components of the buildings using the provided data.	Apply

Mapping with POs and PSOs:

COs	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2		PSO 1	PSO 2	PSO 3
CO1	3													3		
CO2	3	3	2											2	2	
CO3	1		3	3										2		

Mapping Strength: **Strong– 3** **Medium – 2** **Low – 1**

Course Structure

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
	Module – 1			
1.1	**Introduction:** Introduction to Basic Design Concept; Structural Analysis & Design; Plain and Reinforced Concrete – advantages & disadvantages; Application of Reinforced Concrete, Reinforced Concrete Structural Systems	1		

1.2	Design Codes and Handbooks, National building code; Reinforcing Steel - Stress-Strain curve, nominal diameter, chemical properties	1		
1.3	Properties of Concrete, Cover requirements for R.C. Members	1		
1.4	Design Philosophy - Working stress method, Ultimate load method, Limit State Method	1		
1.5	Characteristic strengths and loads, Partial Safety Factor for materials & load	1		
1.6	Limit state of deflection (using empirical method) & cracking (code provisions)	1		
	Module – 2			
2.1	**Design of Beams:** Limit State of Collapse: Flexure Assumptions; Stress block parameters, Balanced, under-reinforced and over-reinforced sections	1		
2.1	Depth of neutral axis; Moment of Resistance of Reinforced Concrete Sections	1		
2.2	Expression for steel area for balanced singly reinforced section	1		
2.3	Limit State of Collapse: Shear Introduction – Shear, Shear failure mechanism; Bond and anchorage in RC members.	1		
2.4	Analysis and design of singly reinforced flexural members	2		
2.5	Analysis and design of doubly reinforced flexural members	2		
	Module – 3			
3.1	**Design of Slabs:** Introduction, Design of one-way slab	2		
3.2	Design of simply supported two-way slab	1		
3.3	**Design of Stairs:** Introduction, Types of Staircases, Loadings, waist slab type	3		
	Module – 4			
4.1	**Design of Column:** Limit State of Collapse: Compression Introduction, Short and slender compression members; Unsupported length; Effective length of compression members	2		
4.2	Slenderness limits for columns; Minimum eccentricity; Longitudinal reinforcement; Transverse reinforcement; Design of short columns under i) axial compression	2		
4.3	Design of short columns under ii) axial compression with uniaxial bending iii) axial compression with biaxial bending	2		

Module – 5				
5.1	**Design of Shallow Foundations:** Introduction, Classification, Types, Soil design consideration	2		
5.2	Axially loaded Isolated footings for column	2		
5.3	Combined footing for two columns - concepts only (Slab type)	2		
Detailing of RC Elements				
1	Guidelines for selection of cross-sectional dimensions and detailing of reinforcement	1		2
2	Beams – Simply supported and Cantilever	1		2
3	Slab – One way and Two way	1		2
4	Staircase – Doglegged	1		2
5	Footing – Isolated column footing, Portal Frame (Concepts only)	1		2
	Total No. of Lecture Hours	**37**		
	Total No. of Tutorial Hours			
	Total No. of Practical Hours			**10**

Self-learning topics identified:

1. Code Recommendations for Earthquake loads.
2. Analysis of slabs as rectangular beams
3. Splicing of Reinforcement
4. IS 456:2000 recommendation for Durability aspects of concrete.
5. Behaviour of slender columns.

Textbooks:

1. N. Krishna Raju and R. N. Pranesh, “Reinforced Concrete Design”, New Age Internation Publishers, 1st Edition, 2003.
2. S. Unnikrishna Pillai and Devdas Menon, “Reinforced Concrete Design”, TMH, 3rd Edition, 2009.
3. Bureau of Indian Standards – IS 456 – 2000, IS 875 – Part 1 to 3 – 1987, SP-16, SP - 34

Reference Books:

1. F. K. Kong and R.H. Evans, “Reinforced and Prestressed Concrete”, ELBS, 3rd Edition, 1987
2. H. J. Shah, Reinforced Concrete Vol-1[Elementary Reinforced Concrete], Charotara Publishig House, 8th Edition, 2009

3. B. C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, “Limit State Design of Reinforced Concrete”, Lakshmi Publications, 1st Edition, 2007
4. P. C. Varghese, “Limit State Design of Reinforced Concrete”, PHI, 2nd Edition, 2009
5. J. N. Bandopadhyay, “Design of Concrete Structure”, PHI, 1st Edition, 2008.
6. M. L. Gambhir, “Fundamentals of Reinforced Concrete Design”, PHI,1st Edition, 2006
7. Dr. Ram Chandra and Virendra Gehlot, “Elements of Limit State Design of Concrete Structures”, Scientific Publishers, 1st Edition, 2004
8. S. N. Sinha, “Reinforced Concrete Design”, TMC, 2nd Edition, 2002
9. Ashok. K. Jain “Reinforced Concrete Limit State Design”, Nem Chand and Bros, 6th Edition, 2010

Online Resources:

1. NPTEL course on “Design of Reinforced Concrete Structure” by Prof. Nirjhar Dhang, IIT Kharagpur. https://archive.nptel.ac.in/courses/105/105/105105105/

Code: 21CV5C02 **Course:** Engineering Economics and Construction Management
Credits: 3 **L:T:P 3:0:0**
SEE: 100 marks (reduced to 50 marks) **CIE: 50 marks**
SEE Hours: 3 **Max. Marks:100**

Prerequisites if any	None
Learning objectives	1. Understanding the basics of Engineering Economics 2. Inculcate fair knowledge of Construction Management

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Describe several economic terms and important laws of economics.	Understand
CO2	Evaluate the worth of one or more economic alternatives based on time value of money.	Apply
CO3	Estimate the economic value of a property and to fix rent of a building and to estimate the cost of a product.	Apply
CO4	Planning and Scheduling of Civil Engineering Projects and understand construction equipments	Apply

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1											3					3
CO2											3					3
CO3											3					3
CO4			2		2						3					3

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
	Module – 1			
1.1	Definitions, Micro and Macro Economics, Goods, Utility, Value, Asset, Liability, Capital, Revenue, Income, Wealth & Welfare, Economic Laws – Basics of Supply & Demand, Price determination.	2		
1.2	Various forms & functions of market, Role of engineering economy in decision making, Basic Macroeconomic Concepts (including GDP/GNP/NI/Disposable Income) and Identities for both closed and open economies.	4		

1.3	Aggregate demand and Supply (IS/LM), Price Indices (WPI/CPI), Interest rates, Direct and Indirect Taxes.	2		
	Module – 2			
2.1	Nominal and effective value of interest, simple interest, compound interest.	1		
2.2	Present worth comparison, Present worth equivalence, Annual worth analysis, compar deferred investments, future worth comparison,	5		
2.3	Payback Period comparison, problems on rate of return method, and Break even analysis.	3		
	Module – 3			
3.1	Depreciation - Methods of depreciation, Mortgage, lease.	3		
3.2	Fixation of rent on buildings, Problems.	3		
3.3	Cost Concept and Classification of Cost, Cost output relationship, Activity based costing; Cost estimation techniques	2		
	Module – 4			
4.1	Meaning, nature and characteristics of management, scope and functional areas of management, goals of management.	3		
4.2	Levels of management, brief overview of evolution of management.	2		
4.3	Needs, objectives and functions of construction management, organizational chart for the Construction Company, Duties and responsibilities of project manager	3		
	Module – 5			
5.1	Necessity of planning and scheduling, various stages in planning	2		
5.2	CPM, PERT and time computation.	4		
5.3	Various earth moving equipment, cost of owning and operating construction equipment, factors to be consider for selection of equipment.	3		
	Total No. of Lecture Hours	42		
	Total No. of Tutorial Hours		**0**	
	Total No. of Practical Hours			**0**

Self-learning topics identified:

1. Effect of inflation on cost estimates
2. Functions of financial management
3. Compaction equipment
4. Tools of total quality management

Textbooks:

1. Banga & Sharma, “Industrial Organization & Engineering Economics”, Khanna Publishers, 2003.
2. K.K. Chaitkara, “Construction Project Management”, Tata McGraw-Hill, 2007.

Reference Books:

1. James L. Riggs, David D. Bedworth, Sabah U. Randhawa, “Engineering Economics” Tata Mc Graw Hill Education Pvt. Ltd., New Delhi, 1996.
2. Tarachand, "Engineering Economics", Nemchand and Brothers. Roorkee, 2000.
3. Yogesh Maheshwari, "Managerial Economics", PHI Learning Pvt. Ltd. New Delhi, 2004.
4. Jack R. Merdith & Samual J.Mantel, “Project Management-a managerial approach”, 7th edition, Wiley India, 2010.
5. P.P. Dharwadkar, “Management in construction Industry”, Oxford IBH, 2008.
6. J.O Brien, “ Construction Management”, McGraw Hill, 2015.

Online Resources:

1. Foundation Course in Managerial Economics by Prof. Barnali Nag, IIT Kharagpur. https://www.digimat.in/nptel/courses/video/110105075/L01.html
2. Principals of Construction management by Prof. Sudhir Misra, IIT Kanpur https://onlinecourses.nptel.ac.in/noc22_ce56

Code: 21CV5C03 **Course: Fundamentals of Geotechnical Engineering**
Credits: 4 **L:T:P 3:2:0**
SEE: 50% **CIE: 50%**
SEE Hours: 3 **Max. Marks:100**

Prerequisites if any	-NA-
Learning objectives	1. To present the foundations of many basic Engineering tools and concepts related Geotechnical Engineering. 2. To give an experience in the implementation of Engineering concepts which are applied in field of Geotechnical Engineering

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	To understand basic soil properties,functional relationship and index properties.	Understand
CO2	To classify the soil and identify the clay minerology.	Apply
CO3	To evaluate permeability and shear strength of soil.	Evaluate
CO3	Application of compaction and consolidation of soil for ground improvement.	Analize

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1	3	2		2										3	2	
CO2	1	3	3	2		2	1							1	1	
CO3	3	3	2	3		3	2				1			3	2	1

Mapping Strength: **Strong– 3** **Medium – 2** **Low – 1**

Course Structure

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
	Module – 1			
1.1	Introduction to Geotechnical Engineering: Introduction to physical geology, Origin and definition of soil, formation of soil, Residual soil and Transported soil.	1		
1.2	Scope of soil Engineering, Terminology of different types of soils.	1		
1.3	Basic Definitions and Relationships Soil as a three phase system.	1		
1.4	Definitions of void ratio, porosity, percentage Air voids, Air content, Degree of saturation, Moisture content, Specific gravity, Bulk density, Dry density, Saturated density and Submerged density.	1		
1.5	Functional relationships derivations.	2		
Module – 2				
2.1	Index Properties of Soils and Their Determination: Introduction: determination of water content, specific gravity, particle size distribution by sieve analysis.	2		
2.2	Consistency limits of soils, Determination of liquid limit by Casagrande and cone penetration methods, plastic limit and shrinkage limit.	2	02	
2.3	Free swell ratio, Free swell index and swell pressure.	1		

2.4	Determination of Insitu density by core cutter and sand replacement methods. Determination of relative density.	1		
	Module – 3			
3.1	Soil Classification, Structure and Clay Minerals: Need for classification, Indian standard classification system, Common clay minerals.	2	02	
3.2	Soil structure, Single grained, honey combed, flocculent, dispersed and composite soil structure.	2		
3.3	Common clay minerals.	1		
3.4	Diffuse double layer and Adsorbed water.	1		
	Module – 4			
4.1	Permeability of Soils and Shear Strength of Soil	1		
4.2	Introduction, Hydraulic head, Darcy's law, Assumptions and validity of Darcy's law	1		
4.3	Coefficient of permeability by constant and variable head methods	1	02	
4.4	Factors affecting permeability	1		
4.5	Seepage velocity, superficial velocity and coefficient of percolation	1		
4.6	Concept of shear strength, Mohr's strength theory, Mohr- coulomb failure Theory, Total and effective shear strength parameters,	2		
4.7	Factors affecting shear strength of soils	1		
4.8	Measurement of shear strength from direct shear test, unconfined compression test, Triaxial compression test and vane shear test.	3	02	
	Module – 5			
5.1	Soil Compaction & Consolidation of Soils: Definition, Theories of compaction, Factors affecting compaction	1		
5.2	Standard and modified Proctor's compaction tests	1	02	
5.3	Effect of compaction on soil properties, Field compaction methods.	1		
5.4	Consolidation of Soils Definition, Initial, primary and secondary consolidation, Spring Analogy for primary consolidation, Consolidation of laterally confined soil	1		
5.5	Definition of coefficient of compressibility, coefficient of volume change, compression index & swelling index	1		
5.6	Terzaghi's theory of one dimensional consolidation	1		
5.7	Definition of normally consolidated, under consolidated and over consolidated soils	1		
5.8	Laboratory consolidation test, Determination of coefficient of consolidation by Casagrande, Taylors, rectangular hyperbola, loglog and one pint method.	4	02	
	Total No. of Lecture Hours	**40**		
	Total No. of Tutorial Hours		**12**	
	Total No. of Practical Hours			--

Self-learning topics identified:

1. Identification of Clay and Silt Content by Hydrometer Test
2. Field Permeability Tests
3. Permeability of stratified deposits. Tests under different drainage conditions.
4. (i) Field compaction control- Proctor's needle. (ii) Causes of pre consolidation, Pre consolidation pressure.

Textbooks:

1. Gopal Ranjan, A S R Rao, "Basic and Applied Soil Mechanics", New Age International Publishers, 2016.
2. V.N.S. Murthy, "Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering", CRC Press, 2002.

Reference Books:

1. B. M. Das, Khaled Sobhan, “Principal of Geotechnical Engineering”, Cengage Learning, 2013.
2. Jonathan Knappett, R.F. Craig, “Craig's Soil Mechanics”, CRC Press, 2019.
3. B. M. Das, “Principal of Foundation Engineering”, Cengage Learning, 2015.

Online Resources:

1. NPTEL course on “Soil Mechanics/Geotechnical Engineering-1” by Prof. D K Baidya, IIT Kharagpur. https://archive.nptel.ac.in/courses/105/105/105105168/
2. NPTEL course on “Soil Mechanics” by Prof. B V S Viswanadham, IIT Mumbai. https://nptel.ac.in/courses/105101084
3. MITOPENCOURSEWARE course on “Advanced Soil Mechanics”, by Prof. Charles Ladd and Dr. Lucy C. Jen, Massachusetts Institute of Technology. https://ocw.mit.edu/courses/1-361-advanced-soil-mechanics-fall-2004/

Code: **21CV5C04** **Course: Highway Engineering**
Credits: **4** **L:T:P 3:0:2**
SEE+SET: **125 marks (reduced to 50 marks)** **CIE: 50 marks**
SEE Hours: **3** **Max. Marks:100**

Prerequisites if any	Surveying, Building Materials and Construction
Learning objectives	1. To acquire knowledge of highway planning, materials and construction. 2. To learn importance of highway drainage and maintenance.

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Understand principles of transportation engineering, planning and alignment surveys.	Understand
CO2	Design geometric elements of pavement and perform tests for pavement materials.	Apply
CO3	Analyse construction, economic and maintenance aspects in highway engineering.	Analyze

Mapping with POs and PSOs:

COs	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2		PSO 1	PSO 2	PSO 3
CO1	3													3		
CO2		3	3												3	
CO3	3															2

Mapping Strength: **Strong– 3** **Medium – 2** **Low – 1**

Course Structure

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
	Module – 1			
1.1	**Principles of Transportation Engineering:** Importance of transportation, different modes of transportation, characteristics and comparison of different modes	01	-	-
1.2	Jayakar Committee recommendations and implementation	01	-	-
1.3	Highway Development and Planning	01	-	-
1.4	Road types and classification, road patterns	01	-	-
1.5	Planning surveys, master plan - saturation system of road planning. Problems on best alignment among alternate proposals	01	-	-
1.6	Phasing road development programme, road development in India	01	-	-

1.7	20-year road development plans. Problems on 3rd 20-year road plan.	01	-	-
1.8	Present scenario of road development in India (NHDP) & PMGSY) and in Karnataka (KSHIP & KRDCL)	01	-	-
	Module – 2			
2.1	**Highway Alignment and Surveys:** Ideal alignment, factors affecting alignment	01	-	-
2.2	Engineering surveys for new and realignment projects	01	-	-
2.3	**Highway Geometric Design:** Important factors controlling the design of geometric elements	01	-	-
2.4	Highway cross section elements: pavement surface characteristics, camber, width of carriage way	01	-	-
2.5	Shoulder width, formation width, right of way, typical cross sections of roads	01	-	-
2.6	Sight distance, types and importance	01	-	-
2.7	Problems on sight distance	01	-	-
2.8	Design of horizontal alignment with problems	01	-	-
2.9	Design of vertical alignment with problems	01	-	-
	Module – 3			
3.1	**Pavement Materials:** Properties and requirements of sub-grade soils	01	-	-
3.2	Determination of CBR and modulus of sub-grade reaction of soil	01	-	-
3.3	Problems on CBR and k values.	01	-	-
3.4	Properties and requirements of road aggregates	01	-	-
3.5	Properties and requirements of bitumen, tar, cutback and emulsion	01	-	-
3.6	**Pavement Design:** Types of pavements, Design factors	01	-	-
3.7	IRC method of flexible pavement design with problems	01	-	-
3.8	Stresses in rigid pavement, IRC method of rigid pavement design	01	-	-
	Module – 4			
4.1	**Pavement Construction:** Subgrade layer, Granular sub-base course	01	-	-
4.2	Granular base courses such as WBM, WMM	02	-	-
4.3	Bituminous binder course such as BM and DBM	02	-	-
4.4	Bituminous surfacing courses such as BC, SDBC	01	-	-
4.5	Surface dressing, premixed carpet (PMC), prime coat, tack coat and seal coat	01	-	-
4.6	Construction of rigid pavement (DLC and PQC)	01	-	-

Module – 5				
5.1	**Highway Drainage System:** Surface and sub-surface drainage system	02	-	-
5.2	Functions and basic design principles.	02	-	-
5.3	**Highway Economics and Financing:** Highway user benefits, VOC charts, highway costs	02	-	-
5.4	Economic analysis by annual cost method and benefit cast ratio method, NPV & IRR methods. Numerical problems on above	02	-	-
5.5	Highway Maintenance: Pavement failure types, causes, remedies and maintenance	01	-	-
List of Experiments:				
1	Sieve analysis, specific gravity, water absorption of coarse aggregates	-	-	1
2	Shape test and angularity number of coarse aggregates	-	-	1
3	Abrasion test on aggregates	-	-	1
4	Impact test on aggregates	-	-	1
5	Crushing value test on aggregates	-	-	1
6	Sieve analysis, specific gravity, water absorption of fine aggregates	-	-	1
7	Bulking of sand	-	-	1
8	Ductility test on bitumen	-	-	1
9	Softening point test on bitumen	-	-	1
10	Penetration test on bitumen	-	-	1
11	Specific gravity test on bitumen	-	-	1
12	Viscosity test	-	-	1
13	Flash and fire point	-	-	1
14	Demonstration: Marshall Stability and CBR test	-	-	1
	Total No. of Lecture Hours	**42**		
	Total No. of Tutorial Hours			**-**
	Total No. of Practical Hours			**14**

Self-learning topics identified:

1. Traffic surveys for estimation of design wheel load
2. Traffic signs and signals
3. Highway furniture's
4. Use of marginal and local materials in road construction.

Textbooks:

1. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, "Highway Engineering", Revised 10th Edition, Nem Chand & Bros., 2018.
2. Prithvi Singh Khandal, "Bituminous Road Construction in India", PHI Learning Private Limited 2016.

Reference Books:

1. MoRTH "Specifications for Roads and Bridges" 5th Revision, New Delhi. – 2013.
2. Relevant IRC Codes.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc22_ce94
2. https://www.nptelvideos.com/civil_engineering/transportation_engineering_video_lectures.php

Code: 21CV5L01 **Course: Computer Application Laboratory**
Credits: 1 **L:T:P 0:0:2**
SET: 50 marks **CIE: 50 marks**
SEE Hours: -- **Max. Marks: 100**

Prerequisites if any	-NA-
Learning objectives	1. Use industry standard software in a professional set up. 2. Understand the elements of finite element modeling, specification of loads and boundary condition, performing analysis and interpretation of results for final design.

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Analyse and design structures with the aid of commercially available and open-source softwares	Analyse

Mapping with POs and PSOs:

COs	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2		PSO 1	PSO 2	PSO 3
CO1	**2**	**2**			2							**1**		2		1

Mapping Strength: **Strong– 3** **Medium – 2** **Low – 1**

Course Structure

Sl. No.	Description	No. of Practical Hours
1	Analyse beams, 2D frames and 2D trusses	8
2	Analyse and design 3-dimensional RCC frames (up to 4 × 4 grids and 4 storeys) subjected to dead load, live load, wind load, and earthquake load.	4
3	Develop excel spread sheet for analysis of beams	2
4	Develop excel spread sheet for design of following RC structural elements: Beams and Slabs	4
5	Use of open-source mobile applications, tools, and software	2

Total No. of Practical Hours - 20

Self-learning topics identified:

1. Code Recommendations for Earthquake loads.
2. Analysis of slabs as rectangular beams
3. Splicing of Reinforcement
4. IS 456:2000 recommendation for Durability aspects of concrete.
5. Behaviour of slender columns.

Textbooks:

1. N. Krishna Raju and R. N. Pranesh, "Reinforced Concrete Design", New Age Internation Publishers, 1st Edition, 2003.
2. S. Unnikrishna Pillai and Devdas Menon, "Reinforced Concrete Design", TMH, 3rd Edition, 2009.
3. Bureau of Indian Standards – IS 456 – 2000, IS 875 – Part 1 to 3 – 1987, SP-16

Reference Books:

1. F.K.Kong and R.H. Evans, "Reinforced and Prestressed Concrete", ELBS, 3rd Edition, 1987
2. H.J.Shah, Reinforced Concrete Vol-1[Elementary Reinforced Concrete], Charotara Publishig House, 8th Edition, 2009
3. B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, "Limit State Design of Reinforced Concrete", Lakshmi Publications, 1st Edition, 2007
4. P.C.Varghese, "Limit State Design of Reinforced Concrete", PHI, 2nd Edition, 2009
5. J.N. Bandopadhyay, "Design of Concrete Structure", PHI, 1st Edition, 2008.
6. M.L.Gambhir, "Fundamentals of Reinforced Concrete Design", PHI,1st Edition, 2006
7. Dr. Ram Chandra and Virendra Gehlot, "Elements of Limit State Design of Concrete Structures", Scientific Publishers, 1st Edition, 2004
8. S.N.Sinha, "Reinforced Concrete Design", TMC, 2nd Edition, 2002
9. Ashok. K. Jain "Reinforced Concrete Limit State Design", Nem Cahnd and Bros, 6th Edition, 2010

Online Resources:

1. NPTEL course on "Design of Reinforced Concrete Structure" by Prof. Nirjhar Dhang, IIT Kharagpur. https://archive.nptel.ac.in/courses/105/105/105105105/

Code: 21CV5L02 **Course: Geotechnical Engineering Laboratory**
Credits: 1 **L:T:P 0:0:2**
SET: 50 marks **CIE: 50 marks**
SEE Hours: -- **Max. Marks:100**

Prerequisites if any	Fundamentals of Geotechnical Engineering
Learning objectives	Understand and determine the Index and Engineering properties of soil

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Determine the index property of soils in order to classify the soil as per BIS specifications.	Apply
C02	Evaluate the properties like shear strength, permeability, compaction and consolidation characteristics of soils.	Apply

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3	PSO4
CO1	2	2												3	2	3	
CO2	2	3															

Mapping Strength: **Strong– 3** **Medium – 2** **Low – 1**

Course Structure

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
List of Experiments:				
1	Test for determination of specific gravity	-	-	1
2.	Grain size analysis of soils by Sieve analysis	-	-	1
3.	In situ density by core cutter and sand replacement methods	-	-	1
4.	Consistency limits (a) Liquid limit by casagrande methods (b) Plastic limit (c) Shrinkage limit	-	-	1
5.	Standard Proctor compaction test	-	-	2
6.	Modified Proctor compaction test	-	-	
7.	Determination of permeability by constant head and variable head methods	-	-	1

8.	Strength tests (a) Unconfined compression test (b) Direct shear test	-	-	2
9.	Consolidation test			1
10.	California bearing ratio test			2
	Total No. of Lecture Hours	**0**		
	Total No. of Tutorial Hours		**0**	
	Total No. of Practical Hours			**12**

Self-learning topics identified:

Hydrometer Analysis
Triaxial Shear Test

Reference Books:

"Laboratory testing of soils SP 36 (Part 1) 1987", Bureau of Indian Standards
Lambe T. W., "Soil testing for Engineers" Wiley India Pvt. Ltd.1985.
Bowles. J.E., "Engineering properties of soils and their measurements"- McGraw Hill. – 1992.

Online Resources:

https://nptel.ac.in/courses/105101160

Code: **21CV5A01** **Course: Research Methodology & IPR**
Credits: **2** **L: T: P: 2:0:0**
SEE: **50 marks** **CIE: 50 marks**
SEE Hours: **2** **Max. Marks: 100**

Prerequisites if any	-NA-
Learning objectives	1.To understand the formulation of research problem 2. To be familiar with data collection and literature survey process 3. To know the statistical concepts in experimentation 4. To acquire knowledge in writing research reports 5. To understand about patent rights and its importance

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Understand the basic framework of research process, research design and techniques	Understand
CO2	Understand the processes of quantitative data collection, analysis, interpretation and scholarly writing	Understand
CO3	Understand the aspects of IPR and the Emerging Trends in IPR.	Understand

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1		3						2						2		
CO2				3	3					2					3	
CO3			2											2		

Mapping Strength: **Strong– 3** **Medium – 2** **Low – 1**

Course Structure

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
	Module – 1			
1.1	**Overview of research** Introduction to research	1		
1.2	Objectives and motivations for research, Significance of research	1		
1.3	Research Methods v/s Methodology, Types of research	1		

1.4	Quantitative Research Methods, Steps in research process	1		
1.5	Criteria of good Research, Importance of literature review in defining a problem	2		
1.6	Survey of literature - Primary and secondary sources - Reviews,	1		
1.7	Web as a source - searching the web; Identifying gap areas from literature, Research problem-definition, selection and formulation of a research problem selection,	3		
1.8	Criteria of a good research problem. Characteristics of good research design	1		
	Module – 2			
2.1	**Data collection, processing and analysis** Sources of data, collection of data, Primary and secondary Data,	1		
2.2	Measurement and scaling, Sources of error in measurement.	1		
2.3	Mathematical Models for research (brief introduction only), Sampling: Concepts of Statistical Population, Sample Size, Sampling Frame, Sampling Error	2		
2.4	Probability and Non-Probability sampling	1		
2.5	Hypothesis, Hypothesis Testing, Level of Significance and Confidence Interval, Type I and Type II errors, Correlation, Regression Analysis (brief introduction only)	1		
2.6	**Writing Research Report:** Format and style. Review of related literature its implications at various stages of research. (Formulation of research problem, hypothesis, interpretation and discussion of results. Major findings, Conclusions and suggestions.)	1		
2.7	Layout of a Research Paper, Research proposal, Citation of references, Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, effective technical presentation in seminars /workshops /symposiums (oral/paper/poster)	2		
2.8	Significance of ethical conduct in research and publishing, Plagiarism & latest regulations. Software for detection of Plagiarism	1		
	Module – 3			
3.1	**Intellectual property rights** Intangible Property; Tangible Property; Introduction to Intellectual property	1		
3.2	Types of intellectual property i. The Copyrights Act, 1957 (“Copyright Act”) ii. The Trade Marks Act, 1999 (“Trade marks Act”) iii. Trade Secret iv. The Patents Act, 1970 (“Patents Act”) v. The Design Act, 2000 (“Design Act”) vi. The Geographical Indications of Goods (Registration and Protection) Act, 1999 (“GI Act”) vii. The Protection of Plant Varieties and Farmer’s Rights Act, 2001 (“Plant Varieties Act”)	4		

	viii. The Semiconductor Integrated Circuits Layout- Design Act, 2000 ("SICLD Act")			
3.3	Importance of intellectual property rights, Agencies responsible for Intellectual property registration	1		
3.4	Cyber Law – Information Technology Act.	1		
Total No. of Lecture Hours		**28**		
		Total No. of Tutorial Hours	--	
			Total No. of Practical Hours	--

Self-learning topics identified:

1. Developing a research plan, Department/program specific research problem discussions
2. Tools for data processing, Graphical representation of Data.
3. Intellectual property rights – laws & practices

Textbooks:

1. Chawla, Deepak & Sondhi, Neena (2011). Research methodology: Concepts and Cases, Vikas Publishing House Pvt. Ltd. Delhi.
2. Kothari, C.R., (2014), Research Methodology, New Age International second revised edition
3. Ranjit Kumar, (2011). Research Methodology a step by step guide for beginners, Sage Publications
4. R. Radha Krishnan, S. Balasubramanian: "Intellectual Property Rights", Excel Books. New Delhi

Reference Books:

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., (2002). An Introduction to Research Methodology, RBSA Publishers.
2. Sinha S.C. and Dhiman AK, (2002). Research Methodology, Ess, Ess Publications
3. Fink A, (2009). Conducting Research Literature Reviews: From the Internet to Paper, Sage Publications
4. Donald R. Cooper and Pamela S. Schindler, (2013). Business Research Methods, TMH, New Delhi, 12th Edition.
5. John W. Creswell, (2003). Research Design, Qualitative, Quantitative and Mixed Approaches, 2ndEdition, Sage Publication.

Online Resources:

1. NPTEL course on "Intellectual Property Rights" by Prof. T K Bandyopadhyay, IIT Kharagpur. https://youtube.com/playlist?list=PLyqxTaS-wsUIHm1y-Eyz6gq891MGEvHHq

DETAILED SYLLABUS

VI SEMESTER

Code: 21CV6C01 **Course: Quantity Surveying and Estimation**
Credits: 3 **L:T:P 3:0:0**
SEE: 100 marks (reduced to 50 marks) **CIE: 50 marks**
SEE Hours: 3 **Max. Marks:100**

Prerequisites if any	Nil
Learning objectives	1. Prepare bill of quantities including financial estimates for civil engineering structures. 2. Conduct rate analysis of civil engineering elements with detailed specification.

Course Outcomes:
On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Prepare bill of quantities for civil engineering structures by different methods	Understand
CO2	Provide & conduct detailed specification and rate analysis for different civil engineering components respectively	Understand & Apply
CO4	Prepare financial estimates of civil engineering structures	Apply

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1					3	3				3				3		
CO2	3	3	2					8			3	3		3		
CO3			2				3		3					3		2

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
	Module – 1			
1.1	**Introduction** Different types of estimates	2	0	0
1.2	Various types of drawings required for preparation of estimates	1	0	0
1.3	Units of measurement and Important terms used in estimates	1		
	Module – 2			
2.1	**Specifications** Definition of specifications, objective of writing specifications	1	0	0

2.2	General specification for various items of works in buildings	2	0	0
2.3	Detailed specification of various items works in buildings	3	0	0
	Module – 3			
3.1	**Rate analysis** Definition, purpose	1	0	0
3.2	Working out data procedure for quantities and rates of cement concrete of different mixes	2	0	0
3.3	Working out data procedure for quantities and rates of brick and size stone masonry	2	0	0
3.4	Working out data procedure for quantities and rates of flooring, plastering	2	0	0
3.5	Working out data procedure for quantities and rates of painting	1	0	0
3.9	Working out data procedure for quantities and rates of form work for different RCC items	2	0	0
	Module – 4			
4.1	**Quantity Surveying & Risk Management in Estimation** Methods of estimating the quantities of earth works excavation, foundation	1	0	0
4.2	Methods of estimating the quantities of earth works masonry	1	0	0
4.3	Methods of estimating the quantities of earth works plastering work, concrete work	1	0	0
4.4	Methods of estimating the quantities of earth works form work	2	0	0
4.5	Risk management in estimation.	1	0	0
	Module – 5			
5.1	**Estimation of bill of quantities of Civil Engineering structures** Method of estimating bills of quantities building (Using IS 1200)	1	0	0
5.2	Preparation of detailed and abstract estimates for residential buildings for masonry structures (Two and three bed room houses with GF and FF)	5	0	0
5.3	Preparation of detailed and abstract estimates for residential buildings for framed structures (Two and three bed room houses with GF and FF)	6	0	0
5.4	Preparation of detailed and abstract estimates for Septic tank	1	0	0
5.5	Preparation of detailed and abstract estimates for Manhole	1	0	0
5.6	Preparation of detailed and abstract estimates for Slab culvert	2	0	0
	Total No. of Lecture Hours	**42**		

Total No. of Tutorial Hours	**0**	
Total No. of Practical Hours		**0**

Self-learning topics identified:

1. Rate Analysis of doors, windows, ventilators and various types of claddings
2. Usage of software for estimating bill of quantities

Textbooks:

1. B.N. Dutta,**" Estimating and costing in civil Engineering Theory and practices''**, UBS Publishers & Distributors, 2010
2. IS 1200 Code Book.

Reference Books:

1. M. Chakroborti, **"Estimating, costing & Specification in Civil Engineering"**, S Chand Publishing House, 2006.
2. S.C. Rangwala, **"Valuation of real properties"**, Charotar Publishing House, 2008.
3. K.K. Chitkara, **" Construction project management"**, Tata McGraw-Hill, 2009.

Online Resources:

1. Swayam course - Building cost estimation simplified
   https://onlinecourses.swayam2.ac.in/nou20_cs11/preview

Code: 21CV6C02 **Course: Design and Drawing of Steel Structures**
Credits: 4 **L:T:P 3:0:2**
SEE+SET: 125 marks (reduced to 50 marks) **CIE: 50 marks**
SEE Hours: 3 **Max. Marks:100**

Prerequisites if any	
Learning objectives	1. To introduce students to the fundamental design process of steel as a structural member. **2.** To give emphasis on the general theory and performance of structural steel, as well as design and analysis of structural members subjected to various loading conditions based on the current Limit State Method of design.

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	**Course Outcomes**	**Bloom's level**
CO1	Design and prepare detailed sketches of Bolted and welded connections	Apply, Analyze
CO2	Evaluate the strength of Tension members, compression members and column bases and prepare detailed drawings	Apply, Analyze
CO3	Design laterally supported beams and draw different types of beams	Apply, Analyze

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1	1	2	3	-	2	-	-	-	-	-	-	-		2	3	-
CO2	1	2	3	-	2	-	-	-	-	-	-	-		2	3	-
CO3	1	2	3	-	2	-	-	-	-	-	-	-		2	3	-

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

		No. of Lecture Hours	**No. of Tutorial Hours**	**No. of Practical Hours**
Module – 1: Bolted Connections				
1.1	Introduction, Limit State Method (LSM) of design & Section classification.	2	0	0
1.2	Introduction to bolted connections, types of bolted joints, failure of bolted joints	2	0	3
1.3	Design strength of ordinary black bolts, simple connections problems	3	0	3
1.4	Design strength of High Strength Friction Grip bolts (HSFG), problems	3	0	3
Module – 2: Welded Connections				
2.1	Introduction, Welding process, Welding electrodes, Advantages of Welding	2	0	0

2.2	Types and Properties of Welds, Weld symbols & specifications, Effective areas of welds, Failure of welds	3	0	2
2.3	Design of welds, Types of welded joints i.e., Simple connections problems	3	0	5
Module – 3: Design of Tension members				
3.1	Introduction, Types of tension members, Slenderness ratio, Behavior of tension members	2	0	0
3.2	Modes of failure, Factors affecting the strength of tension members	3	0	2
3.3	Design of tension members (Angles under tension and other sections) and Lug angles	3	0	2
Module – 4: Design of Compression members				
4.1	Introduction, possible failure modes, slenderness ratio	1	0	0
4.2	Behavior of compression members, elastic buckling of slender compression members	1	0	0
4.3	Sections used for compression members, effective length of compression members	1	0	0
4.4	Design of compression members, design concepts of built-up sections	4	0	3
4.5	Design of column bases	3	0	3
Module – 5: Design of Beams				
5.1	Introduction, beam types, lateral stability of beams	1	0	0
5.2	Maximum allowable deflections, behavior of beam in bending	2	0	0
5.3	Design of laterally supported beams	3	0	2
	Total No. of Lecture Hours	**42**		
	Total No. of Tutorial Hours		**0**	
	Total No. of Practical Hours			**28**

Self-learning topics identified:

1. Moment resistant connections
2. Distortion and residual stresses in welded joints
3. Splices in beams
4. Splices in compression members
5. Laterally unsupported beams

Textbooks:

1. S. K. Duggal, "**Limit state Design of steel Structures**", 3rd Edition, Tata McGraw Hill, 2019.
2. N. Subramanian, "**Design of Steel Structures**", Oxford Publications, 2018.

Reference Books:

1. M. L. Gambir, "**Fundamentals of Structural Steel Design**", Tata McGraw Hill, 2017.
2. Ramachandra and Virendra Gehlot, ―Limit State Design of Steel Structures, Scientific Publishers, 2012.

Bureau of Indian Standards, **IS 800-2007; IS 875 - 1987; SP- 6 (1)** or **―Steel Tables**

Online Resources:

1. Design of Steel Structures, IIT Kharagpur – Prof. Damodar Maity (NPTEL – Video Lecture Course) (https://nptel.ac.in/courses/105105162)
2. Design of Steel Structures, IIT Madras – Prof. Satish Kumar S.R. (NPTEL – Web Lecture Course) (https://nptel.ac.in/courses/105106113)

Code: 21CV6C03 **Course: Hydrology and Irrigation Engineering**
Credits: 4 **L:T:P 3:2:0**
SEE: 50% **CIE: 50%**
SEE Hours: 3 **Max. Marks:100**

Prerequisites if any	Applied Hydraulic Engineering
Learning objectives	1. Understanding the concept of hydrology, components of hydrological cycle, hydrological processes. 2. Estimation of runoff and determination of catchment yield and design flood. 3. Understanding the systems and methods of irrigation including crop water requirements. 4. Understanding reservoirs and dams/weirs including stability analysis.. 5. Understanding conveyance of irrigation water through canals including design of canals

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Provide a background in the theory of hydrological processes and their measurement.	Remember, Understand
CO2	Estimate runoff, use the concept of unit hydrographs and determine the design flood.	Remember, Understand, Apply
CO3	Understand the different systems of irrigation, determination of water requirement for various crops.	Remember, Understand, Apply
CO4	Understand reservoirs, dams/weirs and canal system and make relevant computations.	Remember, Understand, Apply

Mapping with POs and PSOs:

COs	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2		PSO 1	PSO 2	PSO 3	PSO 4
CO1	3													3			
CO2	3	2	2	2										3			
CO3	3	2												3			
CO4	3	2	2											3	2		

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
	Module – 1 **Hydrology – Introduction and Processes**			
1.1	Hydrology – Introduction, Global distribution of water and Indian water availability, Hydrologic cycle (Horton's) qualitative and engineering representation	01		
1.2	Precipitation – Forms, types with characteristics and importance	01		
1.3	Measurement of rainfall using Syphon type of rain gauges, optimum number of rain gauge stations	01		
1.4	Intensity of rainfall, intensity-duration relationship and applications	01		

1.5	Presentation of precipitation data – mass curve, rainfall hyetographs, IDF curves	01		
1.6	Area average methods for the analysis of rainfall data – Thiessen polygon method and Isohyetal method	01	02	
1.7	Evaporation - process, influencing factors, measurement using IS class-A Pan	01		
1.8	Evapotranspiration – process, influencing factors, Blaney-Criddle equation for calculating evapotranspiration	01		
1.9	Infiltration – process, factors affecting infiltration capacity, measurement by double ring infiltrometer, Horton's infiltration equation, infiltration indices	02		
	Module – 2 **Runoff, hydrograph, basin yield and design flood**			
2.1	Runoff – Definition, concept of catchment, factors affecting runoff	01		
2.2	Rainfall-runoff relationship using regression analysis	01	02	
2.3	Hydrographs – Definition, components, separation of base flow	01		
2.4	Yield estimation – a) Through stream hydrographs, b) By modelling (SCS curve number method)	01	02	
2.5	Unit Hydrograph – Its use in convolution, assumption, applications and limitations	01		
2.6	Peak floods and design flood, frequency analysis for the determination of design flood	02		
2.7	Rational method for the determination of design flood	01		
	Module – 3 **Irrigation and Water requirements of crops**			
3.1	Irrigation - Definition, importance, types and systems of irrigation	02		
3.2	Water requirement of crops – duty, delta and base period, relationship between them, factors affecting duty of water crops.	01	02	
3.3	Consumptive use, crop factor, crop seasons in India, efficiency and frequency of irrigation	01		
	Module – 4 **Reservoirs, Dams, Irrigation tanks, Weirs and Barrages**			
4.1	Reservoirs – Definition, investigation for reservoir site, storage zones	01		
4.2	Determination of required storage capacity using mass curves, determination of available storage capacity using area-capacity curves	01		
4.3	Dams – definition, classification, selection of site for a dam	01		
4.4	Gravity dams – Components and its functionalities; including overflow and non-overflow sections	01		
4.5	Forces acting on gravity dam, determination of resultant and stresses at the base of the dam	01		
4.6	Modes of failure of gravity dam and its stability requirements against overturning, sliding, overstressing	02		
4.7	Energy dissipation, high level and low level canals	01		
4.8	Irrigation tanks, components and functionalities of diversion head works	01		
4.9	Weirs and Barrages – Components, seepage under weir and Bligh's method of design of aprons	01	02	
	Module – 5 **Canals**			
5.1	Canals – Definition, types, canal alignment	01		
5.2	Gross command area, culturable command area, intensity of irrigation, time factor, crop factor, full supply coefficient, nominal duty	01	02	
5.2	Determination of design capacity of canals	01		
5.3	Standard canal sections, design of canals in of alluvial soils (Manning's method) and non-alluvial soils (Kennedy's method)	01	02	

5.4	Canal regulators; Head regulator and cross regulator, canal drops	01		
5.5	Canal losses	01		
	Total No. of Lecture Hours	**38**		
		Total No. of Tutorial Hours	**14**	
			Total No. of Practical Hours	**00**

Self-learning topics identified:

1. National Water Policy and National Water Plan
2. CWC aids for design flood, earthen dams – types and components
3. Cross Drainage works

Textbooks:

1. Arora KR "Irrigation Water Power & Water Resources Engineering" - Standard Publishers Distributors – 2010.
2. P Jaya Rami Reddy "A Text Book of Hydrology" - Laxmi Publications, New Delhi - 2011

Reference Books:

1. Garg, S.K "Irrigation Engineering and Hydraulic Structures", Khanna Publishers, New Delhi-2011
2. Subramanya K "Engineering Hydrology" - Tata McGraw Hill, New Delhi – 2010.
3. Ven Te Chow, "Handbook of applied hydrology", McGraw Hill Pub., New Delhi - 1964.
4. Putty M.R.Y., "Principles of Hydrology", IK Internatinal Pub., New Delhi - 2010.
5. Micheal A. M "Irrigation, Theory and Practice", Vikas Publishing House Pvt. Ltd. New Delhi
6. Modi, P.N. "Irrigation Water Resources and Water Power Engineering", Standard Book House, New Delhi.
7. Larry - G. James "Irrigation Principles and Practice" - O.W. Isralson
8. Sharma, R.K and Sharma T.K "Irrigation Engineering", S. Chand & Company Pvt. Ltd, New Delhi

Online Resources:

1. https://archive.nptel.ac.in/courses/126/105/126105010/
2. https://archive.nptel.ac.in/courses/105/102/105102159/

Code: 21CV6L01 **Course: Concrete Laboratory**
Credits: 1 **L:T:P 0:0:2**
SET: 50 marks **CIE: 50 marks**
SEE Hours: -- **Max. Marks: 100**

Prerequisites if any	Concrete Technology
Learning objectives	Understand the properties of concrete and its ingredients.

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Conduct destructive & non-destructive tests on concrete with various tests on cement and aggregates.	Apply

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1	2		1	3										3	1	

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
	List of Experiments:			
1	Test on Cement Normal Consistency, Setting Time, Compressive strength, Specific Gravity, Fineness of Cement (by dry sieving),	-	-	3
2.	Test on Aggregates (CA & FA) Sieve Analysis, Specific Gravity, Water Absorption, Bulk Density	-	-	2
3.	Mix Design and Workability Tests Slump test, Compaction Factor, Vee-Bee Consistometer test.	-	-	1
4.	Tests on Hardened Concrete Compressive strength, Split Tensile test, Flexural Strength test	-	-	2
5.	Rebound Hammer Test	-	-	1
6.	Ultra sonic Pulse velocity Test	-	-	
7.	Determination of Extent of Corrosion in RC elements	-	-	1
8.	Rebar Locater Test	-	-	1
	Total No. of Lecture Hours	**0**		
	Total No. of Tutorial Hours		**0**	
	Total No. of Practical Hours			**11**

Self-learning topics identified: (Maximum of 5 topics)

1. Concrete Mix Proportioning — Guidelines (Second Revision) using IS: 10262 2019

Reference Books:

1. IS 10262-1981 (RA 1989): Recommendation guidelines of concrete mix design
2. SP 23 (S&T) -1982 Hand book on concrete mixes
3. IS 456 – 2000: code of practice for plain & reinforced concrete

4. IS 516-1959 (RA 1991): Method of test for strength of concrete
5. IS 13311 (Part – 1) 1992: Ultrasonic Pulse Velocity
6. IS 13311 (Part 2) 1992: Rebound Hammer Test
7. N. Krishna Raju, "Design of Concrete Mixes", CBS Publishers & distributors, Delhi 2010
8. Neville A. M., "Properties of Concrete", Pitman Publishers-2009.

Online Resources:

1. https://www.youtube.com/results?search_query=Tests+on+Cement
2. https://www.youtube.com/results?search_query=Tests+on+Aggregates
3. https://www.youtube.com/results?search_query=Workability+Tests+on+Concrete
4. https://www.youtube.com/results?search_query=Tests+on+Hardened+Concrete
5. https://www.youtube.com/results?search_query=Rebound+Hammer+Test
6. https://www.youtube.com/results?search_query=Ultra+sonic+Pulse+velocity+Test
7. https://www.youtube.com/results?search_query=Determination+of+Extent+of+Corrosion+in+RC+elements
8. https://www.youtube.com/results?search_query=Rebar+Locater+Test

Code: 21CV6L02 **Course: Design and Drawing of Bridges**
Credits: 2 **L:T:P 1:0:2**
SET: 50 marks **CIE: 50 marks**
SET Hours: 2 **Max. Marks:100**

Prerequisites if any	
Learning objectives	1. To provide students with fundamental knowledge in a wide range of state-of-the-art practices including code specifications, in bridge engineering. 2. Describe the process that an engineer uses to design a bridge, including determining loads.

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	**Course Outcomes**	**Bloom's level**
CO1	Design basic types of bridges and prepare their drawings	Apply, Analyze

Mapping with POs and PSOs:

COs	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2		PSO 1	PSO 2	PSO 3	PSO 4
CO1	2	3	3	-	2	-	-	-	-	-	-	-		2	3	-	-

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

		No. of Lecture Hours	**No. of Tutorial Hours**	**No. of Practical Hours**
Module – 1: Investigation of Bridges				
1.1	Investigation to Bridges: Need for investigations, Selection of bridge site, Determination of design discharge	2	-	-
1.2	Standard Specifications for Road Bridges: General – Indian Road Congress Bridges Code, Loads to be considered, IRC Standard live loads	2	-	-
1.3	Scour depth, Vertical clearance above HFL, Choice of bridge type.	1	-	-
Module – 2 : Design of Bridges				
2.1	Design of RC Slab culvert	3	-	-
2.2	Design of Pipe culverts	2	-	-
2.3	Design of Box culvert (Single vent only)	1	-	-
2.4	Design of RC Tee beam and slab bridge	3	-	-
Module – 3 : Drawing Components				

3.1	Preparation of drawings using given data for RC Slab culvert	-	-	10
3.2	Preparation of drawings using given data for Pipe culverts	-	-	4
3.3	Preparation of drawings using given data for Box culvert (Single vent only)	-	-	4
3.4	Preparation of drawings using given data for RC Tee beam and slab bridge	-	-	10
	Total No. of Lecture Hours	**14**		
	Total No. of Tutorial Hours			
	Total No. of Practical Hours			**28**

Self-learning topics identified:

1. Bridge bearings and types of bridge bearings
2. PSC bridges and its Advantages

Textbooks:

1. N. Krishna Raju, 2019, "Design of Bridges", 5th Edition, Oxford & IBH Publishing Ltd.

Reference Books:

1. Ponnuswamy, 2007, "Bridges Engineering" Tata McGrawHill–2nd Edition
2. D. Johnson Victor, "Essentials of Bridge Engineering", 6th Edition, Oxford & IBH Publishing Company.
3. T. R. Jagadeesh & M. A. Jayaram, 2009, "Design of Bridge Structures", 2nd Edition, Prentice Hall India Learning Private Limited.
4. Richard M.Baker& Jay A. Puckett, 2007, "Design of Highway Bridges - An LRFD Approach", 2nd Edition, John Wiley & Sons, Inc., USA.
5. Relevant BIS Codes & IRC Standards.

Online Resources:

1. Reinforced Concrete Road Bridge, IIT Kharagpur – Prof. Nirjhar Dhang (NPTEL – Video Lecture Course) (https://archive.nptel.ac.in/courses/105/105/105105165/)

Code: 21CV6P01 **Course: Minor Project**
Credits: 2 **L:T:P 0:0:4**
SEE: 50 marks **CIE: 50 marks**
SEE Hours: -- **Max. Marks:100**

Prerequisites if any	None
Learning objectives	To Inculcate research attitude and develop corresponding skills.

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Plan and work out an action plan in a team for completion of a civil engineering problem.	Understand Apply

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1	3	3	3						2					3		3

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

List of Projects:				
1	The project is offered to the students in order to inculcate research attitude and develop corresponding skills. A group of maximum four students work as a team for minor project. Minor project could be in the form of experimental investigation, computational work, data collection etc. At the end of the minor project, a report will be made wherein the details of the work undertaken, methodology adopted, conclusions drawn are provided. Evaluation of the minor project is done as per the rubrics.	-	-	28
Total No. of Lecture Hours				
	Total No. of Tutorial Hours			
	Total No. of Practical Hours			28

Code: **21CV6P01** **Course: Survey Camp**
Credits: **2** **L:T:P 0:0:4**
SEE: **50 marks** **CIE: 50 marks**
SEE Hours: **--** **Max. Marks: 100**

Prerequisites if any	21CV3C03 Surveying 21CV5C04 Highway Engineering
Learning objectives	1. Plan and conduct Survey for various Civil engineering projects. 2. Design and estimate various quantities required for execution of projects.

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Understand principles of surveying and apply alignment surveys to arrive at solutions to real-time Civil engineering projects in terms of quantities.	Understand Apply
CO2	Examine and execute the concepts of advanced surveying methods for engineering projects.	Analyze

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1	3	3	3						2					3		2
CO2					3				2					2	3	3

Mapping Strength: **Strong– 3** **Medium – 2** **Low – 1**

Course Structure

List of Projects:				
1	New Tank Project: reconnaissance survey and center line alignment, longitudinal and cross section of bund, block leveling, canal design and capacity contour.	-	-	7
2	Water Supply Project: reconnaissance survey, block leveling and longitudinal section – water supply network and distribution.	-	-	7
3	Highway Project: reconnaissance survey and center line alignment, cross section, longitudinal section, and curve design.	-	-	7
4	UAV - Drone Surveying: reconnaissance survey, locating and marking ground control points (GCP), flight planning, capturing raw data and processing.	-	-	7
	Total No. of Lecture Hours			
	Total No. of Tutorial Hours			
	Total No. of Practical Hours			**28**

Textbooks:

1. K.R. Arora, "Surveying Vol. 1" Standard Book House, New Delhi. – 2019.
2. K.R. Arora, "Surveying (Vol. 2 & 3)" Standard Book House, New Delhi. – 2018.

Online Resources:

1. Surveying OER by NPTEL https://nptel.ac.in/courses/105107122
2. Geospatial Applications of Unmanned Aerial Systems (UAS) https://www.eeducation.psu.edu/geog892/node/3

Code: **21CV6A01** **Course: Drawing of Irrigation Structures**
Credits: **1** **L:T:P 0:0:2**
SEE: **50%** **CIE: 50%**
SEE Hours: **3** **Max. Marks:100**

Prerequisites if any	Applied Hydraulic Engineering
Learning objectives	1. To determine various concepts involved in preparing the working plans of Irrigation structures. 2. Utilize the available drawing tools to prepare different views of Irrigation structures.

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Understand the conceptualization of sub components of irrigation structures and the elementary design of irrigation structures.	Understand Apply
CO2	Prepare detailed drawings of irrigation structures as per the elementary design.	Apply

Mapping with POs and PSOs:

COs	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2		PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	3											3	3		
CO2	3	3												3			

Mapping Strength: **Strong– 3** **Medium – 2** **Low – 1**

Course Structure

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
	Module – 1			
1.1	Design and drawing Surplus weir	06		
1.2	Design and drawing Tank sluice with Tower head	05		
1.3	Design and drawing Canal drop-Trapezoidal type	05		
1.4	Design and drawing Canal Regulator	05		
1.5	Design and drawing Direct Sluice	05		
	Total No. of Lecture Hours	**26**		

Total No. of Tutorial Hours	**00**	
Total No. of Practical Hours		**00**

Textbooks:

1. C Satyanarayana Murthy "Water Resources Engineering: Principles and Practice"- New Age International Publishers - 2000.

Reference Books:

1. Arora KR "Irrigation Water Power & Water Resources Engineering"- Standard Publishers Distributors– 2010.
2. P.N. Modi,"Irrigation, Water Resources, and Water Power Engineering". Standard book house, New Delhi -2003.
3. B C. Punmia and Pande Lal, "Irrigation and Water Power Engineering"- Lakshmi Publications, New Delhi– 2009.

Online Resources:

1. https://www.youtube.com/watch?v=y-BsqPpFmfI

Code: 21HS6C01 **Course: Environmental Studies**
Credits: 0 **L: T:P 2:0:0**
SEE: 0 marks **CIE: 50 marks**
SEE Hours: 0 **Max. Marks: 0**

Prerequisites if any	Knowledge of Physics, Chemistry, and Biology along with concepts of Ecology and Environment at a Basic level
Learning objectives	1.Understanding the concept of Ecology and environment with the basic knowledge of science. 2.Implication of Pollution on the Environment and remedial measures.

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Illustrate the relationship between human life and environment from scientific perspective and analyse the importance of natural resources	Understand
CO2	Summarize the impact of pollution and describe the control measures and importance of various National environmental acts and regulatory bodies	Apply
CO3	Describe the global environmental issues, explain the concept of EIA and Global environmental summits, treaties and protocol	Apply

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1			1			2			3		1			3		
CO2					2							2			3	
CO3				2				1		3				1		2

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
	Module – 1			
1.1	Introduction and definition of Environment	1		
1.2	Man-Environment interaction	1		
1.3	Impact of man's activity on Environment	1		
1.4	Ecology, Energy/nutrient flow	1		
1.5	Ecological pyramids, Types of Food Chain , Food Web	1		
1.6	Biogeochemical cycle – Carbon Cycle	1		
1.7	Biogeochemical cycle – Nitrogen Cycle	1		
1.8	Biogeochemical cycle – Sulphur Cycle	1		
	Module – 2			
2.1	Pollutant and its classification, Introduction to Pollution, sources of pollution	1		
2.2	Water, Air, Noise pollution, nuclear hazards (Sources, effects, remedial measures standards)	1		
2.3	Solid waste and E-waste management: causes, effects and control measures of urban and industrial wastes.	1		
2.4	Environmental Laws and protection Acts: environment protection act	1		
2.5	Air (prevention and control of pollution) Act	1		
2.6	Water (prevention and control of pollution) Act,	1		

2.7	Wildlife protection act,	1		
2.8	Forest conservation Act	1		
2.9	Pollution Control Boards' roles and responsibilities (CPCB and KPCB)	1		
	Module – 3			
3.1	Global environmental issues- global warming, acid rain, ozone depletion (reasons, effects, control measures)	1		
3.2	carbon footprint and carbon trading.	1		
3.3	International environmental management standards (ISO14000).	1		
3.4	Global environmental summits, treaties and protocols (important summits).	1		
3.5	Introduction to Environmental Impact Assessment (EIA), Environmental Auditing.	1		
3.6	Sustainable environmental concepts: water conservation – rainwater harvesting	1		
3.7	Sustainable environmental concepts: water conservation -artificial recharging	1		
3.8	Sustainable environmental concepts: water conservation - watershed management	1		
3.9	Waste to energy – solid waste to energy conversion.	1		
	Total No. of Lecture Hours	**26**		
	Total No. of Tutorial Hours		**0**	**0**
	Total No. of Practical Hours			

Self-learning topics identified:

1. Land and Forest Wealth.
2. The need of Environment Education/Knowledge (from the point of view of Sustainable Development)
3. Three "R" Concepts of Waste Management.

Textbooks:

1. Benny Joseph **"Environmental Science and Engineering."**. Tata McGraw-Hill Publishing Company Limited.

Reference Books:

1. Gilbert M. Masters **"Introduction to Environmental Engineering and Science."** Prentice-Hall of India Pvt. Limited.
2. Edward J. Kormondy **"Concepts of Ecology"** Prentice-Hall of India Pvt. Limited.
3. P. D. Sarma. **"Ecology and Environment"** Rastogi Publications.

Online Resources:

1. Introduction to Environmental Engineering and Science by NPTEL https://youtu.be/LjFt7rlCU84
2. Environmental Impact Assessment (EIA) Part-1 by NPTEL https://youtu.be/_iLdyhgFv1U
3. EIA by NPTEL https://youtu.be/yO_d6-P-ZZk
4 EIS & EIA by NPTEL .https://youtu.be/ErU5DSUq3B0

OPEN ELECTIVES FOR V SEMESTER

Code: 21CV5O01 **Course: Solar Engineering**
Credits: 3 **L:T:P: 3:0:0**
SEE: 100 marks (reduced to 50 marks) **CIE: 50 marks**
SEE Hours: 3 **Max. Marks: 100**

Prerequisites if any	Basic Physics; Basic Calculus; Trigonometry
Learning objectives	1. Understanding the solar radiations and solar geometry 2. Knowing the working principles of the different Solar and Photovoltaic systems

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Understand the energy senior in India and fundamentals of blackbody radiation in solar energy	Understand
CO2	Solve the solar radiation application problems by employing the solar geometric relationship; & Differentiate between the flat-plate and concentrating collectors and to calculate the flat-plate collector efficiency	Understand, Apply
CO3	Comprehend the working principles of solar concentrating collectors; and Comprehend the fundamentals of photovoltaic cells working, performance characteristics & its applications in photovoltaic systems	Analyze

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1	1													1		
CO2	2	3										1		2		
CO3	2	3	2	1			1							1	2	

Mapping Strength: **Strong– 3** **Medium – 2** **Low – 1**

Course Structure

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
Module – 1 Introduction to Solar Energy				
1.1	Commercial Energy: Coal, Oil, Natural Gas, Nuclear power and Hydro	02		
1.2	Energy utilization pattern in the past, present and future projections of consumption pattern - Energy scenario in India – Growth of energy sector and its planning in India	02		

1.3	Basics of solar energy - Brief History of solar energy utilization	01		
1.4	Various approaches of utilizing solar energy - Blackbody radiation- Relation between radiation field energy density and radiation spectrum - Planck's formula in energy unit - Maximum spectral density - Planck's formula in wavelength unit - Wien displacement law - Stefan - Boltzmann law	03		
	Module – 2 Fundamentals of Solar Radiation			
2.1	Solar radiation at the earth's surface – solar radiation measurements – estimation of av radiation	01		
2.2	Sun–Earth Geometric Relationship; Solar Time and Angles; Sun-Path Diagram;	02		
2.3	Solar Radiation; Extraterrestrial Solar Radiation; Estimation of Terrestrial Solar Radiation;	02		
2.4	Solar Radiation on a Tilted Surface	02		
2.5	Measurement of Solar Radiation: Instruments for Measuring Solar Radiation and Sunshine; Measurement of Sunshine Duration; Measurement of Spectral Solar Radiation; Solar Radiation Data	01		
	Module – 3 Liquid Flat-Plate Collectors			
3.1	Introduction to thermal liquid flat-plate collectors; Performance Analysis; Transmissivity of the Cover System; Transmissivity-Absorptivity Product; Overall Loss Coefficient and Heat Transfer Correlations	03		
3.2	Collector efficiency factor; Collector Heat-Removal factor	03		
3.3	Effects of various parameters on performance	01		
3.4	Thermal testing procedure of collectors	01		
	Module – 4 Concentrating Collectors			
4.1	Introduction to concentrating collectors; Classification & Types	01		
4.2	Flat-plate collector with Plane reflectors	03		
4.3	Linear Fresnel reflector concentrating collector (LFR); Compound parabolic collector (CPC);	02		
4.4	Paraboloid dish collector; Central receiver collector	02		
	Module – 5 Solar Photovoltaics			
5.1	Introduction to Photovoltaic & its application	01		
5.2	Principle of working of a Solar Cell; Performance Characteristics of a Solar Cell	01		
5.3	Analysis of PV Cells; Efficiency of Solar Cells; Maximum Power Point Tracking; Design of a PV System	02		
5.4	Types of Solar Cells: Crystalline Silicon Solar Cells; Thin Film Solar Cells; Multi-junction Solar Cells; & Other Solar Cells	02		

5.5	Photovoltaic Systems and Applications: Stand-Alone Systems & Grid-connected PV Systems	02		
	Total No. of Lecture Hours	**40**		
	Total No. of Tutorial Hours		**00**	
	Total No. of Practical Hours			**00**

Self-learning topics identified:

1. Current status of Renewable Energy Sources
2. Solar system – Sun-Earth movements
3. Types of glasses– Tampered glass & Selective coatings
4. Overview of the concentrating collectors in India
5. Photovoltaic system costing

Textbooks:

1. Sukhatme, S.P., and Nayak J.K., “Solar Energy”, 4th Edition, Tata McGraw Hill, 2018

Reference Books:

1. Kreith, F and Kreider, J. F., “Principles of Solar Engineering”, McGraw-Hill, New York, 1978.
2. Yogi Goswami D., "Principles of Solar Engineering", 3rd Edition, CRC Press, New York, 2015
3. Duffie, J.A., and Beckman, W.A., “Solar Energy Thermal Process”, John Wiley and Sons, New York, 2006.
4. Solanki C. S., “Solar Photovoltaics – Fundamentals, Technologies and Applications”, 2nd edition, PHI Learning, Pvt. Ltd., 2012.
5. Garg H.P, and Prakash J., “Solar Energy: Fundamentals and Applications”, Tata McGraw Hill, 2010.
6. Rai, G.D., “Solar Energy Utilization”, Khanna Publishers, Delhi, 2010.
7. Tiwari. G.N., “Solar Energy: Fundamentals, Design, Modelling and Applications”, 1st Edition, Narosa Publishing House, New Delhi, 2012

Online Resources:

1. https://archive.nptel.ac.in/courses/115/103/115103123/
2. https://archive.nptel.ac.in/courses/112/105/112105051/
3. https://archive.nptel.ac.in/courses/115/107/115107116/

Code: 21CV5O02 **Course: Occupational Safety & Health Hazards**
Credits: 3 **L: T: P: 3:0:0**
SEE: 100 marks (reduced to 50 marks) **CIE: 50 marks**
SEE Hours: 3 **Max. Marks: 100**

Prerequisites if any	Basic Knowledge of Identification and Implication of Hazard at Workplace
Learning objectives	1. Understand Occupational Health and Safety and its practice in the industry 2. Identify hazards, assess the risks and auditing methodology

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Understand Occupational Health and Safety and its practice in the industry, with particular emphasis towards civil engineering.	Understand
CO2	Identify hazards, assess the risks, and manage the consequences	Apply
CO3	Demonstrate a safety audit	Apply

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1				3					3					2		
CO2			2				2			3						1
CO3	2				1							1			3	1

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
Module – 1				
1.1	Introduction – Need for safety	1	**0**	**0**
1.2	Indian Factories act, 1948	1	**0**	**0**
1.3	Introduction to safety management – Safety policy – Safety objectives	1	**0**	**0**
1.4	Safety planning –Safety manuals	1	**0**	**0**
1.5	Responsibilities of safety personnel – Safety training and awareness	1	**0**	**0**
1.6	Emergency preparedness – Safety inspection	1	**0**	**0**
1.7	Documentation and reporting – Inspection and compliance.	1	**0**	**0**
Module – 2				
2.1	Ergonomics Task analysis,	1	**0**	**0**
2.2	Preventing Ergonomic Hazards	1	**0**	**0**

2.3	Work space Envelops	1	**0**	**0**
2.4	Visual Ergonomics	1	**0**	**0**
2.5	Ergonomic Standards, Ergonomic Programs	1	**0**	**0**
2.6	Hazard cognition and Analysis	1	**0**	**0**
2.7	Human Error Analysis	1	**0**	**0**
2.8	Fault Tree Analysis	1	**0**	**0**
2.9	Emergency Response – Decision for action – purpose and considerations	1	**0**	**0**
	Module – 3			
3.1	Various hazards in OSH	1	**0**	**0**
3.2	Physical hazard	1	**0**	**0**
3.3	Chemical hazard	1	**0**	**0**
3.4	Fire Hazard	1	**0**	**0**
3.5	Fire Prevention and Protection:	1	**0**	**0**
3.6	Fire Triangle,	1	**0**	**0**
3.7	Fire Development and its severity	1	**0**	**0**
3.8	Effect of Enclosures, ,	1	**0**	**0**
3.9	Early detection of Fire	1	**0**	**0**
5.10	Classification of fire and Fire Extinguishers	1	**0**	**0**
5.11	Electrical Hazard :	1	**0**	**0**
5.12	Electrical Safety	1	**0**	**0**
5.13	Product Safety: Technical Requirements of Product safety	1	**0**	**0**
	Module – 4			
4.1	Importance of and need for risk management	1	**0**	**0**
4.2	Identification of hazards	1	**0**	**0**
4.3	Assessment of likelihood of occurrence of mishap	1	**0**	**0**
4.4	Severity of consequence	1	**0**	**0**
4.5	Determination of risk	1	**0**	**0**
4.6	Hierarchy of control – HAZOP	1	**0**	**0**
4.7	Bow-tie and other techniques of hazard identification and risk analysis	1	**0**	**0**
4.8	case studies - risk management	1	**0**	**0**

Module – 5				
5.1	IS 14489 – Audit goals	1	**0**	**0**
5.2	Objectives and Responsibilities	1	**0**	**0**
5.3	Audit methodology	1	**0**	**0**
5.4	Implementation of audit report	1	**0**	**0**
5.5	Case studies on Audit Methodology	1	**0**	**0**
	Total No. of Lectur	42		**0**
	Total No. of Tutorial Hours		**0**	**0**
	Total No. of Practical Hours			**0**

Self-learning topics identified:

1. International and national laws
2. *Workmen's compensation act 1923*
3. General OSH safeguards.
4. India Government initiatives in OSH
5. *Safety audit questionnaire*

Textbooks:

1. Industrial Safety Sectional Committee CHD 8, IS 14489: 2018, *"Occupational health and safety audit - Code of practice (First Revision)",* Bureau of Indian Standards**.**
2. Narayanaraju G. (Secretary to GOI), **"***The Occupational Safety, Health and Working Conditions Code, 2020"*, NO. 37 OF 2020, Govt. of India, Ministry of Law and Justice.
3. S.C. Sharma, Vineet Kumar, *"***Safety, Occupational Health and Environmental Management in Construction***"*, Khanna Publishers, 2019.

Reference Books:

1. Deshmukh, L.M., *"***Industrial Safety Management***"*, Tata McGraw Hill, 2010.
2. Krishnamurthy, N., *"***Introduction to Enterprise Risk Management***"*, Partridge Publishing, 2019.
3. Mishra, R.K., *"***Safety Management***"*, AITBS Publishers, 2017.
4. Rana, S.P., P.K. Goswami, and Indu Rathee, *"***Handbook of Occupational Safety and Industrial Psychology***"*, S. Chand, 2014.
5. Ministry of Labour and Employment, "The employees compensation act, 1923*"*.

Online Resources:

1. **Industrial Safety Engineering on NPTEL https://www.digimat.in/nptel/courses/video/110105094/L01.html**
2. Occupational Health & Safety Management Systems(OH&SMS) and OHSAS 18001on NPTEL https://www.youtube.com/watch?v=Rr-xFmErOTk
3.Safety , Health and Environment https://www.youtube.com/watch?v=KoDiuL6NqgQ

Code: 21CV5O03 **Course: Unmanned Aerial Vehicles**
Credits: 3 **L:T:P: 3:0:0**
SEE: 100 marks (reduced to 50 marks) **CIE: 50 marks**
SEE Hours: 3 **Max. Marks: 100**

Prerequisites if any	---Not required---
Learning objectives	1. Familiarize with history of UAV and understand importance of aerodynamics, propulsion and structures in UAV 2. Describe the Payloads, Sensor and Navigation used in UAV

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Understand the evolution of UAV, application and concepts of aerodynamics	Understand and apply
CO2	Illustrate the ability to address various payloads, propulsion systems, launch and recovery systems	Understand
CO3	Understand the significance of guidance and navigation of a UAV	Understand

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1	3	2												3	1	
CO2	3													2		
CO3	3													2		

Mapping Strength: **Strong– 3** **Medium – 2** **Low – 1**

Course Structure

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
	Module – 1			
1.1	Introduction, History of UAVs, Need of unmanned aerial systems	2		
1.2	Overview of UAV Systems-System Composition, Classification of UAVs based on size, range and endurance	3		
1.3	Basic working of fixed, rotary and flapping UAVs	2		
1.4	Applications of UAVs and Disadvantages of UAV	1		
	Module – 2			
2.1	Airfoil nomenclature and its characteristics, Lift	2		

2.2	Basic aerodynamics equations, Aircraft polar	2		
2.3	Types of drag, Aerodynamics of rotary and flapping wings	2		
2.4	Airframe configurations	2		
	Module – 3			
3.1	Mechanic loading, Load calculation, Materials used for UAV (general introduction)	2		
3.2	Selection criteria for structure, Types of structural elements used in UAV their significance and characteristics.	2		
3.3	UAV Propulsion Systems: thrust generation, Power lift, sources of power.	4		
	Module – 4			
4.1	Payloads of UAVs : Non-dispensable Payloads- Electro-optic Payload Systems	2		
4.2	Radar Imaging Payloads, Electronic Warfare Payloads, Dispensable Payloads and other payloads.	2		
4.3	UAV Launch Methods for Fixed-Wing Vehicles- Rail Launchers, Pneumatic Launchers, Hydraulic/Pneumatic Launchers, Zero Length RATO	2		
4.4	Landings and Recovery systems: Conventional Landings, Vertical Net Systems, Parachute Recovery, Mid-Air Retrieval, Shipboard Recovery	2		
	Module – 5			
5.1	UAV flight planning	2		
5.2	UAV Navigation systems: NAVSTAR GPS, Inertial, Radio Navigation, Satellite–Way point Navigation	3		
5.3	UAV guidance, types, Communication systems	2		
5.4	Future of UAV	1		
Total No. of Lecture Hours				
		Total No. of Tutorial Hours	**40**	
		Total No. of Practical Hours		**00**

Self-learning topics identified:

1. Indian UAV
2. UAV Pilot guidelines
3. Drone catcher
4. Commercial role of UAV

Textbooks:

1. Introduction to UAV Systems, Paul G Fahlstrom, Thomas J Gleason, 4th Edition, 2012, Wiley, ISBN: 978-1-119-97866-4

2. Unmanned Aircraft Systems UAV design, development and deployment, Reg Austin, 1st Edition, 2010, Wiley, ISBN 9780470058190.

Reference Books:

1. Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy, Kimon P. Valavanis, 1st Edition,2007, Springer ISBN 9781402061141
2. Randal W. Beard and Timothy W. McLain: Small Unmanned Aircraft: Theory and Practice, Princeton University Press, 2012
3. John Baichtal, "Building your own drones: A beginners'guide to drones, UAVs,and ROVs" Que publishing-2015.

Online Resources:

1. https://www.youtube.com/watch?v=S-XiFIRVkgQ
2. https://www.youtube.com/watch?v=P9adBgSz--g

Code: 21CV5O04 **Course: Water Resource Management**
Credits: 3 **L:T:P : 3:0:0**
SEE: 100 marks (reduced to 50 marks) **CIE: 50 marks**
SEE Hours: 3 **Max. Marks:100**

Prerequisites if any	None
Learning objectives	1. Understanding about surface and ground water resources. 2. Inculcate fair knowledge about water resource management and legal framework of water policy.

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Assess the potential of groundwater and surface water resources.Address the issues related to planning and management of water resources.	Understand
CO2	Know how to implement IWRM in different regions and understand the legal issues of water policy.	Apply
CO3	Select the suitable method for water harvesting system based on the area.	Apply

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1	3													3		
CO2	3	3												2	3	
CO3	2		3	3												3

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
Module – 1: Surface and Ground water Resources				
1.1	Hydrologic Cycle, Horton's cycle	1	0	0
1.2	Global water resources and Indian Water resources	1	0	0
1.3	Surface Water Resources, Water Balance	1	0	0
1.4	Available Renewable Water Resources, Water Scarcity	1	0	0
1.5	The Water Balance as a Result of Human Interference	1	0	0
1.6	Groundwater Resources	1	0	0
1.7	Types of Aquifers	1	0	0
1.8	Groundwater as a Storage Medium	1	0	0
Module – 2: Water Resources Planning and Management				
2.1	Necessity of Water Resources Planning and Management	1	0	0
2.2	System components	1	0	0
2.3	Approaches	1	0	0

2.4	Planning and management aspects, Analysis	1	0	0
2.5	Models for impact prediction and Evaluation	1	0	0
2.6	Adaptive Integrated Policies	1	0	0
2.7	Post Planning and management Issues.	2	0	0
Module – 3: Integrated Water Resources Management				
3.1	Definition of IWRM, Principles,	1	0	0
3.2	Implementation of IWRM	1	0	0
3.3	Legislative and Organizational Framework	2	0	0
3.4	Types and Forms of Private Sector Involvement.	2	0	0
3.5	Complexity of the IWRM process and examining the key elements of IWRM process.	2	0	0
Module – 4: Water Governance and Water Policy				
4.1	Legal Framework of Water – Substance of National Water Laws	1	0	0
4.2	Other key issues and Changing incentives through Regulation	1	0	0
4.3	National Water Policy	1	0	0
4.4	National-Level Commissions	1	0	0
4.5	Irrigation Management Transfer Policies and Activities	1	0	0
4.6	Legal Registration of WUAs – Legal Changes in Water Allocation,	1	0	0
4.7	Role of Local Institutions – Community Based Organizations	1	0	0
4.8	Water Policy Reforms: India.	1	0	0
Module – 5: Water Harvesting and Conservation				
5.1	Water Harvesting Techniques – Micro-catchments	1	0	0
5.2	Design of Small Water Harvesting Structures	1	0	0
5.3	Design of Farm Pond	1	0	0
5.4	Design of Percolation Tank	1	0	0
5.5	Estimation of Yield from a Catchment,	1	0	0
5.6	Rain water Harvesting-various techniques related to Rural and Urban area.	1	0	0
5.7	Planning of Rain water Harvesting system for residential and public buildings	2	0	0
	Total No. of Lecture Hours	40	0	0
	Total No. of Tutorial Hours		**0**	**0**
	Total No. of Practical Hours			**0**

Self-learning topics identified:

1.Watershed management
2. Climate Change and Water
3. United Nations and UK Water policy
4. Sustainable Development Goals (SDGs) and Water

Textbooks:

1.K. Subramanya, “Engineering Hydrology”, Tata McGraw Hill Publishers, New Delhi.
2. H.M. Raghunath, “Ground Water”, Wiley Eastern Publication, New Delhi.
3. Daniel P. Loucks and Eelco van Beek, “Water Resources Systems. Planning and Management”, UNESCO Publication.
4. Mollinga, P. et al, “Integrated Water Resources Management”, Water in South Asia Volume I, Sage Publications, 2006.
5. Singh, Chhatrapati “Water Rights in India,” Ed: Chhatrapati Singh. Water Law in India: The Indian Law Institute, New Delhi,1992.

6. Dhruva Narayana, G. Sastry, V. S. Patnaik, “Watershed Management”, CSWCTRI, Dehradun, ICAR Publications, 1997.

Reference Books:

1. Lal, Ruttan. “Integrated Watershed Management in the Global Ecosystem”. CRC Press, New York.
2. Heathcote, I. W. Integrated Watershed Management: Principles and Practice. 1988. John Wiley and Sons, Inc., New York.

Online Resources:

1. https://www.youtube.com/watch?v=EI9H708LPnw
2. https://archive.nptel.ac.in/courses/105/101/105101215/

Code: 21CV5O05 **Course: Finite Element Method**
Credits: 3 **L:T:P 3:0:0**
SEE: 100 marks (reduced to 50 marks) **CIE: 50 marks**
SEE Hours: 3 **Max. Marks:100**

Prerequisites if any	Solid Mechanics
Learning objectives	1. To learn the mathematical formulation of finite element and its applicability to linear ordinary and partial differential equations 2. To learn to implement finite element method to solve simple problems in various domains of engineering.

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Learn the mathematical formulation of the finite element method and how to apply it to linear ordinary and partial differential equations.	Understand
CO2	Learn how to implement the finite element method efficiently in order to solve a particular equation for simple problems.	Analyze
CO3	Apply the knowledge of FEM for 1D stress analysis, heat transfer analysis and flow analysis.	Apply
CO4	Develop 2-D FE formulations involving triangular, quadrilateral elements and higher order elements	Apply

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1	3													3	2	
CO2	3													3	3	
CO3			3	3		3								3	3	
CO4			3	3										3	3	

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
	Module – 1			
1.1	Finite Element Method: Basics, history, Comparison with other methods,	2		
1.2	General steps of FEM, Applications and Advantages	2		
	Module – 2			
2.1	Basic equations for FEM: Stress and equilibrium conditions	2		
2.2	Boundary conditions	2		
2.3	Basic equations of elasticity	2		
2.4	Strain displacement relations	2		
2.5	The Rayleigh-Ritz method, Formulation of Finite Element Equations.	2		
	Module – 3			
3.1	Axially loaded bars: Fundamental concepts, two node bar element	2		
3.2	Shape functions, Element Stiffness Matrix and Load Vectors,	2		
3.3	Assembly of element stiffness matrices and load vectors,	2		

3.4	Treatment of boundary conditions, Temperature effects,	2		
3.5	Examples of Axially Loaded Members.	2		
	Module – 4			
4.1	Two dimensional problems: Finite Element Modeling, isoperimetric formulation Constant Strain Triangle (CST) Element Stiffness,	2		
4.2	Force terms, Stress calculation, Problem modeling and boundary conditions.	2		
4.3	Plane Stress and plane Strain Problems using CST Element,	2		
4.4	Formulation of 4-noded quadrilateral element.	2		
4.5	Problems on isoperimetric formulation of 4-noded quadrilateral element.	2		
	Module – 5			
5.1	One dimensional scalar field problems: Heat transfer equilibrium equations	1		
5.2	Heat conduction in plane walls,	2		
5.3	Convection heat transfer in fins, finite element formulation	2		
	Total No. of Lecture Hours	39		
	Total No. of Tutorial Hours			
	Total No. of Practical Hours			

Self-learning topics identified:

1. Galerkin method of finite element method
2. Finite element formulation of fluid flow
3. Computer application of finite element method

Textbooks:

1. Finite Elements in Engineering, T.R.Chandraputla and A.D.Belegundu, PHI
2. The Finite Element Method in Engineering, S.S.Rao, Elsevier

Reference Books:

1. Introduction to Finite Element Method, J.N.Reddy, Tata McGraw Hill
2. Concepts & Applications of Finite Element Analysis, Cook, D.S. Malkus & M.E. Plesha, Wiley
3. Numerical Methods in Finite Element Analysis, K.J.Bathe and E.L.Wilson, PHI

Online Resources:

1. https://nptel.ac.in/courses/112/104/112104193/

Code: **21CV5O06** **Course: Road Safety**
Credits: **3** **L:T:P 3:0:0**
SEE: **100 marks (reduced to 50 marks)** **CIE: 50 marks**
SEE Hours: **3** **Max. Marks:100**

Prerequisites if any	NA
Learning objectives	1. To acquire knowledge on causes of road accidents 2. To be able to identify road safety measures to mitigate accidents

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	To understand fundamentals of road traffic characteristics	Understand
CO2	To investigate road accidents and deliberate safety measures	Apply

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	03												03	01		
CO2		03											02	01		
CO3																
CO4																

Mapping Strength: **Strong– 3** **Medium – 2** **Low – 1**

Course Structure

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
	Module – 1			
1.1	Fundamentals of Traffic Engineering: Traffic flow characteristics – speed, flow, density	03	-	-
1.2	Traffic Engineering Studies	02	-	-
1.3	Statistical Methods in Traffic Safety Analysis – Regression Methods, Poisson Distribution, Chi- Squared Distribution, Statistical Comparisons.	03	-	-
	Module – 2			
2.1	Accident Investigations: Collection and Analysis of Accident Data, Condition and Collision Diagram, Causes and Remedies	02	-	-
2.2	Traffic Management Measures and Their Influence on Accident Prevention, Assessment of Road Safety,	02	-	-
2.3	Methods to Identify and Prioritize Hazardous Locations and Elements	02	-	-
2.4	Determine Possible Causes of Crashes, Crash Reduction Capabilities and Countermeasures, Effectiveness of Safety Design Features, Accident Reconstruction	02	-	-
	Module – 3			
3.1	Road Safety in Planning and Geometric Design: Vehicle and Human Characteristics,	02	-	-
3.2	Road Design, Redesigning Junctions, Cross Section Improvements, Reconstruction and Rehabilitation of Roads	03	-	-
3.3	Road Maintenance, Traffic Control, Vehicle Design and Protective Devices, Post Accident Care	03	-	-

Module – 4				
4.1	Role of Urban infrastructure design in safety: Geometric Design of Roads	02	-	-
4.2	Design of Horizontal and Vertical Elements	02	-	-
4.3	Junctions, At Grade and Grade Separated Intersections,	02	-	-
4.4	Road Safety in Urban Transport, Sustainable Modes and their Safety.	02	-	-
Module – 5				
5.1	Road Safety Audits: Traffic Management Systems	02	-	-
5.2	Road Safety Audits and Tools for Safety Management Systems	02	-	-
5.3	Road Safety Audit Process, Approach to Safety	03	-	-
5.4	Road Safety Improvement Strategies, ITS and Safety	03	-	-
	Total No. of Lecture Hours	42		
	Total No. of Tutorial Hours		00	
	Total No. of Practical Hours			00

Self-learning topics identified: (Maximum of 5 topics)

1. Road Signs
2. Traffic Signals

Textbooks:

1. Traffic Engineering and Transportation Planning – L.R. Kadiyali, Khanna Publishers, 2011.

Reference Books:

1. The Handbook of Road Safety Measures; Rune Elvik, Alena Hoye, Truls Vaa, Michael Sorensen Edition: 2nd Revised edition

Online Resources:

1. https://morth.nic.in/road-safety
2. https://www.mygov.in/campaigns/national-road-safety/

OPEN ELECTIVES FOR VI SEMESTER

Code: 21CV6O01 **Course: Geoinformatics and Coding**
Credits: 3 **L:T:P 3:0:0**
SEE: 100 marks (reduced to 50 marks) **CIE: 50 marks**
SEE Hours: 3 **Max. Marks:100**

Prerequisites if any	Highschool Geography, C programming, C++ (optional)
Learning objectives	1. Outline basic concepts in GIS, Remote Sensing and Satellites 2. Summarize the basics and applications of cloud GIS, coding platforms, decision support systems and explore their potential in spatial analysis

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Describe concepts and components of GIS and Remote sensing	Understand
CO2	Interpret simple scripts, perform spatial analysis using Cloud GIS platforms	Apply
CO3	Demonstrate the utility of web-GIS and other GIS applications	Apply

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1	3				2									3		
CO2	3				2									2		
CO3	2				2	2								2	2	

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
	Module – 1			
1.1	**Fundamentals of geographic information system** Definition of GIS, history and evolution of GIS, GIS Technology, functions, components, tools, capabilities.	02		
1.2	Geospatial data, GIS data formats, data storage formats.	01		
1.3	GIS data acquisition, source – primary and secondary data, generation, display and thematic mapping.	01		
1.4	Maps, map reading, coordinate systems, map projections, datums.	01		
1.5	Vector and Raster data models.	01		
1.6	Introduction to GNSS and GPS, segments, working principle.	02		
	Module – 2			
2.1	**Foundations of Remote Sensing and Satellites** Definition of remote sensing, remote sensing process, ideal remote sensing system.	02		
2.2	Principles of electromagnetic remote sensing, electromagnetic energy, electromagnetic spectrum, black body radiation, laws governing electromagnetic radiation.	02		

2.3	Atmospheric effects, scattering and absorption, atmospheric windows, Interaction with earth surface materials, spectral reflectance curves.	01		
	Remote sensing platforms, satellites and orbits, geostationary and sun synchronous satellites, Earth resource satellites.	02		
	Sensors- active and passive sensors, sensor resolutions (spectral, spatial, radiometric and temporal).	01		
	Module – 3			
3.1	**Google Earth Engine** GEE Mission statement, History, Data sets, Timelapse, Computation platforms, Code editors, sample codes and commands	01		
3.2	JavaScript and the Earth Engine API, Exploring Images, Survey of Raster Datasets	02		
	Image Manipulation: Bands, Arithmetic, Thresholds, and Masks, Interpreting an Image: Classification.	02		
3.3	Filter, Map, Reduce, Exploring Image Collections, Aggregating Images for Time Series	02		
3.4	Other applications of GEE, Case studies.	01		
	Module – 4			
4.1	**Python for Geospatial Data** Introduction to GIS modeling and Python, Objects and object-oriented programming, Classes, Inheritance, Python syntax, Introductory Python examples.	03		
4.2	Lists, Loops, Decision structures, String manipulation	02		
4.3	GIS data access and manipulation with Python, Reading vector attribute data, Accessing data fields, Retrieving records using an attribute query, Retrieving records using a spatial query.	03		
	Module – 5			
5.1	**Web GIS and Spatial Decision Support Systems** History of Web GIS, OGC Web Services, System architecture for web mapping, elements of a web map.	03		
5.2	Geocoding and address locations, Geoportals and NSDI, ArcGIS online, Geoserver, Google Earth, Bhuvan, OSM. Mobile GIS – ODK.Web GIS application, case studies.	03		
5.3	Spatial Decision Support Systems, usage and applications, Case studies.	02		
	Total No. of Lecture Hours	40		
	Total No. of Tutorial Hours			
	Total No. of Practical Hours			

Self-learning topics identified:

1. List of open source spatial data sources
2. Common image processing and GIS software
3. List of Earth resource satellites/missions by countries.

Textbooks:

1. Lillesand T.M., and R.W. Kiefer, "**Remote sensing and Image interpretation**", 4th edition, John Wiley & Sons, 2012.
2. Paul Zandbergen, "**Python Scripting for ArcGIS**", Esri Press, 2015.

Reference Books:

1. Peter A. Burrough & Rachel A. McDonnel "**Principles of geographic information systems**" Oxford University press, Great Britain, 2015.
2. Chang, K. T. "**Geographical Information Systems**", McGraw Hill Book Co., 2019.

Online Resources:

1. NPTEL MOOC course on “Geographic Information System” IIT Kharagpur, Prof. Bharath H Aithal. https://nptel.ac.in/courses/107105088
2. A hands-on introduction to applied remote sensing using Google Earth Engine by Ujaval Gandhi https://courses.spatialthoughts.com/end-to-end-gee.html
3. GIS Programming and Software Development OER by Penn State https://www.e-education.psu.edu/geog485/node/91
4. Geographic Information Systems OER by NPTEL - https://nptel.ac.in/courses/105107206
5. Open Web Mapping OER by Penn State - https://www.e-education.psu.edu/geog585/node/519

Code: 21CV6O02 **Course: Occupational Safety & Health Hazards**
Credits: 3 **L: T: P: 3:0:0**
SEE: 100 marks (reduced to 50 marks) **CIE: 50 marks**
SEE Hours: 3 **Max. Marks: 100**

Prerequisites if any	Basic Knowledge of Identification and Implication of Hazard at Workplace
Learning objectives	1. Understand Occupational Health and Safety and its practice in the industry 2. Identify hazards, assess the risks and auditing methodology

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Understand Occupational Health and Safety and its practice in the industry, with particular emphasis towards civil engineering.	Understand
CO2	Identify hazards, assess the risks, and manage the consequences	Apply
CO3	Demonstrate a safety audit	Apply

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1				3					3					2		
CO2			2				2			3						1
CO3	2				1							1			3	1

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
Module – 1				
1.1	Introduction – Need for safety	1	**0**	**0**
1.2	Indian Factories act, 1948	1	**0**	**0**
1.3	Introduction to safety management – Safety policy – Safety objectives	1	**0**	**0**
1.4	Safety planning –Safety manuals	1	**0**	**0**
1.5	Responsibilities of safety personnel – Safety training and awareness	1	**0**	**0**
1.6	Emergency preparedness – Safety inspection	1	**0**	**0**
1.7	Documentation and reporting – Inspection and compliance.	1	**0**	**0**
Module – 2				
2.1	Ergonomics Task analysis,	1	**0**	**0**
2.2	Preventing Ergonomic Hazards	1	**0**	**0**

2.3	Work space Envelops	1	**0**	**0**
2.4	Visual Ergonomics	1	**0**	**0**
2.5	Ergonomic Standards, Ergonomic Programs	1	**0**	**0**
2.6	Hazard cognition and Analysis	1	**0**	**0**
2.7	Human Error Analysis	1	**0**	**0**
2.8	Fault Tree Analysis	1	**0**	**0**
2.9	Emergency Response – Decision for action – purpose and considerations	1	**0**	**0**
	Module – 3			
3.1	Various hazards in OSH	1	**0**	**0**
3.2	Physical hazard	1	**0**	**0**
3.3	Chemical hazard	1	**0**	**0**
3.4	Fire Hazard	1	**0**	**0**
3.5	Fire Prevention and Protection:	1	**0**	**0**
3.6	Fire Triangle,	1	**0**	**0**
3.7	Fire Development and its severity	1	**0**	**0**
3.8	Effect of Enclosures, ,	1	**0**	**0**
3.9	Early detection of Fire	1	**0**	**0**
5.10	Classification of fire and Fire Extinguishers	1	**0**	**0**
5.11	Electrical Hazard :	1	**0**	**0**
5.12	Electrical Safety	1	**0**	**0**
5.13	Product Safety: Technical Requirements of Product safety	1	**0**	**0**
	Module – 4			
4.1	Importance of and need for risk management	1	**0**	**0**
4.2	Identification of hazards	1	**0**	**0**
4.3	Assessment of likelihood of occurrence of mishap	1	**0**	**0**
4.4	Severity of consequence	1	**0**	**0**
4.5	Determination of risk	1	**0**	**0**
4.6	Hierarchy of control – HAZOP	1	**0**	**0**
4.7	Bow-tie and other techniques of hazard identification and risk analysis	1	**0**	**0**
4.8	case studies - risk management	1	**0**	**0**

Module – 5				
5.1	IS 14489 – Audit goals	1	**0**	**0**
5.2	Objectives and Responsibilities	1	**0**	**0**
5.3	Audit methodology	1	**0**	**0**
5.4	Implementation of audit report	1	**0**	**0**
5.5	Case studies on Audit Methodology	1	**0**	**0**
	Total No. of Lectur	42		**0**
	Total No. of Tutorial Hours		**0**	**0**
	Total No. of Practical Hours			**0**

Self-learning topics identified:

1. International and national laws
2. *Workmen's compensation act 1923*
3. General OSH safeguards.
4. India Government initiatives in OSH
5. *Safety audit questionnaire*

Textbooks:

1. Industrial Safety Sectional Committee CHD 8, IS 14489: 2018, *"Occupational health and safety audit - Code of practice (First Revision)",* Bureau of Indian Standards**.**
2. Narayanaraju G. (Secretary to GOI), **"***The Occupational Safety, Health and Working Conditions Code, 2020"*, NO. 37 OF 2020, Govt. of India, Ministry of Law and Justice.
3. S.C. Sharma, Vineet Kumar, *"***Safety, Occupational Health and Environmental Management in Construction***"*, Khanna Publishers, 2019.

Reference Books:

1. Deshmukh, L.M., *"***Industrial Safety Management***"*, Tata McGraw Hill, 2010.
2. Krishnamurthy, N., *"***Introduction to Enterprise Risk Management***"*, Partridge Publishing, 2019.
3. Mishra, R.K., *"***Safety Management***"*, AITBS Publishers, 2017.
4. Rana, S.P., P.K. Goswami, and Indu Rathee, *"***Handbook of Occupational Safety and Industrial Psychology***"*, S. Chand, 2014.
5. Ministry of Labour and Employment, "The employees compensation act, 1923*"*.

Online Resources:

1. **Industrial Safety Engineering on NPTEL https://www.digimat.in/nptel/courses/video/110105094/L01.html**
2. Occupational Health & Safety Management Systems(OH&SMS) and OHSAS 18001on NPTEL https://www.youtube.com/watch?v=Rr-xFmErOTk
3.Safety , Health and Environment https://www.youtube.com/watch?v=KoDiuL6NqgQ

Code:	**21CV6O03**	**Course: Space Technology and Applications**	
Credits:	**3**	**L:T:P 3:0:0**	
SEE:	**100 marks (reduced to 50 marks)**	**CIE: 50 marks**	
SEE Hours:	**3**	**Max. Marks:100**	

Prerequisites if any	N.A.
Learning objectives	1. Define the earth environment and its behavior, launching vehicles for satellites and its associated concepts 2. Use satellites for space applications, remote sensing and metrology.

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Understand the different types of satellites, launching vehicles, and sub systems space applications	Understand
CO2	Analyze the applications of satellite in the area of communication, remote sensing, metrology etc.	Analyze
CO3	Comprehend technology trends, satellite missions and advanced space systems	Understand

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1	3													2		
CO2	3													2		
CO3	3													1		

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
	Module – 1			
1.1	**Earth's environment:** Atmosphere, ionosphere, Magnetosphere, Van Allen Radiation belts, Interplanetary medium, Solar wind, Solar- Earth Weather Relations.	3		
1.2	**Launch Vehicles:** Rocketry, Propellants, Propulsion, Combustion, Solid, Liquid and Cryogenic engines,	2		
1.3	Control and Guidance system, Ion propulsion and Nuclear Propulsion.	2		
	Module – 2			
2.1	**Satellite Technology:** Structural, Mechanical, Thermal, Power control, Telemetry, Telecomm and Quality and Reliability	3		

2.2	Payloads, Classification of satellites..	2		
2.3	**Satellite structure:** Satellite Communications, Transponders, Satellite antennas.	3		
	Module – 3			
3.1	**Satellite Communications:** LEO, MEO and GEO orbits, Altitude and orbit controls, Multiple Access Techniques.	4		
3.2	**Space applications:** Telephony, V-SAT, DBS system, Satellite Radio and TV, Tele-Education, Telemedicine, Satellite navigation, GPS.	4		
	Module – 4			
4.1	**Remote Sensing:** Visual bands, Agricultural, Crop vegetation, Forestry, water Resources, Land use, Land mapping, geology,	3		
4.2	Urban development resource Management and image processing techniques.	3		
4.3	Metrology: Weather forecast (Long term and Short term), weather modelling, Cyclone predictions,	2		
4.4	Disaster and flood warning, rainfall predictions using satellites			
	Module – 5			
5.1	**Space Missions:** Technology missions, deep space planetary missions, Lunar mission gravity experiments.	3		
5.2	Space biology and International space Missions	2		
5.3	**Advanced space systems:** Remote sensing cameras, planetary payloads, space shuttle, space station, Interspace communication systems.	3		
Total No. of Lecture Hours		39		
		Total No. of Tutorial Hours		
			Total No. of Practical Hours	

Self-learning topics identified:

1. History of ISRO
2. Indian Satellites
3. Indian Space Programs
4. ISRO Stations

Textbooks:

1. Atmosphere, weather and climate, R G Barry, Routledge publications, 2009, ISBN- 10 :0415465702.
2. Fundamentals of Satellite Communication, K N Raja Rao, PHI, 2012, ISBN:9788120324015.
3. Space Mission Analysis and Design, 3rd edition Wiley J. Larson (Editor), James R. Wertz (Editor)-1999

Reference Books:

1. Satellite Communication, Timothy pratt, John Wiley, 1986 ISBN: 978-0- 471- 37007 -9, ISBN 10: 047137007X.
2. Remote sensing and applications, B C Panda, VIVA books Pvt. Ltd., 2009, ISBN: 108176496308.

Online Resources:

1. https://www.youtube.com/watch?v=iLUjQAoZhPg&list=PL8f577zRCYcb_JRW1LPRt1uqjfGlrFqy8

Code: 21CV6O04 **Course: Biomaterials**
Credits: 3 **L:T:P 3:0:0**
SEE: 100 marks (reduced to 50 marks) **CIE: 50 marks**
SEE Hours: 3 **Max. Marks:100**

Prerequisites if any	Mechanics of solids, Basic Engineering Chemistry
Learning objectives	1. To understand different types of biomaterials made of metal and ceramics for different applications 2. To decide the testing procedures used for selecting biomaterials/implants for human body.

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Understand the use biomaterials, classifications, their properties, performance specification and biological applications	Understand
CO2	Recognise the types, composition, properties, manufacturing and applications of Metallic & Ceramic biomaterials.	Understand
CO3	Decide the testing procedure for specific biomaterial/implant and evaluate the response of biomaterial/Implant to Human body.	Understand
CO4	Apply the knowledge of biomaterials to judge which material/implant should be used for what kind of application according to nature of diseased and ill area of the body.	Apply

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1	3													3		
CO2	3													3		
CO3			3	3		3								3	2	
CO4			3	3										3	3	

Mapping Strength: **Strong– 3** **Medium – 2** **Low – 1**

Course Structure

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
	Module – 1			
1.1	Introduction to Biomaterials: Introduction, Types of Biomaterials	2		
1.2	Biocompatibility, Biological material, Biodegradable material, Bioresorbable material,	2		
1.3	Bio-inert material, Bio-active material	2		
1.4	Minimum Requirements of Biomaterials, Surface Properties of Biomaterials	2		
1.5	Desirable Properties of Biomaterial	2		
1.6	Performance of Biomaterials	2		
	Module – 2			
2.1	Metallic & Ceramic Biomaterials: Introduction, Stainless steel	1		
2.2	Co-Cr Alloys, Ti-Alloys, Nitinol, Dental metals	1		
2.3	Corrosion of Metallic implants, Manufacturing of Metallic implants, Applications	2		
2.4	Types of Ceramics, Bio-inert ceramics: Alumina, Zirconia, Carbon, Bioresorbable ceramics	2		

2.5	Bio-active ceramics: Glass ceramics, Applications	2		
	Module – 3			
3.1	Polymeric & Composite Biomaterials: Basic structures of Polymers, Polymerization and its Types, Polyethylene, Polypropylene, Polyamides, Polyacrylates	2		
3.2	Silicon Rubber, Bioactive Polymers	1		
3.3	Biodegradable Polymers, Applications	1		
3.4	Dental filling Composites & cement	2		
3.5	Porous Composites, Fibrous & Particulate composites.	2		
	Module – 4			
4.1	Biocompatibility Testing & Response of Biomaterial to Human Body: In-Vitro Testing, In-Vivo Testing	1		
4.2	Hypersensitivity, Hemocompatibility, Odonto Compatibility,, Osteocompatibility	2		
4.3	Cytotoxicity, Genotoxicity, Carcinogenicity	1		
4.4	Blood-Biomaterial Interactions, Biomaterials-Tissue Interactions,	1		
4.5	Tissue response to Implants, Inflammation, Wound Healing, Foreign Body Response	2		
4.6	Infection and Tumorigenesis of Biomaterials	1		
	Module – 5			
5.1	Bio-implants & Surgical Aids: Stent, Vascular grafts, Artificial Heart valves,	1		
5.2	Contact lenses, Intra-ocular lenses, Artificial Silicon Retina,	1		
5.3	Total Hip Replacement, Total Knee Replacement, Dental filling & Restoration material,	2		
5.4	Suture materials, Wound dressings, Tissue Adhesives.	2		
	Total No. of Lecture Hours	**42**		
	Total No. of Tutorial Hours			
	Total No. of Practical Hours			

Self-learning topics identified:

1. Use of Flexible materials for bio applications
2. Use of materials for signal processing in human body
3. Assess the temporary fixation devices utilized in human body

Textbooks:

1. Biomaterials, By Sujata V. Bhatt, Narosa Publishing House, New Delhi, India
2. Biomaterials: An introduction, By Joon B. Park, Roderic S. Lakes, Springer

Reference Books:

1. Biomedical Materials, R.Narayan (ed.), Springer Science
2. Biomaterials Medial Devices and Tissue Engineering By Fredrick H. Silver Chapman and Hall

Online Resources:

1. https://nptel.ac.in/courses/113104009/

Code: **21CV6O05** **Course: Composite Materials**
Credits: **3** **L:T:P 3:0:0**
SEE: **100 marks (reduced to 50 marks)** **CIE: 50 marks**
SEE Hours: **3** **Max. Marks:100**

Prerequisites if any	Nil
Learning objectives	1. To understand the applicability of composite materials as an alternative for isotropic materials. 2. To evaluate the strength and stiffness of composite materials for development of equilibrium equations.

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Understand the significance of replacing existing metal structures with composite materials wherever beneficial	Understand
CO2	Highlight the appropriate use of composite structures in the industry	Understand
CO3	Comprehend the complexity of design of composite materials and structures	Analyze
CO4	Understand the mechanics of composite materials	Apply

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1	3													3		
CO2	3													3		
CO3			3	3										3	3	
CO4			3	3										3	3	

Mapping Strength: **Strong– 3** **Medium – 2** **Low – 1**

Course Structure

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
	Module – 1			
1.1	Introduction to Composite Materials: Definitions: Composite material, Fiber, Matrix.	2		
	Types of fibers and Raw Fiber Properties	2		
1.2	Types of Matrix, Prepegs	2		
1.3	Types of Fillers and other Additives	2		
	Module – 2			
2.1	Advantages and applications: Advantages of Composite Materials and Structures.	1		
2.2	Applications of composite materials	1		
2.3	Use of Composite materials in present world	1		
	Module – 3			
3.1	Basics of composites: Mechanical Behavior of Lamina and Laminate	2		
3.2	Micromechanical Analysis of Composite Strength	2		
3.3	Micromechanical Analysis of Composite Stiffness	2		
3.4	Properties of typical composite materials. Volume and Weight Fractions.	2		
3.5	Longitudinal Strength and Stiffness. Transverse Modulus. In-plane shear Modulus. Poisson's ratio	2		

Module – 4				
4.1	Elastic Properties of the Unidirectional Lamina: Stress-strain relationships	2		
4.2	Engineering Constants	3		
4.3	Stress strain relations of a Thin Lamina. Examples	2		
Module – 5				
5.1	Analysis of Laminated Composites: Basic Assumptions, Strain-Displacement Relationship, Stress-Strain Relationships	3		
5.2	Equilibrium Equations, Laminate Stiffness,	3		
5.3	Determination of Lamina Stresses and Strains	3		
5.4	Types of Laminate Configuration	2		
	Total No. of Lecture Hours	**39**		
	Total No. of Tutorial Hours			
	Total No. of Practical Hours			

Self-learning topics identified:

1. Testing of interlaminar strength of composite materials
2. Experimental characterization of mechanical constants.
3. Evaluating the damage in composite materials

Textbooks:

1. Kaw, Autar K. Mechanics of composite materials. CRC press, 2005.
2. Mechanics of Composite Materials - R M Jones CRC Press Taylor & Francis

Reference Books:

1. Mechanics of Composite Materials and Structures -Madhujit Mukhopadhyay Universities Press
2. Daniel, I. M. and Ishaai., O., “Engineering Mechanics of Composite Materials”, Oxford University Press.

Online Resources:

1. https://nptel.ac.in/courses/112104168

Code:	**21CV6O06**	**Course: Disaster Management and Mitigation**	
Credits:	**3**	**L:T:P: 3:0:0**	
SEE:	**100 marks (reduced to 50 marks)**	**CIE: 50 marks**	
SEE Hours:	**3**	**Max. Marks: 100**	

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	To understand the concepts, risk and disaster management	Understand
CO2	To analyze Emerging Risks of Disasters and prevention, mitigation of Disasters	Understand, Apply
CO3	To understand Disaster Management Act 2005, Land Use Planning and Development Regulations	

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1	1													1		
CO2	2	3	2	1			1					1		2	2	
CO3	1	2		1			1							2	1	

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
Module – 1 Introduction				
1.1	Understanding the Concepts and definitions of Disaster	01		
1.2	Disaster types, Hazard, Vulnerability, Risk, Capacity	01		
1.3	Disaster and Development	01		
1.4	Disaster management	01		
Module – 2 Consequences and Control of Disasters				
2.1	Geological, Hydro-Meteorological Disasters	02		
2.2	Technological and Man- made Disasters, Global Disaster Trends	02		
2.3	Emerging Risks of Disasters	02		
2.4	Climate Change and Urban Disasters	02		
Module – 3 Disaster Management Cycle and Framework				

3.1	Disaster Management Cycle, Paradigm Shift in Disaster Management Pre-Disaster Risk Assessment and Analysis, Risk Mapping, zonation and Micro zonation, Prevention and Mitigation of Disasters, Early Warning System	03		
3.2	Preparedness, Capacity Development, Awareness During Disaster Evacuation, Disaster Communication, Search and Rescue, Emergency Operation Centre, Incident Command System, Relief and Rehabilitation	03		
3.3	Damage and Needs Assessment, Restoration of Critical Infrastructure, Early Recovery, Reconstruction and Redevelopment, IDNDR, Yokohama Strategy	03		
Module – 4 Disaster Management in India				
4.1	Disaster Profile of India, Mega Disasters of India and Lessons Learnt	03		
4.2	Disaster Management Act 2005	02		
4.3	Institutional and Financial Mechanism, National Policy on Disaster Management	02		
4.4	National Guidelines and Plans on Disaster Management, Role of Government, Non-Government Agencies	03		
Module – 5 Applications of Science and Technology for Disaster Management & Mitigation				
5.1	Geo-informatics in Disaster Management	03		
5.2	Land Use Planning and Development Regulations, Structural and Non-Structural Disasters	03		
5.3	S&T Institutions for Disaster Management in India	03		
	Total No. of Lecture Hours	**40**		
	Total No. of Tutorial Hours		**00**	
	Total No. of Practical Hours			**00**

Self-learning topics identified:

1. Biological Disasters
2. Hyogo Framework of Action
3. National Guidelines and Plans on Inter-Governmental Agencies
4. Disaster Communication System

Textbooks:

1. R. Subramanian, "**Disaster Management**", Vikas Publishing House, 2015.
2. Fagel, Michael J., ed. **"Principles of emergency management: Hazard specific issues and mitigation strategies".** CRC Press, 2011.

Reference Books:

1. Coppola D P, 2007. Introduction to International Disaster Management, Elsevier Science

(B/H), London.

2. Manual on natural disaster management in India, M C Gupta, NIDM, New Delhi

3. An overview on natural & man-made disasters and their reduction, R K Bhandani, CSIR, New Delhi

4. Disaster Management Act, Publisher by Govt. of India

5. Publications of National Disaster Management Authority (NDMA) on Various Templates and Guidelines for Disaster Management

6. NIDM Publications, GoI

7. National Disaster Management Policy, GoI

8. Roy, P.S. (2000): Space Technology for Disaster management: A Remote Sensing & GIS Perspective, Indian Institute of Remote Sensing (NRSA) Dehradun.

Online Resources:

https://nptel.ac.in/courses/105104183
https://onlinecourses.swayam2.ac.in/cec19_hs20/preview
https://ndma.gov.in/
https://www.ucf.edu/online/leadership-management/news/the-disaster-management-cycle/