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

2025-26

III Year B.E. (2022/2023 admitted batch)

Department of Civil Engineering

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TABLE OF SCHEME AND EXAMINATION FOR V & VI SEMESTER (2022/2023 admitted batch)

V Semester											
Sl. No	Type of Course	Course Code	Course Title	Teaching Hrs/Week			Examination				Credits
				L	T	P	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
1	HSMS	BCV501	Construction Management and Entrepreneurship	3	0	0	3	50	50	100	**3**
2	IPCC	BCV502	Geotechnical Engineering	3	0	2	3	50	50	100	**4**
3	PCC	BCV503	Concrete Technology	3	0	2	3	50	50	100	**4**
4	PCCL	BCVL504	Environmental Engineering Lab	0	0	2	3	50	50	100	**1**
5	PCC	BCV505	Highway Construction and Maintenance	3	0	0	3	50	50	100	**3**
6	PEC	BCV516X	Professional Elective Course (Industry suggested course) - Group I	3	0	0	3	50	50	100	**3**
7	PROJ	BCV586X	Minor Project/Survey Camp	0	0	2	-	50	-	50	**1**
8	AEC	BRMCV557	Research Methodology and IPR	2	0	0	2	50	50	100	**2**
9	MC	BESK508	Environmental Studies	1	0	0	-	50	-	50	**1**
10	MC	BNSK559	National Service Scheme (NSS)	0	0	2	_	100	_	100	**0**
		BPEK559	Physical Education (PE) (Sports & Athletics)								
		BYOK559	Yoga								
							Total	**550**	**350**	**900**	**22**

VI Semester											
Sl. No	Type of Course	Course Code	Course Title	Teaching Hrs/Week			Examination				Credits
				L	T	P	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
1	IPCC	BCV601	Design of RCC Structures	3	0	2	3	50	50	100	**4**
2	PCC	BCV602	Irrigation Engineering and Hydraulic Structures	3	2	0	3	50	50	100	**4**
3	PEC	BCV613X	Professional Elective Course - Group II	3	0	0	3	50	50	100	**3**
4	OEC	BCV654X	Open Elective Course - Group I	3	0	0	3	50	50	100	**3**
5	PCC	BCV605	Higher Surveying	3	0	0	3	50	50	100	**3**
6	PCC	BCV606	Environmental Hydrology	3	0	0	3	50	50	100	**3**
7	PCCL	BCVL607	Software Application Lab	0	0	2	3	50	50	100	**1**
8	AEC/ SDC	BCV657X	Ability Enhancement Course / Skill Development Course V	If the course is a Theory 1:0:0 OR If the course is a Laboratory 0:0:2			1 2	50	50	100	**1**
9	MC	BNSK658	National Service Scheme (NSS)	0	0	2	_	100	_	100	**0**
		BPEK658	Physical Education (PE) (Sports & Athletics)								
		BYOK658	Yoga								
10	MC	BIKK259	Indian Knowledge Systems	1	0	0	0	50	-	50	**0**
							Total	**550**	**400**	**950**	**22**

Note: Major Project (BCV785- refer to 7th sem curriculum) work shall begin during the start of 6th semester and the project batches, guide allocation shall be done during the same time frame. However, evaluation shall be carried out during 7th semester, as mentioned in the curriculum.

List of Electives

V Semester		
Sl. No	**Course Code**	**Course Title**
Professional Elective Course-I		
1	BCV516A	Numerical Methods in Civil Engineering
2	BCV516B	Occupational Safety and Health Monitoring
3	BCV516C	Remote Sensing and GIS
VI Semester		
Sl. No	**Course Code**	**Course Title**
Professional Elective Course - Group II		
1	BCV613A	Design of Bridges
2	BCV613B	Design of formwork and scaffolding
3	BCV613C	Applied Geotechnical Engineering
4	BCV613D	Special Concrete and Construction Chemicals
5	BCV613E	Construction Surveying
6	BCV613F	Pavement Evaluation and Management
7	BCV613G	Industrial Waste Water Treatment
Open Elective Course - Group I# #Offered by Department of Civil Engineering to other branch students.		
1	BCV654A	Repair and Rehabilitation of Structures
2	BCV654B	Satellite Sensing and GIS
3	BCV654C	Integrated Waste Management for a Smart City
4	BCV654D	Sustainable Development Goals
5	BCV654E	Disaster Management and Mitigation
6	BCV654F	Water conservation and Rainwater Harvesting
Ability Enhancement Course / Skill Development Course V		
1	BCV657A	Structural Health Monitoring Using Sensors
2	BCV657B	Data Analytics for Civil Engineers
3	BCV657C	Quality Control and Quality Assurance

DETAILED SYLLABUS

V SEMESTER

Code: BCV501 **Course: Construction Management and Entrepreneurship**
Credits: 3 **L:T:P 3:0:0**
SEE: 50% **CIE: 50%**
SEE Hours: 3 **Max. Marks:100**

Prerequisites if any	NIL
Learning objectives	1. To understand the concept of Scheduling, cost management, procurement and contract management in construction project 2. To understand Quality and Safety during construction and to identify the risks and its management

Course Outcomes:

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

COs	Course Outcomes	Bloom's level
CO1	Develop WBS and estimate the resource requirements	Apply
CO2	Analyse the cost control monitoring and accounting methods for a project	Apply
CO3	Understand the statutory and legal requirements for a construction and prepare a plan for procurement management & risk mitigation	Understand
CO4	Understand the concept of entrepreneurship and business planning.	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					3	2		3		1
CO2	3	2				2			1		3	2		3		2
CO3	3	2				2		2	1		3	2		3		2
CO4	3	2				2			2	3	3	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	Construction project formulation – construction management, define scope – scope management, types of project planning and its management, Statutory and regulatory requirements- layout and building plan approval, contract, Fire and Safety, Quality, Environmental, commencement certificate, legal and public policies.	4	-	-
1.2	Schedule management – WBS, Bar Charts, Sequencing and Dependency, Network Diagram, Activity Duration, Critical Path Method, PERT, Case study.	3	-	-
1.3	Cost Management - Creating schedules, Assigning Resources, Cost, Evaluation, Optimization and Tracking.	2	-	-
	Module – 2			
2.1	Resource Management - Basic concepts of resource management, class of labour, Wages & statutory requirement	3	-	-
2.2	Labor Production rate or Productivity, Factors affecting labour output	3	-	-
	Module – 3			
3.1	Procurement – procurement types, planning, stages – procurement execution – sustainable procurement management	2	-	-

3.2	Construction contract –formation, types, essential elements, contract law – tendering process, contract award	3	-	-
3.3	Documentation – contractor and sub-contractor management –claims – disputes-compensation – breach of contract – project completion and project closure	3	-	-
	Module – 4			
4.1	Quality Management - Occupational Health, Safety and Environment, Barriers, Quality Management System – Chart and tools.	3	-	-
4.2	Safety management - safety requirements	2	-	-
4.3	Risk management - Process, Terminology, Identification, Analysis and Response Strategy Completion certificate, occupancy certificate, Facilities management	3	-	-
	Module – 5			
5.1	Characteristics of a Successful Entrepreneur, Understand the entrepreneurial journey, different entrepreneurial styles, personality traits, strengths, and weaknesses. 5M Model, Communication skills: communication breakdown- miscommunication and poor listening, rectification	3	-	-
5.2	Business planning process, marketing plan, financial plan, project report and feasibility study, guidelines for preparation of model project report for starting a new venture	3	-	-
5.3	Introduction to international entrepreneurship opportunities, entry into international business, exporting, direct foreign investment	3	-	-
	Total No. of Lecture Hours	40	-	-
	Total No. of Tutorial Hours		-	-
	Total No. of Practical Hours			-

Self-learning topics identified:

1. Safety and Health codes.
2. Venture capital.

Textbooks:

1. Chitkara, K.K, “Construction Project Management: Planning Scheduling and Control”, Tata McGraw Hill Publishing Company, New Delhi.
2. Dr. U.K. Shrivastava “Construction Planning and Management”, Galgotia Publications Pvt. Ltd. New Delhi.
3. Engineering Economics, R Panneerselvam, Eastern Economy Edition 2001, PHI, ISBN – 81- 203-1743-2.
4. Cost Accounting, Khan M Y, 2nd Edition, 2000, Tata McGraw-Hill, ISBN 0070402248

Reference Books:

1. Mechanical Estimating & Costing, T.R.Banga, S.C.Sharma, 16th Edition, 2011, Khanna Publishers, ISBN8174091009
2. Poornima M. Charantimath, “Entrepreneurship Development and Small Business Enterprise” , Dorling Kindersley (India) Pvt. Ltd., Licensees of Pearson education.

Online Resources:

1. https://nptel.ac.in/courses/105104161

Code: BCV502 **Course: Geotechnical Engineering**
Credits: 4 **L:T:P 3:0:2**
SEE: 50% **CIE: 50%**
SEE Hours: 3 **Max. Marks:100**

Prerequisites if any	
Learning objectives	1. Appreciate basic concepts of soil mechanics as an integral part in civil engineering and comprehend basic engineering and mechanical properties of different types of soil 2. Become broadly familiar with geotechnical engineering requirements, such as, flow of water through soil medium and compaction characteristics. Model and measure strength & settlement characteristics and bearing capacity of soils.

Course Outcomes:

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

COs	Course Outcomes	Bloom's level
CO1	Comprehend the fundamentals of Soil mechanics and identify and classify the soil	Understand
CO2	Apply the knowledge to determine MDD and OMC and compute consolidation properties and shear parameters of soil and compute the settlement and bearing capacity of soil	Apply
CO3	Apply the knowledge to determine shear parameters of soil and compute the settlement and bearing capacity of soil	Apply
CO4	Carry out experiments to assess the index properties of soil and determine Compaction, Permeability and Shear Strength characteristics of soil.	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		2								2		3	2	
CO2	3	3	3											1	1	
CO3	3	3	2	2										3	2	1
CO4	3	3			2		2		2			2		2	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	Index Properties: Phase Diagram, definitions, and their interrelationships	2		
1.2	Determination of Index properties	3		
1.3	Types of soil structures and Clay Minerals, IS soil classification of Soil	3		
	Module – 2			
2.1	Permeability, Darcy's law-assumption and validity, coefficient of permeability and its determination (only laboratory method), permeability of stratified soils	4		
2.2	Capillary phenomenon	2		
2.3	Effective stress concept-total stress, effective stress and Neutral stress	2		

Module – 3				
3.1	Principle of compaction, Standard and Modified proctor's compaction tests, factors affecting compaction, effect of compaction on soil properties	3		
3.2	Mass-spring analogy, Terzaghi's one dimensional consolidation theory (No derivation). Consolidation characteristics of soil (Cc, av, mv and Cv).	3		
3.3	Laboratory one dimensional consolidation test, Pre-consolidation pressure and its determination by Casagrande's method.	2		
Module – 4				
4.1	Concept of shear strength, Mohr–Coulomb Failure Criterion, Modified Mohr–Coulomb Criterion Total and effective shear strength parameters	3		
4.2	Measurement of shear strength parameters - Direct shear test, unconfined compression test, triaxial compression test	3		
4.3	Factors affecting shear strength of soils.	2		
Module – 5				
5.1	Types of foundations, Determination of bearing capacity by Terzaghi's and BIS meth 6403), Modes of shear failure, Factors affecting Bearing capacity of soil	3		
5.2	Effect of water table and load eccentricity on bearing capacity of soil, Field methods of determining bearing capacity of soil (SPT and plate load test).	3		
5.3	Settlement: Types of settlements and importance, Computation of immediate and consolidation settlement, permissible differential and total settlements (IS 8009 Part 1).	2		
List of Experiments:				
1	Determination of specific gravity of coarse and fine grained soils.			2
2	Grain size analysis (Sieve analysis of soil)			2
3	In-situ density tests i) Core-cutter method ii) Sand replacement method			2
4	Consistency limits i) Liquid limit test (by Casagrande's and cone penetration method) limit test			2
5	Co-efficient of permeability test i) Constant head test ii). Variable head test			2
6	Standard compaction test (light compaction only)			2
7	Direct shear test			2
8	Unconfined compression test & Laboratory vane shear test			2
9	Triaxial test (unconsolidated undrained test only)			2
10	Demonstration of Standard penetration test, Boring equipment & Proctors needle.			2
	Total No. of Lecture Hours	40		
	Total No. of Tutorial Hours			
	Total No. of Practical Hours			**20**

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

1. Field Vane shear test
2. Flow net characteristics and applications
3. Field compaction control
4. Bearing capacity of heterogeneous soil layers

Textbooks:

1. Gopal Ranjan and Rao A.S.R., Basic and Applied Soil Mechanics, New Age International (P) Ltd., New Delhi. 2016
2. Murthy V.N.S., Principles of Soil Mechanics and Foundation Engineering, UBS Publishers and Distributors, New Delhi. 2018
3. Braja, M. Das, Geotechnical Engineering; Thomson Business Information India (P) Ltd., India. 2015
4. Punmia B C, Soil Mechanics and Foundation Engineering, Laxmi Publications co., New Delhi. 2017

5. Soil Testing for Engineers by S. Mittal and J.P. Shukla 2020

Reference Books:

1. T.W. Lambe and R.V. Whitman, Soil Mechanics-, John Wiley & Sons. 1991
2. Donald P Coduto, Geotechnical Engineering- Phi Learning Private Limited, New Delhi. 2010
3. Shashi K. Gulathi & Manoj Datta, Geotechnical Engineering-Tata McGraw Hill Publications. 2010
4. Bowles J E, Foundation analysis and design, McGraw- Hill Publications 5th edition 2001
5. Malcolm D Bolton, "A Guide to soil mechanics", Universities Press., 2003
6. Manual of Soil Laboratory Testing- Head K.H., (1986)- Vol. I, II, III, Princeton Press, London 2006

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc22_ce03

Code: BCV503
Credits: 4
SEE: 50%
SEE Hours: 3

Course: Concrete Technology
L:T:P:S 3:0:2:0
CIE: 50%
Max. Marks:100

Prerequisites if any	Nil
Learning objectives	1. To recognize material characterization of ingredients of concrete and its influence on properties of concrete 2. To study the properties of fresh concrete and hardened concrete 3. Proportion ingredients of Concrete to arrive at most desirable mechanical properties of Concrete 4. Ascertain various types of special concrete with their properties.

Course Outcomes:

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

COs	Course Outcomes	Bloom's level
CO1	Relate material characteristics and their influence on microstructure of concrete.	Understand
CO2	Distinguish concrete behaviour based on its fresh and hardened properties.	Understand
CO3	Illustrate proportioning of different types of concrete mixes for required fresh and hardened properties using professional codes.	Apply
CO4	Select a suitable type of concrete based on specific application.	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					1							3		
CO2	3	2			2									3	2	
CO3	3	2					1							3		
CO4	3	2	2				1							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	Cement manufacturing process, chemical composition and their importance, hydration of cement, types of cement.	2	-	-
1.2	Testing of cement, steps to reduce carbon footprint.	1	-	-
1.3	Fine aggregate: Functions, requirement, Alternatives to River sand, M-sand introduction, and manufacturing.	1	-	-
1.4	Coarse aggregate: Importance of size, shape and texture. Grading and blending of aggregate. Testing on aggregate, requirement.	2	-	-
1.5	Recycled aggregates, Water – qualities of water. Chemical admixtures – plasticizers, accelerators, retarders, and air entraining agents.	2	-	-
1.6	Mineral admixtures – Pozzolanic and cementitious materials, Fly ash, GGBS, silica fumes, Metakaolin and rice husk ash.	2	-	-
Module – 2				
2.1	Factors affecting workability. Measurement of workability–slump, Compaction factor and Vee-Bee Consistometer tests, flow tests. Segregation and bleeding.	3	-	-

2.2	Process of manufacturing of concrete- Batching, Mixing, Transporting, Placing and Compaction.	1	-	-
2.3	Curing – Methods of curing – Water curing, membrane curing, steam curing, accelerated curing, self- curing.	1	-	-
2.4	Good and Bad practices of making and using fresh concrete and Effect of heat of hydration during mass concreting at project sites.	2	-	-
	Module – 3			
3.1	Factors influencing strength, W/C ratio, gel/space ratio, Maturity concept, testing of hardened concrete,	2	-	-
3.2	Creep – factors affecting creep. Shrinkage of concrete – plastic shrinking and drying shrinkage, Factors affecting shrinkage.	2	-	-
3.3	Definition and significance of durability. Internal and external factors influencing durability,	2	-	-
3.4	Mechanisms- Sulphate attack – chloride attack, carbonation, freezing and thawing. Corrosion, Durability requirements as per IS-456,.	2	-	-
3.5	In situ testing of concrete- Penetration and pull-out test, rebound hammer test, ultrasonic pulse velocity, core extraction – Principal, applications and limitations	2	-	-
	Module – 4			
4.1	Principles of concrete mix design, Parameters and factors influencing mix design	2	-	-
4.2	Concept of Mix Design with and without admixtures, variables in proportioning and Exposure conditions, Selection criteria of ingredients used for mix design	2	-	-
4.3	Procedure of mix proportioning. Numerical Examples of Mix Proportioning using IS10262:2019.	2	-	-
	Module – 5			
5.1	RMC-manufacture and requirement as per QCI-RMCPCS, properties, advantages, and disadvantages.	2	-	-
5.2	Self-Compacting concrete- concept, materials, tests, properties, application and typical mix Fiber reinforced concrete - types of fibers, properties, application of FRC.	3	-	-
5.3	Light weight concrete-material properties and types. Typical light weight concrete mix proportion and applications	2	-	-
5.4	Materials, requirements, mix proportion and properties of Geo polymer Concrete, High Strength Concrete and High-Performance Concrete	2	-	-
	List of Experiments			
1	Testing of Cement: Consistency, Fineness, Setting Time,			**2**
2	Specific Gravity, Soundness and Strength of Cement			**2**
3	Testing of Fine Aggregate: Specific Gravity, Sieve Analysis and zoning,			**2**
4	Bulking of fine aggregate, Bulk Density, Silt Content.			**2**
5	Testing of Coarse Aggregate: Specific Gravity, Sieve Analysis, Bulk Density, Flakiness Index,			**4**
6	Elongation Index, Water Absorption & Moisture Content, Soundness of aggregate.			**2**
7	Concrete Mix design by IS code method as per 10262- 2019 & 456-2000, DOE method.			**2**

8	Demonstration of Testing of concrete cube of specified strength			**2**
9	Demonstration of Testing of concrete beam for pure bending			**2**
	Total No. of Lecture Hours	40		
	Total No. of Tutorial Hours		00	
	Total No. of Practical Hours			**20**

Self-learning topics identified:

1. Blended Cement
2. Alkali- aggregate reaction

Textbooks:

1. M.S. Shetty, Concrete Technology - Theory and Practice Published by S. Chand and Company, New Delhi

Reference Books:

1. Neville A.M. "Properties of Concrete"-4th Ed., Longman
2. Kumar Mehta. P and Paulo J.M. Monteiro "Concrete-Microstructure, Property and Materials", 4th Edition, McGraw Hill Education, 2014
3. A.R. Santha Kumar, "Concrete Technology", Oxford Un iversity Press, New Delhi (NewEdition)

Online Resources:

Cement
https://nptel.ac.in/courses/105102012/1
Aggregates
https://nptel.ac.in/courses/105102012/6
Mineral admixtures
https://nptel.ac.in/courses/105102012/11
Chemical admixtures
https://nptel.ac.in/courses/105102012/9
https://nptel.ac.in/courses/105102012/10
Concrete mix design
https://nptel.ac.in/courses/105102012/14
Concrete production & fresh concrete
https://nptel.ac.in/courses/105102012/19
Engineering properties of concrete
https://nptel.ac.in/courses/105102012/23
Dimensional stability & durability
https://nptel.ac.in/courses/105102012/27
Durability of concrete
https://nptel.ac.in/courses/105102012/31
Special concretes
https://nptel.ac.in/courses/105102012/36

Code: **BCVL504** **Course: Environmental Engineering Lab**
Credits: **01** **L:T:P:S : 0:0:2:0**
SEE: **50%** **CIE: 50%**
SEE Hours: **02** **Max. Marks:100**

Prerequisites if any	Water supply & Wastewater Engineering
Learning objectives	1. To learn different methods of water & waste water quality 2. To conduct experiments to determine the concentrations of water and waste water 3. To determine the degree and type of treatment 4. To understand the environmental significance and application in environmental engineering practice

Course Outcomes:

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

COs	Course Outcomes	Bloom's level
CO1	Acquire capability to conduct experiments and to estimate the concentration of different parameters in water and wastewater and Compare the results with relevant standards to decide the appropriate treatment method.	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		1	1					1		2	1	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	Preparation chemical solutions required for analysis and sampling methodologies	-	-	2
2	Determination of pH, Conductivity, TDS and Turbidity.	-	-	2
3	Determination of Acidity and Alkalinity	-	-	2
4	Determination of Calcium Hardness, Magnesium Hardness and Total Hardness.	-	-	2
5	Determination of Dissolved Oxygen	-	-	2

6	Determination of BOD.	-	-	2
7	Determination of Chlorides	-	-	2
8	Determination of percentage of % of available chlorine in bleaching powder sample, Determination of Residual Chlorine and chlorine demand.	-	-	2
9	Determination of Solids in Sewage: i) Total Solids, ii) Suspended Solids, iii) Dissolved Solids, iv) Volatile Solids, Fixed Solids v) Settleable Solids.	-	-	2
10	Determination of optimum coagulant dosage using Jar test apparatus.	-	-	2
11	Determination Nitrates and Iron by spectrophotometer	-	-	2
Demonstration Experiments (For CIE)				
12	Determination of COD (Demonstration)	-	-	2
13	Determination of Sound-by-Sound level meter at different locations (Demonstration)	-	-	2
Total No. of Lecture Hours				
Total No. of Tutorial Hours				
Total No. of Practical Hours				**26**

Reference Books:

1. Sawyer, McCarty and Parkin. “Chemistry for Environmental Engineering and science” McGraw-Hill publication, 5th Edition, 2003.
2. Eugene W. Rice, Rodger B. Baird, Andrew D. Eaton, Lenore S. Clesceri (Eds.) “Standard methods for the examination of water and wastewater”, American Public Health Association, Washington DC, 21st Edition, 2012.
3. “Manual on water and wastewater analysis”, NEERI, Nagpur 1988.
4. Indian Standard codes IS 3025 and parts thereof, IS 10500, IS 2490.

Online Resources:

1. https://ee1-nitk.vlabs.ac.in/

Code: BCV505 **Course: Highway Construction and Maintenance**
Credits: 3 **L:T:P 3:0:0**
SEE: 50% **CIE: 50%**
SEE Hours: 3 **Max. Marks:100**

Prerequisites if any	1. Transportation Engineering
Learning objectives	1. Gain knowledge of materials and equipment's used for construction of flexible and rigid pavements. 2. Gain knowledge of process involved in construction and maintenance of highways.

Course Outcomes:

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

COs	Course Outcomes	Bloom's level
CO1	Understand specification of various pavement materials and functions of highway construction equipment's.	Understand
CO2	Apply the specifications of MoRTH for understanding the process of construction and maintenance of highways	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	3	
CO2	3	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				
1.1	Highway construction materials: Requirements and properties of road aggregates	02	-	-
1.2	Gradation, blending of aggregates by different methods to meet specifications	02	-	-
1.3	Subgrade: Properties of soil subgrade, HRB soil classification, evaluation of strength of subgrade	02	-	-
1.4	Requirements and properties of binders: Tar, Bitumen, Emulsion and Cutback bitumen	02	-	-
Module – 2				
2.1	Equipment's in highway construction: Various types of equipment's for excavation, grading and compacting- their working principles, advantages and limitations.	03	-	-
2.2	Special equipment for bituminous and cement concrete pavement.	03	-	-
2.3	Pavement repair and maintenance equipment's	03	-	-
Module – 3				
3.1	Construction of flexible pavement: Earthwork grading and Construction of embankments, Preparation of subgrade with quality control tests as per MoRTH.	03	-	-
3.2	Component layers and functions of flexible pavement, material specifications as per MoRTH.	02	-	-
3.3	Construction of Granular sub-base course, granular base such as WBM and WMM.	02	-	-

3.4	Construction of bituminous binder course (BM & DBM). Common types of bituminous surfacing courses such as surface dressing, premixed carpet (PMC) and bituminous concrete,	03	-	-
Module – 4				
4.1	Construction of rigid pavement: Specifications and construction of DLC layer	02	-	-
4.2	Specifications and construction of PQC layer, importance of separation membrane.	02	-	-
4.3	Quality control tests, Construction of various types of joints.	02	-	-
Module – 5				
5.1	Highway maintenance works – day to day and periodic maintenance works of various components of road works and road furniture.	02	-	-
5.2	Preventive maintenance of road drainage system, pavements and other components of road. Preparation of existing pavement – patching, profile correction,	02	-	-
5.3	Special measures to deal with reflection cracks in pavement layers, slipperiness of surface, etc. Requirements for rehabilitation, recycling and re-construction.	03	-	-
	Total No. of Lecture Hours	**40**	-	-
	Total No. of Tutorial Hours		-	-
	Total No. of Practical Hours			**-**

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

1. Sustainable pavement materials
2. Stresses in flexible and rigid pavements
3. Special equipment's for road repair
4. QMC and PMC for road works

Textbooks:

1. Highway Engineering-Khanna and Justo and Veeraragavan
2. Peurifoy, R.L., and Clifford, J.S "Construction Planning Equipment and Method"- McGraw Hill Book Co. Inc

Reference Books:

1. RRL, DSIR, 'Bituminous materials in road construction', HMSO publication.
2. Relevant IRC codes and MORTH specification

Online Resources:

1. https://archive.nptel.ac.in/courses/105/107/105107219/
2. https://archive.nptel.ac.in/courses/105/103/105103206/

Code: BCV586A **Course: Minor Project**
Credits: 1 **L:T:P 0:0:2**
SEE: -- **CIE: 100%**
SEE Hours: -- **Max. Marks:50**

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.	-	-	13
Total No. of Lecture Hours				
	Total No. of Tutorial Hours			
	Total No. of Practical Hours			**13**

Code: BCV586B **Course: Survey Camp**
Credits: 2 **L:T:P 0:0:4**
SEE: 50% **CIE: 50%**
SEE Hours: - **Max. Marks:50**

Prerequisites if any	Surveying, 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. Condition survey of pavement and inspection composition.	-	-	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: BRMCV557 **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, be familiar with data collection and literature survey process. 2. To know the statistical concepts in experimentation, acquire knowledge in writing research reports and 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	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	PSO4
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 d 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 (“Trademarks 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”) viii. The Semiconductor Integrated Circuits Layout- Design Act, 2000 (“SICLD Act”)	4		
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: (Maximum of 5 topics)

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

Code: BESK508 **Course: Environmental Studies**
Credits: **1** **L: T: P 1:0:0**
SEE: **--** **CIE: 100%**
SEE Hours: **--** **Max. Marks: 50**

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 Analyze the impact of pollution and describe the control measures*	Apply
CO2	*importance of various National environmental acts and regulatory bodies, explain the concept of EIA and Global environmental summits, treaties and protocol*	Analyze
CO3	*Analyze the global environmental issues and sustainable technologies.*	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		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	NA	NA
1.2	Man-Environment interaction, Impact of man's activity on Environment	1	NA	NA
1.3	Pollutant and its classification, Introduction to Pollution, sources of pollution	1	NA	NA
1.4	Water, Air, Noise pollution, nuclear hazards (Sources, effects, remedial measures, standards)	1	NA	NA
1.5	Solid waste and E-waste management: causes, effects and control measures of urban and industrial wastes.	1	NA	NA
Module – 2				
2.1	Environmental Laws and protection Acts: environment protection act	1	NA	NA
2.2	Pollution Control Boards' roles and responsibilities (CPCB and KPCB)	1	NA	NA

2.3	Global environmental summits, treaties and protocols (important summits).	1	NA	NA
2.4	Introduction to Environmental Impact Assessment (EIA),	1	NA	NA
2.5	Environmental Auditing, International environmental management standards (ISO14000).	1	NA	NA
Module – 3				
3.1	Global environmental issues- global warming, acid rain, ozone depletion (reasons, effects, control measures)	1	NA	NA
3.2	carbon footprint and carbon trading	1	NA	NA
3.3	Sustainable environmental concepts: water conservation – rainwater harvesting, artificial recharging, watershed management	1	NA	NA
3.4	Waste to energy – solid waste to energy conversion.	1	NA	NA
	Total No. of Lecture Hours	14	NA	NA
	Total No. of Tutorial Hours		**NA**	**NA**
	Total No. of Practical Hours			

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

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

ELECTIVES

Code: BCV516A **Course: Numerical Methods in Civil Engineering**
Credits: 3 **L:T:P: 3:0:0**
SEE: 50% **CIE: 50%**
SEE Hours: 3 **Max. Marks:100**

Prerequisites if any	
Learning objectives	1. Develop algorithms and analyze numerically civil engineering problems to arrive at a closed form solution.

Course Outcomes:

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

COs	Course Outcomes	Bloom's level
CO1	Apply the of solution techniques of linear and non-linear systems to analyse frame civil engineering problems	Apply
CO2	Apply numerical methods to obtain approximate solutions to civil engineering problems	Apply
CO3	Develop algorithms and programs for solving civil engineering problems	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												2	2	
CO3		3	2		1									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				
1.1	Historical development of Numerical techniques, role in investigations, Research and design in the field of civil engineering	1		
1.2	Development of algorithm/ flow charts for the solution of linear simultaneous equation using Gaussian elimination method	2		
1.3	Development of algorithm/ flow charts for the solution of linear simultaneous equation using Gauss-Jordan matrix inversion method	2		
1.4	Development of algorithm/ flow charts for the solution of linear simultaneous equation using Gauss-Siedel method	2		
1.5	Development of algorithm/ flow charts for the solution of linear simultaneous equation using Factorization method	2		
Module – 2				
2.1	Development of algorithm for Bisection method	2		
2.2	Newton-Raphson method	2		
2.3	Application of Newton Raphson Method in the area of hydraulics,	1		
2.4	Application of Newton Raphson Method in the area of irrigation engineering	1		
2.5	Application of Newton Raphson Method in the area of structural engineering	1		
2.6	Application of Newton Raphson Method in the area of environmental engineering.	1		
Module – 3				
3.1	Approximation of derivatives using interpolation polynomials	1		

3.2	Numerical integration using Trapezoidal, Simpson's 1/3 rule	1		
3.3	Romberg's Method	1		
3.4	Two-point and three-point Gaussian quadrature formulae	1		
3.5	Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules	2		
3.6	Trapezoidal rule, Simpson's one third and their application for computation of area of BMD drawn for statically determinate beams.	2		
Module – 4				
4.1	New Marks method for computation of slopes and deflections in statically determinate beams	2		
4.2	Development of algorithm and application of solution of ordinary differential equation by Euler's method	2		
4.3	Development of algorithm and application of solution of ordinary differential equation by Runge Kutta method	2		
4.4	Development of algorithm and application of solution of ordinary differential equation by 4th order method	2		
Module – 5				
5.1	Expression of derivatives by finite difference: backward differences, forward differences, and central differences.	2		
5.2	Application of finite difference method for analysis of statically determinate beams	1		
5.3	Application of finite difference method for analysis of statically indeterminate beams	2		
5.4	Application of finite difference method for analysis of Buckling of columns	1		
5.5	Application of finite difference method for analysis of Beams on elastic foundation	1		
	Total No. of Lecture Hours	40		
	Total No. of Tutorial Hours		**0**	
	Total No. of Practical Hours			**0**

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

1. Application of Taylor series in civil engineering
2. *LU* decomposition
3. General methods for Boundary-Value problems

Textbooks:

1. Grewal. B.S. and Grewal. J.S., "Numerical methods in Engineering and Science", Khanna Publishers, 9th Edition, New Delhi
2. Gerald. C. F., and Wheatley. P. O., "Applied Numerical Analysis", Pearson Education, Asia, 6th Edition, New Delhi.

Reference Books:

1. Chapra. S.C. and Canale. R. P., "Numerical Methods for Engineers, Tata McGraw Hill, New Delhi.
2. Brian Bradie. "A friendly introduction to Numerical analysis", Pearson Education, Asia, New Delhi
3. Sankara Rao. K., "Numerical methods for Scientists and Engineers", Prentice Hall of India Private, New Delhi.

Online Resources:

1. https://nptel.ac.in/courses/111107105
2. https://www.coursera.org/learn/numerical-methods-engineers

Code: BCV516B **Course: Occupational Safety and Health Monitoring**
Credits: 3 **L:T:P** 3:0:0:
SEE: 50 **CIE: 50**
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	Identify hazards in the workplace that pose a danger or threat to their safety or health, Control unsafe or unhealthy hazards, propose methods to eliminate the hazard and analyze a potential safety or health hazard	Understand
CO2	To Discuss role of health and safety in the workplace pertaining to the responsibilities of workers, managers, supervisors.	Apply
CO3	To Identify decisions required to maintain protection of the environment, workplace as well as personal health and safety..	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					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 Occupational Hazard and Control Principles				
1.1	Safety, History and Development, National Safety Policy	1	-	-
1.2	Occupational Safety and Health Act (OSHA)	1	-	-
1.3	Occupational Health and Safety Administration - Laws governing OSHA and the right to know	1	-	-
1.4	Accident – causation, investigation, investigation plan	2	-	-
1.5	Methods of acquiring accident facts,	1	-	-
1.6	Supervisory role in accident investigation	2	-	-
Module – 2 Ergonomics at Work Place				
2.1	Ergonomics Task analysis,	1	-	-
2.2	Preventing Ergonomic Hazards	1	-	-
2.3	Work space Envelops, Visual Ergonomics	1	-	-
2.4	Ergonomic Standards, Ergonomic Programs	1	-	-
2.5	Hazard cognition and Analysis	2	-	-
2.6	Human Error Analysis – Fault Tree Analysis –	1	-	-

2.7	Emergency Response - Decision for action – purpose and considerations.	1	-	-
Module – 3 Fire Prevention and Protection				
3.1	Fire Triangle, Fire Development and its severity	1	-	-
3.2	Effect of Enclosures,	1	-	-
3.3	early detection of Fire	1	-	-
3.4	Classification of fire and Fire Extinguishers	1	-	-
3.5	Electrical Safety,	2	-	-
3.6	Product Safety	1	-	-
3.7	Technical Requirements of Product safety.	1	-	-
Module – 4 Health Considerations at Work Place				
4.1	Types of diseases and their spread,	1	-	-
4.2	Health Emergency	1	-	-
4.3	Personal Protective Equipment (PPE) – types and advantages	1	-	-
4.4	effects of exposure and treatment for engineering industries	2	-	-
4.5	effects of exposure and treatment for municipal solid waste	2	-	-
4.6	Environment management plans (EMP) for safety and sustainability	1	-	-
Module – 5 Occupational Health and Safety Considerations				
5.1	Water and wastewater treatment plants	1	-	-
5.2	Handling of chemical and safety measures in water and wastewater treatment plants and labs	1	-	-
5.3	Construction material manufacturing industries like cement plants	2	-	-
5.4	RMC Plants,	1	-	-
5.5	precast plants, and construction sites	1	-	-
5.6	Policies, roles and responsibilities of workers, managers	2	-	-
Total No. of Lecture Hours		40	-	-
Total No. of Tutorial Hours			-	-
Total No. of Practical Hours				**-**

Textbooks:

1. “Goetsch D. L.,(1999), “Occupational Safety and Health for Technologists, Engineers and Managers” , Prentice Hall.
2. Heinrich H.W.,(2007),“Industrial Accident Prevention-A Scientific Approach”,McGraw-Hill Book Company National Safety Council and Associate (Data) Publishers Pvt. Ltd., (1991),
3. “Industrial Safety and Pollution Control Handbook.
4. Colling D.A.,(1990),“Industrial Safety Management and Technology”, Prentice Hall,New Delhi.
5. Della D.E., and Giustina, (1996), “Safety and Environmental Management”, Van Nostrand Reinhold International Thomson Publishing Inc.

Online Resources:

- https://www.cdc.gov/niosh/index.htm
- https://nptel.ac.in/courses/114106017
- https://youtu.be/8nbOI-0U9Co
- https://youtu.be/Be9inw8xlw8

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- http://nptel.ac.in
- https://swayam.gov.in

Code: BCV516C **Course: Remote Sensing and GIS**
Credits: 3 **L:T:P 3:0:0**
SEE: 50% **CIE: 50%**
SEE Hours: 3 **Max. Marks:100**

Prerequisites if any	Highschool Geography, Surveying
Learning objectives	1. Outline basic concepts of GIS and Remote sensing 2. Summarize applications of Geospatial technology in Civil Engineering

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 Mapping	Understand
CO2	Understand and discuss concepts of Remote sensing, satellites and sensors	Understand
CO3	Demonstrate the use of Remote sensing, GIS, Satellite data, GPS for various applications	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				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	**Concepts 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.	02		
1.3	GIS data acquisition, source – primary and secondary data, generation, display.	02		
	Module – 2			

2.1	**Concepts of Geodesy, Maps and Transformation** Shape of earth, Georeferencing systems (introduction only), Continuous and discrete georeferencing.	02		
2.2	Geodetic datums, representations of earth, coordinate reference systems, GCS and PCS.	01		
2.3	Map, map layout, features of a map, Topographic map, scale of a map.	01		
2.4	Geometric transformation, map projection and types (cylindrical, cone, azimuthal),	02		
2.5	Universal Transverse Mercator (UTM) projection, projection distortion, preserving map properties.	02		
	Module – 3			
3.1	**Introduction to Remote Sensing, Satellites and Sensors** Definition of remote sensing, remote sensing process.	02		
3.2	Physics of remote sensing, electromagnetic energy, electromagnetic spectrum, black body radiation, laws governing electromagnetic radiation, atmospheric effects, scattering and absorption, Interaction with earth surface materials, spectral reflectance curves.	03		
3.3	Remote sensing platforms, satellites and orbits, geostationary and sun synchronous satellites, Earth resource satellites – IRS mission, LANDSAT, other satellite missions.	02		
3.4	Sensors – active and passive sensors, sensor resolutions (spectral, spatial, radiometric and temporal).	02		
	Module – 4			
4.1	**Recent Advances in Geoinformatics** Introduction to Global Positioning System (GPS), segments of GPS, working principle, satellite geometry, errors in GPS, differential GPS surveying, applications of GPS.	03		
4.2	Introduction to UAV photogrammetry, Geometry of vertical aerial photographs- scale, ground coordinates, relief displacement, photographic overlaps, flight planning.	03		
4.3	Drones – types, payloads, limitations, software and applications of UAVs in civil engineering projects.	03		
	Module – 5			
5.1	**Applications of Geoinformatics** Land use/cover mapping, Agriculture and forestry.	02		
5.2	Road and Bridge construction, Urban and regional planning applications - city planning, solid waste management.	02		
5.3	Applications in water resources and management, Environmental applications.	02		
5.4	Disaster management applications - Flood mapping, Pandemic hotspots analysis.	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,
2. John Wiley & Sons, 2012.
3. Burrough, P. A., McDonnell, R., McDonnell, R. A., & Lloyd, C. D. **"Principles of geographical information systems"**, 3rd Edition, Oxford university press, 2015.
4. Chang, K. T. **"Introduction to geographic information systems",** 9th Edition, Boston: McGraw-Hill Higher Education, 2019.

Reference Books:

1. Manoj K. Arora, R.C. Badjatia. **"Geomatics Engineering"**, Nemichand & Bros. Roorkee, 2011.
2. Panigrahi, N. **"Geographical information science"**. Universities press, 2009.
3. Reddy, M. A. **"Remote Sensing and Geographical Information Systems: An Introduction"**, 4th Edition, Book Syndicate, 2012.
4. DeMers, M. N. **"Fundamentals of geographic information systems"**, 4th Edition, John Wiley & Sons, 2008.

Online Resources:

1. https://nptel.ac.in/courses/107105088 NPTEL MOOC course on "**Geographic Information System**" IIT Kharagpur, Prof. Bharath H Aithal.
2. https://www.e-education.psu.edu/geog485/node/91
3. Geographic Information Systems OER by NPTEL - https://nptel.ac.in/courses/105107206
4. Open Web Mapping OER by Penn State - https://www.e-education.psu.edu/geog585/node/519

DETAILED SYLLABUS

VI SEMESTER

Code: **BCV601** **Course: Design of RCC Structures**
Credits: **4** **L:T:P 3:0:2**
SEE: **50%** **CIE: 50%**
SEE Hours: **3** **Max. Marks:100**

Prerequisites if any	NIL
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. 4. Acquire knowledge in analysis and design of RC elements.

Course Outcomes:

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

COs	**Course Outcomes**	**Bloom's level**
CO1	Understand the design philosophy and principles.	Understand
CO2	Solve problems of RC elements subjected to flexure, shear and torsion.	Apply
CO3	Demonstrate the procedure in designs of RC structural elements such as slabs, columns and footings.	Analyze

Mapping with POs and PSOs:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1	3													2		
CO2	3	2	3											3	1	
CO3	3	3	2		3							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			
1.1	Introduction to working stress and limit State Design: Introduction to working stress method,	1	-	-
1.2	Difference between Working stress and Limit State Method of design.	1	-	-

1.3	Philosophy and principle of limit state design with assumptions.	1	-	-
1.4	Partial Safety factors, Characteristic load and strength. Stress block parameters,	1	-	-
1.5	Concept of balanced section, under reinforced and over reinforced section.	1	-	-
1.6	Limiting deflection, short term deflection, long term deflection, Calculation of deflection of singly reinforced beam only.	2	-	-
	Module – 2			
2.1	Limit State Analysis of Beams: Analysis of singly reinforced,	3	-	-
2.2	doubly reinforced and flanged beams for flexure and shear.	3	-	-
	Module – 3			
3.1	Limit State Design of Beams: Design of singly reinforced beams with check for shear,	3	-	-
3.2	check for development length and other checks	3	-	-
3.3	Design of doubly reinforced beams and flanged sections without checks.	3	-	-
	Module – 4			
4.1	Limit State Design of Slabs and Stairs: Introduction to one way and two way slabs, Design of Cantilever, simply supported and one way continuous slab.	3	-	-
4.2	Design of two way slabs for different boundary conditions.	3	-	-
4.3	Design of dog legged and open well staircases	3	-	-
	Module – 5			
5.1	Limit State Deign of Columns and Footings: Analysis and design of short axially loaded RC column.	3	-	-
5.2	Design of columns with uniaxial and biaxial moments	3	-	-
5.3	Design concepts of the footings. Design of Rectangular and square column footings with axial load.	3	-	-
	List of Experiments:			
1	Calculation of deflection of singly reinforced beam using Excel	-	-	2
2	Design of a simply supported RCC singly reinforced beam using Excel and draw the reinforcement details	-	-	2
3	Design of a simply supported RCC doubly reinforced beam using Excel and draw the reinforcement details	-	-	2
4	Design of singly reinforced beams with check for shear, check for development length and other checks using Excel.	-	-	2
5	Design of a cantilever beam using Excel and draw the reinforcement	-	-	2
6	Design a simply supported RCC one way slab with intermediate support and	-	-	2

	draw the reinforcement details			
7	Design a two-way slab for the given data and prepare Bar bending schedule	-	-	2
8	Design a short axially loaded RC column using Excel	-	-	2
9	Design the reinforcement for RCC square column with isolated square footing	-	-	2
10	Design the reinforcement for RCC circular column with isolated square footing	-	-	2
	Total No. of Lecture Hours	40	-	-
	Total No. of Tutorial Hours		-	-
	Total No. of Practical Hours			**20**

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

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. Shah and S.R. Karve, “Limit State Theory & Design of Reinforced Concrete (I.S. 456 - 2000)”, Structures Publication.
4. 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: BCV602 **Course: Irrigation Engineering and Hydraulic Structures**
Credits: 4 **L: T:P 3:2:0**
SEE: 50% **CIE: 50%**
SEE Hours: 3 **Max. Marks:100**

Prerequisites if any	-Not Required-
Learning objectives	1. Analyse and design gravity dams. 2. Find the cross-section of earth dam and estimate the seepage loss. 3. Design spillways and aprons for diversion works. 4. Design CD works and chose appropriate canal regulation works.

Course Outcomes:

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

COs	Course Outcomes	Bloom's level
CO1	Know types of water retaining structures for multiple purposes and its key parameters considered for planning and designing.	Understand Apply
CO2	Understand details in any Irrigation System and its requirements	Understand Apply
CO3	Analyse and Design irrigation system components	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	2				3							3		
CO2	3	3	2				3							3		
CO3	3	3	3	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	**Storage works:** Reservoirs – Types of reservoirs, selection of site for reservoir, zones of storage of a reservoir.	3		
1.2	Reservoir yield, estimation of capacity of reservoir using mass curve- Reservoir Sedimentation, Life of Reservoir.	2	2	
1.3	Types of dams, factors affecting selection of type of dam, factors governing selection of site for a dam	2		
	Module – 2			
2.1	**Gravity dams:** Forces acting on a gravity dam, Causes of failure of a Gravity dam.	3	2	
2.2	Elementary profile and Practical profile of a gravity dam, limiting height of a low gravity dam	2		
2.3	Factors of Safety – Stability Analysis, Foundation for a Gravity Dam, drainage and inspection galleries.	3		
	Module – 3			
3.1	**Earth dams:** Types of Earth dams, causes of failure of earth dam, criteria for safe design of earth dam,	2		
3.2	seepage through earth dam-graphical method, measures for control of seepage. Spillways: types of spillways	2	2	
3.3	Design principles of Ogee spillways – Spillway gates. Energy Dissipaters and Stilling Basins	2		

3.4	Significance of Jump Height curve and Tail Water Rating Curve-USBR and Indian types of Stilling Basins	2		
	Module – 4			
4.1	**Diversion Head Works:** Types of Diversion head works- weirs and barrages, layout of diversion head work – components, Causes and failure of Weirs and Barrages on permeable foundations, -Silt Ejectors and Silt Excluders	3		
4.2	Weirs on Permeable Foundations – Creep Theories – Bligh's, Lane's and Khosla's theories.	2		
4.3	Determination of uplift pressure- Various Correction Factors – Design principles of weirs on permeable foundations using creep theories- exit gradient, U/S and D/S sheet piles - Launching Apron.	3	2	
	Module – 5			
5.1	**Canal Falls:** Types of falls and their location, Design Principles of Notch fall and Sarada type Fall.	3	2	
5.2	Canal Regulation Works, Principles of design of cross and distributary head regulators, types of Canal escapes – types of canal modules, proportionality, sensitivity, setting and flexibility.	3		
5.3	Cross Drainage works: types, selection of suitable type, various types, design considerations for cross drainage works.	3		
	Total No. of Lecture Hours	40		
	Total No. of Tutorial Hours		10	
	Total No. of Practical Hours			

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

1. Important Barrages of India
2. Provision of joints and water bars in R.C.C ducts in Aqueducts and Super passages
3. Design of a syphon well drop

Textbooks:

1. Irrigation Engineering and Hydraulic structures by Santhosh kumar Garg, Khanna Publishers.
2. Irrigation engineering by K. R. Arora Standard Publishers.
3. Irrigation and water power engineering by Punmia & Lal, Laxmi publications Pvt. Ltd., New Delhi

Reference Books:

1. Theory and Design of Hydraulic structures by Varshney, Gupta & Gupta
2. Irrigation Engineering by R.K. Sharma and T.K. Sharma, S. Chand Publishers 2015.
3. Irrigation Theory and Practice by A. M. Micheal Vikas Publishing House 2015.
4. Irrigation and water resources engineering by G.L. Asawa, New Age International Publishers.

Online Resources:

1. NPTEL Videos.

Code: **BCV605** **Course: Higher Surveying**
Credits: **3** **L:T:P 3:0:0**
SEE: **50%** **CIE: 50%**
SEE Hours: **3** **Max. Marks:100**

Prerequisites if any	Engineering Survey
Learning objectives	1. Develop an understanding of the principles of surveying using modern techniques 2. Apply geometric and trigonometric principles to field surveying calculations.

Course Outcomes:

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

COs	Course Outcomes	Bloom's level
CO1	Apply geometric and trigonometric principles to arrive at solutions to surveying problems.	Apply
CO2	Understand the concepts of LIDAR, RADAR and Photogrammetry.	Understand
CO3	Use the concepts of advanced data capturing methods necessary for engineering practice.	Analyze

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		
CO2	3				3									2	2	
CO3	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 to Total Station** Basic concepts of EDM, measurement of distance using phase difference, total station errors and accuracy (simple numerical problem), effect of atmospheric conditions.	2		
1.2	Total station setup and operation: Orientation with Angle, Orientation with Coordinates, Resection.	3		
1.3	Measuring coordinates (N,E) and heights/reduced levels (Z) with total station (simple numerical problem).	3		
	Module – 2			
2.1	**Introduction to Astronomical Surveying** Earth, celestial sphere, Earth and celestial coordinate systems	2		
2.2	Spherical triangle, astronomical triangle, Napier's rule	3		
2.3	Astronomical coordinate system: the horizon System, independent and dependent system, simple numerical problems	3		
	Module – 3			
3.1	**LIDAR and RADAR Systems** Basic definitions, LIDAR operation system and components, Distance Measurement in LIDAR system	3		

3.2	Introduction to microwave remote sensing, Overview of non-imaging and imaging microwave sensors, Scattering of Microwaves, Fundamentals of Synthetic Aperture Radar (SAR), Radar equation.	3		
3.3	Applications of LIDAR and RADAR systems.	2		
	Module – 4			
4.1	**Aerial Photogrammetry** Definitions, advantages, applications.	2		
4.2	Geometry of vertical aerial photographs over flat and variable terrain- scale, ground coordinates, relief displacement, photographic overlaps (simple numerical problems).	3		
4.3	Flight planning: procedure (simple numerical problems)	3		
	Module – 5			
5.1	**Unmanned Aerial System** UAS History, UAS System overview, UAS Status, classification of the UAS, Missions of the UAVs	2		
5.2	The Air Vehicle, command and control element, Payload and sensors	2		
5.3	Obstacle to UAS Operations, Guidelines to UAS Operations, UAS Challenges, UAS Safety and Privacy Concerns	2		
5.4	Indian scenario - Remote Pilot License, process flow chart Unique Identification Number (UIN) and application flow chart, various government schemes.	2		
	Total No. of Lecture Hours	**40**		
	Total No. of Tutorial Hours		**--**	
	Total No. of Practical Hours			**--**

Self-learning topics identified:

1. Total station for Tunnel boring applications.
2. Ground penetration radar survey.
3. Inter-planetary space missions.
4. Introduction to digital photogrammetry.

Textbooks:

1. K.R. Arora, “Surveying (Vol. 1, 2 & 3)” Standard Book House, New Delhi. – 2010
2. F. T. Ulaby, Richard, K. M., Adrian K. F., “Microwave Remote Sensing Active and Passive” – 2000.
3. Fahlstrom P, Gleason T, “Introduction to UAV systems”, 4th edn. Wiley, UK – 2012.

Reference Books:

1. Eugene A Sharkov “Passive microwave remote sensing of the Earth” - 2014.
2. P.R. Wolf, “Elements of Photogrammetry”, McGraw Hill Publications – 2009.

Online Resources:

1. https://www.e-education.psu.edu/geog892/node/508
2. https://digitalsky.dgca.gov.in/home
3. DGCA RPAS Manual and OER Geospatial Applications of Unmanned Aerial Systems (UAS)
4. Introduction to LiDAR Technology: click here
5. Basics of LiDAR by NOAA
6. NPTEL Course on Microwave Remote Sensing

Code: **BCV606** **Course: Environmental Hydrology**
Credits: **3** **L: T:P 3:0:0**
SEE: **50%** **CIE: 50%**
SEE Hours: **3** **Max. Marks:100**

Prerequisites if any	------
Learning objectives	• Understand the hydrological processes and their effect on environment • Understand flood and drought management and their impacts on water resources. • Understand ground water flow, contamination and its remediation

Course Outcomes:

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

COs	Course Outcomes	Bloom's level
CO1	Identify and analyse natural processes within the hydrological cycle and their impact on the environment	Understand Analyze
CO2	Comprehend the process of flood and drought and its effective management	Understand Apply
CO3	Understand Groundwater movement in aquifers and develop strategies for sustainable groundwater management.	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					2							3	2	
CO2		3					2							3	2	
CO3	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	**Hydrology:** Introduction, Importance of environmental hydrology, Implications of climate change on hydrological cycle.	03		
1.2	Principles of surface water and ground water flow, Watershed delineation and characteristics.	03		
1.3	Interaction between hydrology and ecosystem, Water balance in ecosystem.	02		
	Module – 2			
2.1	Runoff generation process, factors influencing runoff generation and Runoff Characteristics (rainfall intensity and drainage basin)	03		
2.2	**Storm flow** - estimation through rational method (inclusive of concepts of Time of concentration, use of rainfall intensity curves, etc.)	03		
2.3	Fate and behavior of pollutants in Runoff (Sorption, transformation and degradation)	03		
	Module – 3			
3.1	**Floods:** Importance of flood studies, definition of flood, types of floods, causes of flood, factors affecting flood flow.	03		
3.2	Estimating the magnitude and frequency of floods.	03		

3.3	**Drought management**: Definition of drought, causes of drought, drought contingency planning, impacts of drought on water resources	03		
	Module – 4			
4.1	**Groundwater Hydrology** - Aquifer properties and groundwater flow.	03		
4.2	Groundwater exploration and well hydraulics -Numerical	03		
4.3	Contamination and remediation of groundwater resources, control of overdraft of ground water.	02		
	Module – 5			
5.1	Environmental impacts of hydrological projects (dams, irrigation schemes, Urban development) and its mitigation.	03		
5.2	Altered flow regimes and impacts on biodiversity.	03		
5.3	Impact of land use/land cover changes on hydrology	02		
	Total No. of Lecture Hours	**42**		
	Total No. of Tutorial Hours		**-**	
	Total No. of Practical Hours			**-**

Textbooks:

1. Andy D. Ward., “Environmental Hydrology" 3rd edition CRC Press, 2015.

Reference Books:

1. Ward A D., “Environmental Hydrology",3rd edition 2015
2. Jayarami Reddy P., “A textbook of Hydrology” - Lakshmi Publications, Delhi – 2011
3. Subramanya K., “Engineering Hydrology”-Tata McGraw Hill, New Delhi. – 2010
4. S.N.Ghosh., “Environmental Hydrology and Hydraulics” Science publishers-2006

Online Resources:

1. https://archive.nptel.ac.in/courses/105/103/105103213/
2. https://archive.nptel.ac.in/courses/105/105/105105042/

Code: BCVL607 **Course: Software Application Lab**
Credits: 1 **L: T:P 0:0:2**
SEE: 50% **CIE: 50%**
SEE Hours: 3 **Max. Marks:100**

Prerequisites if any	NA
Learning objectives	1. Understand the elements of finite element modelling, specification of loads and boundary condition, performing analysis and interpretation of results for final design 2. Develop customized automation tools

Course Outcomes:

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

COs	Course Outcomes	Bloom's level
CO1	Use software for analysis and design of structural elements	L3
CO2	Model and analyze structural elements of buildings	L3
CO3	Analyze and design using excel spread sheet	L3

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1	2	2	1		2									2	1	
CO2	2	2	1		2									2	1	
CO3	2	2	1		2									2	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	Analysis of plane trusses, continuous beams using software	NA	NA	4
2	Analysis of portal frames using software	NA	NA	2
3	Understanding basic features of Project management software. Constructing Project: create WBS, Activities, and tasks and computation time using Excel spread sheet and transferring the same to Project management software	NA	NA	4
4	Identification of Predecessor and Successor activities with constrain. Constructing Network diagram (AON Diagram) and analyzing for Critical path	NA	NA	2
5	Critical activities and Other non-Critical paths, Project duration, Floats. Study on various View options available	NA	NA	4
6	Basic understanding about Resource Creation and allocation. Understanding about Splitting the activity, linking multiple activity, assigning Constrains, Merging Multiple projects, Creating Baseline Project	NA	NA	4
7	GIS applications using open-source software: To create shape files for point, line and polygon features with a map as reference. To create decision maps for specific purpose	NA	NA	4
8	Computation of earthwork, Design of horizontal curve by offset method, Design of super elevation Using Excel	NA	NA	4
	Total No. of Lecture Hours	NA	NA	NA
	Total No. of Tutorial Hours		NA	NA
	Total No. of Practical Hours			**28**

Suggested Learning Resources:

Training manuals and User manuals and Relevant course reference books.

ELECTIVES

Code: BCV613A **Course: Design of Bridges**
Credits: 3 **L:T:P 3:0:0**
SEE: 50% **CIE: 50%**
SEE Hours: 3 **Max. Marks:100**

Prerequisites if any	Analysis of Structures, Design of RC structures,
Learning objectives	1. Introduce the aspects of bridge structures and design small span bridges based on the requirements 2.To introduce the stability aspects of sub-structures of bridges.

Course Outcomes:

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

COs	Course Outcomes	Bloom's level
CO1	Understand the selection criteria for the construction of different types of bridges.	Understand
CO2	Design pipe culverts, box culverts and deck slabs based on critical loads	Design
CO3	Analyse the stability of bridge piers and abutments	Analyze

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												3	
CO3		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 and Conceptual Design of Bridges** Components of a bridge and their functions, Site investigations prior to bridge construction, classification of bridges,	2		
1.2	IRC loading standards, IRC A, AA, and 70 R.	1		
1.3	Hydraulic design of bridges,	2		
1.4	Natural and artificial water ways,	2		
1.5	Afflux, Economical span,	1		
	Module – 2			
2.1	**Culverts:** Pipe culverts. Hydraulic design and structural design, IRC standards. Design problems	3		
2.2	Design of Box culverts, general procedure of design for all the conditions of culvert	4		
2.3	Reinforcement details of box culverts	1		
	Module – 3			
3.1	**Design of Deck slab (Limit state method)** Effective dispersion of wheel load along the span and effective width concept	1		
3.2	Arrangement of wheel loads of IRC A for obtaining maximum bending moment and shear force with design example.	2		

3.3	Arrangement of IRC class 70R wheeled vehicle for obtaining maximum bending moment and shear force with design example.	2		
3.4	Arrangement of IRC class 70R Tracked vehicle for obtaining maximum bending moment and shear force with design example.	2		
	Module – 4			
4.1	**Introduction to T-beam bridges** Code provisions, typical arrangement of longitudinal and cross girders	2		
4.2	Pigeaud's method, design of interior panel (for IRC class A & 70R)	3		
4.3	Methods for finding load distribution among longitudinal girders using Courbon's, Hednry Jaguer's method, (only design concepts)	4		
	Module – 5			
5.1	**Bridge substructures, abutments and Piers:** Types of abutments and piers	1		
5.2	Stability analysis of piers and abutments	3		
5.3	Base pressure distribution	2		
5.4	Bridge bearings, types and their suitability.	2		
	Total No. of Lecture Hours	40		
	Total No. of Tutorial Hours			
	Total No. of Practical Hours			

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

1. Maintenance and rehabilitation of Bridges
2. Seismic design of highway bridges
3. Seismic design of railway bridges

Textbooks:

1. D. Johmson Victor, "Essentials of Bridge Engineering", 6th edition, Oxford IBH publications, New Delhi, 2019
2. T.R.Jagadeesh & M A Jayaram, Design of Bridge Structures, 4th edition, PHI, New Delhi, 2020,
3. N. Krishna Raju, "Design of Bridges", 5th Edition, Oxford & IBH Publishing, 2019

Reference Books:

1. Rajagopalan, Bridge Super Structures, Narosa Publishing House, 2013
2. IRC: 112- 2020: Code of Practice for Concrete Bridges, July 2020, New Delhi
3. IRC:6, IRC: 20; IS 458

Online Resources:

1. https://archive.nptel.ac.in/courses/105/105/105105216/
2. https://archive.nptel.ac.in/courses/105/105/105105165/

Code: BCV613B **Course: Design of formwork and scaffolding**
Credits: 3 **L:T:P 2:2:0/ 3:0:0**
SEE: 50% **CIE: 50%**
SEE Hours: 3 **Max. Marks:100**

Prerequisites if any	
Learning objectives	1. To select the appropriate formwork system 2. To design the formwork system 3. To compute the bill of quantity for the formwork system 4. To incorporate safer design and construction aspects including assembling and dismantling to prevent formwork failures 5. To comprehend plan, layout and detailed drawing for formwork systems

Course Outcomes:

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

COs	**Course Outcomes**	**Bloom's level**
CO1	Analyse the project and decide appropriate formwork materials and suitable formwork system	Analyze
CO2	Design formwork systems as per industrial requirement	Evaluate
CO3	Estimate the bill of quantity and optimize the formwork cost	Apply
CO4	Prepare the layout and detailed drawing for the formwork system	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				1					1			3	1	-
CO2	3	2	3			2					1			3	2	-
CO3	3	2									1	1		3	2	3
CO4	3	2				2					1	1		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 to formwork:** Classification, benefits, objectives, areas of competitiveness	2	-	-
1.2	Selection of Formwork, formwork materials, accessories and consumables, application of Tools.	1	-	-
1.3	Formwork for Foundation, Wall, Columns, Slab and Beam. Conventional drawings.	1	-	-
1.4	Vertical Application of Conventional Foundation Formwork, Formwork components, Components, assembly and de-shuttering of formwork System,	2	-	-
1.5	Flex System, Heavy Duty Tower System, safety of work, Formwork for stairs, Load Bearing Tower.	2	-	-
	Module – 2			
2.1	**Planning and Design of formwork:** Formwork planning and monitoring, basics of formwork design, design assumptions and design methods.	3	-	-
2.2	Design of wall formwork, slab formwork and checks.	3	-	-
2.3	Formwork drawing Concept and Preparation Guidelines, BOQ Calculation and	3	-	-

	Checklist.			
	Module – 3			
3.1	**Formwork cost estimation and optimization:** Schedule of formwork, Mobilization distribution,	2	-	-
3.2	BOQ, Quantity Calculation,	3	-	-
3.3	Cost optimization	3	-	-
	Module – 4			
4.1	**Modular and Special formwork, scaffolding Modular and Special formwork:** Advantages and Limitations, Shuttering and de-shuttering, applications,	2	-	-
4.2	Aluminum formwork - Drawings & Components, Activities, High rise construction, Table lifting system.	2	-	-
4.3	Scaffolding: Modular scaffold Installation sequence, Tie and material specification,	2	-	-
4.4	Ladder safety, Loading Classification, application,	1	-	-
4.5	Components of L&T Modular Scaffolding system, Access scaffold Do's and Don'ts. Innovation and Global practices	2	-	-
	Module – 5			
5.1	Formwork building and erection, Formwork assembly for Wall & Column Panels, Equipment	2	-	-
5.2	and Layout, Plant and Machinery, Formwork erection and safety, Inspection and Corrections,	1	-	-
5.3	Plant and Machinery, Code and Contractual Requirements.	1	-	-
5.4	Formwork Failures: Causes, design deficiency, safety in formwork, prevention of formwork failures.	2	-	-
	Total No. of Lecture Hours			
	Total No. of Tutorial Hours			
	Total No. of Practical Hours			

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

NIL

Textbooks:

1. Jha, K.N., Formwork for Concrete Structures, First Edition, McGraw Hill. 2012
2. Robert L. Peurifoy and Garold D. Oberiender, Formwork for Concrete Structures, McGraw-Hill, 1996.

Reference Books:

1. IS 14687 -Guidelines for falsework for concrete structures
2. Concrete pressure on formwork (R108D) - CIRIA 5.
3. IS 456: Plain and Reinforced Concrete - Code of Practice

Online Resources:

1. NPTEL and YouTube Videos.

Code: BCV613C **Course: Applied Geotechnical Engineering**
Credits: 3 **L:T:P 3:0:0**
SEE: 50% **CIE: 50%**
SEE Hours: 3 **Max. Marks:100**

Prerequisites if any	
Learning objectives	1. Learn concepts of Geotechnical investigations required for civil engineering projects emphasizing in situ investigations, bearing capacity of soil and their application in the design of shallow foundations and deep foundations. 2. Estimate internal stresses in the soil mass, assessing stability of slopes and earth pressure on rigid retaining structures.

Course Outcomes:

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

COs	Course Outcomes	Bloom's level
CO1	Ability to plan and execute geotechnical site investigation programs for different civil engineering projects.	Apply
CO2	Understanding of stress distribution beneath the loaded footings on sand and clayey soils	Analyze
CO3	Ability to estimate factor of safety against failure of slopes and to compute lateral pressure distribution behind earth retaining structures	Analyze

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1	2			3		2				3		3		3		1
CO2	2	3	3											3		1
CO3		2	3	3	3		3					2		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, Objectives and Importance, Stages and Methods of exploration- Test pits, Borings, stabilization of boreholes, Sampling techniques	4		
1.2	Undisturbed, disturbed and representative samples, sample disturbance and Borehole log.	4		

Module – 2				
2.1	Drainage and Dewatering methods	3		
2.2	Estimation of depth of GWT (Hvorslev's method) Flownets: Importance, properties and applications,	2		
2.3	Phreatic Lines ,Seepage in earth dams.	3		
Module – 3				
3.1	Active, Passive and earth pressure at rest	2		
3.2	Rankine's theory for cohesionless and cohesive soils, Factors influencing lateral earth pressure.	3		
3.3	Geotechnical design of gravity and cantilever retaining walls.	3		
Module – 4				
4.1	Assumptions, infinite and finite slopes, factor of safety.	2		
4.2	Swedish slip circle method for C and C-ø (Method of slices) soils, Fellineous method for critical slip circle, Use of Taylor's stability charts	4		
4.3	Causes for slope instability, Methods of stabilization of slopes	2		
Module – 5				
5.1	Geostatic stress and Stress due to structures.	2		
5.2	Boussinesq's Stress distribution in ground for point load, line load and uniformly distributed loads	4		
5.3	Contact Pressure, Pressure Bulbs	2		
	Total No. of Lecture Hours	40		
	Total No. of Tutorial Hours			
	Total No. of Practical Hours			

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

1. Determination of number and depth of boreholes
2. Newmark's Chart
3. Rebban's graphical method for active earth pressure

Textbooks:

1. . Murthy V.N.S., Principles of Soil Mechanics and Foundation Engineering,UBS PublishersandDistribu tors, NewDelhi.
2. K.R.Arora, Soil Mechanics and Foundation Engineering, Standard Publisher Distributors, NewDelhi.
3. PC Varghese, Foundation Engineering, PHI India Learning Private Limited, NewDelhi.
4. Punmia BC, Soil Mechanics and Foundation Engineering (2017), 16th edition, LaxmiPublicationsco., New Delhi.

Reference Books:

1. T.W. Lambe and R.V. Whitman, Soil Mechanics-, John Wiley & Sons.
2. Donald P Coduto, Geotechnical Engineering- Phi Learning Private Limited, New Delhi.
3. Malcolm D Bolton, “A Guide to soil mechanics”, Universities Press.,
4. Bowles J E , Foundation analysis and design, McGraw- Hill Publications.
5. Bureau of Indian Standards: IS-1904, IS-6403, IS-8009, IS-2950, IS-2911 and all other relevant codes.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc22_ce96

Code: BCV613D **Course: Special Concretes Construction Chemicals**
Credits: 3 **L:T:P 3:0:0**
SEE: 50% **CIE: 50%**
SEE Hours: 3 **Max. Marks:100**

Prerequisites if any	Concrete Technology
Learning objectives	1. To acquire knowledge on various new types of concrete 2. To be able to identify usage of construction chemicals.

Course Outcomes:

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

COs	Course Outcomes	Bloom's level
CO1	Describe specification of various new age concrete	Understand
CO2	Describe advantages of property modifying chemical used during construction	Apply

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1	03													03		
CO2		03	03												03	

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	Review of Concrete Technology: Components of modern concrete and developments in the process and constituent materials	03	-	-
1.2	Role of constituents, Development in cement, and cement replacement materials, pozzolona, fly ash, silica fume, rice husk ash, recycled aggregates.	03	-	-
	Module – 2			
2.1	Light Weight Concrete-Introduction, classification, properties,	03	-	-
2.2	Light Weight Concrete-strength and durability, mix proportioning	03	-	-
2.3	High Density Concrete-Radiation shielding ability of concrete, materials for high density concrete,	03	-	-
2.4	High Density Concrete-mix proportioning, properties in fresh and hardened state, placement methods.	03	-	-
	Module – 3			
3.1	Ferro Cement: Ferrocement materials, mechanical properties, cracking of ferrocement, strength and behavior in tension,	03	-	-
3.2	compression and flexure, Design of ferrocement in tension, Ferrocement constructions, durability.	03	-	-
3.3	Fibre Reinforced Concrete: Fibre materials, mix proportioning, distribution and orientation, interfacial bond, properties in fresh state,	03	-	-
3.4	strength and behavior in tension, compression and flexure of steel fibre reinforced concrete, mechanical properties,	03	-	-

	Crack arrest and toughening mechanism.			
Module – 4				
4.1	High Performance Concrete: constituents, Properties in fresh and hardened states, applications and limitations.	02	-	-
4.2	Ready Mixed Concrete-QCI-RMCPC scheme requirements,	02	-	-
4.3	Self Compacting Concrete (SCC) - general characteristics, properties, microstructure, robustness, and Methods of mix proportioning, and its applications.	02	-	-
4.4	Reactive Powder Concrete: Introduction, Polymers Concrete: Introduction and types.	02		
Module – 5				
5.1	Introduction on Chemical and Mineral Admixtures; Accelerators; Retarders; Plasticizers: Introduction, Categories, Chemical Composition and Manufacture of Water Reducers; use of water reducers/retarders;	02	-	-
5.2	Superplasticizers: Background and definitions, the chemistry of superplasticizers Effects of superplasticizers on the properties of concrete.	02	-	-
	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. Mix proportioning of Concrete per IS 10262: 2019
2. Application of Light Weight Concrete and High Density Concrete
3. Applications of FRC and Ferro Cement
4. Bacterial Concrete Constituents

Textbooks:

1. Shetty M. S., “Concrete Technology - Theory & Practice”, S. Chand and Company, New Delhi-2002

Reference Books:

1. N. Krishnaraju., “Concrete mix Design”, Sehgal Publishers 2009.
2. Neville, A.M., “Properties of Concrete”, ELBS, London 2000.
3. Ramachandran, V.S., “Concrete admixtures handbook: properties, science and technology”, William Andrew – 1996.
4. Roger Rixom and Noel Mailvaganam., “Chemical admixtures for concrete”, 3rd edition,CRC Press, 1999
5. Relevant IS codes

Online Resources:

1. Development and Applications of Special Concretes - Course (nptel.ac.in)
2. Admixtures And Special Concretes - Course (nptel.ac.in)
3. Concrete Technology - Course (swayam2.ac.in)

Code: BCV613E **Course: Construction Surveying**
Credits: 3 **L:T:P 3:0:0**
SEE: 50% **CIE: 50%**
SEE Hours: 3 **Max. Marks:100**

Prerequisites if any	Surveying
Learning objectives	1. Understand the roles of a site engineer and principles underlying surveying controls 2. Comprehend the usage of recent improved techniques for construction industry

Course Outcomes:

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

COs	Course Outcomes	Bloom's level
CO1	Describe and follow the procedures required for setting out works	Understand
CO2	Apply horizontal and vertical control techniques for setting out operations	Apply
CO3	Summarize the importance of virtual site inspection procedures and usage of advanced technologies in construction site	Understand

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2											2		
CO2		3											2		
CO3	2				3								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	**Introduction** Construction surveying, role of surveying in civil engineering practice, typical responsibilities of a construction surveyor,	02		
1.2	Skills required, Reading maps and drawings, Equipments for construction surveying; Levels, theodolite, total station, GPS, Laser levels	02		
1.3	Horizontal control and vertical control Techniques	02		
1.4	Reference grids, base line, offsets, marking control stations, reference pillars, marking corners and lines.	02		

Module – 2				
2.1	**Setting out works** Setting out buildings and structures.	02		
2.2	Conventional and coordinate methods, usage of Theodolite, Total Station and GPS in setting out.	02		
2.3	Measurement and methods of setting out for various Civil Engineering structures, slopes and grades and pipe lines.	02		
2.4	Controlling and checking verticality in tall structures.	02		
Module – 3				
3.1	**Route and Tunnel surveys** Route surveys, alignments, procuring GTS bench marks/establishing DGPS control points.	02		
3.2	Traversing and other surveys.	01		
3.3	Tunnels, Surface and underground alignments,	02		
3.4	Transferring surface alignment through vertical shafts, transferring levels.	02		
3.5	Use of laser instruments and laser/total station guided tunnel boring machines.	01		
Module – 4				
4.1	**Site Inspection and Building Information Surveying** Need for site inspection, Virtual site inspection	02		
4.2	Virtual reality and virtual environments – Augmented reality in construction industry.	02		
4.3	3D scanning to track progress, automated scan-to-BIM inspection, Methods for preventing delays, Identifying future problems.	02		
4.4	Building information modelling, role of artificial intelligence in BIMs, Automated data handling process.	02		
Module – 5				
5.1	**Advanced Construction Surveying Techniques** Digital capture of construction data, digital image processing and recognition,	01		
5.2	Use of laser scanners for 3D modelling and designing. Point Cloud registration, visualisation and laser data analysis.	02		
5.3	Drone technology, Photogrammetry - Geometry of vertical aerial photographs- scale, ground coordinates, relief displacement, photographic overlaps, flight planning. Role of UAV's in construction projects, payloads and sensors.	03		
5.4	Application of UAV's in road, dam and building construction.	02		

Total No. of Lecture Hours	**40**		
Total No. of Tutorial Hours		**--**	
Total No. of Practical Hours			**--**

Self-learning topics identified:

1. Use of laser level in construction
2. Data collection apps for construction surveys
3. Computer aided earth work calculations

Textbooks:

1. A.M. Chandra. "**Higher Surveying**" New Age International Publishers, 2007.
2. Uren, John, William Frank Price. "**Surveying for engineers**". Macmillan International Higher Education, 2010.
3. Tal, Daniel, and Jon Altschuld. "**Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation**". John Wiley & Sons, Incorporated, 2021.

Reference Books:

1. James M Anderson, Edward M Mikhail., "**Introduction to Surveying**", McGraw Hill Publications, 1984.
2. S.K. Roy., "**Fundamentals of Surveying**", Prentice Hall of India New Delhi, 2009.
3. Kavanagh, Barry F., Dianne Kay Slattery., "**Surveying: with construction applications**". Upper Saddle River, NJ: Pearson, 2010.
4. Taylor, Gil L., "**Construction codes and inspection handbook**". McGraw-Hill Professional, 2006.
5. Whyte, Jennifer, and Dragana Nikolić., "**Virtual reality and the built environment**". Routledge, 2018.

Online Resources:

1. https://archive.nptel.ac.in/courses/105/103/105103176/ NPTEL MOOC course on "**Introduction to Higher Surveying**", Prof. Ajay Dashora.
2. https://archive.nptel.ac.in/courses/105/107/105107158/ NPTEL MOOC course on "**Digital Land Surveying and Mapping**", Prof. Jayanta K Ghosh, IIT Roorkee.

Code: BCV613F **Course: Pavement Evaluation and Management**
Credits: 3 **L:T:P 3:0:0**
SEE: 50% **CIE: 50%**
SEE Hours: 3 **Max. Marks:100**

Prerequisites if any	1. Transportation Engineering 2. Highway Construction and Maintenance
Learning objectives	1. Gain knowledge of evaluating pavement surface and structural condition. 2. Gain knowledge of pavement management systems.

Course Outcomes:

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

COs	Course Outcomes	Bloom's level
CO1	Describe various pavement distresses, pavement structure and to evaluate the surface condition	Understand
CO2	Evaluate the pavement structural condition and to apply the expert systems for pavement management.	Apply

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3	PSO4
CO1	3	3												3	3		
CO2	3	3	3								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: Structural and functional requirements of flexible and rigid pavements.	02	-	-
1.2	Pavement distress; different types of failures, causes and remedial measures.	02	-	-
1.3	Pavement Surface Condition: Various aspects of surface and their importance.	02	-	-
1.4	Factors affecting deterioration and measures to reduce: (i) Pavement slipperiness (ii) Unevenness (iii) Ruts, pot holes and cracks.	02	-	-
	Module – 2			
2.1	Evaluation of Surface Condition: Methods of measurement of skid resistance using portable and dynamic methods, unevenness, ruts and cracks.	03	-	-
2.2	Pavement surface condition evaluation by physical measurements by Profilograph, 5th wheel Bump Integrator.	03	-	-
2.3	ROMDAS and other methods and their applications; Micro paver and applications.	03	-	-
	Module – 3			
3.1	Pavement Structure Factors affecting structural condition of flexible and rigid pavements.	02	-	-

3.2	Effects of subgrade soil, moisture, pavement layers, temperature, environment and traffic on structural stability.	02	-	-
3.3	Pavement deterioration.	02	-	-
	Module – 4			
4.1	Evaluation of Pavement Structural Condition: Evaluation by non-destructive tests: FWD, Benkelman Beam rebound deflection,	04	-	-
4.2	Plate load test, wave propagation and other methods.	03	-	-
4.3	Evaluation by destructive test methods, and specimen testing	03	-	-
	Module – 5			
5.1	Pavement Management: Components of pavement management systems, pavement maintenance measures,	02	-	-
5.2	Pavement Preservation Programmes, Techniques and Tools.	02	-	-
5.3	Role of computers in pavement management, applications of expert systems for managing pavements, expert system for pavement evaluation and rehabilitation	03	-	-
	Total No. of Lecture Hours	**40**	-	-
	Total No. of Tutorial Hours		-	-
	Total No. of Practical Hours			**-**

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

1. Maintenance measures to reduce pavement distresses
2. Standards for surface condition
3. Basic Structural Response Models
4. Application of HDM

Textbooks:

1. Ralph Haas and Ronald W. Hudson, “Pavement Management System”, McGraw Hill Book

Reference Books:

1. Ralph Haas, Ronald Hudson and Zanieswki, “Modern Pavement Management”, Kreiger Publications, 2000.
2. David Croney, “The Design and Performance of Road Pavements”, HMSO Publication

Online Resources:

1. https://nptel.ac.in/courses/105104098
2. https://www.youtube.com/watch?v=lDv67Eppaos

Code: BCV613G **Course: Industrial Waste Water Treatment**
Credits: 3 **L: T:P 3:0:0**
SEE: 50% **CIE: 50%**
SEE Hours: 3 **Max. Marks:100**

Prerequisites if any	Waste water engineering
Learning objectives	1. To provide an understanding of the mechanisms and processes used to treat waters that have been contaminated by industrial activity prior to its release into the environment or its re-use. 2. To understand various technologies used in industrial wastewater treatment and to acquaint with different steps involved in treatment of industrial wastewater.

Course Outcomes:

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

COs	Course Outcomes	Bloom's level
CO1	Understand the concept of industrial wastewater quality and impact. of untreated effluents on the receiving environment	Understand
CO2	Comprehend various advanced treatment methods to treat industrial wastewater	Understand
CO3	Understand various methods of treatment available for selected industrial wastes	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				2	2							3		
CO2	3													3		
CO3	3						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	**Introduction**: Difference between Domestic and Industrial Wastewater, Effect on Streams and on Municipal Sewage Treatment Plants.	02		
1.2	**Quality:** Stream quality, Dissolved Oxygen Sag curve in Stream, Streeter-Phelps formulation, Numerical Problems	03		
1.3	Stream Sampling, Effluent and stream Standards and Legislation to Control Water Pollution. Waste minimization strategies – Zero discharge concept	03		
	Module – 2			
2.1	**Treatment Methods:** Volume Reduction, Strength Reduction, Neutralization, Equalization and Proportioning	03		
2.2	Removal of Inorganic and organic solids, Removal of colloidal and suspended.	03		

	Solids, oil separation.			
2.3	**Combined Treatment:** Feasibility of combined Treatment of Industrial Raw Waste with Domestic Waste. Treatment and Disposal of Sludge Solids.	02		
	Module – 3			
3.1	**Advanced Waste Treatment Methods** - Nitrification and De-Nitrification- Phosphorous removal -Heavy metal removal - Membrane Separation Process - Air Stripping and Absorption Processes.	03		
3.2	Chemical oxidation, ozonation, wet air oxidation, ion exchange process	03		
3.3	**Treatment process of Industrial Wastes:** Process flow sheet showing origin/sources of wastewater, Characteristics of waste, alternative treatment methods, disposal, reuse, and recovery along with flow sheet. Effect of disposal on receiving bodies - streams and land.	02		
	Module – 4			
4.1	**Treatment of Selected Industrial Wastes:** Cotton Textile Industry. Tanning Industry	03		
4.2	Canning Industry, Brewery and Distillery Industry	03		
4.3	Sugar Industry, Paper, and Pulp Industry	03		
	Module – 5			
5.1	**Treatment of Selected Industrial Wastes:** Food Processing Industry, Dairy Industry	03		
5.2	Pharmaceutical Industry, cement, and steel factories Industry	03		
5.3	Oil refineries Industry, fertilizers Industry	03		
	Total No. of Lecture Hours	42		
	Total No. of Tutorial Hours		---	
	Total No. of Practical Hours			---

Textbooks:

1. Nemerow, N.L. “Industrial Wastewater Treatment.” Edison–Wesley 1980

Reference Books:

1. Haward. S Peavy, Donald R Rowe, Environmental Engineering – George Tchnobanglous McGraw Hill International Ed. - 1987
2. Arceivala S.J. “Wastewater treatment for pollution control” 1990
3. Vivek Ranade, Vinay Bhandari , “Industrial Wastewater Treatment, Recycling and Reuse”. ISBN: 9780080999685

4. M.N Rao . A.K Datta’ “Wastewater Treatment” Oxford & IBH Publishing Company Pvt Ltd. ISBN: 9878117120

Online Resources:

1. NPTEL course by By Prof. Alok Sinha, Prof. S K Gupta , IIT Dhanbad titled “Industrial Wastewater Treatment”

Code: BCV654A **Course: Repair and Rehabilitation of Structures**
Credits: 3 **L:T:P 3:0:0**
SEE: 50% **CIE: 50%**
SEE Hours:3 **Max. Marks:100**

Prerequisites if any	Design of Reinforced concrete structures, Concrete Technology.
Learning objectives	1. To determine causes of deterioration of concrete and steel in structural elements. 2. To Assess existing conditions of buildings. 3. Evaluate structures & suggest methods of repair and strengthening methods.

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

COs	Course Outcomes	Bloom's level
CO1	Investigate the cause of deterioration of concrete structures.	Understand
CO2	Strategies for different repair and rehabilitation of structures.	Apply
CO3	Evaluate the performance of the elements as well as materials for repair.	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		2										3		
CO2	3	2												1		
CO3	3	2	2	2										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	**The Challenge of Renovation / Rehabilitation** Terminology, When to Renovate, Beginning a Renovation Project,	2	-	-
1.2	Typical Structural Challenges,	2	-	-
1.3	Physical and Chemical Causes of deterioration of concrete structures,	2	-	-
1.4	Evaluation of structural damages to the concrete structural elements due to earthquake.	2	-	-
Module – 2				

2.1	**Damage Assessment:** Purpose of assessment, Rapid assessment,	2	-	-
2.2	Investigation of damage, Evaluation of surface and structural cracks,	2	-	-
2.3	Damage assessment procedure, Destructive tests	2	-	-
2.4	Non-destructive tests and semi destructive testing systems	2	-	-
	Module – 3			
3.1	**Repairing Deteriorated Concrete** Overview, Cracks in concrete and Repairing cracks.	2	-	-
3.2	Corrosion of Reinforcement and its Effects on concrete, Patching spalls and Deteriorated Areas.	2	-	-
3.3	Cathodic and Anodic – Protection and Electrochemical Chloride Extraction.	2	-	-
3.4	Corrosion Inhibitors, Other types of Damage to concrete.	2	-	-
3.5	Materials for concrete Repair, Durability of Repairs.	2	-	-
	Module – 4			
4.1	**Rehabilitation of Concrete Structures** Method of repair & restoration – patch repair, pressure grouting, guniting shotcreting.	1	-	-
4.2	Retrofitting of structural members i.e., columns and beams by Jacketing technique.	2	-	-
4.3	Externally bonding (ERB) technique, near surface mounted (NSM) technique.	2	-	-
4.4	External post- tensioning, Section enlargement and guidelines for seismic rehabilitation of existing building.	2	-	-
	Module – 5			
5.1	**Renovating Steel-Framed Buildings** Steel: The Venerable Material, Past Design Methods and Allowable Stresses for iron and steel Beams.	2		
5.2	Early Iron and Steel Columns, Properties of Early Fasteners, Open- Web Joists, Strengthening Floors.	2		
5.3	Reinforced Steel Members by Welding, Reinforced Beams by Composite Action with Concrete, Strengthening Beams Connections.	3		
5.4	Composite Steel-Concrete Columns, Openings in Existing Steel Beams, Thermal Prestressing of Steel Structures.	2		
	Total No. of Lecture Hours	42		
	Total No. of Tutorial Hours			

Total No. of Practical Hours	

Textbooks:

1. Newman, Alexander. Structural Renovation of Buildings Methods, Details, and Design Examples. McGraw Hill, 2021.
2. Johnson, Sidney M. Deterioration, Maintenance, and Repair of Structures. R.E. Krieger Pub. Co., 1981.
3. Campbell-Allen, Denison, and Harold Roper. Concrete Structures: Materials, Maintenance and Repair. Harlow, Essex, 1991.

Reference Books:

1. R.T. Allen and S.C. Edwards, “Repair of Concrete Structures”-
2. Blakie and Sons Raiker R.N., “Learning for failure from Deficiencies in Design, Construction and Service”- R&D Centre (SDCPL).

Online Resources:

1. NPTEL Course: https://archive.nptel.ac.in/courses/105/105/105105213/

Code: BCV654B **Course: Satellite Sensing and GIS**
Credits: 3 **L:T:P 3:0:0**
SEE: 50% **CIE: 50%**
SEE Hours: 3 **Max. Marks:100**

Prerequisites if any	Highschool Geography, Surveying.
Learning objectives	1. Outline basic concepts of GIS and Remote sensing 2. Summarize applications of Geospatial technology in Civil Engineering

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 Mapping	Understand
CO2	Understand spatial data models and analysis	Analyze
CO3	Demonstrate the use of Remote sensing, GIS, Satellite data, GPS for various applications including mapping	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				2								3		
CO2	3				2								2		
CO3	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	**Introduction to Remote Sensing, Satellites and Sensors** Definition of remote sensing, remote sensing process, ideal remote sensing system.	02		
1.2	Physics of remote sensing, electromagnetic energy, electromagnetic spectrum, black body radiation, laws governing electromagnetic radiation, atmospheric effects, scattering and absorption.	02		
1.3	Remote sensing platforms, satellites and orbits, geostationary and sun synchronous satellites, Earth resource satellites – IRS mission, LANDSAT, other satellite missions.	02		
1.4	Sensors – active and passive sensors, sensor resolutions (spectral, spatial, radiometric	02		

	and temporal).			
	Module – 2			
2.1	**Concepts Geographic Information System** Definition of GIS, history and evolution of GIS, GIS Technology, functions, components, tools, capabilities.	02		
2.2	Geospatial data, GIS data formats, data storage formats.	02		
2.3	GIS data acquisition, source – primary and secondary data, generation, display.	02		
	Module – 3			
3.1	**Concepts of Geodesy, Maps and Transformation** Shape of earth, Georeferencing systems (introduction only), Continuous and discrete georeferencing.	02		
3.2	Geodetic datums, representations of earth, coordinate reference systems, GCS and PCS.	01		
3.3	Map, map layout, features of a map, Topographic map, scale of a map.	01		
3.4	Geometric transformation, map projection and types (cylindrical, cone, azimuthal),	02		
3.5	Universal Transverse Mercator (UTM) projection, projection distortion, preserving map properties.	02		
	Module – 4			
4.1	**Vector, Raster Data Model and Analysis** Vector data: Nature and characteristics, data input, map digitizing procedures, topology building and errors.	02		
4.2	Vector data analysis, buffering, overlay, vector functions, spatial query.	02		
4.3	Raster data: Nature and elements, types, data structure and compression, quad tree data representation.	02		
4.4	Surface representation, DEMs. Raster versus vector. Raster data analysis, map calculator, reclassification, raster functions, terrain analysis (slope, aspect, hillshade)	02		
	Module – 5			
5.1	**Recent Advances and Applications of Geoinformatics** Introduction to Global Positioning System (GPS), segments of GPS, working principle, satellite geometry, errors in GPS, differential GPS surveying, applications of GPS.	03		
5.2	Introduction to UAV photogrammetry, Geometry of vertical aerial photographs- scale, ground coordinates, relief displacement, photographic overlaps, flight planning.	03		
5.3	Drones – types, payloads, limitations, software and applications of UAVs in engineering projects.	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,
2. John Wiley & Sons, 2012.
3. Burrough, P. A., McDonnell, R., McDonnell, R. A., & Lloyd, C. D. **"Principles of geographical information systems"**, 3rd Edition, Oxford university press, 2015.
4. Chang, K. T. **"Introduction to geographic information systems",** 9th Edition, Boston: McGraw-Hill Higher Education, 2019.

Reference Books:

1. Manoj K. Arora, R.C. Badjatia. **"Geomatics Engineering"**, Nemichand & Bros. Roorkee, 2011.
2. Panigrahi, N. **"Geographical information science"**. Universities press, 2009.
3. Reddy, M. A. **"Remote Sensing and Geographical Information Systems: An Introduction"**, 4th Edition, Book Syndicate, 2012.
4. DeMers, M. N. **"Fundamentals of geographic information systems"**, 4th Edition, John Wiley & Sons, 2008.

Online Resources:

1. https://nptel.ac.in/courses/107105088 NPTEL MOOC course on "**Geographic Information System**" IIT Kharagpur, Prof. Bharath H Aithal.
2. https://www.e-education.psu.edu/geog485/node/91
3. Geographic Information Systems OER by NPTEL - https://nptel.ac.in/courses/105107206
4. Open Web Mapping OER by Penn State - https://www.e-education.psu.edu/geog585/node/519

Code: BCV654C **Course: Integrated Waste Management for a Smart City**
Credits: 3 **L:T:P:S 3:0:0:0**
SEE: 50% **CIE: 50%**
SEE Hours: 3 **Max. Marks:100**

Prerequisites if any	Nil
Learning objectives	1. To introduce the fundamentals of Solid Waste Management 2. To provide details of Sustainable Cities 3. Understand the Sustainable Development Goals.

Course Outcomes:

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

COs	Course Outcomes	Bloom's level
CO1	Understand basic idea about Sustainable Development.	Understand
CO2	Get knowledge about Sustainable Cities.	Apply
CO3	Gain knowledge on Saving Biodiversity and understand Sustainable Development Goals.	Apply & understand

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1	1						3							1	3	
CO2	1					2	2							1	2	
CO3	1					3	3					2		1	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	**Introduction to Solid Waste Management** Municipal Solid Waste Characteristics	4	-	-
1.2	Quantities generation rates and waste composition;	3	-	-
1.3	Integrated waste management issues, collection, recovery, reuse, recycling, energy-from-waste, and landfilling;	3		
	Module – 2			
2.1	**Biological treatment of the organic waste fraction;** Direct land application,	4		
2.2	Composting, and anaerobic digestion.	4		
2.3	MSW Rules 2016, Swachh Bharat Mission and Smart Cities Program	2		
	Module – 3			
3.1	**Biochemical Processes and Composting** Energy Recovery from Municipal Solid Waste.	4		
3.2	Current Issues in Solid Waste Management and Review of MSW Management Status in First List of 20 Smart Cities in the Country	4		
	Module – 4			
4.1	**Construction and Demolition (C&D) Waste**	4		

	Construction and Demolition (C&D) Waste Management - Overview			
4.2	C&D Waste – Regulation, Beneficial Reuse of C&D Waste Materials	3		
	Module – 5			
5.1	**Electronic Waste (E-Waste)** Electronic Waste (E-Waste) Management - Overview	4		
5.2	Electronic Waste Management – Issues and Status in India and Globally, E-Waste Management Rules 2016 and Management Challenges.	3		
	Total No. of Lecture Hours	42		
	Total No. of Tutorial Hours		-	
	Total No. of Practical Hours			-

Self-learning topics identified:

1. Scope and importance of Solid Waste Management.
2. Geosynthetic Fabric in Sanitary Landfills

Textbooks:

1. George Tchobanoglous, Hilary Theisen and Samuel A Vigil, Integrated Solid Waste management, Tata
McGraw Hill

Reference Books:

1. William A Worrell and P. Aarne Veslind Solid Waste Engineering, 2nd Edition (SI Edition) Cengage Learning, 2012 (ISBN-13: 978-1-4390-6217-3)
2. Manual on Solid Waste Management, prepared by The Central Public Health and Environmental Engineering Organization (CPHEEO), India
3. MSW Management Rules 2016, Govt. of India, available online at CPCB website.
4. Electronic Waste Management Rules 2016, Govt. of India, CPCB website.

Online Resources:

1. NPTEL MOOC course on “Integrated Waste Management for a Smart City” by Prof. Brajesh Kumar Dubey IIT Kharagpur

Code: BCV654D **Course: Sustainable Development Goals**
Credits: 3 **L:T:P 3:0:0**
SEE: 50% **CIE: 50%**
SEE Hours: 3 **Max. Marks:100**

Prerequisites if any	NA
Learning objectives	1. Understand the embedment of sustainability issues in environmental, societal, and economic systems, and the relevance of the conditions, interrelations, and dynamics of these systems. 2. To learn and analyze the factors that support to achieve sustainability and resilience in an individual level and in a community

Course Outcomes:

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

COs	Course Outcomes	Bloom's level
CO1	Students will be able to develop a fair understanding of the social, economic and ecological linkage of human production and consumption	L1, L2
CO2	To use environmental management tools that help to improve the quality of environment, to assess local vulnerabilities with respect to climate, natural disasters and to achieve sustainable developmental needs.	L1, L2, L3

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1			1			1	3					2		1		
CO2			1			1						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	Sustainable Development: Introduction to Sustainable Development	03	-	-
1.2	Economic Growth and Progress, Continuing Poverty	03	-	-
1.3	Environmental Threats, Business as Usual Versus, Sustainable Development	03		
Module – 2				
2.1	Sustainable Cities,	02	-	-
2.2	The Patterns of Urbanization Around the World,	02	-	-
2.3	Development of Sustainable city, Smart Infrastructure,	03	-	-
2.4	Urban Resilience, Planning for Sustainable Development.	03	-	-
Module – 3				
3.1	Curbing Climate Change	03	-	-
3.2	The Basic Science of Climate Change,	03	-	-
3.3	Consequences, Mitigation	02	-	-
3.4	Adaptation, Mitigation Policies	02	-	-
Module – 4				

4.1	Saving Biodiversity:	02	-	-
4.2	Concept of Biodiversity,	02	-	-
4.3	Biodiversity Under Threat, Oceans and Fisheries	01	-	-
4.4	Deforestation International Dynamics.	02		
Module – 5				
5.1	Sustainable Development Goals, Introduction to Sustainable Development Goals, Goal-Based Development, Financing for Sustainable	02	-	-
5.2	Development, Principles of Good Governance, Feasibility of Sustainable Dev	02	-	-
Total No. of Lecture Hours		**40**		
Total No. of Tutorial Hours			**00**	
Total No. of Practical Hours				**00**

Self-learning topics identified:

1. Sustainable Acquisitions, Sustainable Communities Electronics Stewardship
2. Implementation of green infrastructure, urban farming
3. Global warming , alternative energy or renewable energy
4. Biodiversity at global, national and local levels, India as a mega diversity nation

Textbooks:

1. Ram Kumar Mishra, Ch Lakshmi Kumari, Sandeep Chachra, P.S. Janaki Krishna “Smart Cities for Sustainable Development” Springer, 2022 Edition

Reference Books:

1. The Sustainable Development Goals Report 2020 Kindle Edition, Department of Economic and Social Affairs
2. The Sustainable Development Goals” Hardcover – December 4, 2018 United Nations.

Online Resources;

1. NPTEL :: Humanities and Social Sciences - NOC:United Nations Sustainable Development Goals (UN SDGs)
2. NPTEL :: Civil Engineering - NOC:Sustainable River Basin Management
3. NPTEL :: Architecture - NOC:Strategies for Sustainable Design
4. NPTEL :: Multidisciplinary - NOC:Sustainable and Affordable Sanitation Solutions For Small Towns: Policy, Planning and Practice
5. NPTEL :: Civil Engineering - NOC:Sustainable Materials and Green Buildings
6. NPTEL :: Management - NOC:Business and Sustainable Development

Code: **BCV654E** **Course: Disaster Management and Mitigation**
Credits: **3** **L:T:P: 3:0:0**
SEE: **50%** **CIE: 50%**
SEE Hours: **3** **Max. Marks: 100**

Prerequisites if any	Basic Knowledge of Identification and Implication of Hazard, Risk and Disaster
Learning objectives	1. Understand concepts of risk and disaster management , 2. Emerging Risks of Disasters , prevention and mitigation of Disasters

Course Outcomes:

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

COs	Course Outcomes	Bloom's level
CO1	Understand the concepts of risk and disaster management ,	Understand
CO2	To analyze Emerging Risks of Disasters , prevention and mitigation of Disasters, need and importance of implementation of Disaster Management Act 2005	Analyze
CO3	To Apply the knowledge of Science and Technology for Disaster Management & Mitigation	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 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	Climate Change and Urban Disasters, Emerging Risks of Disasters	02	-	-
2.4	Global Disaster Trends	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 Mitigation o	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. S C Sharma 2022 , Disaster Management, preparedness, impact, risk reduction mitigation and management, Khanna Publication

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. National Disaster Management Policy, GoI

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/

Code: BCV654F **Course: Water Conservation and Rain Water Harvesting**
Credits: 3 **L:T:P 3:0:0**
SEE: 50% **CIE: 50%**
SEE Hours: 3 **Max. Marks:100**

Prerequisites if any	
Learning objectives	1. Knowing the Various water conservation methods to mitigate water stress 2. To gain Knowledge of rainwater harvesting strategies to improve groundwater resources and contributing to sustainable development.

Course Outcomes:

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

COs	Course Outcomes	Bloom's level
CO1	Appreciate basic concepts of Water and its importance.	Understand Analyze
CO2	Learn elementary knowledge of ground water.	Understand Analyze
CO3	Conceptually learn various theories related to Groundwater recharge and Groundwater recharge	Understand Analyze
CO4	Study about Subsurface investigation of Ground water.	Apply

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3	PSO4
CO1	3	1												3	2		
CO2	2	2												1	1		
CO3		1	2											2	2		
CO4			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	Monsoon– types and behavior in India, rainfall – characteristics and distribution, onset and withdrawal of effective	2		
1.2	Dry spells and wet spells, critical dry spells, water loss from the soil, measurement and factors, hydrological cycle,	2		
1.3	Importance and issues relating water status Scenario of water in Karnataka: sources, geographical distribution, quality.	2		
1.4	Water (hydrological) cycle, influence of human activity on the water cycle, Surface water resources.	2		
	Module – 2			
2.1	General aquifer. Water quality and its impact on human beings	2		
2.2	Water harvesting: need, principles of water harvesting, general water harvesting methods	2		
2.3	Rain water harvesting - methods, classes, benefits, approach, rooftop	2		

	rainwater harvesting			
2.4	Subsurface barrier/dykes, farm ponding, etc mostly used in rural areas	2		
	Module – 3			
3.1	Factors affecting groundwater recharge, Revival of traditional techniques for water harvesting.	2		
3.2	Calculation of available rain water for harvesting.	2		
3.3	Preparation of suitable technical design of rainwater harvesting	2		
3.4	Preparation of suitable technical drawing of rainwater harvesting	2		
	Module – 4			
4.1	Importance, knowledge regarding conservation/saving of water in daily use,	2		
4.2	Importance, knowledge regarding conservation/saving of water in in agriculture, in industries.	2		
4.3	Water Conservation strategies- Limiting the consumption	2		
4.4	Reuse and recycling, Elimination of losses, Pollution prevention	2		
	Module – 5			
5.1	Geophysical methods and its importance. Present law regarding water manage	2		
5.2	Water footprints- Blue water footprint	2		
5.3	Green water footprint, grey water footprint.	2		
5.4	Sustainability assessment	2		
	Total No. of Lecture Hours	40		
	Total No. of Tutorial Hours			
	Total No. of Practical Hours			

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

1. Rainwater harvesting in ancient India
2. National Water Policy
3. Jal Shakti Abhiyan
4. Water Conservation Initiatives of Govt. of India

Textbooks:

1. Samra, J.S., V.N. Sharda and A.K. Sikka. 2002. Water Harvesting and Recycling: Indian Experiences. CSWCR & TI, Dehradun, Allied Printers, Dehradun.
2. Theib Y. Oweis, DiterPrinz and Ahmed Y. Hachum. 2012. Rainwater Harvesting for Agriculture in the Dry Areas. CRC Press, Taylor and Francis Group, London.
3) Studer Rima Mekdaschi and HanspeterLiniger. 2013 Water Harvesting – Guidelines to Good Practice Centre for Development and Environment. University of Bern. Switzerland

Reference Books:

1. Singh Gurmel, C. Venkataraman, G. Sastry and B. P. Joshi. 2004, 6thed. Manual of Soil and Water Conservation Practices. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Michael, A.M. and T.P. Ojha 2003. Principles of Agricultural Engineering. Volume II. 4th Edition, Jain Brothers, New Delhi.
3. Murthy, V.V.N. 2002. Land and Water Management Engineering. 3rd Edition, Kalyani Publishers, New Delhi.

Online Resources:

1. Sustainable Architecture -NPTEL
https://www.youtube.com/watch?v=oRt0zRuFKC4&list=PLLy_2iUCG87CfjAcR9lGNrJ16Fe6OqXzr
2. Soil and Water Conservation Engineering- NPTEL
(https://www.youtube.com/watch?v=CxgwgMtzrsQ&list=PLbRMhDVUMngdZvhdNC31fHsV_HLlW5Jby)
3. Introduction to Watershed Management- NPTEL
(https://www.youtube.com/watch?v=wkPu4LwRKro&list=PLHBZBnEudI11UBAehNFN02u9v9qNaKSjH)

Code: BCV657A **Course: Structural Health Monitoring using Sensors**
Credits: 1 **L:T:P 1:0:0**
SEE: -- **CIE: 100%**
SEE Hours: -- **Max. Marks: 50**

Prerequisites if any	NA
Learning objectives	1. To provide an understanding of the principles of SHM, its importance, types of sensors used in SHM and their working principle. 2. To understand the design and implementation of sensor-based monitoring system, data acquisition, processing and analysis techniques for SHM.

Course Outcomes:

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

COs	Course Outcomes	Bloom's level
CO1	Understand the concept of structural health monitoring and various methods applied for monitoring of structures and structural safety	L2
CO2	Apply the concept of SHM in the assessment of engineering structures	L3
CO3	Analyze the sensor systems in structural health monitoring	L3
CO4	Design and implement a sensor-based monitoring system for a civil engineering structure	L3

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1	2													2		
CO2	2	2		2										2		
CO3	2	2		2	2									2		
CO4	2		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	Introduction to Structural Health Monitoring, Definition and importance of SHM in civil engineering	1	NA	NA
1.2	History and evolution of SHM	1	NA	NA
1.3	SHM system components and their functions	1	NA	NA
Module – 2				
2.1	Overview of different types of sensors	1	NA	NA
2.2	Principles of operation and selection of sensors for different structures, Advantages and disadvantages of different sensors	1	NA	NA
2.3	SHM using Optical Fibres and other sensors	1	NA	NA
Module – 3				
3.1	Structural Health Monitoring versus Non-Destructive Evaluation	1	NA	NA
3.2	Health Monitoring and Demolition Techniques, Long term health monitoring techniques	1	NA	NA
3.3	Understanding Piezoelectric materials	1	NA	NA
Module – 4				
4.1	System design considerations	1	NA	NA
4.2	Sensor placement and installation	1	NA	NA
4.3	System calibration and validation	1	NA	NA

Module – 5				
5.1	Monitoring of buildings, bridges, and dams	1	NA	NA
5.2	Case studies of SHM applications in civil engineering	1	NA	NA
5.3	Future trends and challenges in SHM	1	NA	NA
	Total No. of Lecture Hours	**15**	NA	NA
	Total No. of Tutorial Hours		**NA**	
	Total No. of Practical Hours			**NA**

Textbooks:

1. Daniel Balageas, Claus-Peter Fritzen, Alfredo Güemes, “Structural Health Monitoring”, John Wiley and Sons, 2006
2. Douglas E Adams, “Health Monitoring of Structural Materials and Components”, John Wiley and Sons, 2000
3. E-resources 1. E-learning content on L&T EduTech Platform

Online Resources:

1. L&T EduTech Lecture Videos

Code: BCV657B **Course: Data Analytics for Civil Engineers**
Credits: 1 **L:T:P 1:0:0**
SEE: -- **CIE: 100%**
SEE Hours: -- **Max. Marks: 50**

Prerequisites if any	Basics of structural engineering, water resources and environmental engineering
Learning objectives	1. Analyze the data pertaining to civil engineering domain to check its effectiveness, prepare models to simulate the conditions based on the available data and visualize the data for decision making exercises

Course Outcomes:

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

COs	Course Outcomes	Bloom's level
CO1	Apply data analysis processes to civil engineering related data in decision making.	Apply
CO2	Apply appropriate data visualization techniques and perform correlation analysis on the real-world data pertaining to civil engineering	Apply
CO3	Analyse data for its impartiality and efficiency on the data pertaining to civil 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													2	
CO2		3		2											2	
CO3		3		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			
1.1	**Introduction to Data Analytics:** Data and knowledge, criteria to assess the knowledge	1		
1.2	Descriptive statistics of the data, inferential statistics, exploratory data analysis, Knowledge discovery in data bases, data analysis processes,SEMMA, CRISP-DM, methods, tasks and tools.	1		
	Module – 2			

2.1	**Understanding the Data:** Attribute understanding, kinds of attributes (nominal, interval, ratio types).Character dimensional data, location measures, dispersion measures, and shape measures.	1		
2.2	Characteristic measures of multidimensional data, data quality, visual analytics of one dimensional data, Density plots, box plots, scatter plots, Correlation and covariance, Methods for multidimensional data	2		
	Module – 3			
3.1	**Principles of Data Modelling:** The four steps of modeling, model classes, black-box models Fitting criteria and score functions, error functions for classification problems, measure of interestingness, closed form algorithm for model fitting.	1		
3.2	Types of errors. Model validation (briefing on methods).	1		
	Module – 4			
4.1	**Data Preparation:** Selection of data, feature selection, selecting top ranked subset of data, Cross product, wrapper approach, and correlation-based filter. Cleaning data, improving data quality, dealing with missing values,	1		
4.2	Construct data, providing operability, assuring impartiality and maximize efficiency, Complex data types. Implementation of methods on data specific to civil engineering.	1		
	Module – 5			
5.1	**Finding patterns in data:** Clustering – methods. Hierarchical clustering. Dissimilarity measures, Minkowisci, Euclidian, Chebyshev, and cosine. Deviation measures. Association rules.	2		
5.2	Brief introduction to self-organizing maps. Implementation of methods on data specific to civil engineer	1		
	Total No. of Lecture Hours	12		
	Total No. of Tutorial Hours			
	Total No. of Practical Hours			

Self-learning topics identified:

1. Introduction to Design of Experiments
2. Different algorithms of optimization

Textbooks:

1. Michel R. Berthold, Christian Borgelt, Frank Hoopner, Guide to Intelligent Data Analysis, Springer- Verlag Publications, London.

Reference Books:

1. Charles M.Zudd, Garry H.Mcchelland, Carry S.Ryan, Data Analysis: A Model Comparison Approach, Routledge Publication, NY, 2009.

2. Allan Agresty, An Introduction to Categorical Data Analysis, 2nd Edition, Wiley Publication.

Online Resources:

1. https://www.kdnuggets.com
2. www.kaggle.com
3. www.datameer.com

Code: BCV657D **Course: Quality Control and Quality Assurance**
Credits: 1 **L:T:P 1:0:0**
SEE: -- **CIE: 100%**
SEE Hours: -- **Max. Marks: 50**

Prerequisites if any	NIL
Learning objectives	1. Appreciate the concept of Quality 2. Articulate the Implication of Quality in construction 3. Implement QA & QC Programs 4. Realise the importance of QMS in Civil Engineering.

Course Outcomes:

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

COs	Course Outcomes	Bloom's level
CO1	Realize the importance of quality in construction	Understand
CO2	Apply SQC techniques in different aspects of construction	Understand
CO3	Implement QMS programs at different levels of construction	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				1				1				3		1
CO2	3	2				1				1				3	2	1
CO3	3	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	**Overview of Quality:** Quality History, Quality Definition, Quality Inspection	1	-	-
1.2	Quality Control, Quality Assurance, Quality Engineering, Quality	1	-	-

	Management			
1.3	Quality Gurus: Philip B. Crosby, W. Edwards Deming etc, PDCA Cycle, Costs associated with Quality	1		
	Module – 2			
2.1	Quality Management: Management Practices: TQM, Vision and Quality policy Function Deployment	1	-	-
2.2	Bench marking and performance evaluation	1	-	-
2.3	ISO 9000 Quality Management System, ISO 14000 Environmental Manageme	1		
	Module – 3			
3.1	**Statistical Quality Control:** Importance of SQC in construction, Statistical parameters: sampling, population and sampling, measure of variability, measure of central tendency,	1	-	-
3.2	Recommendations of IS 456:2000 on sampling, testing and acceptance criteria for concrete	2	-	-
	Module – 4			
4.1	**QA and QC in Construction:** Errors in concrete construction; Frequency of material testing and reporting of basic construction materials (cement, sand, coarse aggregate, bricks, steel)	2	-	-
4.2	Norms for accepting and rejecting criteria of basic construction materials as per relevant IS codes	1	-	-
	Module – 5			
5.1	**On-Site Quality:** Achieving quality at different stages of construction: Conceptual Design, Preliminary Design, Detailed Design,	1	-	-
5.2	Construction, Testing, Commissioning, and Handover.	1	-	-
5.3	Quality assessment of concrete through NDT: rebound hammer and USPV tests and guidelines for accepting and rejecting.	1	-	-
	Total No. of Lecture Hours	15	-	-
	Total No. of Tutorial Hours		-	-
	Total No. of Practical Hours			-

Self-learning topics identified:

1. Reasons for Poor Quality

Textbooks:

1. Juran J M and Gryna F M, Quality Planning and Analysis
2. Hutchins G, John L Ashford, The Management of Quality in Construction

Reference Books:

1. Mohamed A. El-Reedy, "Concrete and Steel Construction, Quality Control and Assurance", CRC Press, Taylor and Francis Group
2. M. S. Shetty, Concrete Technology, S Chand Publications
3. Relevant IS Codes

Online Resources:

1. Online study material
2. You Tube videos