NEW HORIZON
COLLEGE OF ENGINEERING

Department of Civil Engineering

Academic Year 2023-24

5th and 6th Semester

Scheme and Syllabus

BATCH – 2021-2025

CREDITS: 160

NEW HORIZON COLLEGE OF ENGINEERING

VISION

To emerge as an institute of eminence in the fields of engineering, technology and management in serving the industry and the nation by empowering students with a high degree of technical, managerial and practical competence.

MISSION

- To strengthen the theoretical, practical and ethical dimensions of the learning process by fostering a culture of research and innovation among faculty members and students.
- To encourage long-term interaction between the academia and industry through their involvement in the design of curriculum and its hands-on implementation.
- To strengthen and mould students in professional, ethical, social and environmental dimensions by encouraging participation in co-curricular and extracurricular activities.

QUALITY POLICY

To provide educational services of the highest quality both curricular and co-curricular to enable students integrate skills and serve the industry and society equally well at global level

VALUES

- Academic Freedom
- Integrity
- Inclusiveness
- Innovation
- Professionalism
- Social Responsibility

DEPARTMENT OF CIVIL ENGINEERING

VISION

To contribute to society by imparting quality education encompassing Technical, Managerial and Entrepreneurial skills

MISSION

- To create an environment wherein Faculty and Students engage in cutting edge research.
- To undertake Collaborative projects in order to develop a partnership between Institute and Industry
- To motivate Entrepreneurship and to imbibe Professional Ethics
- To promote participation in activities which help in holistic development of students.

Program Education objectives (PEOs)

PEO1	Graduates will be able contribute to the development of sustainable infrastructure
PEO2	Graduates as part of an organization or as Entrepreneurs, will continue to learn to hone-up evolving technologies
PEO3	Graduates will be professional Civil Engineers with ethical and societal responsibility
PEO4	Graduates will be able to work as a team in intra and interdisciplinary endeavors for development of new ideas and products for the betterment of society

Program Specific objectives (PSOs)

PSO1	Enhancing the employability skills by making the students find innovative solutions for challenges and problems in various domains of Civil Engineering
PSO2	Inculcating in students tech suaveness to deal with practical aspects of Civil Engineering

PEO to Mission Statement Mapping

Mission Statements	PEO1	PEO2	PEO3	PEO4
To create an environment wherein Faculty and Students engage in cutting edge research.	2	3	2	3
To undertake Collaborative projects in order to develop a partnership between Institute and Industry.	2	2	2	3
To motivate Entrepreneurship and to imbibe Professional Ethics.	2	3	3	3
To promote participation in activities which help in holistic development of students.	2	3	2	2

Correlation: 3-High, 2-Medium, 1-Low

Program Outcomes (PO)with Graduate Attributes

SL NO	Graduate Attributes	Program Outcomes (POs)
1	Engineering Knowledge	**PO1:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex civil engineering problems.
2	Problem analysis	**PO2:** Identity, formulate, research literature and analyze complex civil engineering problems reaching substantiated conclusion using first principles of mathematics and engineering sciences.
3	Design/ Development of Solutions	**PO3:** The ability to analyse complexities of various civil engineering elements and design similar such elements.
4	Investigation of Problem	**PO4:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information related to civil engineering problems to provide valid conclusions.
5	Modern Tool usage	**PO5:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex civil engineering activities with an understanding of the limitations.
6	The Engineer and society	**PO6:** Apply reasoning based on the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the civil engineering professional practice.
7	Environment and sustainability	**PO7:** Understand the impact of the civil engineering solutions in societal and environmental contexts and demonstrate the knowledge of need for sustainable development.
8	Ethics	**PO8:** Apply ethical principles, commit to professional ethics, own up responsibilities and abide by the norms of the civil engineering practice.
9	Individual & team work	**PO9:** As a civil engineer function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10	Communication	**PO10:** Communicate effectively on complex civil engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make
11	Project management and finance	**PO11:** Demonstrate knowledge and understanding of the civil engineering and management principles and apply these to one's work, as a member and leader in a team, to manage projects and in multidisciplinary environments as a civil engineer.
12	Lifelong learning	**PO12:** Recognize the need for, willingness to prepare for and to exhibit pro-activeness to engage in independent and lifelong learning in the broadest context of technological change with respect to civil engineering field

Mapping of POs TOPEOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEO1	3	3	3	3	2	3	3	2	2	2	2	3
PEO2	3	3	3	3	3	3	2	3	2	2	3	3
PEO3	3	3	3	3	2	3	2	3	2	3	2	3
PEO4	3	3	3	3	2	3	2	3	3	3	3	3

NEW HORIZON COLLEGE OF ENGINEERING
B. E. in Civil Engineering
Scheme of Teaching and Examinations for 2021- 2025 BATCH (2021 Scheme)

Sl.No	Course and Course Code		Course Title	BOS	Credit Distribution				Overall Credits	Contact Hours	Marks		
					L	T	P	S			CIE	SEE	Total
1	PCC	21CIV51	Environment Engineering	CIV	3	0	0	0	3	3	50	50	**100**
2	PCCL	21CVL51	Environment Engineering Lab	CIV	0	0	1	0	1	2	50	50	**100**
3	PCC	21CIV52	Design of RC Structural Elements	CIV	3	0	0	0	3	3	50	50	**100**
4	PCCL	21CVL52	RC Structural Elements Lab	CIV	0	0	1	0	1	2	50	50	**100**
5	PCC	21CIV53	Hydrology and Irrigation Engineering	CIV	3	0	0	0	3	3	50	50	**100**
6	PEC	21CIV54*	Professional Elective Course-I	CIV	3	0	0	0	3	3	50	50	**100**
7	AEC	21CVL55*	Ability Enhancement Course-V	CIV	0	0	1	0	1	2	50	50	**100**
8	MP	21CIV56	Mini Project – (STAAD-Analysis of Structure concepts)	CIV	0	0	1	0	1	2	50	50	**100**
9	AEC	21CVK57	Research Methodology and IPR	CIV	1	0	0	0	1	2	50	50	**100**
10	UHV	21CVK58	Innovation and Design Thinking	CIV	1	0	0	0	1	1	50	50	**100**
	Total								**18**	**23**	**500**	**500**	**1000**

NCMC	21NSS84	National Service Scheme (NSS)	NSS coordinator	All students have to register for any of the courses namely National Service Scheme, Physical Education (PE), Sports and Athletics and Yoga with the concerned coordinator of the course during the first week of V semester. SEE in the above courses shall be conducted during VIII semester examinations and the accumulated CIE marks shall be added to the SEE marks. Successful completion of the registered course is mandatory for the award of the degree. The events shall to be reflected in the calendar prepared for the NSS, PE and Yoga activities.
	21PES84	Physical Education (PE) (Sports and Athletics)	Physical Education Director	
	21YOG84	Yoga	Yoga Teacher	

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **NCMC**: Non-Credit Mandatory Course, **AEC**: Ability Enhancement Course, **PEC**: Professional Elective Course, **PROJ**: Mini Project work **L:** Lecture, **T**: Tutorial, **P**: Practical **S: SDA**: Self Study for Skill Development, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation

Professional Elective Course - I		**Ability Enhancement Course - V**	
21CIV541	Advance concrete technology	21CVL551	Concrete Mix design Concept
21CIV542	Air pollution and control	21CVL552	Building Design Lab
21CIV543	Applied Geotechnical Engineering	21CVL553	Data Analytics with Excel
21CIV544	Construction quality and safety	21CVL554	Construction and Services Lab
21CIV545	Prefabricated Structures		

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering andTechnology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering.

Mini-project work: Mini Project is a laboratory-oriented/hands on course that will provide a platform to students to enhance their practical knowledge and skills by thedevelopmentofsmallsystems/applicationsetc.Basedontheability/abilities of the student/sandrecommendationsofthementor. A student can do mini project as

(i) A group of 2 if mini project work is single discipline (applicable to all IT allied branches)

(ii) A group of 2-4 if mini project work is single discipline (applicable to all Core Branches)

(S) A group of 2 –4 students if the Mini Project work is amultidisciplinary(Applicable to all Branches)

CIE procedure for Mini-project:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batches mates.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project.

The CIE marks awarded for the Mini-project, shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the percentage ratioof 50:25:25.The marks awarded for the project report shall be the same for all the batch mates

Credit Definition:	
1-hour Lecture (L) per week=1Credit 2-hoursTutorial(T) per week=1Credit 2-hours Practical / Drawing (P) per week=1Credit 2-hours Self Study for Skill Development (SDA) per week = 1 Credit	03-Credits courses are to be designed for 40 hours in Teaching-Learning Session 02- Credits courses are to be designed for 25 hours of Teaching-Learning Session 01-Credit courses are to be designed for 15 hours of Teaching-Learning Sessions

NEW HORIZON COLLEGE OF ENGINEERING
B. E. in Civil Engineering
Scheme of Teaching and Examinations for 2021- 2025 BATCH (2021 Scheme)

Sl. No	Course and Course code		Course Title	BOS	Credit Distribution				Overall Credits	Contact Hours	Marks		
					L	T	P	S			CIE	SEE	Total
1	HSMC	21CIV61	Construction Management and Engineering	CIV	3	0	0	0	3	3	50	50	**100**
2	PCC	21CIV62	Transportation Engineering	CIV	3	0	0	0	3	3	50	50	**100**
3	PCCL	21CVL62	Transportation Engineering Lab	CIV	0	0	1	0	1	2	50	50	**100**
4	PCC	21CIV63	Design of Steel Structures	CIV	3	0	0	0	3	3	50	50	**100**
5	PCCL	21CVL63	Steel Structures Lab	CIV	0	0	1	0	1	2	50	50	**100**
6	PEC	21CIV64*	Professional Elective Course-II	CIV	3	0	0	0	3	3	50	50	**100**
7	UHV	21CVK65	Social Connect and Responsibility	CIV	0	0	1	0	1	2	50	50	**100**
8	INT	21CIV66	Innovation/Entrepreneurship/ Societal Internship	CIV	0	0	3	0	3	0	50	50	**100**
9	MP	21CIV67	Mini project(Extensive survey project)	CIV	0	0	1	0	1	2	50	50	**100**
10	OEC	21NHOP6XX	Industrial Open Elective Course-I	Offering Dept.	3	0	0	0	3	3	50	50	**100**
		Total							**22**	**23**	**500**	**500**	**1000**

NCMC	21NSS84	National Service Scheme (NSS)	NSS coordinator	All students have to register for any of the courses namely National Service Scheme, Physical Education (PE), Sports and Athletics and Yoga with the concerned coordinator of the course during the first week of V semester. SEE in the above courses shall be conducted during VIII semester examinations and the accumulated CIE marks shall be added to the SEE marks. Successful completion of the registered course is mandatory for the award of the degree. The events shall to be reflected in the calendar prepared for the NSS, PE and Yoga activities.
	21PES84	Physical Education (PE) (Sports and Athletics)	Physical Education Director	
	21YOG84	Yoga	Yoga Teacher	

HSMC: Humanity and Social Science & Management Course, **PCC**: Professional Core Course, **PCCL**: Professional Core Course laboratory, **NCMC:** Non-Credit Mandatory Course, **AEC**: Ability Enhancement Course, **PEC**: Professional Elective Course, **OEC**: Open Elective Course, **PROJ**: Project work**, L:** Lecture, **T**: Tutorial, **P**: Practical **S: SDA**: Self Study for Skill Development, C**IE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation.

Industrial Open Elective Course-I (OEC): Credit for OEC is 03 (L: T: P: S) can be considered as(3: 0: 0 : 0). The teaching and learning of these Courses will be based on hands-on. The Course Assessment will be based on CIE and SEE in practical mode. This Courses will be offered by Centre of Excellence to students of all the branches. Registration to Industrial open electives shall be documented and monitored on college level.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering.

21XXX61(HSMC)- This course must be pertaining to economics and management of the concerned degree program. The course syllabus should have both economics and management topics and the course title should bear the word Management.
For IT allied Branches: Software Product Management
For Core Branches: Engineering Economics and Management / Industrial Management / Construction Management

Professional Elective Course - II	
21CIV641	Ground Water Hydrology
21CIV642	Pavement Materials and construction
21CIV643	Recycling of waste water
21CIV644	Design & Drawing of Hydraulic Structure
21CIV645	Bio Inspired Design and Innovation

Credit Definition: 1-hour Lecture (L) per week=1Credit 2-hoursTutorial(T) per week=1Credit 2-hours Practical / Drawing (P) per week=1Credit 2-hours Self Study for Skill Development (SDA) per week = 1 Credit	03-Credits courses are to be designed for 40 hours in Teaching-Learning Session 02- Credits courses are to be designed for 25 hours of Teaching-Learning Session 01-Credit courses are to be designed for 15 hours of Teaching-Learning Sessions

FIFTH SEMESTER

(SYLLABUS)

ENVIRONMENTAL ENGINEERING

Course Code	**21CIV51**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**3**	**Exam Hours**	**3**

Course outcomes:
At the end of the course, the student will be able to:

21CIV51.1	Apply the knowledge of environmental engineering to assess the quality of water and estimate the demand of water supply
21CIV51.2	Evaluate the quality of water of different sources
21CIV51.3	Design efficient treatment units
21CIV51.4	Examine the process of disinfection and water softening.
21CIV51.5	Develop layout of water supply in buildings
21CIV51.6	Analyze the effects of air pollution and different elements of solid waste Management.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CIV51.1	3	3	-	-	-	-	3	-	-	-	-	-	3	3
21CIV51.2	3	3	2	-	-	-	3	-	-	-	-	-	3	3
21CIV51.3	3	3	2	-	-	1	3	-	-	-	-	-	3	3
21CIV51.4	3	-	-	-	-	-	3	-	-	-	-	-	3	3
21CIV51.5	3	3	-	-	-	-	3	-	-	-	-	-	3	3
21CIV51.6	3	-	-	-	-	-	3	-	-	-	-	-	3	3

MODULE-1	**DEMAND OF WATER**	**21CIV51.1**	**8 Hours**

Introduction: Human activities and environmental pollution. Need for protected water supply. Drinking water standards BIS & WHO guidelines (IS 10500). Objectives of water quality management. Wholesomeness & palatability, water borne diseases.

Demand of Water: Types of water demands- domestic, institutional, commercial, public and fire. Per capita consumption –factors affecting per capita demand, population forecasting, different methods with merits & demerits- variations in demand of water. Fire demand – estimation by Kuichling's formula, peak factors, design periods & factors governing the design periods

Self-study/ Case study/ Applications	Health significance of Fluoride, Nitrates and heavy metals like Mercury, Cadmium, Arsenic etc. and toxic / trace organics.
Text Book	Text Book : 1.1, 1.2, 2.1, 2.5, 3.1.

MODULE-2	**QUALITY OF WATER**	**21CIV51.2**	**8 Hours**

Sources and Collection: Sources- Surface and subsurface sources – suitability with regard to quality and quantity.

Quality of Water: Sampling of water for examination Water quality parameters – Testing Physical- Temperature, Electrical conductivity, Turbidity, colour, odour, taste. Chemical – Total solids, Hardness, Chlorides, Chlorine, pH Sulphates, nitrogen compounds, iron, DO, BOD, COD, sodium and potassium. Microbiological analysis.

Self-study/ Case study/ Applications	Intake structures – different types of intakes; factor of selection and location of intakes.
Text Book	Text Book 1.3 1.4, 2.3, 3.5.

MODULE-3	**WATER TREATMENT PROCESS - 1**	**21CIV51.3**	**8 Hours**

Water Treatment: Objectives – Treatment flow-chart. **Sedimentation:** Theory, settling tanks, types, design. Coagulant aided sedimentation, jar test, chemical feeding, flash mixing, and clari- flocculator **Filtration:** Mechanism – theory of filtration, types of filters, slow sand, rapid sand and pressure filters including construction, operation, cleaning and their design (excluding under drainage system) , back washing of filters. Operational problems in filters.			
Self-study/ Case study/ Applications	Operational problems in filters.		
Text Book	Text Book 1.9, 2.7, 2.8, 2.9, 3.10, 3.11, 3.12.		
MODULE-4	**WATER TREATMENT PROCESS - 1**	**21CIV51.4**	**8 Hours**
Disinfection: Theory of disinfection, types of disinfection, Chlorination, chlorine demand, residual chlorine, use of bleaching powder. Softening – Definition, methods of removal of hardness by lime soda process and zeolite process. **Miscellaneous Treatment**-Aeration- Types of Aeration. Adsorption technique. Conveyance of water- Design of the economical diameter for the rising main; Nomograms.			
Self-study/ Case study/ Applications	RO & Membrane technique.		
Text Book	Text Book 1.9, 2.11, 3.14,3.15.		
MODULE-5	**WATER DISTRIBUTION SYSTEM**	**21CIV51.5 & 21CIV51.6**	**8 Hours**
Layout of water supply pipes in buildings. **Distribution Systems**: System of supply, service reservoirs and their capacity determination, methods of layout of distribution systems. **Introduction to Solid Waste management and Air Pollution** –Types of solid waste, Sources and properties, Solid waste management. Air pollution, effects, classification of pollutants and air quality management concepts.			
Self-study/ Case study/ Applications	Methods of layout of distribution systems.		
Text Book	Text Book 1.10, 3.18, 3.20.		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		**Marks Distribution**		
		Test (s)	**Qualitative Assessment (s)**	**MCQ's**
		25	**15**	**10**
L1	**Remember**	-	-	5
L2	**Understand**	10	5	5
L3	**Apply**	10	5	-
L4	**Analyze**	5	5	-
L5	**Evaluate**	-	-	-
L6	**Create**	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	**-**
L2	**Understand**	20
L3	**Apply**	20
L4	**Analyze**	10
L5	**Evaluate**	**-**
L6	**Create**	**-**

Suggested Learning Resources:

Text Books:

1. S.K.Garg"Water supply Engineering", Khanna Publishers, 33 rd edition, ISBN: 9788174091208, 2010.
2. Punmia B C & Ashok Jain., "Environmental Engineering I", Laxmi Publications, 10th edition, ISBN: 10: 9788131807033, 2012.
3. Birdie, G S & Birdie J S., "Water supply & Sanitary engineering", DhanpatRai Publishing company,8th edition, 2012. ISBN-10: 8187433795

Reference Books:

1. Hammer, M.J., "Water and Wastewater Technology –SI Version", 7th Edition, Pearson publishers, . ISBN:13: 978-0135114049, 2011.
2. Peavy, H.S., Rowe, D.R., and Tchobanoglous, G.,,"Environmental Engineering",McGraw Hill Edition (India) 2013, .ISBN: 13: 9789351340263 .
3. Sincero, A.P., and Sincero, G.A., (1999), Environmental Engineering – A Design Approach– Prentice Hall of India Pvt. Ltd., New Delhi.ISBN: 10: 002410564, 2014.

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/103107084
- https://archive.nptel.ac.in/courses/105/105/105105201/

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

- Visit to any treatment plant
- Organizing Group wise discussions on issues
- Video demonstration of Treatment process of water
- Instruct students to prepare flowcharts and Handouts

ENVIRONMENTAL ENGINEERING LAB

Course	**21CVL51**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs /	**2**	**Total Marks**	**100**
Credits	**1**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

21CVL51.1	Estimate the physical, chemical and biological parameters of the water quality
21CVL51.2	Implement safety of drinking water by proper disinfection.
21CVL51.3	Compare the experimental results with standards and deliberate based on the purpose of analysis
21CVL51.4	Analyze the environmental significance and application in environmental engineering practice

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CVL51.1	3	3	-	3	-	3	3	-	-	-	-	-	3	3
21CVL51.2	3	-	-	3	-	3	3	-	-	-	-	-	3	3
21CVL51.3	3	3	-	3	-	-	-	-	-	-	-	-	-	3
21CVL51.4	-	-	-	3	-	3	3	-	-	-	-	2	-	3

Exp. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	• Physical, chemical and biological parameters of the water quality • Standard values of Potable water.	2	NA
	PART-A		
1	Determination of Alkalinity, Acidity and pH	2	21CVL51.1, 21CVL51.3, 21CVL51.4.
2	Determination of Electrical conductivity	2	21CVL51.1, 21CVL51.3, 21CVL51.4.
3	Determination of Chlorides.	2	21CVL51.1, 21CVL51.3, 21CVL51.4.
4	Determination of Calcium, Magnesium and Total Hardness.	2	21CVL51.1, 21CVL51.3, 21CVL51.4.
5	Determination of Dissolved Oxygen	2	21CVL51.1, 21CVL51.3, 21CVL51.4.
6	Determination of BOD	2	21CVL51.1, 21CVL51.3, 21CVL51.4.
	PART-B		
7	Determination of sodium and potassium by flame photometer	2	21CVL51.1, 21CVL51.3, 21CVL51.4.
8	Jar Test for Optimum Dosage of Alum	2	21CVL51.1, 21CVL51.3, 21CVL51.4.

9	Determination of Residual Chlorine	2	21CVL51.2, 21CVL51.3, 21CVL51.4.
10	Determination of percentage of available chlorine in bleaching powder	2	21CVL51.2, 21CVL51.3, 21CVL51.4.
11	Determination of Solids in Sewage: Total Solids, Suspended Solids	2	21CVL51.2, 21CVL51.3, 21CVL51.4.
12	Determination of Solids in Sewage: Dissolved Solids, Volatile Solids, Fixed Solids, Settleable Solids.	2	21CVL51.2, 21CVL51.3, 21CVL51.4.

PART-C
Beyond Syllabus Virtual Lab Content
(To be done during Lab but not to be included for CIE or SEE)

- Determination of Alkalinity
  https://ee1-nitk.vlabs.ac.in/exp/determination-of-alkalinity/
- Determination of Total Iron
  https://ee1-nitk.vlabs.ac.in/exp/determination-of-total-iron/

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		20	30
L1	Remember	-	-
L2	Understand	-	5
L3	Apply	10	10
L4	Analyze	5	10
L5	Evaluate	5	5
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	15
L4	Analyze	15
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:

Reference Books:

1. KVSGMuralikrishna (1997), "Chemical analysis of water and soil - a laboratory manual", Environmental Protection Society, 1997.
2. Manual on Water supply and treatment 1999, –CPHEEO manual, Ministry of Housing and Urban affairs, New Delhi.
3. S.K.Garg"Water supply Engineering", Khanna Publishers, 33 rd edition, ISBN: 9788174091208, 2010.

DESIGN OF RC STRUCTURAL ELEMENTS

Course Code	**21CIV52**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**3**	**Exam Hours**	**3**

Course outcomes:
At the end of the course, the student will be able to:

21CIV52.1	Comprehend the principle of working stress method of RCC design.
21CIV52.2	Comprehend the philosophy and principle of limit state method RCC design.
21CIV52.3	Analyse singly reinforced, doubly reinforced and flanged beam sections for flexure, shear and check for serviceability conditions.
21CIV52.4	Design singly reinforced, doubly reinforced and flanged beam sections and one way slabs as per IS 456:2000.
21CIV52.5	Design two way slabs for various boundary conditions and staircases as per IS 456:2000.
21CIV52.6	Analyse and design Column and Footing as per IS 456:2000.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CIV52.1	3	3	3	3	-	-	-	-	-	-	-	3	3	3
21CIV52.2	3	3	3	3	-	-	-	-	-	-	-	3	3	3
21CIV52.3	3	3	3	3	-	-	-	-	-	-	-	3	3	3
21CIV52.4	3	3	3	3	-	-	-	-	-	-	-	3	3	3
21CIV52.5	3	3	3	3	-	-	-	-	-	-	-	3	3	3
21CIV52.6	3	3	3	3	-	-	-	-	-	-	-	3	3	3

MODULE-1	**RCC DESIGN PHILOSOPHY**	**21CIV52.1, 21CIV52.2**	**8 Hours**

Introduction To Working Stress Method: Relationship between Structural Analysis and Design. Design Philosophies, Introduction to working stress method, Modular Ratio and Factor of Safety and evaluation of design constants for working stress method.

Introduction To Limit State Method: Relationship between Structural Analysis and Design. Materials used in RCC. Partial Safety factors, Characteristic load and strength. Stress block parameters, Design codes and loading standards. Concept of balanced section, under reinforced and over reinforced section.

Self-study/ Case study/ Applications	Concept of balanced section, under reinforced and over reinforced section.
Text Book	Text Book 2: 1.3, 1.5,1.6,1.7,2.1,3.2,3.3,3.3,3.4 Text Book 1: 4.3

MODULE-2	**LIMIT STATE ANALYSIS OF BEAMS**	**21CIV52.3**	**8 Hours**

Limit State Analysis of Beams: Analysis of singly reinforced, doubly reinforced and flanged beams for flexure and shear.

Limit State Serviceability: Limiting deflection, short term deflection, long term deflection, Calculation of deflection of singly reinforced beam only. Cracking in reinforced concrete members, calculation of

crack width of singly reinforced beam. Side face reinforcement, slender limits of beams for stability. Importance of bond, anchorage length and lap length.			
Self-study/ Case study/ Applications	Cracking in reinforced concrete members		
Text Book	Text Book 1: 4.4,7.1 to 7.7 Text Book 2: 4.4 ,4.6 ,5, 6 ,7 ,8		
MODULE-3	**LIMIT STATE DESIGN OF BEAMS/ ONE WAY SLAB**	**21CIV52.4**	**8 Hours**
Limit State Design of Beams: Design of singly and doubly reinforced beams, flanged beams and design for combined action of bending and torsion as per IS-456. **Limit State Design of One way Slabs:** Introduction to one way and two way slabs, Design of simply supported, cantilever and one way continuous slab as per IS-456			
Self-study/ Case study/ Applications	Flat slab design		
Text Book	Text Book 2: 5, 6 ,7 ,8,9,11		
MODULE-4	**LIMIT STATE DESIGN OF 2 WAY SLAB/STAIRCASE**	**21CIV52.5**	**8 Hours**
Limit State Design of Two way Slabs and Staircases: Design of two way slabs for different boundary conditions and Dog legged.			
Self-study/ Case study/ Applications	Open well staircases		
Text Book	Text Book 2: 12,15		
MODULE-5	**LIMIT STATE DESIGN OF COLUMN/FOOTING**	**21CIV52.6**	**8 Hours**
Limit State Design of Columns: Analysis and design of short axially loaded RC column. Design of columns subjected to combined axial loads with uniaxial and biaxial moments. **Limit State Deign of Footings:** Design concepts of the footings. Design of isolated Rectangular and Square column footings.			
Self-study/ Case study/ Applications	Design of Square column footings.		
Text Book	Text Book 2: 13,14		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		**Marks Distribution**		
		Test (s)	**Qualitative Assessment (s)**	**MCQ's**
		25	**15**	**10**
L1	**Remember**	-		5
L2	**Understand**	10	5	5
L3	**Apply**	10	5	
L4	**Analyze**	5	5	-
L5	**Evaluate**	-	-	-
L6	**Create**	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	**-**
L2	**Understand**	20
L3	**Apply**	20
L4	**Analyze**	10
L5	**Evaluate**	-
L6	**Create**	**-**

Suggested Learning Resources:

Text Books:

1. 1. Reinforced Concrete Design, IS :456-2000 Principles and Practice by N. Krishna Raju Pranesh., ISBN (10): 81-224-1460-5/ISBN(13): 978-81-224-1460-8, First edition :2003, Reprint : 2013 New Age International(P) Ltd. New Delhi.
2. Reinforced concrete Design, ISBN No. 978-93-5014-515-9, -by N. hinha, 1st Edition, 2014 S.K Kataria & Sons, New Delhi.

Reference Books:

1. Limit state design of reinforced concrete, P.C. Varghese, 2, 2008, ISBN-10: 8120320395, ISBN-13:978-8120320390, 2nd edition-2016, PHI Learning Private Limited, New Delhi.
2. Design of RCC Structural Elements, S.S. Bhavikatti, 2017, ISBN No: 9788122440515, 2017 edition, New Age International, New Delhi

Web links and Video Lectures (e-Resources):

- **https://youtu.be/CnnehyXwT5M**
- **https://youtu.be/CLmS2icWEN0**
- **https://youtu.be/X46Eh3mwPiM**
- **https://youtu.be/oVW6LuYd6A8**
- **https://youtu.be/tdMR2W-_R0A**

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

- Visit to any construction site
- Models to be prepared by students
- Organizing Group wise discussions on issues at construction site.
- Seminars

RC STRUCTURAL ELEMENTS LAB

Course	**21CVL52**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs /	**2**	**Total Marks**	**100**
Credits	**1**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

21CVL52.1	Apply IS provisions and computational tool in structural design & detailing
21CVL52.2	Prepare detailed drawings and bar bending schedule of beams and slabs.
21CVL52.3	Prepare detailed drawings and bar bending schedule of column and footings
21CVL52.4	Prepare detailed drawings and bar bending schedule of staircases

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CVL52.1	3	3	3	3	3	-	-	-	3	-	-	-	3	3
21CVL52.2	3	3	3	3	3	-	-	-	3	-	-	-	3	3
21CVL52.3	3	3	3	3	3	-	-	-	3	-	-	-	3	3
21CVL52.4	3	3	3	3	3	-	-	-	3	-	-	-	3	3

Exp. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	Design of Structural Elements	2	NA
	PART-A		
1	Layout Drawing: General layout of building showing position of columns, footings, beams, slabs and staircase with standard notations.	2	21CVL52.1
2	Introduction to detailing of RC structures, Codal provisions as per SP34-1987. Reinforcement specifications, Detailing functions	2	21CVL52.1
3	Detailing of simply supported and Preparing their Bar Bending Schedule.	2	21CVL52.2
4	Detailing of cantilever beams, and Preparing their Bar Bending Schedule.	2	21CVL52.2
5	Detailing of continuous beams and One way continuous slab and Preparing their Bar Bending Schedule..	2	21CVL52.2
6	Detailing of Two way continuous slab with different boundary conditions and Preparing their Bar Bending Schedule.	2	21CVL52.2
	PART-B		
7	Detailing of square ,rectangular and circular columns and Preparing their Bar Bending Schedule.	2	21CVL52.3
8	Detailing of isolated square and sloped square footing and Preparing their Bar Bending Schedule.	2	21CVL52.3
9	Detailing of isolated rectangular footing and sloped rectangular footing. Preparing their Bar Bending Schedule.	2	21CVL52.3
10	Detailing of Doglegged staircase and Preparing their Bar Bending Schedule.	2	21CVL52.4
11	Detailing of open well staircase and Preparing their Bar Bending Schedule.	2	21CVL52.4
12	Exposure to construction sites –presentation of videos by students.	2	21CVL52.1, 21CVL52.2, 21CVL52.3, 21CVL52.4

PART-C
Beyond Syllabus Virtual Lab Content
(To be done during Lab but not to be included for CIE or SEE)

- Design of simply supported beam
  https://www.youtube.com/watch?v=6dZMWrNVwBY
- Design of continuous beam
  https://www.youtube.com/watch?v= WoCxFutyoI

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		20	30
L1	Remember	-	-
L2	Understand	-	5
L3	Apply	10	10
L4	Analyze	5	10
L5	Evaluate	5	5
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	15
L4	Analyze	15
L5	Evaluate	10
L6	Create	-

Note: Submissions:-

- All the drawings should be drawn using AUTOCAD drafting software.
- Bar bending schedule be done in A4 sheets

Suggested Learning Resources:

Reference Books:

1. SP 34 - 1987 Handbook on Concrete Reinforcement and Detailing. Krishnamurthy., "Elementary Structural Design and Drawing", CBS publishers,1st edition, 2006, (Concrete Structures), CBS publishers, New Delhi. 1999.
2. S.N.Sinha., "Reinforced Concrete Design ",Mc Graw Hill Education, 3rd edition, New Delhi,2014.
3. Ghosh Karuna Moy, "Practical Design of Reinforced Concrete Structures", PHI Learning, 1st edition, New Delhi, 2010.

HYDROLOGY AND IRRIGATION ENGINEERING

Course Code	**21CIV53**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**3**	**Exam Hours**	**3**

Course outcomes:
At the end of the course, the student will be able to:

21CIV53.1	Apply Engineering Knowledge to understand various components of hydrological cycle and compute the missing rainfall data.
21CIV53.2	Estimate the evaporation, evapo-traspiration and infiltration.
21CIV53.3	Get acquainted with the concepts of hydrographs, floods and its computation.
21CIV53.4	Comprehend the different methods of irrigation, soil-water-crop relationship and frequency of irrigation for sustainable development.
21CIV53.5	Investigate different methods to improve duty of water, assessment of irrigation water and irrigation efficiencies.
21CIV53.6	Analyze the concept of canal alignment & design.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CIV53.1	3	3	3	3	-	-	-	-	-	-	-	-	3	3
21CIV53.2	3	3	3	3	-	-	-	-	-	-	-	-	3	3
21CIV53.3	3	3	-	3	-	3	-	-	-	-	-	-	3	-
21CIV53.4	3	3	-	3	-	3	2	-	-	-	-	-	3	3
21CIV53.5	3	3	-	3	-	3	2	-	-	-	-	-	3	3
21CIV53.6	3	3	3	3	-	3	-	-	-	-	-	-	3	3

MODULE-1	**COMPUTATION OF RAINFALL**	**21CIV53.1**	**8 Hours**

Introduction to Hydrology: Introduction, Hydrologic cycle - Horton's representation, Water budget equation (including numerical problems).*Precipitation:* Forms, Types, Measurement using Simon's gauge, Syphon gauge, Weighing bucket & Tipped bucket type rain gauge.

Computation of Rainfall: Selection of rain gauge station, Adequacy of rain gauges (including numerical problems), Methods of computing average rainfall (including numerical problems), Interpolation of missing rainfall data (including numerical problems).

Self-study/ Case study/ Applications	Double mass curve method, Hyetograph and mass curve of rainfall.
Text Book	Text Book 1: 1.1, 1.2,1.3,2.1,2.2,2.3,2.5,2.6,2.7,2.8,2.9

MODULE-2	**EVAPORATION AND EVAPOTRANSPIRATION**	**21CIV53.2**	**8 Hours**

Evaporation: Definition, Factors affecting evaporation, Measurement using ISI standard pan, Estimation using Meyer's and Rohwer's equation (including numerical problems),Methods to reduce evaporation losses.

Evapotranspiration: Definition, Factors affecting evapotranspitation, Measurement using Lysimeter and field plots, Estimation by Blaney criddle method (including numerical problems).

Infiltration: Definition, Factors affecting infiltration, Measurement using double ring infiltrometer, Infiltration indices (including numerical problems).			
Self-study/ Case study/ Applications	Horton's equation of infiltration.		
Text Book	Text Book 1: 3.1,3.2,3.3,3.4,3.6,3.8,3.9,3.10,3.15,3.16,3.17,3.18,3.20		
MODULE-3	**HYDROGRAPHS AND ESTIMATION OF FLOOD**	**21CIV53.3**	**8 Hours**
Hydrographs: Definition, Components of hydrographs, Base flow separation, Unit hydrograph– its derivation from simple storm hydrograph, Limitations and uses. Numerical problems related to derivation of T-hour unit hydrograph by superposition method and S-Curve method. **Estimation of flood**: Definition of flood, factors affecting flood, Estimation of floods by using envelope curves, empirical formulae and rational method (including numerical problems).			
Self-study/ Case study/ Applications	Estimation of floods		
Text Book	Text Book 1: 6.1,6.3,6.4,6.6,6.7,6.8,6.9,7.1,7.2,7.3		
MODULE-4	**SOIL-WATER-CROP RELATIONSHIP**	**21CIV53.4**	**8 Hours**
Introduction to irrigation Introduction, Need for irrigation, Advantages and disadvantages of irrigation, Types of irrigation system. **Soil-water-crop relationship:** Introduction, Soil profile, Physical properties of soil, Functions of irrigation soils, maintaining soil fertility, Soil-water-plant relationship and soil moisture - irrigation relationship, Frequency of irrigation (including numerical problems).			
Self-study/ Case study/ Applications	Methods of irrigation.		
Text Book	Text Book 2: 1, 2, 3, 4		
MODULE-5	**WATER REQUIREMENT OF CROPS AND CANALS**	**21CIV53.5 & 21CIV53.6**	**8 Hours**
Water Requirement of Crops: Crop seasons of India, Definition of Base period, Crop period, Delta and Duty (including numerical problems), Factors affecting duty, Methods to improving duty of water, Consumptive use, Assessment of irrigation water, Irrigation efficiencies. **Canals**: Definition, Types of canals, Alignment of canals, Design of canals by Kennedy's and Lacey's methods – Numerical problems.			
Self-study/ Case study/ Applications	Assessment of irrigation water, Irrigation efficiencies		
Text Book	Text Book 2: 2, 5		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		25	15	10
L1	Remember	-	-	5
L2	Understand	10	5	5
L3	Apply	10	5	-
L4	Analyze	5	5	-
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	20
L3	Apply	20
L4	Analyze	10
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:

Text Books:

1. Engineering Hydrology, Subramanya.K., McGraw Hill Education (India) Private Limited, 4th Edition, 2015. ISBN-10: 1-25-902997-2, ISBN-13: 978-1-25-902997-4.
2. Irrigation Engineering: Including Hydrology, SharmaR.K. &Sharma T.K., S Chand & Company Pvt. Ltd., Third Edition, 2015. ISBN: 1010B-240-0515.

Reference Books:

1. A Text Book of Hydrology, Jayarami Reddy, Laksmi Publications (P) Ltd., 3rd Edition, 2016. ISBN-10: 9380856040, ISBN-13: 978-9380856049.
2. Irrigation, water Resources and water power Engineering, P.N. Modi, Standard book house, 9th Edition, 2014. ISBN: 978-81-89401-29-0.
3. Irrigation Engineering and Hydraulic structures, S. K. Garg, Khanna Publication, 1stEdition, 2006. ISBN-10: 8174090479, ISBN-13: 978-8174090478.

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/105/103/105103213/
- https://www.youtube.com/watch?v=TWvxYnu6hE0&list=PLwdnzlV3ogoU-zxx2wMFG_FSDsGKVQ93g&index=13
- https://www.youtube.com/watch?v=thWKpvnXA8U&list=PLwdnzlV3ogoU-zxx2wMFG_FSDsGKVQ93g&index=17
- https://www.youtube.com/watch?v=pxXsyE-_TXg&list=PLwdnzlV3ogoU-zxx2wMFG_FSDsGKVQ93g&index=18
- https://www.youtube.com/watch?v=JSyFikUCb_U&list=PLwdnzlV3ogoU-zxx2wMFG_FSDsGKVQ93g&index=19
- https://www.youtube.com/watch?v=_YRnR2wTpvE&list=PLwdnzlV3ogoU-zxx2wMFG_FSDsGKVQ93g&index=21

• https://www.youtube.com/watch?v=4RZF1L70mRY&list=PLwdnzlV3ogoU-zxx2wMFG_FSDsGKVQ93g&index=22 • https://www.youtube.com/watch?v=HUS5G10O4io&list=PLwdnzlV3ogoU-zxx2wMFG_FSDsGKVQ93g&index=27 • https://www.youtube.com/watch?v=Xbf1Pjc64eo&list=PLwdnzlV3ogoU-zxx2wMFG_FSDsGKVQ93g&index=28 • https://www.youtube.com/watch?v=NlkByUnGcZg&list=PLwdnzlV3ogoU-zxx2wMFG_FSDsGKVQ93g&index=33 • https://www.youtube.com/watch?v=zAm9mvLz3es&list=PLwdnzlV3ogoU-zxx2wMFG_FSDsGKVQ93g&index=34 • https://www.youtube.com/watch?v=Eth8f4mnkns&list=PLwdnzlV3ogoU-zxx2wMFG_FSDsGKVQ93g&index=52 • https://www.youtube.com/watch?v=KeIUcUIxBS0&list=PLwdnzlV3ogoU-zxx2wMFG_FSDsGKVQ93g&index=56 • https://www.youtube.com/watch?v=-d9TCMP112c&list=PLwdnzlV3ogoU-zxx2wMFG_FSDsGKVQ93g&index=57
Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning • Contents related activities (Activity-based discussions) • For active participation of students, instruct the students to prepare Flowcharts and Handouts • Organizing Group wise discussions on issues • Seminars Organizing Group wise discussions on issues at construction site. • Seminars

ADVANCED CONCRETE TECHNOLOGY

Course Code	**21CIV541**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**3**	**Exam Hours**	**3**

Course outcomes:
At the end of the course, the student will be able to:

21CIV541.1	Conceptualize rheology of concrete and understand the properties of recycled aggregate concrete
21CIV541.2	Design mix proportion for ferro-cement and understand its applications.
21CIV541.3	Comprehend the properties and applications of fiber reinforced concrete.
21CIV541.4	Comprehend the properties and applications of high performance concrete and light Weight & high Density Concrete.
21CIV541.5	Analyze the properties of Self-Compacting Concrete and prepare its mix design.
21CIV541.6	Analyze the design concepts and applications of geo polymer concrete.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CIV541.1	3	-	-	2	-	2	2	-	-	-	-	3	3	3
21CIV541.2	3	-	-	2	-	2	2	-	-	-	-	3	3	3
21CIV541.3	3	3	2	2	-	2	2	-	-	-	-	3	3	3
21CIV541.4	3	-	-	2	-	2	2	-	-	-	-	3	3	3
21CIV541.5	3	3	2	2	2	2	2	-	-	-	-	3	3	3
21CIV541.6	3	-	-	-	2	2	2	-	-	-	-	3	3	3

MODULE-1	**RHEOLOGY OF CONCRETE/ RECYCLED AGGREGATE CONCRETE**	**21CIV541.1**	**8 Hours**

RHEOLOGY OF CONCRETE:
Introduction, factors affecting, rheology of fresh concrete by Bingham model, equation for measuring its properties.

RECYCLED AGGREGATE CONCRETE(RAC):
Characterization of Coarse recycled concrete aggregates and Fine recycled Concrete aggregates, Properties of RAC such as workability, Strength and Durability.

Self-study/ Case study/ Applications	Application of RAC
Text Book	Text Book 1: 5.2, 5.3, 5.4, 5.8,5.9, Text Book 2: 10.1, 10.3, 10.5, 10.7

MODULE-2	**FERRO CEMENT / FIBER REINFORCED CONCRETE**	**21CIV541.2 & 21CIV541.3**	**8 Hours**

FERRO CEMENT:
Materials, mechanical properties, strength, cracking and durability of normal Ferrocement. Strength and behavior of light weight Ferrocement, and Prestressed Ferrocement. Mix design procedure

FIBER REINFORCED CONCRETE:

Fibers, types, characteristics, Fiber CO1 distribution, orientation and interfacial bond. Mechanical properties of FRC mix design of FRC, behavior of hardened FRC under compression, tension flexure and impact, SIFCON, Ductal Concrete.			
Self-study/ Case study/ Applications	Prestressed Ferrocement		
Text Book	Text Book 1: 6.2, 6.3, 6.4 ,7.2,7.3 and 7.4		
MODULE-3	**HIGH PERFORMANCE / LIGHT WEIGHT AND HIGH DENSITY CONCRETES**	**21CIV541.4**	**8 Hours**
HIGH PERFORMANCE CONCRETES: Concept, materials selection, mineral admixture, proportioning, strength, and durability aspects, Construction & economic Aspects, codal provisions. **LIGHT WEIGHT AND HIGH DENSITY CONCRETE**: Definition, Proportioning, Properties and Applications, typical light weight concrete mix.			
Self-study/ Case study/ Applications	Applications and performance of High performance concrete.		
Text Book	Text Book 2:6.1, 6.3, 6.5, 6.7, 6.10		
MODULE-4	**SELF-COMPACTING CONCRETE/ MIX DESIGN**	**21CIV541.5**	**8 Hours**
SELF-COMPACTING CONCRETE: Brief history of development, Definition, Fresh property requirements, Tests as per EFNARC and ASTM, -applications. **MIX DESIGN** :Mix design procedures, Comparison of hardened properties with conventional concrete, Applications, Economical			
Self-study/ Case study/ Applications	Comparison of hardened properties with conventional concrete		
Text Book	Text Book 3: 10.1, 10.3, 10.5, 10.7		
MODULE-5	**GEO-POLYMER CONCRETE**	**21CIV541.6**	**8 Hours**
GEO-POLYMER CONCRETE: Brief history of development, Definition. Mix Design: Mix proportioning, properties and applications			
Self-study/ Case study/ Applications	Reaction chemistry, material characterization		
Text Book	Text Book 1: 9.1,9.2,9.3,9.4 and 9.7		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		**Marks Distribution**	
		Test (s)	**NPTEL**
		25	**25**
L1	**Remember**	-	5
L2	**Understand**	10	10
L3	**Apply**	10	5
L4	**Analyze**	5	5
L5	**Evaluate**	-	-
L6	**Create**	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	-
L2	**Understand**	20
L3	**Apply**	20
L4	**Analyze**	10
L5	**Evaluate**	-
L6	**Create**	-

Suggested Learning Resources:

Text Books:

1. Neville, A M, "Properties of Concrete", ELBS Publications, 5th Edition, 2012.
2. M S Shetty, "Concrete Technology", Chand S and Co, 8th Edition, 2019.
3. Gambhir B L, "Concrete Technology", Tata McGraw Hill, New Delhi, 4th Edition, 2015.

Reference Books:

1. IS: 10262-2019, "Recommended guidelines for Concrete Mix design", – BIS Publications
2. P. Kumar Mehta, Paulo J. M. Monteiro, ISBN: 9780071797870, 4th Edition, 2014, McGraw-Hill Education.
3. Mohan Raj and Jai Singh, "Advanced Building Materials and Construction", CBRI Publications, Roorkee, 2018.

Web links and Video Lectures (e-Resources):

- **https://archive.nptel.ac.in/courses/105/106/105106176/**
- **https://onlinecourses.nptel.ac.in/noc20_ce45/preview**
- **http://kec.edu.np/wp-content/uploads/2017/06/Advanced-Concrete-Technology.pdf**
- **https://www.sciencedirect.com/book/9780750656863/advanced-concrete-technology**
- **https://www.google.co.in/books/edition/Advanced_Concrete_Technology_2/CHpuiLmJLX0C?hl=en&gbpv=1&dq=Advanced+Concrete+Technology+textbook+PDF&printsec=frontcover**
- **https://myyardimci.weebly.com/uploads/1/6/3/4/16347790/ce321_ch01_introduction.pdf**

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

- Visit to any construction site
- Demonstration of concrete mix design
- Contents related activities (Activity-based discussions)
- For active participation of students, instruct the students to prepare Concrete mix design
- Organizing Group wise discussions on issues
- Seminars

AIR POLLUTION AND CONTROL

Course Code	**21CIV542**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**3**	**Exam Hours**	**3**

Course outcomes:
At the end of the course, the student will be able to:

21CIV542.1	Identify air pollutants and their classification along with its adverse effects
21CIV542.2	Analyze sampling techniques for air quality assessment
21CIV542.3	Apply the knowledge of plume behavior and atmospheric stability conditions to assess the concentrations of pollutants
21CIV542.4	Design air pollution-controlling devices.
21CIV542.5	Design automobile emission and controlling method
21CIV542.6	Apply the knowledge of environmental policies, acts, and legislations in controlling global environmental issues of air pollution.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
21CIV542.1	3	-	-	-	-	3	3	-	-	-	-	-	3	-
21CIV542.2	3	3	-	-	-	-	-	-	-	-	-	-	3	-
21CIV542.3	3	3	-	-	-	-	-	-	-	-	-	-	3	-
21CIV542.4	3	3	3	-	-	3	3	-	-	-	-	-	3	-
21CIV542.5	3	-	3	-	-	3	3	-	-	-	-	-	3	-
21CIV542.6	3	3	-	-	-	3	3	-	-	-	-	-	3	-

MODULE-1	**AIR POLLUTANTS**	**21CIV542.1**	**8 Hours**

Introduction: Air pollution definition, Sources, classification and formation/transformation of air pollutants: Meteorology and Atmospheric Stability.

Classification of air pollutants: Sources of air Pollution - natural and manmade. Photo-chemical Smog, Coal-induced smog, Major Environmental Air Pollution Episodes – London Smog, Los Angeles Smog & Bhopal Gas Tragedy

Self-study/case study /application	Classification and formation/transformation of air pollutants: Meteorology and Atmospheric Stability.
Text Book	Text Book 1: 3, 5, 6 ,21Text Book 2: 1, 2, 3,5

MODULE-2	**AIR POLLUTION –IMPACT, SAMPLING AND ANALYSIS**	**21CIV542.1 &21CIV542.2**	**8 Hours**

Impacts of air pollution: On Human Health, Animals, Vegetation, building Materials, structures, atmosphere, soil and water bodies.

Sampling and analysis: Sampling and Measurement of Gaseous and Particulate matter, Stack Sampling, Analysis of Air Pollutants, Smoke and Smoke Measurement.

Self-study/case study /application	Analysis of Air Pollutants, Sampling and Measurement of Gaseous and Particulate matter
Text Book	Text Book 1: 4,22 Text Book 2:5, 6, 7, 8, 9, 10,14

MODULE-3	AIR QUALITY	21CIV542.3	8 Hours
Meteorological variables: General Characteristics of Stack Plumes, Primary and Secondary Lapse Rate, maximum mixing depths, plume rise Inversions Stability Conditions. **Prediction of air quality:** Box model - Gaussian model –Dispersion coefficient-Application of tall chimney for Pollutant dispersion. Air quality monitoring and Air Quality Index (AQI).			
Self-study/case study /application	Air quality monitoring and Air Quality Index (AQI), Box model - Gaussian model –Dispersion coefficient-Application of tall chimney for Pollutant dispersion		
Text Book	Text Book 1: 6, Text Book 2: 12,19,20		
MODULE-4	**AIR POLLUTION CONTROL**	**21CIV542.4**	**8 Hours**
Air pollution control methods: Particulate, Emission Control, Gravitational Settling Chambers, Cyclone Separators, Fabric Filters, Electrostatic Precipitators, Wet Scrubbers along with working principles and advantages/disadvantages. **Control by absorption:** Control of Gaseous Emissions, Adsorption by Liquids, Adsorption by Solids, Combustion odours and their control.			
Self-study/case study /application	Control of Gaseous Emissions, Adsorption by Liquids, Particulate, Emission Control, Gravitational Settling Chambers		
Text Book	Text Book 1: 7, 8, 12, 23 Text Book 2:13, 14, 15, 16,		
MODULE-5	**AIR POLLUTION- DUE TO AUTOMOBILES - ENVIRONMENTAL ISSUES**	**21CIV542.5 &21CIV542.6**	**8 Hours**
Air pollution due to automobiles: Air Pollution due to Gasoline Driven and Diesel Driven Engines, Effects, Direct and Indirect methods of control. **Global environmental issues of air pollution and legislation:** Ozone layer depletion, Climate change, Global warming, Acid rain. Air Pollution Emission Standards, National and International policies, acts, rules and regulations.			
Self-study/case study /application	Ozone layer depletion, Climate change, Global warming, Acid rain. Air Pollution Emission Standards		
Text Book	Text Book 1: 5, 14 Text Book 2: 11, 22, 24		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution	
		Test (s)	NPTEL
		25	25
L1	Remember	-	5
L2	Understand	10	10
L3	Apply	10	5
L4	Analyze	5	5
L5	Evaluate	-	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	0
L2	**Understand**	20
L3	**Apply**	20
L4	**Analyze**	10
L5	**Evaluate**	-
L6	**Create**	-

Suggested Learning Resources:

Text Books:

1. Textbook of Air pollution and its control, S. C. Bhatia, Atlantic publishers and distributors (P) Ltd. Latest edition, 2021. ISBN-10:9788126908257, ISBN-13: 978-8126908257.
2. Air pollution, M N Rao and H V N Rao, Mc Graw Hill Education (India) Pvt. Ltd., 51st Reprint, 2016. ISBN-10: 0074518712, ISBN-13: 978-0-07-451871-7.
3. Principles and Practices of Air Pollution Control and Analysis Hardcover, I K International Publishing House Pvt. Ltd, ISBN-10: 9380026382, ISBN-13 978-9380026381.

Reference Books:

1. Air Pollution Control Theory, Crawford, M., Tata McGraw Hill Publishing Co. Ltd., TMH Edition, 1976. ISBN-10: 0070134901, ISBN-13: 978-0-07-0134904.
2. Air Pollution: Its Origin and Control, Wark, K., Warner, C.F. and Davies, W.T., Pearson, 3rd edition, 1998. ISBN-10: 0673994163, ISBN-13: 978-0-67-3994165.

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/105/107/105107213/
- https://nptel.ac.in/courses/105102089
- https://archive.nptel.ac.in/courses/105/104/105104099/
- https://archive.nptel.ac.in/courses/123/105/123105001/

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

- Visit to any treatment plant
- Organizing Group wise discussions on issues
- Video demonstration of Treatment process of air pollutant by using different equipment.
- Instruct students to prepare flowcharts and Handouts

APPLIED GEOTECHNICAL ENGINEERING

Course Code	**21CIV543**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**3**	**Exam Hours**	**3**

Course outcomes:
At the end of the course, the student will be able to:

21CIV543.1	Suggest suitable soil exploration technique/s, and interpret the results obtained
21CIV543.2	Prepare borelog and soil exploration report
21CIV543.3	Estimate the lateral pressures on earth retaining structures using numerical methods
21CIV543.4	Compute safe bearing capacity of soil for design of shallow foundation.
21CIV543.5	Analyze the settlement of foundations.
21CIV543.6	Estimate single pile and pile group capacity under various soil conditions.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CIV543.1	3	3	-	-	-	-	-	-	-	-	-	2	3	3
21CIV543.2	3	3	-	-	2	-	-	-	-	-	-	2	3	3
21CIV543.3	3	3	3	3	2	-	-	-	-	-	-	2	3	3
21CIV543.4	3	3	-	3	2	-	-	-	-	-	-	2	3	3
21CIV543.5	3	3	-	-	-	-	-	-	-	-	-	2	3	3
21CIV543.6	3	3	-	-	-	-	-	-	-	-	-	2	3	3

MODULE-1	**SOIL EXPLORATION**	**21CIV543.1, 21CIV543.2**	**8 Hours**

SOIL EXPLORATION:

Importance of soil exploration, objectives and importance, Methods of exploration: Boring (Auger, Rotary, drilling), types of samples, Samplers (Split spoon, Shelby & Rotary), Sample disturbance, Area ratio, Recovery ratio, clearance, Number and depth of borings for various civil engineering structures, Standard penetration test, Seismic refraction method. Preparation of Soil exploration report.

Self-study/ Case study/ Application	Typical bore log
Text Book	Text Book 1.17, 2.32

MODULE-2	**LATERAL EARTH PRESSURE**	**21CIV543.3**	**8 Hours**

LATERAL EARTH PRESSURE:

Types of Lateral earth pressures - Active and Passive earth pressures, Earth pressure at rest. Rankine's Earth pressure theories--assumptions, Active earth pressure theory for retaining wall in Cohesion less soil with dry back fill partially saturated backfill, with surcharge.

Self-study/Case study/ Application	Active earth pressure theory for retaining wall in Cohesion less soil with dry back fill partially saturated backfill
Text Book	Text Book 1: 19, 2.20

MODULE-3	**BEARING CAPACITY**	**21CIV543.4**	**8 Hours**

BEARING CAPACITY:

Definitions of bearing capacity, ultimate, net and safe bearing capacities. Types of shear failure, Terzaghi's theory for bearing capacity – assumptions, bearing capacity determination under general shear failure for strip and square footings, Effect of ground water table on bearing capacity.

Self-study/Case study/ Application	Plate load test.
Text Book	Text Book 1.23, 2.24

MODULE-4	**SETTLEMENT ANALYSIS**	**21CIV543.5**	**8 Hours**

SETTLEMENT ANALYSIS:

Stages of settlement of footings, Estimation of immediate of cohesive soil, consolidation settlement and secondary consolidation settlement - causes of settlement - permissible, total and differential settlement.

Self-study/Case study/ Application	Methods of reducing differential settlement.
Text Book	Text Book 1.12, 2.25

MODULE-5	**PILE FOUNDATION**	**21CIV543.6**	**8 Hours**

PILE FOUNDATION:

Types and classification of piles, single loaded pile capacity in cohesion less and cohesive soils by static method. Efficiency of Pile group, group capacity of piles in cohesion less and cohesive soils.

Self-study/Case study/ Application	Pile load test
Text Book	Text Book 1.25, 2.26

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		**Marks Distribution**	
		Test (s)	**NPTEL**
		25	**25**
L1	**Remember**	-	5
L2	**Understand**	10	10
L3	**Apply**	10	5
L4	**Analyze**	5	5
L5	**Evaluate**	-	-
L6	**Create**	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	-
L2	**Understand**	20
L3	**Apply**	20
L4	**Analyze**	10
L5	**Evaluate**	-
L6	**Create**	-

Suggested Learning Resources:

Text Books:

1. Dr. Arora K. R, "Soil Mechanics and Foundation Engineering", Standard Publishers and Distributors, 3rd Edition, 2009.
2. Punmia B.C., "Soil Mechanics and Foundation Engineering", Laxmi Publications Co., 16th Edition, New Delhi, 2005.
3. Gopal Ranjan& A.S.R Rao, "Basic and Applied Soil Mechanics", New Age International Pvt Ltd, 3rd Edition, 2016.

Reference Books:

1. Braja, M. Das, "Principles of Foundation Engineering", PWS Publishing Company, 3rd Edition, 2007.
2. Murthy V.N.S., "Textbook of Soil Mechanics and Foundation Engineering", CBS Publishers & Distributors, 2018.
3. Bowles J.E., "Foundation Analysis and Design", McGraw Hill Book Co. New York, 5th Edition.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/playlist?list=PLq46p_ppqQek8ZfKSj-z6aO9bbpkHR6gH
- https://www.youtube.com/watch?v=DjWDOqQjsyQ
- https://onlinecourses.nptel.ac.in/noc22_ce96/preview

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

- Video demonstration of applications of soil explorations.
- Case study on Stability of slopes
- Contents related activities (Activity-based discussions)
- Organizing Group wise discussions on issues

CONSTRUCTION QUALITY AND SAFETY

Course Code	**21CIV544**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**3**	**Exam Hours**	**3**

Course outcomes:
At the end of the course, the student will be able to:

21CIV544.1	Analyze the elements of quality planning and the implication.
21CIV544.2	Comprehend with the objectives and advantage of quality assurance
21CIV544.3	Examine the relationship between quality and safety management.
21CIV544.4	Examine the various safety concepts and requirements applied to construction projects.
21CIV544.5	Examine the construction accidents, safety programmers.
21CIV544.6	Examine the construction obligations and design for safety.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CIV544.1	3	3	3	3	2	-	-	-	-	-	-	2	3	3
21CIV544.2	3	3	3	3	2	-	-	-	-	-	-	2	3	3
21CIV544.3	3	3	3	3	2	-	-	-	-	-	-	2	3	3
21CIV544.4	3	3	3	3	2	-	-	-	-	-	-	2	3	3
21CIV544.5	3	3	3	3	2	-	-	-	-	-	-	2	3	3
21CIV544.6	3	3	3	3	2	-	-	-	-	-	-	2	3	3

MODULE-1	**QUALITY ASSURANCE OF CONSTRUCTION**	**21CIV544.1**	**8 Hours**

Construction Quality, Inspection and Testing, Quality control, Quality Assurance, Quality Certification for companies and laboratories (ISO Certification, NABL certification)

Self-Study/ Case Study/ Applications	Testing, Quality control, Quality Assurance.
Text Book	Text Book 1: 2.3 , 2: 2.5

MODULE-2	**QUALITY MANAGEMENT**	**21CIV544.2**	**8 Hours**

Total Quality Management, Critical factors of TQM, TQM in Projects, Benchmarking, concepts of quality policy, standards, manual

Self-Study/ Case Study/ Applications	TQM in Projects, Benchmarking
Text Book	Text Book 1: 4.3 , 2: 4.5

MODULE-3	**THIRD PARTY INSPECTION PROCESS**	**21CIV544.3**	**8 Hours**

Third Party Certification: Construction Safety-meaning and scope, Safety in construction- Technological aspects, organizational aspects and behavioral aspects, Safety legislation and Standards, Contract conditions on safety in Civil Engineering projects

Self-Study/ Case Study/ Applications	organizational aspects and behavioral aspects, Safety legislation
Text Book	Text Book 3: 4.5, 4: 5.6

MODULE-4	**SAFETY IN CONSTRUCTION - 1**	**21CIV544.4**	**8 Hours**

Safety in Construction: Causes, classification, cost and measurement of an accident, safety programme for construction, protective equipment, accident report, safety measure: (a) For storage and handling of building materials. (b) Construction of elements of a building (c) In demolition of buildings Safety lacuna in Indian scenario

Self-Study/ Case Study/ Applications	protective equipment, accident report, safety measure:
Text Book	Text Book 5: 4.5, 5: 2.4

MODULE-5	**SAFETY IN CONSTRUCTION - 2**	**21CIV544.5**	**8 Hours**

Types of injuries, Factors affecting safety, Strategic Planning for safety provisions. Personal & Structural safety - Safety consideration during construction, demolition and during use of equipment. Recording injuries and accident indices. Method statement, SOPs, PPE, Inspections, Investigations. Site safety programmes - JSA, JHA, Root cause analysis, meetings, safety policy, manuals, training & orientation

Self-Study/ Case Study/ Applications	Recording injuries and accident indices. Method statement, SOPs, PPE, Inspections, Investigations.
Text Book	Text Book 4: 5.2, 4: 4.2, 5: 4.2

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		**Marks Distribution**	
		Test (s)	**NPTEL**
		25	**25**
L1	**Remember**	-	5
L2	**Understand**	10	10
L3	**Apply**	10	5
L4	**Analyze**	5	5
L5	**Evaluate**	-	-
L6	**Create**	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		**Exam Marks Distribution (50)**
L1	**Remember**	-
L2	**Understand**	20
L3	**Apply**	20
L4	**Analyze**	10
L5	**Evaluate**	-
L6	**Create**	-

Suggested Learning Resources:

Text Books:

1. N. Logothetis, "Management for Total Quality", Prentice Hall of India, New Delhi,. 2003, ISBN-81-203-1137-X
2. David Gold Smith, "Safety Management in construction and Industry", McGraw Hill, ISBN-13 : 978-0070236776, McGraw Hill Higher Education (1 January 1987)
3. K N Vaid, "Construction Safety Management", NICMAR, Bombay, Year: 1988
4. D S Rajendra Prasad, "Quality Management System in Civil Engineering", Sapna Book House, Bangalore - ISO 9001-. 2000
5. "The Building and Other Construction Workers" (Regulation of Employment and Conditions of Service) Act, 1996, Universal Law Publishing Co. Pvt. Ltd., 1 February 2022

Reference Books:

1. Robert (QMP) " Bench Marking", " The search for industry Best Practices that led to superior performance" American Society of Quality 1995
2. Break Joseph and Susan Joseph "Total Quality Management", Excel Books, New Delhi, 1995.
3. Juran Frank, J.M. and Gryna, F.M. "Quality Planning and Analysis", Tata McGraw Hill 2002.
4. James, J.O Brian, "Construction Inspection Handbook –Quality" 2009

Web links and Video Lectures (e-Resources):

- **https://onlinecourses.nptel.ac.in/noc21_ce16/preview**
- **https://archive.nptel.ac.in/courses/105/102/105102206/**

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

- Visit to any industry or construction site.
- Demonstration of construction safety equipments.
- Video demonstration of latest construction safety technology.
- Students will prepare Flowcharts and Handouts on safety techniques
- Seminars/ Group wise discussions on quality management.

PREFABRICATED STRUCTURES

Course Code	**21CIV545**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**3**	**Exam Hours**	**3**

Course outcomes:
At the end of the course, the student will be able to:

21CIV545.1	Apply the fundamentals of prefabricated structures and materials
21CIV545.2	Design Simple prefabricated structures elements using design principles and understand joints for structural connection.
21CIV545.3	Comprehend the production and storage technology of prefabricated structural components.
21CIV545.4	Examine the hoisting technology of prefabricated structural Components.
21CIV545.5	Design and detail precast unit for factory structures.
21CIV545.6	Design single storey buildings for abnormal loads.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CIV545.1	3	-	-	-	2	-	-	-	-	-	-	-	3	-
21CIV545.2	3	3	3	-	-	-	-	-	-	-	-	-	3	-
21CIV545.3	3	3	-	-	2	-	-	-	1	-	-	-	3	-
21CIV545.4	3	3	-	-	2	-	-	-	1	-	-	-	3	-
21CIV545.5	3	3	3	-	-	-	-	-	-	-	-	-	3	-
21CIV545.6	3	3	3	-	-	-	-	-	-	-	-	-	3	-

MODULE-1	**PREFABRICATED COMPONENTS - 1**	**21CIV545.1, 21CIV545.2**	**8 Hours**

Introduction:
Comparison with monolithic construction need for prefabrication, Principles, Materials – Types of prefabrication - site and plant prefabrication – Economy of prefabricated, Modular coordination – Standardization – Systems – Planning for Components of prefabricated structures- Disuniting of Structures.

Prefabricated Components :
Design of simple regular beams and I beams – Handing and erection stresses, Elimination of erection stresses – Beams, columns.

Self-study/Case study/ Application	Symmetrical frames.
Text Book	Text Book 1: 1.1, 1.2, 1.3,1.4,1.5

MODULE-2	**PREFABRICATED COMPONENTS 2 / CONNECTIONS**	**21CIV545.2**	**8 Hours**

Prefabricated Components:
Roof and floor slabs, ribbed floor panels – wall panels, footings.

Joints for different structural connections:
Joints for different structural connections, Dimensions and detailing – Effective sealing of joints for water proofing – Provisions for non – structural fastenings – Expansion joints in pre-cast construction

Self-study/Case study/ Application	Shear walls.
Text Book	Text Book 1: 2.1, 2.2, 2.3

MODULE-3	**PRODUCTION & STORAGE TECHNOLOGY**	**21CIV545.3**	**8 Hours**

Production technology methods:
Choice of production set up – Manufacturing methods – Stationary and mobile production – Planning of production setup.
Storage technology:
Storage of precast elements –Dimensional tolerances.

Self-study/Case study/ Application	Acceleration of concrete hardening.
Text Book	Text Book 1: 2.4,2.3, 2.4, Text Book 2: 1.2, 1.3

MODULE-4	**HOISTING TECHNOLOGY**	**21CIV545.4, 21CIV545.5**	**8 Hours**

Hoisting Technology:
Equipments for hoisting and erection – Techniques for erection of different types of members like Beams, Slabs
Designing and detailing of precast unit for factory structures – Purlins, Principal rafters, roof trusses, lattice girders, Cable frames.

Self-study/Case study/ Application	Wall panels and Columns- Vacuum lifting pads.
Text Book	Text Book 1: 4.5, .4.6 Text Book 2: 4.2, 4.6

MODULE-5	**MISCELLANEOUS TOPICS**	**21CIV545.6**	**8 Hours**

Concepts of Single span single storeyed frames – Single storeyed buildings – Slabs, beams and Columns.
Progressive collapse – Code provisions – Equivalent design loads for considering abnormal effects such as earthquakes, cyclones, etc,. Importance of avoidance of progressive collapse.

Self-study/Case study/ Application	Design for abnormal loads:
Text Book	Text Book 1: 5.3, 5.4. Text Book 2: 6.1, 6.2, 6.3

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		**Marks Distribution**	
		Test (s)	**NPTEL**
		25	**25**
L1	**Remember**	-	5
L2	**Understand**	10	10
L3	**Apply**	10	5
L4	**Analyze**	5	5
L5	**Evaluate**	-	-
L6	**Create**	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		**Exam Marks Distribution (50)**
L1	**Remember**	-
L2	**Understand**	20
L3	**Apply**	20
L4	**Analyze**	10
L5	**Evaluate**	-
L6	**Create**	-

Suggested Learning Resources:

Text Books:

1. "Prefabricated Concrete for Industrial and Public Structures", L. Mokk, Publishing House of the Hungarian Academy of Sciences, Budapest, 2007.
2. "Knowledge based process planning for construction and manufacturing", Gerostiza. C.Z, Hendrikoson C, and Rehat D.R, Academic Press Inc., (ISBN – 9780127819006), 2007.
3. I.T. Konc, "Manual of Precast Concrete Construction:, Vol. I ,II, III & IV, Berlin, 1971

Reference Books:

1. CBRI. "Building materials and components:, India, 1990.
2. Structural design manual, Precast concrete connection details, Society for the studies in the use of precast concrete, Netherland Betor Verlag, 2009.
3. "Prefabricated Concrete for Industrial and Public Sectors", Lasslo Mokk, Akademia I Kiado, Budapest, 1964

Web links and Video Lectures (e-Resources):

- **https://youtu.be/VHOC0ZaZErE**
- **https://youtu.be/xTDvY2BRxpk**
- **https://youtu.be/JvAVlrJNsl4**

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

- Contents related activities (Activity-based discussions)
- For active participation of students, instruct the students to prepare Flowcharts and Handouts
- Organizing Group wise discussions on issues
- Seminars Organizing Group wise discussions on issues at construction site.

CONCRETE MIX DESIGN LAB

Course	**21CVL551**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs /	**2**	**Total Marks**	**100**
Credits	**1**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

21CVL551.1	Apply IS provisions in mix design of concrete.
21CVL551.2	Compute data requirement of ingredients of concrete
21CVL551.3	Determine parameters needed for the Concrete Mix Design
21CVL551.4	Design the mix for various grades of Concrete.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CVL551.1	3	3	3	3	3	-	-	-	-	-	-	2	3	3
21CVL551.2	3	3	3	3	3	-	-	-	-	-	-	2	3	3
21CVL551.3	3	3	3	3	3	-	-	-	-	-	-	2	3	3
21CVL551.4	3	3	3	3	3	-	-	-	-	-	-	2	3	3

Exp. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	Knowledge about construction materials – Properties & Tests	2	NA
	PART-A		
1	Mix Design Methods	2	21CVL551.1
2	Data Requirement- Concrete and Cement	2	21CVL551.2
3	Data Requirement- Aggregates and water	2	21CVL551.2
4	IS-2000 Clauses, Mix Design Steps	2	21CVL551.2
5	Computation of Target Mean Strength,	2	21CVL551.3
6	Water/Cement Ratio	2	21CVL551.3
	PART-B		
7	Computation of Water quantity and determination of entrapped air.	2	21CVL551.3
8	Determination of cement content, quantity of Coarse Aggregate and Fine Aggregate per m^3 of Concrete.	2	21CVL551.3
9	Determination of Mix Proportions and Mix Design implementation.	2	21CVL551.3
10	Design Mix of M25, M30	2	21CVL551.4

11	Design Mix of M35	2	21CVL551.4
12	Design Mix of M40	2	21CVL551.4

PART-C
Beyond Syllabus Virtual Lab Content
(To be done during Lab but not to be included for CIE or SEE)

- Target mean strength
  https://youtu.be/S8oc4rsleAY
- Design mix of M25
  https://www.youtube.com/watch?v=JLZwdOdsaac

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		20	30
L1	Remember	-	-
L2	Understand	-	5
L3	Apply	10	10
L4	Analyze	5	10
L5	Evaluate	5	5
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	15
L4	Analyze	15
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:

Reference Books:

1. IS 10262:2019,Guidelines for concrete mix design proportioning, Bureau of Indian Standards, New Delhi, India.
2. Design of concrete mixes, N Krishna Raju , ISBN-13:978-8123902180, 4thedition, CBS Publisher
3. "Concrete Manual", Gambhir M.L, 4th edition, Dhanpat Rai & Sons, New Delhi.

BUILDING DESIGN LAB

Course	**21CVL552**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs /	**2**	**Total Marks**	**100**
Credits	**1**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

21CVL552.1	Apply the knowledge of Building components and to do Planning & Drafting by using AutoCAD.
21CVL552.2	Prepare drawings – Plans, Elevation , Layouts
21CVL552.3	Apply execution process
21CVL552.4	Providing utility facility and generating report.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CVL552.1	3	3	3	3	3	-	-	-	3	-	-	3	3	3
21CVL552.2	3	3	3	3	3	-	-	-	3	-	-	3	3	3
21CVL552.3	3	3	3	3	3	-	-	-	3	-	-	3	3	3
21CVL552.4	3	3	3	3	3	-	-	-	3	-	-	3	3	3

Exp. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	Building Planning and Drawing using AutoCAD Software	2	NA
	PART-A		
1	Drawing a line diagram of a residential building. [Framed structure, minimum of 1200 sft].	2	21CVL552.1
2	Drawing a plan of ground floor and first floor.	2	21CVL552.2
3	Drawing elevations	2	21CVL552.2
4	Drawing the column layout	2	21CVL552.2
5	Drawing the Foundation layout	2	21CVL552.2
6	Drawing the plinth beam layout & beam layout	2	21CVL552.2
	PART-B		
7	Site clearance and excavation process	2	21CVL552.3
8	Locating openings for utility facilities- electrical, drinking water	2	21CVL552.4
9	Locating openings for utility facilities- sewerage facilities	2	21CVL552.4
10	Detailing of plumbing facilities.	2	21CVL552.4
11	Detailing of Electrical facilities	2	21CVL552.4

12	Generating report/ drawing for approval.		

PART-C
Beyond Syllabus Virtual Lab Content
(To be done during Lab but not to be included for CIE or SEE)

- **https://youtu.be/i264OQmaTZc**
- **https://youtu.be/6jx1rY0rlt0**

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		20	30
L1	Remember	-	-
L2	Understand	-	5
L3	Apply	10	10
L4	Analyze	5	10
L5	Evaluate	5	5
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	15
L4	Analyze	15
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:

Reference Books:

1. National Building Code (NBC, 2016).
2. SP34-1987 Hand book on Concrete Reinforcement and Detailing.
3. Krishna murthy., "Elementary Structural Design and Drawing", CBS publishers,1stedition,2006,(Concrete Structures),CBS publishers, New Delhi.1999.
4. S.N.Sinha.,"ReinforcedConcreteDesign",McGrawHillEducation,3rdedition,NewDelhi,2014.
5. Ghosh Karuna Moy, "Practical Design of Reinforced Concrete Structures", PHILearning,1st edition, NewDelhi,2010.

DATA ANALYTICS WITH EXCEL

Course	**21CVL553**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs /	**2**	**Total Marks**	**100**
Credits	**1**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

21CVL553.1	Develop the Spreadsheet for data collection and analysis.
21CVL553.2	Evaluate the equations using Excel functions.
21CVL553.3	Learn to standardize the data quality and maintain data consistency.
21CVL553.4	Design and apply solutions to verify the data sets

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CVL553.1	3	3	3	3	3	-	-	-	-	-	-	3	3	3
21CVL553.2	3	3	3	3	3	-	-	-	-	-	-	3	3	3
21CVL553.3	3	3	3	3	3	-	-	-	-	-	-	3	3	3
21CVL553.4	3	3	3	3	3	-	-	-	-	-	-	3	3	3

Exp. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	Knowledge of Microsoft excel	2	NA
	PART-A		
1	Introduction to Data Analysis Using Spreadsheets: Fundamentals of spreadsheet applications, Excel interface, and learn how to navigate around a worksheet and workbook.	2	21CVL553.1
2	Using Excel Spreadsheets: To Perform basic spreadsheet tasks - viewing, entering and editing data, and moving, copying and filling data. To learn about the fundamentals of formulas, the most common functions used by a data analyst and to learn how to reference data in formulas.	2	21CVL553.2
3	Cleaning & Wrangling Data Using Spreadsheets: To learn the importance of data quality, to import file data in to Excel, to learn the fundamentals of data privacy, removal of duplicate and inaccurate data, and how to remove empty rows in one's data	2	21CVL553.3
4	Cleaning & Wrangling Data Using Spreadsheets: To learn the fundamentals of data privacy, removal of duplicate and inaccurate data, and how to remove empty rows in one's data	2	21CVL553.3
5	To deal with inconsistencies in one's data and to use the Flash Fill and Text to Columns and	2	21CVL553.4
6	To learn the features to manipulate and standardize one's data.	2	21CVL553.4
	PART-B		

7	Analyzing Data Using Spreadsheets: Fundamentals of analyzing data using a spreadsheet, and learn how to filter and sort data. Learn how to use some of the most useful functions for a data analyst	2	21CVL553.4
8	To use the VLOOKUP and HLOOKUP reference functions. tables in Excel, and use several pivot table features	2	21CVL553.4
9	To learn how to create pivot tables in Excel.	2	21CVL553.4
10	To learn how to use several pivot table features.	2	21CVL553.4
11	Introduction to Hands –on- lab: Cleaning and preparing data.	2	21CVL553.1 21CVL553.2 21CVL553.3 21CVL553.4
12	Analyzing the cleaned and prepared data using an Excel spreadsheet.	2	21CVL553.1 21CVL553.2 21CVL553.3 21CVL553.4

PART-C
Beyond Syllabus Virtual Lab Content
(To be done during Lab but not to be included for CIE or SEE)

- **https://youtu.be/qYm1dZ8T_DU**

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		20	30
L1	Remember	-	-
L2	Understand	-	5
L3	Apply	10	10
L4	Analyze	5	10
L5	Evaluate	5	5
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	15
L4	Analyze	15
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:

- https://www.coursera.org/learn/excel-basics-data-analysis-ibm
- Any online platform with the above course content like YouTube videos and NPTEL courses

CONSTRUCTION AND SERVICES LAB

Course	**21CVL554**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs /	**2**	**Total Marks**	**100**
Credits	**1**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

21CVL554.1	Apply the knowledge of services required for buildings
21CVL554.2	Illustrate the various specifications in building
21CVL554.3	Carry out measurements of basic services required in buildings
21CVL554.4	Estimate different loads on building

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CVL554.1	3	-	-	-	-	3	-	-	-	-	-	-	1	-
21CVL554.2	3	-	-	-	-	3	-	-	-	-	-	3	1	-
21CVL554.3	3	-	-	-	-	3	-	-	-	-	-	3	-	2
21CVL554.4	3	-	-	-	-	3	3	-	-	-	-	3	-	-

Exp. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	Concepts of Building Materials	2	NA
	PART-A		
1	Setting out works	2	21CVL554.2
2	Construction of Masonry: Header and stretcher bond	2	21CVL554.2
3	Construction of Masonry: English bond	2	21CVL554.2
4	Construction of Masonry: Flemish bond	2	21CVL554.2
5	Calculation of Electrical load	2	21CVL554.4
6	Calculation of AC load	2	21CVL554.4
	PART-B		
7	Calculation of Fire load	2	21CVL554.4
8	Demonstration on Plumbing, Sanitary fittings & fixtures	2	21CVL554.1
9	Measurement of Intensity of Sound & Light	2	21CVL554.3
10	Measurement of Moisture Content	2	21CVL554.3
11	Measurement of pH	2	21CVL554.3

12	Measurement of Indoor Air Quality	2	21CVL554.3

PART-C

Beyond Syllabus Virtual Lab Content

(To be done during Lab but not to be included for CIE or SEE)

- **English bond**
  https://www.youtube.com/watch?v=m2x105Tkqqg
- **Flemish bond**
  https://www.youtube.com/watch?v=hP8EbjnwI18

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		20	30
L1	Remember	-	-
L2	Understand	-	5
L3	Apply	10	10
L4	Analyze	5	10
L5	Evaluate	5	5
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	15
L4	Analyze	15
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:

1. Building Services for Water Supply and Sanitation by Panchdhare.
2. Water Supply and Sanitary Engineering, by Rangawala
3. Relevant IS Codes. (IS 1905 1987)
4. Alternative building materials and technologies.
5. Alternative building methodologies for engineers and architects, lecture notes edited: K.S. Jagadish and B.V. Venkatarama Reddy, Indian Institute of Science, Bangalore.
6. National Building Code - 2016

MINI PROJECT
(STAAD-ANALYSIS OF STRUCTURE CONCEPTS)

Course	**21CIV56**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs /	**2**	**Total Marks**	**100**
Credits	**1**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

21CIV56.1	Use software in a professional set up to meet industrial standards.
21CIV56.2	Model and Analyse Residential building using software.
21CIV56.3	Design of Residential building using software and generating report.
21CIV56.4	Compare the design manually.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CIV56.1	3	3	2	3	3	-	-	-	-	3	-	3	3	3
21CIV56.2	3	3	2	3	3	-	-	-	-	3	-	3	3	3
21CIV56.3	3	3	2	3	3	-	-	-	-	3	-	3	3	3
21CIV56.4	3	3	2	3	3	-	-	-	-	3	-	3	3	3

Exp. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	Knowledge of Manual Design of RCC structural elements	2	NA
	PART-A		
1	Drawing a plan of a residential building. [G+1 Framed structure, minimum of 1200sft].	2	21CIV56.1
2	Modeling of above Residential Building.	2	21CIV56.2
3	Analysis of above Residential Building	2	21CIV56.2
4	Design of above Residential Building	2	21CIV56.3
5	Generating Report	2	21CIV56.3
	PART-B		
6	Identifying critical structural elements – Beam , Slab, Column, Footing	2	21CIV56.4
7	Manual Design of Critical Beam & Slab.	2	21CIV56.4
8	Manual Design of Critical Column.	2	21CIV56.4
9	Manual Design of Critical Footing.	2	21CIV56.4
10	Validation of design – comparing manual design with Staad Pro.	2	21CIV56.4

PART-C
Beyond Syllabus Virtual Lab Content
(To be done during Lab but not to be included for CIE or SEE)

- https://youtu.be/Yfh_1VM2kzg
- https://youtu.be/HSC5Ngscmtg

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Project Report	Project Presentation Skill	Viva Voce
		25	15	10
L1	Remember	-	-	5
L2	Understand	-	-	5
L3	Apply	10	5	-
L4	Analyze	10	5	-
L5	Evaluate	5	5	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	15
L4	Analyze	15
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:

Reference Books:

1. Training and user manuals of STAAD PRO
2. Bhavikatti SS, Structural Analysis II, Vikas Publishers, 4th Edition, 2011, New Delhi.
3. Thandavamoorthy TS, Structural Analysis, Oxford University Press, 3rd Edition, 2012, Bengaluru
4. Ramamrutham S, Theory of structures, Dhanpat Rai Publications, 9th Edition, 2014, New Delhi
5. S.P. Gupta, G.S. Pandit and R. Gupta, Theory of Structures Vol. 2, n Tata McGraw Hill Publication Company Ltd., 1st Edition, 1999, New Delhi
6. Manish S, Finite Element Method and Computational Structural Dynamics, PHI learning Pvt. Ltd, 1st Edition, 2012, New Delhi.

RESEARCH METHODOLOGY AND IPR

Course Code	**21CVK57**	**CIE Marks**	**50**
L:T:P:S	**1:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**1**	**Exam Hours**	**2**

Course outcomes:
At the end of the course, the student will be able to:

21CVK57.1	Characterize the significance and suitability of research in engineering applications.
21CVK57.2	Demonstrate the various processing techniques of research.
21CVK57.3	Evaluate the research in the development of engineering materials, process and tools.
21CVK57.4	Analyze criteria to fit own intellectual work in particular form of IPR.
21CVK57.5	Apply statutory provisions to protect particular form of research.
21CVK57.6	Develop the art of scholarly writing and evaluate its quality.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CVK57.1	3	3	3	-	-	-	-	-	3	3	2	3	3	-
21CVK57.2	3	3	3	1	2	-	-	-	3	3	2	3	3	-
21CVK57.3	3	3	3	1	2	-	-	2	3	3	2	3	3	-
21CVK57.4	3	3	-	-	-	-	-	2	3	3	2	3	3	-
21CVK57.5	3	-	-	-	-	-	-	2	3	3	2	3	3	-
21CVK57.6	3	3	3	1	2	-	-	1	3	3	2	3	3	-

MODULE-1	**RESEARCH FORMULATION AND DESIGN**	**21CVK57.1, 21CVK57.2**	**3 Hours**

Definition and objective of research, types of research, steps in research process, research design, concept and types of research design, defining and formulating the research problems, importance of literature review-primary and secondary sources, reviews, monographs, patent, research database, web sources, identifying gap areas from the literature and research data base, surveying synthesis, Interpretation.

Self- Study/Case Study/Applications	Identifying research problem & literature Survey
Text Book	Text Book 1: Ch. 1, 2& 6

MODULE-2	**SAMPLING & DATA INTERPRETATION**	**21CVK57.2, 21CVK57.3**	**3 Hours**

Mathematical tools for analysis, statistical analysis of data, regression analysis, correlation, concept of best fit and exact fit, exact fit, theory, examples from linear regression with one and more unknowns.

Self- Study/Case Study/Applications	Sampling methods on construction materials, their testing, construction techniques, material selection.
Text Book	Text Book 1: Ch. 4& 7

MODULE-3	**PATENT RIGHTS AND IPR**	**21CVK57.3, 21CVK57.4**	**3 Hours**

Patents and its basics, process of filing patent at national and international level, Introduction and significance of intellectual property rights, commercialization, royalty, copyright, trade related aspects of IPR, Administration of patent system in India, licensing and transfer of technology, case studies.

Self- Study/Case Study/Applications	Drafting of Patent
Text Book	Text Book 2: Ch. 1 & 2/ IPR India website

MODULE-4	RESEARCH AND PUBLICATIONETHICS	21CVK57.4, 21CVK57.5	3 Hours
Research and Integrity, Scientific mis conduct: Falsification, Fabrication and Plagiarism (FFP), Conflict of research, Predatory publishers and Journals, Open access publication, citation and acknowledgement, reproducibility and accountability, software tools for similarity check			
Self- Study/Case Study/Applications	Drafting of research/Journal papers.		
Text Book	Text Book 1: Ch. 14 & 15		
MODULE-5	**REPORT WRITING**	**21CVK57.5, 21CVK57.6**	**3 Hours**
Structure and components of research report, types of report, layout of research report, mechanism of writing a research report, referencing in academic writing, Abstracting, Bibliography			
Self- Study/Case Study/Applications	Drafting of research report		
Text Book	Text Book 1: Ch. 14		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	-
L3	Apply	5	5	5
L4	Analyze	5	5	5
L5	Evaluate	5	5	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	10
L4	Analyze	10
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:

Text Books:

1) 1. Kothari, C.R., "Research Methodology: Methods and Techniques". New Age International, 2018, ISBN-13: 978-8122436235
2) Ramakrishna Chintakunta, A Text book of Intellectual Property rights, Blue Hill Publication, ASIN: B09T6YDB5N, 2022

Reference Books:

1) Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K, An introduction toResearch Methodology, RBSA Publishers. 2015, ISBN-13:978-8176111652
2) Ranjith Kumar, Research methodology, Saga publications,4th edition, 2014, ISBN-13- 978-

9351501336Anderson, T. W., "An Introduction to Multivariate Statistical Analysis", Wiley Eastern Pvt., Ltd., New Delhi, 2011, ISBN-13: 978-8126524488

3) Montgomary, Douglas C. &Runger, George C. (2016) 6/e, Applied Statistics & probability for Engineers (Wiley India) ISBN-13: 978-1118539712
4) Montgomary, Douglas C. (2012) 8th edition, Design and Analysis of Experiments (Wiley India) ISBN: 978-1-118-14692-7
5) Sinha, S.C. and Dhiman, A.K., 2012. Research Methodology, EssEss Publications. 2 volumes. ISBN : 81-7000-324-5, 81-7000-334-2

Web links and Video Lectures (e-Resources):

- https://youtu.be/tCUSTxaPYZk
- https://youtu.be/K50KayEiP2A
- https://youtu.be/y6L5aeSz4Z0
- https://youtu.be/Ju4ov_ZBZn4
- https://youtu.be/-MdYCbwast8

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

Sampling for Construction materials /Waste management

INNOVATION AND DESIGN THINKING

Course Code	**21CVK58**	**CIE Marks**	**50**
L:T:P:S	**1:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**1**	**Total Marks**	**100**
Credits	**1**	**Exam Hours**	**1**

Course outcomes:
At the end of the course, the student will be able to:

21CVK58.1	Articulate a comprehensive understanding of the concept of Design Thinking
21CVK58.2	Apply Design Thinking methodologies to solve complex and ambiguous problems effectively
21CVK58.3	Utilize design thinking tools for creative solutions
21CVK58.4	Implement design thinking in IT that showcase the ability to drive meaningful innovation
21CVK58.5	Develop strategic innovation for Business Model Design
21CVK58.6	Create the Minimum Viable Product to solve societal needs using Design Thinking

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CVK58.1	3	-	-	-	-	-	-	-	3	3	-	3	3	-
21CVK58.2	3	3	2	-	-	-	-	-	3	3	-	3	3	-
21CVK58.3	3	3	2	-	2	-	-	-	3	3	-	3	3	-
21CVK58.4	3	3	2	2	2	-	-	-	3	3	-	3	3	-
21CVK58.5	3	3	2	2	-	-	-	-	3	3	-	3	3	-
21CVK58.6	3	3	2	2	2	1	1	1	3	3	-	3	3	-

MODULE-1	**UNDERSTANDING DESIGN THINKING**	**21CVK58.1, 21CVK58.2**	**3Hours**

Understanding Design thinking
Definition Origin and features of Design Thinking, Design thinker in organization, Principles and stages of Design thinking. Design Shared model in team-based design. Theory and practice in Design thinking. Collaborative design thinking. Live examples of MVP or Prototyping

Self- Study/Case Study/Applications	Identifying Problems in Civil Engineering domain- Structural Engineering, Construction activities, water management, issues in transportation systems, quality of construction- roadways , etc.

MODULE-2	**TOOLS FOR DESIGN THINKING**	**21CVK58.3**	**3 Hours**

Tools for Design Thinking
Visualization, Journey mapping, Value Chain Analysis, the mind map, Rapid Concept development, Assumption testing, Prototype, Co creation, Learning launches and Storytelling.

Self- Study/Case Study/Applications	Green building Assessment

MODULE-3	**DESIGN THINKING IN IT**	**21CVK58.4**	**3 Hours**

Design Thinking in IT
Business process modelling (BPM). Agile in Virtual collaboration environment. Scenario based Prototyping. Case studies on Design thinking.

Self- Study/Case Study/Applications	Construction site problems/Environmental Problems.

MODULE-4	**DESIGN THINKING FOR STRATEGIC INNOVATION**	**21CVK58.5**	**3 Hours**

Design Thinking for Strategic Innovation

Strategic management and Innovation management, Types of Innovations, Features and Scope of strategic innovations, Design thinking and strategic innovation, Practices of integrating Design thinking in Strategic Innovation.

Self- Study/Case Study/Applications	Developing sensors to monitor structural health, water management.

MODULE-5	**DESIGN THINKING WORK SHOP**	**21CVK58.6**	**3 Hours**

Design Thinking Work shop

Focus, Need and stages of Design thinking workshop. Empathize, Design, Ideate, Prototype and Test

Self- Study/Case Study/Applications	Using generic design thinking stages i.e. Empathizing, defining, ideating, prototyping 7 testing, issues in various civil engineering domain i.e. traffic congestion, poor quality in construction, air pollution etc. will be taken up as case studies/ activities/ specific self-study

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	Seminar/ Activity
		15	10	25
L1	Remember	5	-	-
L2	Understand	5	-	5
L3	Apply	5	5	5
L4	Analyze	-	5	10
L5	Evaluate	-	-	5
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks
L1	Remember	10
L2	Understand	25
L3	Apply	15
L4	Analyze	-
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:

Text Books:

1. Christian Mueller-Roterberg, Handbook of Design Thinking - Tips & Tools for how to design thinking.
2. John.R.Karsnitz, Stephen O'Brien and John P. Hutchinson, "Engineering Design",Cengage learning (International edition) Second Edition, 2013.
3. Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage",Harvard Business Press, 2009.
4. Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve - Apply", Springer, 2011
5. Yousef Haik and Tamer M.Shahin, "Engineering Design Process", CengageLearning, SecondEdition, 2011.
6. Book - Solving Problems with Design Thinking - Ten Stories of What Works (Columbia BusinessSchool Publishing) Hardcover – 20 Sep 2013 by Jeanne Liedtka (Author), Andrew King (Author), Kevin Bennett (Author)

Web links and Video Lectures (e-Resources): • **https://www.ibm.com/design/thinking/** • **https://www.ideou.com/pages/design-thinking** • **https://www.youtube.com/watch?v=3RemkU4BH8U** • **https://youtu.be/3RemkU4BH8U** • **https://youtu.be/p5m7CoHC4r4** • **https://youtu.be/ZBxZC9I6xyk** • **https://youtu.be/0DeBHxnR0kM** • **https://youtu.be/4nTh3AP6knM**
Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning • Green Construction / Sustainability in Construction.

SIXTH SEMESTER
(SYLLABUS)

CONSTRUCTION MANAGEMENT AND ENGINEERING ECONOMICS

Course Code	**21CIV61**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**3**	**Exam Hours**	**3**

Course outcomes:
At the end of the course, the student will be able to:

21CIV61.1	Apply the basic principles of Engineering Economics
21CIV61.2	Comprehend the fundamentals of contract administration
21CIV61.3	Analyze the concepts of Project Management for planning to execution of projects
21CIV61.4	Manage Resources Economically
21CIV61.5	Analyze different types of cost estimates
21CIV61.6	Analyze on highway economics using different methods

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CIV61.1	3	2	-	2	-	2	1	-	-	-	3	-	3	-
21CIV61.2	3	-	-	-	-	-	-	-	-	-	3	-	3	-
21CIV61.3	3	2	-	2	-	-	-	-	-	-	3	3	3	1
21CIV61.4	3	-	-	-	-	2	-	-	-	-	3	3	3	-
21CIV61.5	3	-	-	-	-	-	-	-	-	-	3	-	3	-
21CIV61.6	3	2	-	-	-	-	-	1	-	-	3	-	3	-

MODULE-1	**INTRODUCTION TO ENGINEERING ECONOMICS**	**21CIV61.1**	**8 Hours**

ENGINEERING ECONOMICS: BASIC PRINCIPLES – Time value of money, quantifying alternatives for decision making, Cash flow , simple numerical problems
COMPARISON OF ALTERNATIVES: Present, future and annual worth method of comparing alternatives, simple numerical problems

Self-Study/Case Study/Applications	Cash flow
Text Book	Text Book 1: 1.4, 1.5, 1.6 Text Book 2: 1.1, 1.3, 1.5

MODULE-2	**BREAK EVEN ANALYSIS / CONTRACTS**	**21CIV61.1, 21CIV61.2**	**8 Hours**

BREAK EVEN ANALYSIS: Break-even comparisons, Capitalized cost analysis, Benefit-cost analysis, simple numerical problems
CONTRACTS: Introduction, Types, Stages of awarding contract, Disputes and arbitrations

Self-Study/Case Study/Applications	Case Study on contracts
Text Book	Text Book 2: 4.2, 4.3, 4.4

MODULE-3	**PROJECT MANAGEMENT/ MATERIAL MANAGEMENT**	**21CIV61.3, 21CIV61.4**	**8 Hours**

PROJECT MANAGEMENT: Project Organization, Bar Charts, Work Breakdown Structure, Time estimates Applications of CPM and PERT simple numerical problems **MATERIAL MANAGEMENT:** Introduction to Material Management, ABC analysis- simple numerical problems			
Self-Study/Case Study/Applications	Purchase management and inventory control.		
Text Book	Text Book 3: 3.1, 3.3, 3.5, 3.7, 3.10		
MODULE-4	**EQUIPMENT – MANAGEMENT, ECONOMICS**	**21CIV61.4**	**8 Hours**
EQUIPMENT MANAGEMENT: Identification, Planning of equipment, Selection of Equipment, Equipment Management in Projects **EQUIPMENT ECONOMICS: Equipment** cost, Operating cost, Replacement of Equipment- Replacement Analysis - Buy/Rent/Lease options, simple numerical problems			
Self-Study/Case Study/Applications	Maintenance Management		
Text Book	Text Book 3: 5.1, 5.3, 5.5, 5.7		
MODULE-5	**COST ANALYSIS**	**21CIV61.5, 21CIV61.6**	**8 Hours**
COST ESTIMATING: Types of Estimates, Approximate estimates – Unit estimate, Factor estimate, Cost indexes, Parametric estimate, Life cycle cost **HIGHWAY ECONOMICS:** Highway user benefits, Economic analysis - annual cost method-Benefit Cost Ratio method- simple numerical problems, Highway financing-BOT-BOOT concepts			
Self-Study/Case Study/Applications	Introduction to Documentation		
Text Book	Text Book 1: 10.1 to 10.6		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		**Marks Distribution**		
		Test (s)	**Qualitative Assessment (s)**	**MCQ's**
		25	**15**	**10**
L1	**Remember**		-	5
L2	**Understand**	5	5	5
L3	**Apply**	10	5	-
L4	**Analyze**	5	5	-
L5	**Evaluate**	5	-	-
L6	**Create**	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	-
L2	**Understand**	10
L3	**Apply**	20
L4	**Analyze**	10
L5	**Evaluate**	10
L6	**Create**	-

Suggested Learning Resources:

Text Books:

1. Peurifoy. R L, "Construction Planning, Equipment and Methods"- McGraw Hill,
   a. (ISBN 978-0070498365)
2. "Construction Project Management, Theory and Practice", by Jha, K. N., Pearson, New Delhi, 2011 (ISBN 9789332542013)
3. "Estimating Construction Costs" by Peurifoy, R. L. and Oberlender, G. D., 5th ed., McGraw- Hill, New Delhi, 2004 (ISBN 9781259002106).

Reference Books:

1. Courtland A. Collier and William B. Ledbetter, "Engineering Economics and Cost Analysis" - Harper & Ro2. "Fundamentals of Financial management", by Bose, D. C., 2nd ed., PHI, New Delhi, 2010, (ISBN 8120340744)
2. "Managing the Construction Process", by Gould, F. E., 2nd ed., Prentice Hall, Upper Saddle River, New Jersey, 2002 (ISBN 9788131766804)
3. "Construction Equipment Management for Engineers, Estimators, and Owners", CRC/Taylor & Francis, Boca Raton, 2006 (ISBN 9780849340376).

Web links and Video Lectures (e-Resources):

- **http://nptel.ac.in/downloads/105103023/**
- **https://nptel.ac.in/courses/105104161**
- **https://nptel.ac.in/courses/112107209**
- **https://kanchiuniv.ac.in/coursematerials/CS8T1%20%20Engineering%20Economics%20and%20Management-Course%20Material%20Feb%202021.pdf**
- **https://easyengineering.net/engineering-economics-by-panneerselvam-book/**
- **https://www.uoanbar.edu.iq/eStoreImages/Bank/6298.pdf**

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

- Visit to any construction site
- Demonstration of Work breakdown structures
- Contents related activities (Activity-based discussions)
- For active participation of students, instruct the students to prepare bar chart and Gantt chart
- Organizing Group wise discussions on issues
- Seminars

TRANSPORTATION ENGINEERING

Course Code	**21CIV62**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**3**	**Exam Hours**	**3**

Course outcomes:

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

21CIV62.1	Analyze the principles of road development and planning.
21CIV62.2	Apply various surveys in highway alignment.
21CIV62.3	Identify the principles of geometric design of highways.
21CIV62.4	Comprehend the applications of various traffic volume studies
21CIV62.5	Identify various pavement materials and examine the suitability of different construction methods of pavements as per MORTH
21CIV62.6	Design Flexible and Rigid pavement as per IRC codes.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CIV62.1	3	3	3	-	-	3	3	-	-	-	-	-	-	3
21CIV62.2	3	3	3	3	3	3	3	-	-	-	-	3	3	3
21CIV62.3	3	3	3	3	-	3	3	-	-	-	-	-	-	3
21CIV62.4	3	3	-	3	3	3	-	-	-	-	-	-	3	3
21CIV62.5	3	3	-	-	3	-	-	-	-	-	-	-	3	3
21CIV62.6	3	3	3	-	3	-	-	-	-	-	-	3	3	3

MODULE-1	**HIGHWAY DEVELOPMENT**	**21CIV62.1**	**8 Hours**

Introduction to transportation engineering: Importance of transportation, Different modes of transportation and comparison, Characteristics of road transport Jayakar committee recommendations, and implementation – Central Road Fund, Indian Roads Congress, Central Road Research Institute.

Highway Development : Planning Road types and classification ,road patterns, planning surveys, master plan – saturation system of road planning, phasing road development in India, problems on best alignment among alternate proposals Salient Features of 3rd twenty-year road development plans and Policies.

Self-Study/Case Study/Applications	Present scenario of road development in India (NHDP& PMGSY) and in Karnataka (KSHIP & KRDCL) Road development plan - vision2021.
Text Book	Text Book 1: 1.2, 1.3

MODULE-2	**HIGHWAY ALIGNMENT**	**21CIV62.2**	**8 Hours**

Highway Alignment: Ideal Alignment, Factors affecting the alignment, Engineering Surveys-Map study, Reconnaissance.

Surveys: Preliminary and Final location & detailed survey, Reports and drawings for new and re-aligned projects.

Self-Study/Case	Engineering Surveys-Map study, Reconnaissance.

Study/Applications			
Text Book	Text Book 1: 2.1		
MODULE-3	**GEOMETRIC ELEMENTS & TRAFFIC ENGINEERING**	**21CIV62.3 &21CIV62.4**	**8 Hours**
Geometric Elements: Importance of highway geometric design–highway Cross sectional elements. Sight distances- elements of horizontal and vertical alignments. **Introduction to Traffic Engineering:** Scope of traffic engineering, traffic characteristics, volume studies, speed studies, origin & Destination studies,. Related problems.			
Self-Study/Case Study/Applications	PCU and Traffic Capacity		
Text Book	Text Book 1: 2.3, 2.4, 3.1		
MODULE-4	**PAVEMENT – MATERIALS/CONSTRUCTION**	**21CIV62.5**	**8 Hours**
Pavement Materials: Sub grade soil–Desirable properties-HRB soil classification-determination of CBR and modulus of sub grade reaction-Examples on CBR and Modulus of sub grade reaction, Aggregates-Desirable properties and list of tests, Bituminous Materials-Explanation on Tar, bitumen, cutback and emulsion-List of tests on bituminous materials **Pavement Construction**: Earth work–cutting-Filling, Preparation of sub grade, Specification and construction of Granular Sub base, WBM Base, WMM base, Bituminous Macadam, Dense Bituminous Macadam Bituminous Concrete, Dry Lean Concrete sub base.			
Self-Study/Case Study/Applications	PQC and Concrete roads.		
Text Book	Text Book 1: 1.4, 3.6 ,Text Book 2: 2.4, 5.5		
MODULE-5	**PAVEMENT DESIGN**	**21CIV62.6**	**8 Hours**
PAVEMENT DESIGN: Pavement types, component parts of flexible and rigid pavements and their functions, design factors, ESWL and its determination - Examples, Flexible pavement- Design of flexible pavements as per IRC:37 – 2012 with IIT Pave Software–Examples. **Rigid pavement:** Westergaard's equations for load and temperature stress-Examples - Design of slab thickness only as per IRC:58 - 2015.			
Self-Study/Case Study/Applications	Introduction to white topping		
Text Book	Text Book 2: 2.1, 2.3		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		**Marks Distribution**		
		Test (s)	**Qualitative Assessment (s)**	**MCQ's**
		25	**15**	**10**
L1	**Remember**	-	-	5
L2	**Understand**	10	5	5
L3	**Apply**	10	5	-
L4	**Analyze**	5	5	-
L5	**Evaluate**	-	-	-
L6	**Create**	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	-
L2	**Understand**	20
L3	**Apply**	20
L4	**Analyze**	10
L5	**Evaluate**	-
L6	**Create**	-

Suggested Learning Resources:

Text Books:

1. S.K. Khanna, C.E.G.Justo,A. Veeraragavan, "Highway Engineering", Nem Chand Bros,10thedition Roorkee,2015.
2. L.R. Kadiyali "Principles and Practices of Highway Engineering", Khanna Publishers, 4th edition, New Delhi, 2005.
3. K P Subramanium "Transportation Engineering", 2^{nD}edition, Scitech Publications, Chennai 2011.

Reference Books:

1. Guidelines for the design of flexible pavements IRC: 37-2012-3rd revision, NewDelhi, 2013.
2. Guidelines for the design of Plain jointed rigid pavements for Highways IRC: 58-2015-4th revision, New Delhi, 2015.
3. Specifications for Roads and Bridge works, MORT&H-5threvision, New-Delhi, 2013.

Web links and Video Lectures (e-Resources):

- **https://onlinecourses.nptel.ac.in/noc22_ce93/preview**
- **https://www.youtube.com/watch?v=sQ63_AvwGFY&list=PLLy_2iUCG87CHFdFEAVGc2iISoF9DD554**
- **https://www.youtube.com/watch?v=NcmzzJoAPZQ**
- **https://nptel.ac.in/courses/105105107**

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

- Contents-related activities (Activity-based discussions)
- For active participation of students, instruct the students to prepare Handouts
- Organizing Group wise discussions on issues
- Seminars

TRANSPORTATION ENGINEERING LAB			
Course	**21CVL62**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs /	**2**	**Total Marks**	**100**
Credits	**1**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

21CVL62.1	Determine the CBR value of sub grade for flexible pavement design
21CVL62.2	Determine the basic physical properties of coarse aggregates
21CVL62.3	Determine the physical properties of bitumen
21CVL62.4	Determine the proportioning of coarse aggregates and bitumen mix design

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CVL62.1	3	3	3	3	-	-	3	-	-	-	3	-	3	-
21CVL62.2	3	3	3	3	-	-	3	-	-	-	3	-	3	-
21CVL62.3	3	3	3	3	-	-	3	-	-	-	3	-	3	-
21CVL62.4	3	3	3	3	-	-	3	-	-	-	3	-	3	-

Exp. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	Practical Application of Coarse aggregate and bitumen	2	NA
	PART-A		
1	To conduct the sieve analysis and bulk density test of given coarse aggregates	2	21CVL62.2
2	To determine the Impact value, Specific gravity and water absorption of given aggregates	2	21CVL62.2
3	To determine the Shape test Flaky, Elongation and Angularity number of given aggregates	2	21CVL62.2
4	To determine the crushing value of given aggregates	2	21CVL62.2
5	To determine the Abrasion Value of given aggregates	2	21CVL62.2
6	To determine the Specific Gravity and Penetration value of given bitumen	2	21CVL62.3
	PART-B		
7	To determine the Ductility and Softening point of given bitumen	2	21CVL62.3
8	To determine the Flash & fire point of given bitumen	2	21CVL62.3
9	To determine the Viscosity of given bitumen	2	21CVL62.3
10	To determine the California Bearing Ratio (CBR) test on given soil	2	21CVL62.1

11	To determine the proportioning of aggregate mixes by Rothfutch Method.	2	21CVL62.4
12	To conduct the Marshall Stability test of the given bituminous Mix	2	21CVL62.4

PART-C
Beyond Syllabus Virtual Lab Content
(To be done during Lab but not to be included for CIE or SEE)

- Los Angeles Abrasion test on aggregates
  https://ts-nitk.vlabs.ac.in/exp/los-angeles-abrasion/
- Penetration test on Bitumen
  https://ts-nitk.vlabs.ac.in/exp/penetration-test/

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		20	30
L1	Remember	-	-
L2	Understand	-	5
L3	Apply	10	10
L4	Analyze	5	10
L5	Evaluate	5	5
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	15
L4	Analyze	15
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:

Reference Books:

1. Guidelines for the design of flexible pavements IRC: 37-2012-3rd revision, New Delhi, 2013.
2. Guidelines for the design of Plain jointed rigid pavements for Highways IRC: 58-2015-4th revision, New Delhi, 2015.
3. Specifications for Roads and Bridge works, MORTH -5th revision, New-Delhi, 2013.

DESIGN OF STEEL STRUCTURES			
Course Code	**21CIV63**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**3**	**Exam Hours**	**3**

Course outcomes:
At the end of the course, the student will be able to:

21CIV63.1	Apply design philosophy and the IS code of practice for the design of various structural elements.
21CIV63.2	Analyze and design bolted and welded connections
21CIV63.3	Analyze and design the structural steel members subjected to tension.
21CIV63.4	Design axially loaded columns and column base connections.
21CIV63.5	Design laterally restrained & unrestrained steel beams.
21CIV63.6	Analyze the concepts of plastic analysis and apply them to design steel beams.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CIV63.1	3	3	3	3	-	-	-	-	-	-	-	-	3	-
21CIV63.2	3	3	3	3	-	-	-	-	-	-	-	-	3	-
21CIV63.3	3	3	3	3	-	-	-	-	-	-	-	-	3	-
21CIV63.4	3	3	3	3	-	-	-	-	-	-	-	-	3	-
21CIV63.5	3	3	3	3	-	-	-	-	-	-	-	-	3	-
21CIV63.6	3	3	3	3	-	-	-	-	-	-	-	-	3	-

MODULE-1	**INTRODUCTION TO CONNECTIONS**	**21CIV63.1, 21CIV63.2**	**8 Hours**

Introduction: Advantages and disadvantages of steel structures, Specifications and section classification. Loads and load combinations, Design considerations, Limit state method (LSM) of design as per code, Failure criterion of steel.

Introduction to connections, Types of connections, Types of joints, Advantages and Disadvantages of connections and Joints. Splicing of two members. Behavior of bolted joints, Design of Simple joints with ordinary black bolts and High strength Friction Grip Bolts(HSFG), Welding process, Advantages of welding, Types and properties of welds, Types of joints, weld symbols, Weld specifications, Effective areas of welds, Design of welds, Design of Simple joints.

Self-Study/Case Study/Applications	Welding process, Advantages of welding
Text Book	Text Book 1: 1.1,1.2.13

MODULE-2	**BOLTED/WELDED CONNECTIONS**	**21CIV63.2**	**8 Hours**

Bolted Connections: Introduction, Moment resistant connections (moment parallel and perpendicular to the plane of joint), beam to beam and beam to column connection, Seated stiffened and un-stiffened connections.

Welded Connections: Introduction, Moment resistant connections (moment parallel and perpendicular to the plane of joint), beam to beam and beam to column connection, Seated stiffened and un-stiffened connections.

Self-Study/Case Study/Applications	Seated stiffened and un-stiffened connections.
Text Book	Text Book2: 2.2.2.2.3,2.4

MODULE-3	**TENSION MEMBERS**	**21CIV63.3**	**8 Hours**

Introduction to Tension Members: Introduction, Types of tension members, Slenderness ratio, Behavior of axially loaded tension members, Factors affecting the strength of tension members. **Design of Tension Members:** Design of axially loaded tension members with bolted and welded connection, Lug angles.			
Self-Study/Case Study/Applications	Modes of failure in tension members		
Text Book	Text Book 1: 2.2.2.3,2.4		
MODULE-4	**COMPRESSION MEMBERS/COLUMN BASES**	**21CIV63.4**	**8 Hours**
Design of Compression Members: Introduction, Behavior of compression members, Sections used for compression members, built up sections, Effective length of compression members, Design of compression members with lacing and battens, Design of column splices (For columns of equal and un-equal sections) **Design of Column Bases:** Simple slab base and Gusseted base.			
Self-Study/Case Study/Applications	Design of compression members with lacing and battens		
Text Book	Text Book 2: 5.2.5.5.3,5.4		
MODULE-5	**DESIGN OF LATERALLY SUPPORTED/UNSUPPORTED BEAMS/ PLASTIC BEHAVIOR STRUCTURAL STEEL**	**21CIV63.5, 21CIV63.6**	**8 Hours**
Design of laterally supported/Unsupported beams: Beam sections, factors affecting lateral stability, Behavior of simple rolled steel beams in bending, Concepts of laterally supported rolled steel beams, Design of laterally supported beams &laterally unsupported beams. **Plastic Behavior Structural Steel:** Introduction, plastic theory, Shear center, Plastic hinge concept, plastic collapse load, conditions of plastic analysis, Theorems of plastic collapse.			
Self-Study/Case Study/Applications	Plastic Analysis and Design of beams.		
Text Book	Text Book 1: 6.1.6.2,6.3,6.4		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		**Marks Distribution**		
		Test (s)	**Qualitative Assessment (s)**	**MCQ's**
		25	**15**	**10**
L1	**Remember**	-	-	5
L2	**Understand**	10	5	5
L3	**Apply**	10	5	-
L4	**Analyze**	5	5	-
L5	**Evaluate**	-	-	-
L6	**Create**	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	-
L2	**Understand**	20
L3	**Apply**	20
L4	**Analyze**	10
L5	**Evaluate**	-
L6	**Create**	-

Suggested Learning Resources:

Text Books:

1. Limit State Design of Steel Structures, S.K Duggal, TATA McGraw Hill Publications, 2017, ISBN:9789351343493.
2. Design of Steel Structures, N. Subramanian, Oxford University Press, 2016, ISBN: 9780199460915.
3. Limit state Design in Structural Steel, M.R Shiyekar, PHI learning Publications, 2013, ISBN: 9788120347847.
4. Comprehensive Design of Steel Structures, B.C Punmia, Laxmi Publications, 2015, ISBN: 9788131806456

Reference Books:

1. Dayaratnam, P., "Design of Steel Structures", Second edition, S. Chand & Company, 2003
2. S S Bhavikatti, Design of Steel Structures, Second edition, I.K International Publishing House Pvt. Ltd., 2010
3. Bureau of Indian Standards, IS800-2007, IS875-19874)
4. Steel Tables/SP6-1

Web links and Video Lectures (e-Resources):

- **https://youtu.be/38XpptPMqNc?list=PLk7ptZcI9vmjnjLfWRNMJxhVY9BFgdTOu**
- **https://youtu.be/B6wXE9wao0E**
- **https://youtu.be/7mcAVua0rKM**

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

- Visit to any manufacturing industry
- Demonstration of bolted , welded and rivet connection operations
- Demonstration of metal joining process
- Video demonstration of latest trends in steel structures

STEEL STRUCTURES LAB

Course	**21CVL63**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs /	**2**	**Total Marks**	**100**
Credits	**1**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

21CVL63.1	Apply IS provisions and computational tool in detailing.
21CVL63.2	Prepare detailed drawings for connecting beam with column using bolted and welded connections using AUTOCAD drawing tools.
21CVL63.3	Prepare detailed drawings for framing build up columns using AUTOCAD drawing tools.
21CVL63.4	Prepare detailed drawings for column splicing and column base using AUTOCAD drawing tools.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CVL63.1	3	3	3	3	3	-	-	-	3	-	-	-	3	3
21CVL63.2	3	3	3	3	3	-	-	-	3	-	-	-	3	3
21CVL63.3	3	3	3	3	3	-	-	-	3	-	-	-	3	3
21CVL63.4	3	3	3	3	3	-	-	-	3	-	-	-	3	3

Exp. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	Basic Concepts of Structural Steel Members	2	NA
	PART-A		
1	Drawing and detailing of beam to beam bolted connection.	2	21CVL63.1, 21CVL63.2
2	Drawing and detailing of beam to column bolted connection	2	21CVL63.1, 21CVL63.2
3	Drawing and detailing of beam to beam welded connection	2	21CVL63.1, 21CVL63.2
4	Drawing and detailing of beam to column welded connection	2	21CVL63.1, 21CVL63.2
5	Drawing and detailing of beam to beam and beam to column stiffened bolted connection.	2	21CVL63.1, 21CVL63.2
6	Drawing and detailing of beam to beam and beam to column un stiffened bolted connection.	2	21CVL63.1, 21CVL63.2
	PART-B		
7	Drawing and detailing of beam to beam and beam to column stiffened welded connection.	2	21CVL63.1, 21CVL63.3
8	Drawing and detailing of beam to beam and beam to column un stiffened welded connection.	2	21CVL63.1, 21CVL63.3
9	Drawing and detailing of column lacing & column battens.	2	21CVL63.1, 21CVL63.3
10	Drawing and detailing of column splices	2	21CVL63.1, 21CVL63.3
11	Drawing and detailing of slab base	2	21CVL63.1, 21CVL63.4
12	Drawing and detailing of gusseted base.	2	21CVL63.1, 21CVL63.4

PART-C
Beyond Syllabus Virtual Lab Content
(To be done during Lab but not to be included for CIE or SEE)

- https://youtu.be/S2dRHK53RM0
- https://youtu.be/OAy2yV0UMaQ
- https://youtu.be/tN96h7jpbuk

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		20	30
L1	Remember	-	-
L2	Understand	-	5
L3	Apply	10	10
L4	Analyze	5	10
L5	Evaluate	5	5
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	15
L4	Analyze	15
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:

Reference Books:

1. Dayaratnam, P., "Design of Steel Structures", Second edition, S. Chand & Company, 2003
2. S S Bhavikatti, Design of Steel Structures, Second edition, I.K International Publishing House Pvt. Ltd., 2010
3. Bureau of Indian Standards, IS800-2007, IS875-2187
4. Steel Tables/SP 6-1

GROUND WATER HYDROLOGY			
Course Code	**21CIV641**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**3**	**Exam Hours**	**3**

Course outcomes:
At the end of the course, the student will be able to:

21CIV641.1	Understand about types of aquifer, aquifer parameters and movement of ground water
21CIV641.2	Apply basic principles of well hydraulics related to steady & unsteady flow in aquifers with general derivations.
21CIV641.3	Gain basic knowledge about ground water investigation techniques.
21CIV641.4	Apply basic principles of Ground water development and management skills.
21CIV641.5	Analyze Ground water modeling.
21CIV641.6	Analyze Sea water intrusions in aquifers.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CIV641.1	3	-	-	-	-	3	2	-	-	-	-	2	3	3
21CIV641.2	3	3	-	-	-	-	2	-	-	-	-	-	3	3
21CIV641.3	3	3	2	2	3	3	2	-	-	-	3	2	3	3
21CIV641.4	3	3	2	2	-	3	2	-	-	-	3	2	3	3
21CIV641.5	3	3	-	-	3	3	2	-	-	-	-	-	3	3
21CIV641.6	3	3	-	2	3	3	2	-	-	-	-	-	3	3

MODULE-1	**GROUND WATER**	**21CIV641.1**	**8 Hours**

Introduction: Scope and Importance of Ground Water Hydrology. Vertical distribution of ground water. Occurrence in different types of rocks and soils. Definition of aquifer, Aquifuge, Aquitard and Aquiclude. Confined, unconfined, leaky and pearched aquifers.

Movement of Ground Water:

Aquifer parameters: Specific yield, Specific retention, Porosity, Storage coefficient, Darcy's Law, Hydraulic conductivity, Coefficient of permeability and intrinsic permeability, Transmissibility. Permeability in Isotropic medium.

Self-study/ Case study/ Applications	unconfined, leaky and pearched aquifers.
Text Book	Text Book 1: 1, 2, 3

MODULE-2	**STEADY AND UNSTEADY FLOW**	**21CIV641.2**	**8 Hours**

Well hydraulics – Steady flow: Steady unidirectional flow, steady radial flow to a well. Dupit's and Theim's equations, Pumping tests.

Well hydraulics – Unsteady flow: Unsteady radial flow in confined and unconfined aquifers, Theis's method, Cooper and Jacob method, Chow's method.

Self-study/ Case study/ Applications	Dupit's and Theim's equation.
Text Book	Text Book 1: 4

MODULE-3	**GROUND WATERINVESTIGATION**	**21CIV641.3**	**8 Hours**

Surface investigation of ground water: Geologic methods, Remote sensing, geophysical explorations: Seismic refraction method, Electrical resistivity method, gravity and magnetic methods, water witching. **Subsurface investigation of ground water:** Test drilling, Water level measurements, Borehole geo-physical techniques: Electrical logging, Radioactive logging, Induction logging, Sonic logging and Fluid logging.			
Self-study/ Case study/ Applications	Test drilling, Water level measurements.		
Text Book	Text Book 1: 11, 12, Text Book 2: 12		
MODULE-4	**GROUND WATER - DEVELOPMENT & MANAGEMENT**	**21CIV641.4**	**8 Hours**
Ground water development: Types of wells, Methods of constructions, well completion and development, Pumps for lifting water: Working principles, Power requirements. **Ground water management:** Concepts of basin management, equation of hydrologic equilibrium, ground water basin investigation, data collection and field work. Artificial recharge of ground water.			
Self-study/ Case study/ Applications	Types of wells, Methods of constructions.		
Text Book	Text Book 1: 5, 9, 13, Text Book 2: 14, 16		
MODULE-5	**GROUND WATER – MODELING/ SEA WATER INTRUSIONS**	**21CIV641.5 & 21CIV641.6**	**8 Hours**
Ground water modelling: porous media models, analog models, electric analog models, digital computer models. **Sea water intrusions in aquifers:** Occurrence of saline water intrusion, Ghyben-Herzberg relation between fresh and saline water, shape and structure of fresh-salt water interface, control of saline water intrusion.			
Self-study/ Case study/ Applications	Digital computer models.		
Text Book	Text Book 1: 10, 14, Text Book 2:8, 13,		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution	
		Test (s)	NPTEL
		25	25
L1	Remember	-	5
L2	Understand	10	10
L3	Apply	10	5
L4	Analyze	5	5
L5	Evaluate	-	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	20
L3	Apply	20
L4	Analyze	10
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:

Text Books:

1. Ground Water Hydrology, David Keith Todd, Wiley and Sons, Second Edition, 2010. ISBN: 978-81-265-0836-5.
2. Ground water assessment, development and management, K R Karanth, Tata McGraw Hill Education Private Limited, first edition, 2012. ISBN-10: 0-07-451712-0, ISBN-13: 978-0-07-451712-3.
3. Ground Water Hydrology, David K Todd, Larry W May, Wiley India Pvt Ltd, Third edition ISBN-10:9788126530038, ISBN-13: 978-8126530038

Reference Books:

1. Ground Water- H.M. Raghunath, New age International Publishers, Fourth Edition, 2021. ISBN-10: 8122472346, ISBN-13: 978-8122472349.
2. Numerical Ground Water Hydrology, A.K. Rastogi, Penram, International Publishing (India), Pvt. Ltd., Latest edition, 2007. ISBN-10: 8187972920, ISBN-13: 978-8187972921.

Web links and Video Lectures (e-Resources):

- **https://archive.nptel.ac.in/courses/105/101/105101214/**
- **https://archive.nptel.ac.in/courses/105/105/105105042/**

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

- Contents related activities (Activity-based discussions)
- For active participation of students, instruct the students to prepare Flowcharts and Handouts
- Organizing Group wise discussions on issues
- Seminars

PAVEMENT MATERIALS & CONSTRUCTION

Course Code	**21CIV642**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**3**	**Exam Hours**	**3**

Course outcomes:
At the end of the course, the student will be able to:

21CIV642.1	Identify the properties of pavement materials.
21CIV642.2	Formulate the proportions of different sizes of aggregates to suit gradation criteria for various mixes.
21CIV642.3	Analyze the different types and characteristics of bituminous materials.
21CIV642.4	Design the different bituminous mixes
21CIV642.5	Identify the different types of road construction equipment.
21CIV642.6	Understand the construction method of flexible and Rigid pavements and quality control in road construction.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CIV642.1	3	2	2	-	2	2	-	-	-	-	-	2	3	3
21CIV642.2	3	2	2	-	2	2	-	-	-	-	-	2	3	3
21CIV642.3	3	2	2	3	2	2	-	-	-	-	-	2	3	3
21CIV642.4	3	2	2	3	2	2	-	-	-	-	-	2	3	3
21CIV642.5	3	2	2	-	2	2	-	-	-	-	-	2	3	3
21CIV642.6	3	2	2	-	2	2	-	-	-	-	-	2	3	3

MODULE-1	**AGGREGATES**	**21CIV642.1, 21CIV642.2**	**8 Hours**

AGGREGATES:
Origin, classification, requirements, properties and tests on road aggregates, concepts of size and gradation – design gradation, maximum aggregate size, aggregate blending by different methods to meet specification.

Self-study/ Case study/ Applications	Tests on road aggregates
Text Book	Text Book 1.6, 2.18, 2.19

MODULE-2	**BITUMEN, TAR, EMULSIONS AND CUTBACKS**	**21CIV642.3**	**8 Hours**

BITUMEN AND TAR:
Origin, preparation, properties and chemical constitution of bituminous road binders; requirements. Basic tests on bitumen.

BITUMINOUS EMULSIONS AND CUTBACKS:
Preparation, characteristics, uses Basic tests. Adhesion of Bituminous Binders to Road Aggregates: Adhesion failure, mechanism of stripping, tests and methods of improving adhesion.

Self-study/ Case study/ Applications	Properties and chemical constitution of bituminous road binders
Text Book	Text Book 1.6, 2.20

MODULE-3	**BITUMINOUSMIX DEISGN**	**21CIV642.4**	**8 Hours**

BITUMINOUS MIXES:
Mechanical properties, dense and open textured mixes, flexibility and brittleness, without Hveem Stabilometer & Hubbar – Field Tests.

MIX DEISGN:

Types of bituminous mix, design methods using Rothfuch's Method only and specification, Marshal mixed design criteria- voids in mineral aggregates, voids in total mix, density, flow, stability, percentage voids filled with bitumen.			
Self-study/ Case study/ Applications	Flexibility and brittleness, without Hveem Stabilometer & Hubbar – Field Tests		
Text Book	Text Book 1.6, 2.20		
MODULE-4	**CONSTRUCTION EQUIPMENT / SUB GRADE PREPARATION**	**21CIV642.5**	**8 Hours**
EQUIPMENT IN HIGHWAY CONSTRUCTION: Various types of equipment for excavation, grading and compaction – their working principle, advantages and limitations. Special equipment for bituminous and cement concrete pavement and stabilized soil road construction. **SUBGRADE:** Earthwork grading and construction of embankments and cuts for roads, Preparation of sub grade, quality control tests			
Self-study/ Case study/ Applications	Earthwork grading and construction of embankments and cuts for roads		
Text Book	Text Book 1.8, 2.18		
MODULE-5	**PAVEMENTS – FLEXIBLE/ CEMENT CONCRETE**	**21CIV642.6**	**8 Hours**
FLEXIBLE PAVEMENTS: Specifications of materials, construction method and field control checks for various types of flexible pavement layers. **CEMENT CONCRETE PAVEMENTS:** Specifications and method of cement concrete pavement construction (PQC Importance of providing DLC as sub-base and polythene thin layer between PQC and sub-base); Quality control tests; Construction of various types of joints.			
Self-study/ Case study/ Applications	construction method and field control checks for various types of flexible pavement layers		
Text Book	Text Book 1.7, 2.21, 2.22		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution	
		Test (s)	NPTEL
		25	25
L1	Remember	-	5
L2	Understand	10	10
L3	Apply	10	5
L4	Analyze	5	5
L5	Evaluate	-	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	-
L2	**Understand**	20
L3	**Apply**	20
L4	**Analyze**	10
L5	**Evaluate**	-
L6	**Create**	-

Suggested Learning Resources:

Text Books:

1. Highway Engineering, S K Khanna , C E G Justo, ISBN: 9788185240800 10th Edition, 2014, Nem Chand and Bros. Roorkee.
2. Highway Engineering, Dr. L. R. Kadyil, Dr. N. B Lal, Khanna publishers, Sixth edition, 2012.
3. Construction Equipment and its Management", S C Sharma, ISBN-13: 978-8174092670 Revised, 2008, Khanna Publishers

Reference Books:

1. "Soil mechanics for Road Engineers", ISBN 978-0115502781, RRL DSIR, Ist edition 1952 HMSO Publications.
2. "Bituminous Materials in Road Construction", ISBN 978-012973433, RRL DSIR, Ist edition 1962 HMSO Publications.
3. MORTH Specification (5th Revision).

Web links and Video Lectures (e-Resources):

1. http://nptel.ac.in/courses.php?disciplineID=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://academicearth.org/
4. VTU EDUSAT PROGRAMME-20

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

- Contents related activities (Activity-based discussions)
- Organizing Group wise discussions on issues
- Video demonstration of various equipment's used in pavement construction
- Instruct students to prepare flowcharts and Handouts

RECYCLING OF WASTE WATER

Course Code	**21CIV643**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hours / Week	**3**	**Total Marks**	**100**
Credits	**3**	**Exam Hours**	**3**

Course outcomes:
At the end of the course, the student will be able to:

21CIV643.1	Implement wastewater recycling practices
21CIV643.2	Estimate the quantity of sewage
21CIV643.3	Analyze the characteristics of sewage
21CIV643.4	Identify different disposal methods of sewage.
21CIV643.5	Design of various units of sewage treatment plant and operation and maintenance measures.
21CIV643.6	Estimate best practices in wastewater management.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CIV643.1	3	3	-	-	-	3	3	-	-	-	-	-	3	-
21CIV643.2	3	3	3	-	-	-	-	-	-	-	-	-	3	-
21CIV643.3	3	3	-	-	-	-	-	-	-	-	-	-	3	-
21CIV643.4	3	3	-	-	-	3	3	-	-	-	-	-	3	-
21CIV643.5	3	3	3	3	-	-	-	-	-	-	-	-	3	-
21CIV643.6	3	3	3	3	-	3	3	-	-	-	-	-	3	1

MODULE-1	**ESTIMATION OF QUANTITY OF SEWAGE**	**21CIV643.1 & 21CIV643.2**	**8 Hours**

INTRODUCTION: Waste water generation in India, Need for sewerage system, Need for recycling of waste water, Methods of domestic waste water disposal, Definitions: sewage, sullage, sewerage, Conservancy and water carriage system, Systems of sewerage and their layouts : Separate, Combined and partially combined system, Merits and demerits

ESTIMATION OF QUANTITY OF SEWAGE: Dry weather flow, factors affecting dry weather flow, flow variations and their effects on design of sewerage system; computation of design flow, estimation of storm flow, rational method and empirical formulae of design of storm water drain, Time of concentration.

Self-study/ Case study/ Applications	Combined and partially combined system
Text Book	Text Book : 1.1, 1.2, 2.1, 2.5, 3.1.

MODULE-2	**DISPOSAL OF EFFLUENTS**	**21CIV643.3 & 21CIV643.4**	**8 Hours**

WASTE WATER CHARACTERIZATION: Sampling techniques, Physical, Chemical and Biological characteristics, Aerobic and Anaerobic activity, CNS cycles. BOD and COD. Their significance & problems

DISPOSAL OF EFFLUENTS: Disposal of Effluents by dilution, self-purification phenomenon. Oxygen sag curve, Zones of purification, Sewage farming, sewage sickness, Effluent Disposal standards for land, surface water & ocean as per BIS, Numerical Problems on Disposal of Effluents. Streeter Phelps equation (No

derivation**).**			
Self-study/ Case study/ Applications	Sampling techniques, Physical, Chemical and Biological characteristics		
Text Book	Text Book 1.3 1.4, 2.3, 3.5.		
MODULE-3	**SEWAGE TREATMENT- 1**	**21CIV643.5**	**8 Hours**
TREATMENT PROCESSES: Objective, methods of treatment, flow sheets showing Preliminary, Primary, Secondary and Tertiary treatment. Preliminary& Primary treatment: Screening, grit chambers, skimming tanks, primary sedimentation tanks, Operation and maintenance of sedimentation tanks – Design criteria & Design examples. **SECONDARY TREATMENT**: Activated sludge process- Principle and flow diagram, Modifications of ASP, F/M ratio, Operation and maintenance, Design of ASP.			
Self-study/ Case study/ Applications	Activated sludge process- Principle and flow diagram		
Text Book	Text Book 1.9, 2.7, 2.8, 2.9, 3.10, 3.11, 3.12.		
MODULE-4	**SEWAGE TREATMENT- 2**	**21CIV643.5**	**8 Hours**
ANAEROBIC SLUDGE DIGESTION: Sludge characterization – Thickening – Biogas recovery – Sludge Conditioning and Dewatering– Sludge digestion tanks, Design of Sludge drying beds. Septic tank, Design. **ADDITIONAL TREATMENT METHODS**: Low cost treatment systems, Oxidation Pond and Oxidationditches,Design, Membrane bio reactors (MBR), Sequential bio reactor (SBR), DEWAT System, Operation and maintenance issues, Reclamation and Reuse of sewage - sewage recycle in residential complex - Recent Advances in Sewage Treatment			
Self-study/ Case study/ Applications	Design of Sludge drying beds. Septic tank, Design.		
Text Book	Text Book 1.10, 3.18, 3.20		
MODULE-5	**WASTEWATER MANAGEMENT**	**21CIV643.6**	**8 Hours**
BEST PRACTICES IN WASTEWATER MANAGEMENT: **Waste water-**A growing resource, Economic characteristics of recycled wastewater, Key-Drivers in wastewater recycling. Government/Institutional Role in wastewater recycling, **REUSE AND RECYCLE OF WASTE WATER:**Social Aspect of wastewater recycling, Wastewater reuse in India. Direct and indirect reuse of wastewater- Municipal reuse/industrial reuse/agricultural reuse/recreational reuse/groundwater recharge.			
Self-study/ Case study/ Applications	Direct and indirect reuse of wastewater- Municipal reuse/industrial reuse/agricultural reuse/recreational reuse/groundwater recharge.		
Text Book	Text Book 1 & 2		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution	
		Test (s)	NPTEL
		25	25
L1	Remember	-	5
L2	Understand	10	10
L3	Apply	10	5
L4	Analyze	5	5
L5	Evaluate	-	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	20
L3	Apply	20
L4	Analyze	10
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:

Text Books:

1. Environmental Engineering Sewage Waste Disposal and Sir Pollution Engineering – Vol.2 – S.K.Garg, Khanna Publishers, ISBN:9788174092304
2. Waste water Engineering (Including Air Pollution) –B C Punima and Ashok Jain, Arun K Jain, Laxmi Publications, ISBN:8131805964, 2nd edition.
3. Metcalf& Eddy (2009), Wastewater Engineering- Treatment, Disposal and Reuse, Second edition, Tata McGraw-Hill, New Delhi.

Reference Books:

1. Hammer, M.J., (1986), Water and Wastewater Technology –SI Version, 2nd Edition, John Wiley and Sons. ISBN: 10: 0471838284
2. Peavy, H.S., Rowe, D.R., and Tchobanoglous, G., (1986),Environmental Engineering– McGraw Hill Book Co.ISBN:9780070495395 .

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc22_ge24/preview
- https://biodesign.berkeley.edu/bioinspired-design-course/
- https://nsf-gov-resources.nsf.gov/2023-03/Bio-inspired%20Design%20Workshop%20Report_2232327_October%202022_Final.508.pdf

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

- Visit to waste water treatment plant
- Contents-related activities (Activity-based discussions)
- Organizing Group wise discussions on issues

DESIGN & DRAWING OF HYDRAULIC STRUCTURES

Course Code	**21CIV644**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**3**	**Exam Hours**	**3**

Course outcomes:
At the end of the course, the student will be able to:

21CIV644.1	Apply the concept of Reservoir planning.
21CIV644.2	Apply the properties and role of various constituent materials used in earth dams.
21CIV644.3	Analyse, Design and draw of Surplus weir.
21CIV644.4	Analyse, Design and draw of Tank Plug sluice.
21CIV644.5	Analyse, Design and draw of Canal Drop.
21CIV644.6	Analyze, Design and draw of Canal regulator.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CIV644.1	3	3	-	-	-	-	-	-	-	-	-	-	3	-
21CIV644.2	3	3	3	-	-	1	-	-	-	-	-	-	3	-
21CIV644.3	3	3	3	-	-	-	-	-	-	-	-	-	3	-
21CIV644.4	3	3	3	-	-	-	-	-	-	-	-	-	3	-
21CIV644.5	3	3	3	-	-	-	-	-	-	-	-	-	3	-
21CIV644.6	3	3	3	-	-	-	-	-	-	-	-	-	3	-

MODULE-1	**RESERVOIR PLANNING**	**21CIV644.1**	**8 Hours**

Introduction, classification of Reservoirs, Storage zones of a reservoir, Mass curve, fixing capacity of a reservoir, safe yield, problems, density currents, Trap efficiency, Reservoir sedimentation, life of a reservoir, economic height of a dam, Environmental effects of reservoir.

Self-study/ Case study/ Applications	Fixing capacity of a reservoir
Text Book	Text Book 1.1, 2.2

MODULE-2	**EARTH DAMS**	**21CIV644.2**	**8 Hours**

Introduction, types of Earth dams, construction methods, Design criteria for Earth dams, causes of failure of earth dams, section of dam, preliminary design criteria, problems, control of seepage through earth dams, Safety measures.

Self-study/ Case study/ Applications	Preliminary design criteria, problems, control of seepage through earth dams
Text Book	Text Book 1.3, 2,3.4

MODULE-3	**SURPLUS WEIR WITH STEPPED APRON**	**21CIV644.3**	**8 Hours**

Design and Drawing with all the three views of :
Surplus weir with stepped apron

Self-study/ Case study/ Applications	Surplus weir design
Text Book	Text Book 1.1 ,2,3

MODULE-4	**TANK PLUG SLUICE WITHOUT TOWER HEAD**	**21CIV644.4**	**8 Hours**

Design and Drawing with all the three views of :
Tank Plug sluice without tower head

Self-study/ Case study/ Applications	Tank Plug sluice design
Text Book	Text Book 1,3.2,4

MODULE-5	**NOTCH-TYPE CANAL DROP / CANAL CROSS REGULATOR**	**21CIV644.5, 21CIV644.6**	**8 Hours**

Design and Drawing with all the three views of :
Notch-type Canal drop / Canal Cross regulator

Self-study/ Case study/ Applications	Notch-type Canal drop
Text Book	Text Book 3,4.1

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution	
		Test (s)	NPTEL
		25	25
L1	Remember	-	5
L2	Understand	10	10
L3	Apply	10	5
L4	Analyze	5	5
L5	Evaluate	-	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	20
L3	Apply	20
L4	Analyze	10
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:

Text Books:

1. Text book of irrigation engineering & Hydraulic Structures-R. K. Sharma, Oxford & IBH publishing Co., New Delhi(2002)(ISBN: 9788121921282)
2. Irrigation & Water resources engineering- G. L. Asawa, New Age International Publishers, New Delhi (2005)(ISBN: 978-81-224-1673-2)
3. Irrigation, Water Resources & Water power engineering-Modi .P.N., Standard Book House, New Delhi, (**ISBN-13:**978-8189401290)
4. Design of minor irrigation and Canal structures- C. Sathya Narayana Murthy, Wiley eastern limited, New Delhi (1990)**(ISBN**:978-92-79-78247-2)

Reference Books:

1. Irrigation engineering & Hydraulic structures-Garg. S. K., khanna publishers, New Delhi (ISBN:8174090479)
2. Hydraulic Structures & Irrigation Design Drawing- Dr. N. Balasubramanya, Tata Mc graw-Hill Education Pvt. Ltd., New Delhi
3. Irrigation and Water Power Engineering-Madan Mohan Das & Mimi Das Saikia, PHI Learning Pvt. Ltd., New Delhi(2009)(ISBN:9788120335875)views)

Web links and Video Lectures (e-Resources):

- **https://youtu.be/kaA76r2JKlU**
- **https://youtu.be/LERJkDv5JV4**
- **https://youtu.be/y-BsqPpFmfI**
- **https://youtu.be/z3IIMgs3xIQ**
- **https://youtu.be/oTDGbb6QTNk**
- **https://youtu.be/Af0FR0QU-UM**

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

- Visit to Reservoir site
- Organizing Group wise discussions on issues
- Video demonstration of Hydraulic structure
- Instruct students to prepare flowcharts and Handouts

BIO INSPIRED DESIGN AND INNOVATION

Course Code	**21CIV645**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

21CIV645.1	Verify the biomimetics principles in relation to the needs at that moment.
21CIV645.2	Evaluate the Bio-material properties for health care applications.
21CIV645.3	Investigate novel bioengineering initiatives by evaluating design and development principles.
21CIV645.4	Investigate creative bio-based solutions for socially vital issues with critical thought.
21CIV645.5	Understand the bio computing optimization through research and experiential learning.
21CIV645.6	Explain the fundamental biological ideas through pertinent industrial applications and case studies.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CIV645.1	3	3	3	3	2	-	-	-	1	1	-	2	3	3
21CIV645.2	3	3	3	3	2	-	-	-	1	1	-	2	3	3
21CIV645.3	3	3	3	3	2	-	-	-	1	1	-	2	3	3
21CIV645.4	3	3	3	3	2	-	-	-	1	1	-	2	3	3
21CIV645.5	3	3	3	3	2	-	-	-	1	1	-	2	3	3
21CIV645.6	3	3	3	3	2	-	-	-	1	1	-	2	3	3

MODULE-1	**BIO-INSPIRED DESIGN AND ENGINEERING**	**21CIV645.1**	**8 Hours**

Bio-Inspired Engineering and design, History, Evolution, Basics of Biomimetics and other Disciplines, Rawling's Classifications, Need for Bio-Inspired Designs. Bio inspired Additive manufacturing techniques, (self-healing, self-assembly).

Text Book	Text Book 1: 1.2, 1.3, 1.4, 1.13, 1.15, 1.16

MODULE-2	**BIO MATERIALS AND BIO HEALTHCARE DESIGN**	**21CIV645.2**	**8 Hours**

Biomaterials, Design of Forms- (Hexagonal unit cells, Intrinsic disorder, anisotropy), Design of materials- (Hierarchy, fracture tough materials, structural colours, Actuating Materials, Bio-Compatible Materials). Bio-Mechanics, Applications of Biomaterials and Bio systems in Health care design (Human Prosthetics, Parasitic Wasp-Inspired Needle, Octopus-Inspired Sucker for Tissue Grafting, Peacock-Inspired Biosensors, Gecko-Inspired Surgical Glue) Robotics, Marine and Aeronautical.

Text Book	Text Book 1: 2.2, 2.3, 2.4 to 2.15

MODULE-3	**BIO SUSTAINABLE DEVELOPMENT**	**21CIV645.3 & 21CIV645.4**	**8 Hours**

Innovations in Energy (Termite mound inspired shopping malls), Innovations in Resource-Air (purification, filtration), Dew water collection systems, water purification, desalination, Management of spaces, designs for mega structures.

Text Book	Text Book 2: 3.1, 3.3, 3.5, 3.7, 3.10

MODULE-4	BIO COMPUTING AND OPTIMISATION	21CIV645.5	8 Hours
No Free Lunch Theorem, Bat Algorithm, Flower Pollination Algorithm, Genetic Algorithm- Crossover and Mutation Operations. Bio-Inspired Optimisation, Ant Colony Optimisation (ACO), Swam Intelligence-Particle Swam Optimisation (PSO).			
Text Book	Text Book 1: 6.1, 6.3, 6.5, 6.7, Text Book 2: 10.1, 10.3, 10.5, 10.7		
MODULE-5	**APPLICATIONS OF BIO-INSPIRED INNOVATIONS**	**21CIV645.6**	**8 Hours**
Bio inspired innovations in– Automotive, Automation, Materials and Manufacturing, Sensors, Controllers, Communications, Healthcare, Agriculture, food production, and Sports, Environment infrastructure. Carbon Neutral Solutions (Coral Reefs, Eco-cements), Carbon Free Solutions (Lotus leaf inspired paints), eco-restorations (Eco-friendly pesticide).			
Text Book	Text Book 2: 12.1 to 12.10		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution	
		Test (s)	NPTEL
		25	25
L1	**Remember**	-	5
L2	**Understand**	10	5
L3	**Apply**	10	5
L4	**Analyze**	5	5
L5	**Evaluate**	-	5
L6	**Create**	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	-
L2	**Understand**	-
L3	**Apply**	20
L4	**Analyze**	30
L5	**Evaluate**	-
L6	**Create**	-

Suggested Learning Resources:

Text Books:

1. Helena Hashemi Farzaneh, UdoLindemann, "A Practical Guide to Bio-inspired Design", Springer : Vieweg, 1st edition 2019, ISBN-10 366257683X, ISBN-13 : 978-3662576830
2. Torben A. Lenau, Akhlesh Lakhtakia," Biologically Inspired Design: A Primer (Synthesis Lectures on Engineering, Science, and Technology)", Publisher: :Morgan & Claypool Publishers, 2021, ISBN-10 1636390471, ISBN-13: 978-1636390475

Reference Books:

1. French M, "Invention and evolution: Design in nature and engineering", Publisher: Cambridge University Press, 2020
2. Pan L., Pang S., Song T. and Gong F. eds, "Bio-Inspired Computing: Theories and Applications", 15th International Conference, BIC-TA 2020, Qingdao, China, October 23-25, 2020, Revised Selected Papers (Vol. 1363). Springer Nature, 2021
3. WannD ,"Bio Logic: Designing with nature to protect the environment", Wiley Publisher,1994

Web links and Video Lectures (e-Resources):

- **https://onlinecourses.nptel.ac.in/noc22_ge24/preview**
- **https://biodesign.berkeley.edu/bioinspired-design-course/**
- **https://www.youtube.com/watch?v=cwxXY9Qe8ss**
- **https://www.youtube.com/watch?v=V2GvQXvjhLA**
- **https://nsf-gov-resources.nsf.gov/2023-03/Bio-inspired%20Design %20Workshop%20Report_2232327_October%202022_Final.508.pdf**

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

- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to prepare Flowcharts and Handouts
  - Organizing Group wise discussions on issues
  - Seminars

SOCIAL CONNECT & RESPONSIBILITY

Course Code	**21CVK65**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**1**	**Exam Hours**	**2**

Course outcomes:
At the end of the course, the student will be able to:

21CVK65.1	Realize social responsibility through societal activities
21CVK65.2	Review the history and culture of city through community interaction
21CVK65.3	Develop responsible connection for societal benefits
21CVK65.4	Cultivate the best practices for diverse scenarios
21CVK65.5	Build planning and organizational skills
21CVK65.6	Develop deep drive into societal challenges being addressed by NGO(s), social enterprises & the Government

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CVK65.1	-	-	-	-	-	3	2	2	3	2	-	-	3	-
21CVK65.2	-	-	-	-	-	3	2	2	3	2	-	-	3	-
21CVK65.3	-	-	-	-	-	3	2	2	3	2	-	-	3	-
21CVK65.4	-	-	-	-	-	3	2	2	3	2	-	-	3	-
21CVK65.5	-	-	-	-	-	3	2	2	3	2	-	-	3	-
21CVK65.6	-	-	-	-	-	3	2	2	3	2	-	-	3	-

MODULE-1	**PLANTATION AND ADOPTION OF A TREE**	**21CVK65.1 21CVK65.2**	**3 Hours**

Plantation of a tree that will be adopted for four years by a group of B.E students. They will also execute a documentary or a photoblog describing the plant's origin, its usage in daily life, and its appearance in folklore and literature.

Self-study/ Case study Applications	Photoblog/Documentary on any plant with all details.

MODULE-2	**HERITAGE WALK AND CRAFTS CORNER**	**21CVK65.1 21CVK65.2 21CVK65.3**	**3 Hours**

Heritage tour, knowing the history and culture of the city, connecting to people around through their history, knowing the city and its craftsman, photoblog and documentary on evolution and practice of various craft forms.

Self-study/ Case study Applications	Photoblog/Documentary on heritage of different places/crafts in their location.

MODULE-3	**ORGANIC FARMING AND WASTE MANAGEMENT**	**21CVK65.4 21CVK65.5**	**3 Hours**

Usefulness of organic farming, wet waste management in neighboring villages, and implementation in the campus

Self-study/ Case study /Applications	Photoblog/Documentary on organic farming / waste management.

MODULE-4	WATER CONSERVATION	21CVK65.4 21CVK65.5 21CVK65.6	3 Hours
Knowing the present practices in the surrounding villages and implementation in the campus, documentary or photo blog presenting the current practices.			
Self-study/ Case study /Applications	Photoblog/Documentary on water conservation techniques.		
MODULE-5	**FOOD WALK**	**21CVK65.3 21CVK65.4**	**3 Hours**
City's culinary practices, food lore, and indigenous materials of the region used in cooking.			
Self-study/ Case study /Applications	Photoblog/Documentary on healthy diet / Culinary practices.		

CIE Assessment Pattern (50 Marks – Activity based)

- **Each module is evaluatedfor50 Marks and average of all the five modules will be the final marks.**

CIE component for each module	Marks
Planning and scheduling the social connect	15
Information/Data collected during the social connect	15
Analysis of the information/data and report writing	20
Total (each module)	**50**

SEE Assessment Pattern (50 Marks – Activity based)

SEE	Marks
Presentation	20
Jamming session / Open Mic	15
Group discussion / debate	15
Total	**50**

Activity-Based Learning / Practical Based learning

- Platform to connect to others and share the stories with others:
  - Jamming session
  - Open mic
  - Poetry
- Share the experience of Social Connect.
- Exhibit the talent like playing instruments, singing, one-act play, art-painting, and fine art.

Pedagogy:

- The students will be divided into groups. Each group will be handled by faculty mentor.
- Faculty mentor will design the activities (particularly Jamming sessions, open mic and poetry)
- The course is mainly activity-based that will offer a set of activities for the student that enables them to connect with fellow human beings, nature, society, and the world at large.
- The course will engage students for interactive sessions, open mic, reading group, storytelling sessions, and semester-long activities conducted by faculty mentors.
- Studentsshouldpresenttheprogressoftheactivitiesaspertheschedule intheprescribedpracticalsessioninthefield.
- There should be positive progress in the vertical order for the benefit of society in general through activities.

Plan of Action:

- Each student should do activities according to the scheme and syllabus.
- At the end of semester student performance has to be evaluated by the faculty mentor for the assigned activity progress and its completion.
- At last consolidated report of all activities from 1st to 5th, compiled report should be submitted as per the instructions and scheme.
- Practice Session Description:
    - Lecture session in field to start activities
    - Students Presentation on Ideas
    - Commencement of activity and its progress
    - Execution of Activity
    - Case study-based Assessment, Individual performance
    - Sector/ Teamwise study and its consolidation
    - Videobasedseminarfor10minutes by each student at the end of semester with Report.

Module Name	Group Size	Location	Magnitude	Activity	Reporting
Plantation and adoption of a tree	03–05	Farmers Land or Roadside or Community area or institution's campus, anyone location to be selected.	Students must monitor till end of B Tech degree	Site selection Select suitable species in consultation with horticulture, forest or agriculture department. Interact with NGO/Industry and community to plant Tag the plant for continuous monitoring	Report shall behand written with paintings, sketches, poster, video

Heritage walk and crafts corner	03-05	Preferably Within the city where institution is located or home town of the student group	One or two: One can be a structure or a heritage building the other can be heritage custom or practice	Survey in the form of questioner by connecting to the people and asking. No standard questioner to be given by faculty and has to be evolved involving students. Questions during survey can be asked in local language but report language is English.	and/or photograph with Geotag.
Waste management	03-05 More than one group Can be assigned one task based on magnitude of task.	Preferably in the near by villages and within the campus.	One	Report on importance and benefits of Waste management. Report on segregation, collection, transportation and disposal. Suggestion for composting. Visit near by village/location to sensitize farmers and public about waste management and also document	
Water Conservation	03–05	Rain water harvesting demonstration available in the campus or surroundings	One	Visit lakes/pond/river/drywell to involve on rejuvenation activity. Or Assessment of Water budget in the campus / village Report on traditional water conservation practices(to minimize wastage)	
Food Walk	03-05	Within the city where institution is located Food culture of student's resident region	One	Survey local food centers and identify the specialty Identify and study the food ingredients Report on the regional foods Report on Medicinals values of the local food grains, and plants.	

MINI PROJECT - (EXTENSIVE SURVEY PROJECT)

Course Code	**21CIV67**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hours / Week	**2**	**Total Marks**	**100**
Credits	**1**	**Exam Hours**	**3**

Course outcomes:
At the end of the course, the student will be able to:

21CIV67.1	Apply the concepts of surveying in the construction sites.
21CIV67.2	Design a new reservoir and enhance the capacity of the exiting one.
21CIV67.3	Geometrically design the stretch of road and its pavement as per IRC provision.
21CIV67.4	Prepare a layout for the township and design water supply and sanitary facility.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CIV67.1	3	-	-	3	-	-	-	-	3	3	-	3	3	3
21CIV67.2	3	-	1	3	-	-	-	-	3	3	-	3	3	3
21CIV67.3	3	-	-	3	-	-	-	-	3	3	-	3	3	3
21CIV67.4	3	-	1	3	1	-	-	-	3	3	-	3	3	3

MODULE-1	**NEW TANK PROJECT**	**21CIV67.1, 21CIV67.2**	**6 Hours**

INTRODUCTION: Importance of project works, Reconnaissance of the sites and setting up of bench marks.
NEW TANK PROJECT: Alignment of center line of the proposed bund, Longitudinal and cross sections of the bund. Capacity Contour survey, block leveling at Waste weir and sluice points and canal alignment

Text Book	Text Book 1, 2

MODULE-2	**WATER SUPPLY AND SANITARY PROJECT**	**21CIV67.1, 21CIV67.4**	**6 Hours**

Identifying the proper water supply source, Calculation of water requirement based on present and future population, Preparation of village map by using plane table surveying, block leveling at waste weir and overhead tanks, underground drainage system surveys for laying the sewers.

Text Book	Text Book 2, 3

MODULE-3	**HIGHWAY PROJECT**	**21CIV67.1, 21CIV67.3**	**6 Hours**

Preliminary and detailed investigations to align a new road. The investigations shall consist of topographic surveying of strip of land for considering alternate routes for final alignment. Longitudinal and cross sections of the proposed road and its pavement design.

Text Book	Text Book 3, 4

MODULE-4	**OLD TANK PROJECTS**	**21CIV67.1, 21CIV67.2**	**6 Hours**

Longitudinal and cross sections of the center line of the existing bund. Capacity Contour survey of existing bund, block leveling at existing Waste weir and sluice points.

Text Book	Text Book 1, 4

MODULE-5	**TOWN/HOUSING/LAYOUT PLANNING**	**21CIV67.1, 21CIV67.4**	**6 Hours**

Reconnaissance survey for selection of site and conceptualization of project. Detailed survey required for project execution like contour surveys. Preparation of layout plans for township development as per regulations. Centerline marking. Preparation of drawing along with report as per regulations.

Text Book	Text Book 1, 3

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution	
		Phase 1	Phase 2
		25	25
L1	Remember	-	-
L2	Understand	-	-
L3	Apply	5	5
L4	Analyze	5	5
L5	Evaluate	5	5
L6	Create	10	10

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	-
L3	Apply	10
L4	Analyze	10
L5	Evaluate	10
L6	Create	20

Suggested Learning Resources:

Text Books:

1. B.C. Punmia ,Er. Ashok Kr. Jain, Dr.Arun Kumar Jain., "Surveying Vol 2 and Vol 3", Laxmi Publications, Edition: 16th (2016), New Delhi.
2. A. M. Chandra., "Plane surveying''– New age international (P) Ltd, 3rd Edition (Reprint 2015).
3. A. M. Chandra., "Higher surveying''– New age international (P) Ltd, 3rd Edition (Reprint 2015).

Reference Books:

1. Milton O. Schmidt – Wong, Thomson Learning., "Fundamentals of Surveying''.
2. S.K. Roy., "Fundamentals of Surveying'' -– Prentice Hall of India.
3. S.K. Duggal., "Surveying Vol. I'', Tata McGraw Hill - Publishing Co. Ltd., New Delhi.

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

- Contents related on site activities

SYLLABUS FOR COMMON COURSES

NATIONAL SERVICE SCHEME (NSS)			
Course Code	**21NSS84**	**CIE Marks**	**50**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**00**	**Exam Hours**	**2**

Course outcomes:
At the end of the course, the student will be able to:

21NSS84.1	Understand the importance of his / her responsibilities towards society
21NSS84.2	Analyze the environmental and societal problems/issues and will be able to design solutions for the same.
21NSS84.3	Evaluate the existing system and to propose practical solutions for the same for sustainable development.
21NSS84.4	Implement government or self-driven projects effectively in the field.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
21NSS84.1	-	-	-	-	-	3	1	1	3	2	2	1
21NSS84.2	-	-	-	-	-	3	1	1	3	2	2	1
21NSS84.3	-	-	-	-	-	3	1	1	3	2	2	1
21NSS84.4	-	-	-	-	-	3	1	1	3	2	**2**	1

Semester	CONTENT	HOURS
5th to 8th	**PART A** ONENSS–CAMP @College/University/State or Central Govt Level/ NGO's/General Social Camps **PART B** 1. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing 2. Waste management–Public, Private and Govtorganization,5R's. 3. Setting of the information imparting club for women leading to contribution in social and economic issues. 4. Water conservation techniques–Role of different stakeholders–Implementation. 5. Preparing an actionable business proposal for enhancing the village income and approach for implementation. 6. Helping local schools to achieve good results and enhance their enrolment in Higher/technical/vocational education. 7. Developing Sustainable Water management system for rural areas and implementation approaches.	Total 32 Hrs/ Semester 2 Hrs/week
	8. Contribution to any national level initiative of Government of India. For. eg. Digital India, Skill India, Swachh Bharat, AtmanirbharBharath, Make in India, Mudra scheme, Skill development programs etc. 9. Spreading public awareness under rural outreach programs. (minimum5programs). 10. Organize National integration and social harmony events/workshops / Seminars. (Minimum02programs). 11. Govt. school Rejuvenation and helping them to achieve good infrastructure.	

CIE Assessment Pattern (50 Marks – Practical) –

1. **PART A:** Compulsorily students have to attend one camp.

2. **PART B:** Students have to take up anyone activity on the above said topics and have to prepare content for awareness and technical contents for implementation of the projects and have to present strategies for implementation of the same.
3. CIE will be evaluated based on their presentation, approach and implementation strategies.

CIE Components	Marks
Presentation1-Selection of topic-(phase1)	10
Experiential Learning Presentation 2 (phase2)	10
Case Study-based Teaching-Learning	10
Sector-wise study & consolidation	10
Video based seminar (4-5 minutes per student)	10
Total	**50**

SEE Assessment Pattern (50 Marks – Practical)

- Implementation strategies of the project with report duly signed by the Dept's Coordinator, HoD and Principal.
- At last it should be evaluated by the NSS Coordinator.
- Finally consolidated report should be sent to the University.

Suggested Learning Resources:

Reference Books:

1. NSS Course Manual, Published by NSS Cell, VTU Belagavi.

Pre-requisites to take this Course:

1. Students should have a service-oriented mindset and social concern.
2. Students should have dedication to work at any remote place, anytime with available resources and proper time management for the other works.
3. Students should be ready to sacrifice some of the time and wishes to achieve service-oriented targets on time.

PHYSICAL EDUCATION (PE) (SPORTS AND ATHLETICS)

Course Code	**21PES84**	**CIE Marks**	**50**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**00**	**Exam Hours**	**02**

Course outcomes:

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

21PES84.1	Demonstrate the starting and finishing positions of different track and jump events.
21PES84.2	Demonstrate the holding and releasing stances in various throwing events, and takeoff and landing position in various jumping events of Athletics.
21PES84.3	Demonstrate the specific skills and techniques of the selected game/event.
21PES84.4	Demonstrate and describe the rules and regulations of specific games.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
21PES84.1	-	-	-	-	-	-	-	1	2	-	-	1
21PES84.2	-	-	-	-	-	-	-	1	2	-	-	1
21PES84.3	-	-	-	-	-	-	-	1	2	-	-	1
21PES84.4	-	-	-	-	-	-	-	1	2	-	-	1

Semester	CONTENT	HOURS
5th	**Fitness Components:** Meaning and Importance, Fit India Movement, Definition of fitness, Components of fitness, Benefits of fitness, Types of fitness and Fitness tips. **Practical Components:** Speed, Strength, Endurance, Flexibility, and Agility **Athletics**: 1. Track -Sprints: • Starting Techniques: Standing start and Crouch start(its variations)use of Starting Block. • Acceleration with proper running techniques. • Finishing technique: Run Through, Forward Lunging and Shoulder Shrug. 2. Jumps- Long Jump: Approach Run, Take-off, Flight in the air (Hang Style/Hitch Kick)and Landing 3. Throws- Shot Put: Holding the Shot, Placement, Initial Stance, Glide, Delivery Stance and Recovery (Perry O'Brien Technique) **Kabaddi OR Kho-Kho** **Kabaddi:** A. Fundamental skills 1. Skills in Raiding: Touching with hands, Use of leg-toe touch, squat leg thrust, side kick, mule kick, arrow fly kick, crossing of baulk line. Crossing of Bonus line. 2. Skills of holding the raider: Various formations, catching from particular position, different catches, catching formation and techniques. 3. Additional skills in raiding: Escaping from various holds, techniques of escaping from chain formation, offense and defense. 4. Game practice with application of Rules and Regulations. B. Rules and their interpretations and duties of the officials. **Kho-Kho:** A Fundamental skills 1. Skills in Chasing: Sit on the box (Parallel &Bullet toe method),Getup from the box(Proximal & Distal foot method),Give Kho(Simple,Early, Late& Judgment),Pole Turn, Pole Dive, Tapping, Hammering, Rectification of foul. 2. Skills in running: Chain Play, Ring play and Chain & Ring mixed play. 3. Game practice with application of Rules and Regulations.	Total 32 Hrs/ Semester 2 Hrs/week

	B. Rules and their interpretations and duties of the officials.	
6th	**Athletics**: 1. Track -110 Mtrs and 400Mtrs: • Hurdling Technique: Lead leg Technique, Trail leg Technique, Side Hurdling, Over the Hurdles • Crouch start (its variations)use of Starting Block. • Approach to First Hurdles, In Between Hurdles, Last Hurdles to Finishing. 2. Jumps- High jump: Approach Run, Take-off, Bar Clearance (Straddle) and Landing. 3. Throws- Discus Throw: Holding the Discus, Initial Stance Primary Swing, Turn, Release and Recovery (Rotation in the circle). **Volleyball OR Throw Ball** **Volleyball:** A. Fundamental skills 1. Service: Under arm service, Side arm service, Tennis service, Floating service. 2. Pass: Under arm pass, Over-head pass. 3. Spiking and Blocking. 4. Game practice with application of Rules and Regulations B. Rules and their interpretation and duties of officials. **Throw Ball:** A. Fundamental skills: Over hand service, Side arm service, two hand catching, one hand over head return, side arm return. B. Rules and their interpretations and duties of officials **Football OR Hockey** **Football:** A. Fundamental Skills 1. Kicking: Kicking the ball with inside of the foot, Kicking the ball with Full Instep of the foot, Kicking the ball with Inner Instep of the foot, Kicking the ball with Outer Instep of the foot and Lofted Kick. 2. Trapping: Trapping- the Rolling ball, and the Bouncing ball with sole of the foot. 3. Dribbling: Dribbling the ball with Instep of the foot, Dribbling the ball with Inner and Outer Instep of the foot. 4. Heading: In standing, running and jumping condition. 5. Throw-in: Standing throw-in and Running throw-in. 6. Feinting: With the lower limb and upper part of the body. 7. Tackling: Simple Tackling, Slide Tackling. 8. Goal Keeping: Collection of Ball, Ball clearance-kicking, throwing and deflecting. 9. Game practice with application of Rules and Regulations. C. Rules and their interpretation and duties of officials. **Hockey:** A. Fundamental Skills 1. Passing: Short pass, Longpass, pushpass, hit 2. Trapping. 3. Dribbling and Dozing 4. Penalty stroke practice. 5. Penalty corner practice. 6. Tackling: Simple Tackling, Slide Tackling. 7. Goal Keeping, Ball clearance- kicking, and deflecting.	

	8. Game practice with application of Rules and Regulations. B. Rules and their interpretation and duties of officials.	
7th	**Athletics**: 1. Track -Relay Race: • Starting, Baton Holding/Carrying, Baton Exchange in between zone, and Finishing • Crouch start (its variations) use of Starting Block. • Approach to First Hurdles, In Between Hurdles, Last Hurdles to Finishing. 2. Jumps- Triple Jump: Approach Run, Take-off, Flight in the Hop, Step, Jump and Landing 3. Throws- Javelin Throw: Grip, Carry, and Recovery (3/5 Impulse stride). Release **Cricket OR Baseball** **Cricket:** A. Fundamental skills 1. Batting- Forward Defense Stroke, Backward Defense Stroke, OffDrive, On Drive, Straight Drive, Cover Drive, Square Cut. 2. Bowling-Out-swing, In-swing Off Break, Leg Break and Googly. 3. Fielding: Catching - The High Catch, The Skim Catch, The Close Catch and throwing at the stumps from different angles. Long Barrier and Throw, Short Throw, Long Throw, Throwing on the Turn. 4. Wicket Keeping B. Rules and their interpretation and duties of officials. **Baseball:** A. Fundamental skills: 1. Player Stances – walking, extending walking, L stance, cat stance Grip – standard grip, choke grip 2. Batting – swing and bunt. 3. Pitching 4. Baseball: slider, fast pitch, curve ball, drop ball, rise ball, change up, knuckle ball, screw ball B. Rules and their interpretations and duties of officials **Basketball OR Net Ball** **Basketball:** A. Fundamental Skills 1. Passing: Two hand Chest Pass, Two hands Bounce Pass, One hand Baseball Pass, Side arm Pass, Overhead Pass, Hook Pass. 2. Receiving: Two hand receiving, One hand receiving, Receiving in stationary position, Receiving while Jumping and Receiving while Running. 3. Dribbling: How to start dribble, drop dribble, High Dribble, Low Dribble, Reverse Dribble, Rolling Dribble. 4. Shooting: Lay-up shot and its variations, One hand set shot, Two hands jump shot, Hook shot, Free Throw. 5. Rebounding: Defensive rebound and Offensive rebound. 6. Individual Defence: Guarding the player with the ball and without the ball, Pivoting. 7. Game practice with application of Rules and Regulations. **Netball:** A. Fundamental Skills 1. Catching: one handed, two handed, with feet grounded and in flight. 2. Throwing (Different passes and their uses): One hand passes (shoulder, high shoulder, underarm, bounce, lob), two hand passes (Push, overhead and bounce). 3. Footwork: Landing on one foot, landing on two feet, Pivot, Running pass. 4. Shooting: One hand, forward step shot, and backward step shot. 5. Techniques of free dodge and sprint, sudden sprint, sprint and stop, sprinting with change at speed.	

	6. Defending: Marking the player, marking the ball, blocking, inside the circle, outside the circle. Defending the circle edge against the passing. 7. Intercepting: Pass and shot. 8. Game practice with application of Rules and Regulations. B. Rules and their interpretation and duties of officials.	
8th	**Athletics**: A. Track -Combined Events: a. Heptathlon all the 7 events b. Decathlon: All 10 Events B. Jumps- Pole Vault: Approach Run, Planting the Pole, Take-off, Bar Clearance and Landing. C. Throws- Hammer Throw: Holding the Hammer, Initial Stance Primary Swing, Turn, Release and Recovery (Rotation in the circle). **Shuttle Badminton OR Table Tennis** **Shuttle Badminton:** A. Fundamental skills D. Basic Knowledge: Various parts of the Racket and Grip. E. Service: Short service, Long service, Long-high service. F. Shots: Over head shot, Defensive clear shot, Attacking clear shot, Drop shot, Net shot, Smash. G. Game practice with application of Rules and Regulations. B. Rules and their interpretation and duties of officials. **Table Tennis:** A. Fundamental skills: 1. Basic Knowledge: Various parts of the Racket and Grip(Shake Hand &PenHold Grip). 2. Stance: Alternate & Parallel. 3. Push and Service: Backhand &Forehand. 4. Chop: Backhand & Forehand. 5. Receive: Push and Chop with both Backhand & Forehand. 6. Game practice with application of Rules and Regulations. B. Rules and their interpretations and duties of officials **Handball OR Ball Badminton** **Handball:** A. Fundamental Skills 1. Catching, Throwing and Ball control, 2. Goal Throws: Jumpshot, Centershot, Diveshot, Reverseshot. 3. Dribbling: High and low. 4. Attack and counter attack, simple counter attack, counter attack from two wings and center. 5. Blocking, Goal Keeping and Defensive skills. 6. Game practice with application of Rules and Regulations. B. Rules and their interpretations and duties of officials **Ball badminton:** A. Fundamental Skills 1. Basic Knowledge: Various parts of the Racket and Grip. 2. Service: Short service, Long service, Long-high service. 3. Shots: Overhead shot, Defensive clearshot, Attacking clearshot, Dropshot, Netshot, Smash. 4. Game practice with application of Rules and Regulations. B. Rules and their interpretation and duties of officials.	

CIE Assessment Pattern (50 Marks – Practical) –

CIE to be evaluated every semester end based on practical demonstration of Sports and Athletics activities learnt in the semester.

CIE	Marks
5th Semester	10
6th Semester	10
7th Semester	15
8th Semester	15
Total	**50**

SEE Assessment Pattern (50 Marks – Practical)

SEE	Marks
Athletics	20
Kabaddi OR Kho-Kho	05
Volleyball / Throw ball	05
Football/Hockey	05
Netball/Basketball	05
Shuttle Badminton / Table Tennis	05
Handball/ Badminton	05
Total	**50**

Suggested Learning Resources:

Reference Books:

1. Saha, A.K. SarirSiksherRitiniti, Rana Publishing House, Kalyani.
2. Bandopadhyay,K. SarirSikshaParichay, Classic Publishers, Kolkata.
3. Petipus, etal. Athlete's Guide to Career Planning, Human Kinetics.
4. Dharma,P.N. Fundamentals of Track and Field, KhelSahitya Kendra, NewDelhi.
5. Jain,R. Play and Learn Cricket, KhelSahitya Kendra, New Delhi.
6. VivekThani, Coaching Cricket ,KhelSahitya Kendra, NewDelhi.
7. Saha,A.K.SarirSiksherRitiniti,RanaPublishingHouse,Kalyani.
8. Bandopadhyay,K. SarirSikshaParichay, Classic Publishers, Kolkata
9. Naveen Jain, Play and Learn Basketball, KhelSahitya Kendra, NewDelhi.
10. Dubey,H.C. Basketball, Discovery Publishing House, NewDelhi.
11. RachanaJain, Teach Yourself Basketball, Sports Publication.
12. JackNagle,Power Pattern Offences for Winning basketball,ParkerPublishingCo.,NewYork.
13. RenuJain, Play and Learn Basketball, KhelSahityaKendra,NewDelhi.
14. SallyKus, Coaching Volleyball Successfully, HumanKinetics.
15. Saha, A. K. SarirSiksherRitiniti, Rana Publishing House, Kalyani.
16. Bandopadhyay, K.SarirSikshaParichay, Classic Publishers, Kolkata

YOGA			
Course Code	**21YOG84**	**CIE Marks**	**50**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**00**	**Exam Hours**	**02**

Course outcomes:
At the end of the course, the student will be able to:

21YOG84.1	Use Yogasana practices in an effective manner
21YOG84.2	Become familiar with an authentic foundation of Yogic practices
21YOG84.3	Practice different Yogic methods such as Suryanamaskara, Pranayama and some of the Shat Kriyas
21YOG84.4	Use the teachings of Patanjali in daily life.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
21YOG84.1	-	-	-	-	-	3	-	-	2	-	-	1
21YOG84.2	-	-	-	-	-	3	-	-	2	-	-	1
21YOG84.3	-	-	-	-	-	3	-	-	2	-	-	1
21YOG84.4	-	-	-	-	-	3	-	-	2	-	-	1

Semester	CONTENT	HOURS
5th	**Introduction of Yoga:** Aim and Objectives of yoga, Prayer: Yoga,its origin ,history and development. Yoga, its meaning, definitions. Different schools of yoga, importance of prayer **Brief introduction of yogic practices for common man:** Yogic practices for common man to promote positive health **Rules and regulations:** Rules to be followed during yogic practices by practitioner **Misconceptions of yoga:** Yoga its misconceptions, Difference between yogic and non-yogic practices. **Suryanamaskara:** 1. Suryanamaskar prayer and its meaning, Need, importance and benefits of Suryanamaskar. 2. Suryanamaskar 12 count,2rounds **Kapalabhati:** Meaning, importance and benefits of Kapalabhati - 40strokes/min3rounds **Different types of Asanas**: 1. Sitting: Padmasana, Vajrasana, Sukhasana 2. Standing: Vrikshana, Trikonasana, ArdhakatiChakrasana 3. Prone line: Bhujangasana, Shalabhasana 4. Supineline: Utthitadvipadasana, Ardhahalasana, Halasana **Patanjali'sAshtanga Yoga**: Yama, Niyama **Pranayama:** Suryanuloma –Viloma, Chandranuloma-Viloma	Total 32 Hrs/ Semester 2 Hrs/week
6th	**Suryanamaskara:** Suryanamaskar 12 count,4rounds **Kapalabhati:** Revision ofKapalabhati -60strokes/min3rounds **Differenttypesof Asanas**: 1. Sitting: Paschimottanasana, ArdhaUshtrasana, Vakrasana, AakarnaDhanurasana 2. Standing: ParshvaChakrasana, UrdhvaHastothanasana, Hastapadasana 3. Prone line: Dhanurasana 4. Supine line: KarnaPeedasana, Sarvangasana, Chakraasana **Patanjali'sAshtangaYoga**: Asana, Pranayama **Pranayama:**Chandra Bhedana, Nadishodhana, Surya Bhedana	
7th	**Suryanamaskara:** Suryanamaskar 12 count,8rounds **Kapalabhati:** Revision ofKapalabhati - 80strokes/min3rounds **Differenttypesof Asanas**: 1. Sitting: Yogamudra in Padmasana, VibhaktaPaschimottanasana, Yogamudra in Vajrasana 2. Standing: ParivrittaTrikonasana, Utkatasana, Parshvakonasana 3. Prone line: PadangushthaDhanurasana, PoornaBhujangasana /	

	Rajakapotasana 4. Supine line: Navasana/Noukasana, Pavanamuktasana, Sarvangasana **Patanjali'sAshtangaYoga**: Pratyahara, Dharana **Pranayama:**Ujjayi, Sheetali, Sheektari	
8th	**Suryanamaskara:** Suryanamaskar 12 count,12rounds **Kapalabhati:** Revision ofKapalabhati - 100strokes/min3rounds **Differenttypesof Asanas**: 1. Sitting: Bakasana, Hanumanasana, EkapadaRajakapotasana 2. Standing: ParivrittaTrikonasana, Utkatasana, Parshvakonasana 3. Prone line: Mayurasana 4. Supine line: Setubandhasana, Shavasanaa (Relaxation posture) 5. Balancing: Sheershasana **Patanjali'sAshtangaYoga**: Dhyana (Meditation), Samadhi **Pranayama:**Bhastrika, Bhramari, Ujjai **Shat Kriyas:**Jalanetiandsutraneti, SheetkarmaKapalabhati	

CIE Assessment Pattern (50 Marks – Practical) –

CIE to be evaluated every semester end based on practical demonstration of Yogasana learnt in the semester.

CIE	Marks
5th Semester	10
6th Semester	10
7th Semester	15
8th Semester	15
Total	**50**

SEE Assessment Pattern (50 Marks – Practical)

SEE	Marks
Suryanamaskara	10
Kapalabhati	10
Asanas	10
Patanjali'sAshtangaYoga	10
Pranayama / Shat Kriyas	10
Total	**50**

Suggested Learning Resources:

Reference Books:

2. Swami Kuvulyananda: Asma (Kavalyadhama, Lonavala)
3. Tiwari, O P: Asana Why and How
4. Ajitkumar: Yoga Pravesha (Kannada)
5. Swami SatyanandaSaraswati: Asana Pranayama, Mudra, Bandha(Bihar School of yoga, Munger)
6. Swami SatyanandaSaraswati: Surya Namaskar(Bihar School of yoga, Munger)
7. Nagendra H R: The art and science of Pranayama
8. Tiruka: Shatkriyegalu (Kannada)
9. Iyengar B K S: Yoga Pradipika (Kannada)
10. Iyengar B K S: Light on Yoga (English)

Appendix A: List of Assessment Patterns

S.NO	Pattern of Assessments
1	Assignments
2	Group Discussions
3	Case Study / Caselets
4	Practical-Orientation on Design Thinking
5	Participatory & Industry-Integrated Learning
6	Practical Activities / Problem Solving Exercises
7	Class Presentations
8	Analysis of Industry / Technical / Business Reports
9	Reports on Industrial Visit
10	Industrial / Social / Rural Projects
11	Participation in external seminars / Workshops
12	Any Other Academic Activity
13	Online / Offline Quizzes

APPENDIX B: Outcome Based Education

Outcome-based education (OBE) is an educational theory that bases each part of an educational system around goals (outcomes). By the end of the educational experience each student should have achieved the goal. There is no specified style of teaching or assessment in OBE; instead classes, opportunities, and assessments should all help students achieve the specified outcomes.

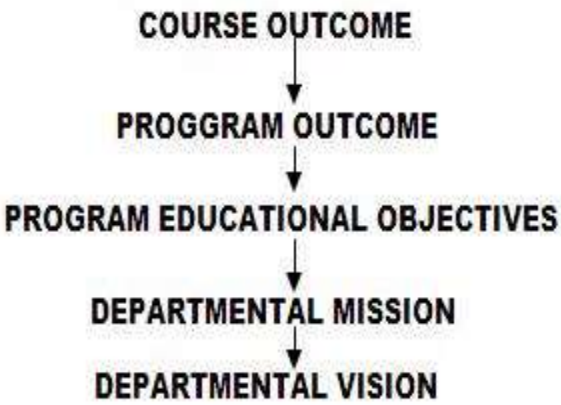
There are three educational Outcomes as defined by the National Board of Accreditation:

Program Educational Objectives: The Educational objectives of an engineering degree program are the statements that describe the expected achievements of graduate in their career and also in particular what the graduates are expected to perform and achieve during the first few years after graduation. [nbaindia.org]

Program Outcomes: What the student would demonstrate upon graduation. Graduate attributes are separately listed in Appendix C

Course Outcome: The specific outcome/s of each course/subject that is a part of the program curriculum. Each subject/course is expected to have a set of Course Outcomes

Mapping of Outcomes



APPENDIX C: The Graduate Attributes of NBA

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

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

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

Conduct investigations of complex problems: The problems that cannot be solved by straightforward application of knowledge, theories and techniques applicable to the engineering discipline that may not have a unique solution. For example, a design problem can be solved in many ways and lead to multiple possible solutions that require consideration of appropriate constraints/requirements not explicitly given in the problem statement (like: cost, power requirement, durability, product life, etc.) which need to be defined (modeled) within appropriate mathematical framework that often require use of modern computational concepts and tools.

Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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

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

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

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

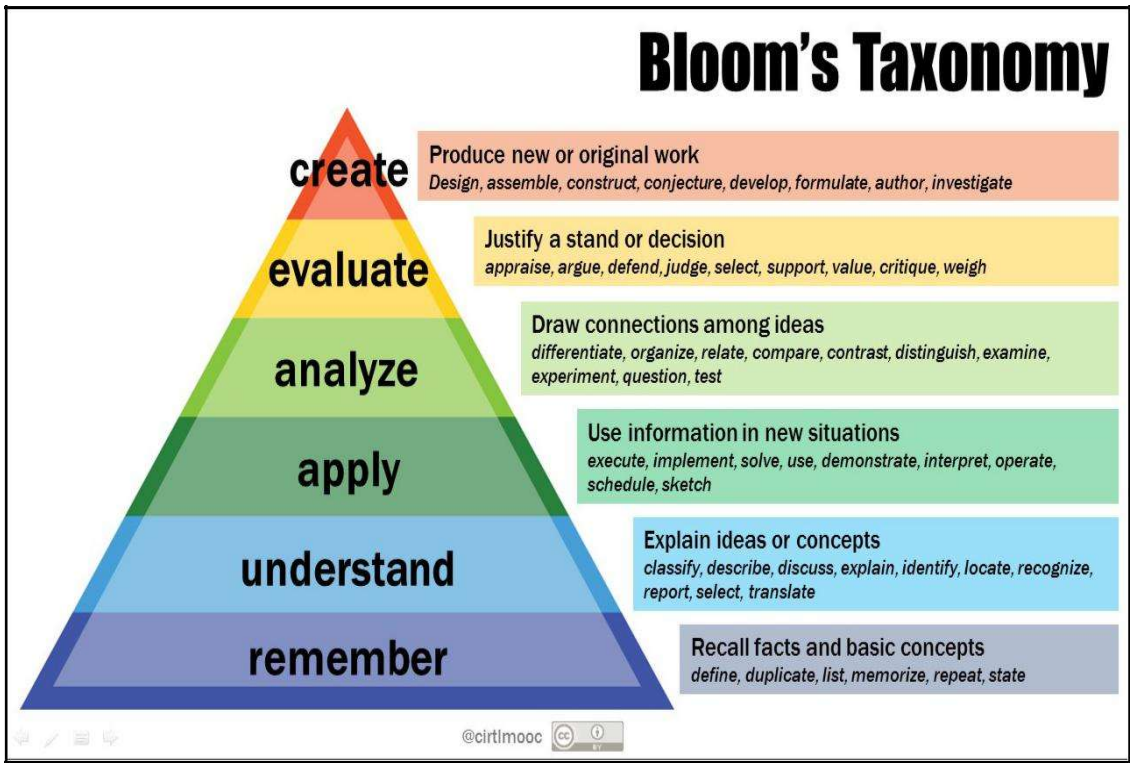
Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

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

APPENDIX D: BLOOM'S TAXONOMY

Bloom's taxonomy is a classification system used to define and distinguish different levels of human cognition—i.e., thinking, learning, and understanding. Educators have typically used Bloom's taxonomy to inform or guide the development of assessments (tests and other evaluations of student learning), curriculum (units, lessons, projects, and other learning activities), and instructional methods such as questioning strategies.



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www.newhorizonindia.edu

Ring Road, Bellandur Post, Near Marathahalli,
Bengaluru, Karnataka 560103, India.

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