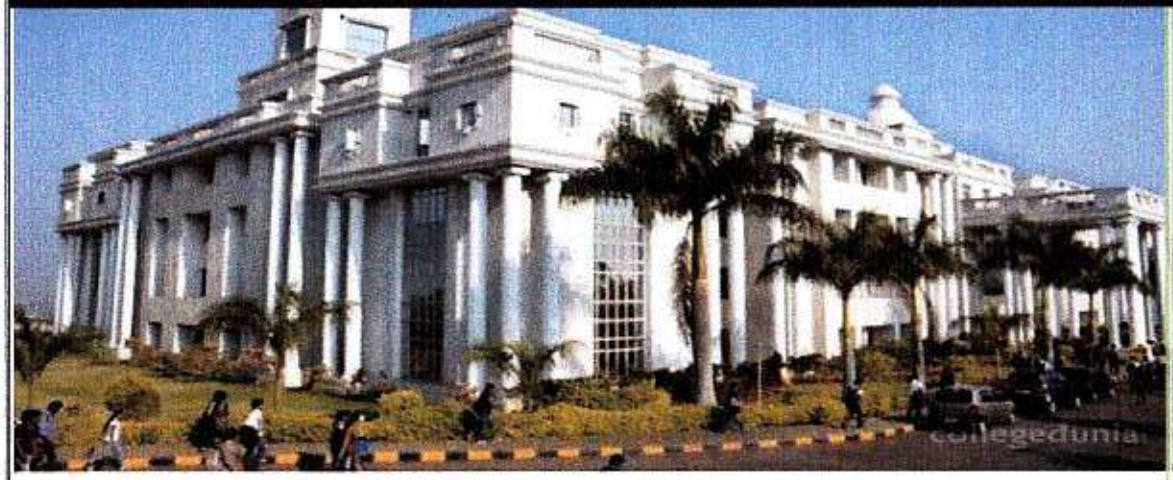
SCHEME AND SYLLABUS



Department of Civil Engineering

Head of Department
Civil Engineering
Global Academy of Technology
Rajarajeshwarinagar, Bangalore - 98

V - VI Semester Scheme (2022-23)

Civil Engineering

GLOBAL ACADEMY OF TECHNOLOGY
(Autonomous institution affiliated to VTU, Belagavi.
Accredited by NAAC with 'A' grade,
NBA Accredited Civil, CS, E&C, E&E, MECH and IS branches)
Ideal Homes Township,
Raja Rajeshwari Nagar, Bengaluru-560098.

H.P. Rajashekhar

Dean Academic
Global Academy of Technology,
Rajarajeshwarinagar, Bengaluru-98

Global Academy of Technology

(An Autonomous Institution, affiliated to VTU, Belagavi, recognized by Karnataka and Approved by AICTE, New Delhi.)

B.E. in Civil Engineering Scheme of Teaching and Examinations 2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Effective from 2023-24

V SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lectue	Tutorial	Practica/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	HSMS	22CIV51	Construction Management	PSB: Civil TD: Civil	3	0	0		03	50	50	100	3
2	IPCC	22CIV52	Design & Drawing of RCC Elements		2	2	2		03	50	50	100	4
3	PCC	22CIV53	Basic Geotechnical Engineering		3	0	2		03	50	50	100	4
4	PCCL	22CIVL54	Green Audit Laboratory		0	0	2		03	50	50	100	1
5	PEC	22CIV55X	Professional Elective - I		3	0	0		03	50	50	100	3
6	PROJ	22CIVP56	Mini Project / Extensive Survey		0	0	4		03	100	-	100	2
7	AEC	22RMIK57	Research Methodology and IPR	Any Department	2	2	0		03	50	50	100	3
8	MC	22CIVK58	Environmental Studies	TD:CV/Env/Chem PSB:CV	2	0	0		02	50	50	100	2
9	MC	22UHK59	National Service Scheme (NSS)	NSS coordinator	0	0	2			100		100	0
		22PEK59	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		22YOK59	Yoga	Yoga Teacher									
									Total	**550**	**350**	**900**	**22**

Professional Elective Course - I

22CIV55A	Advanced Mechanics of Solids	22CIV55C	Ground Water Hydrology
22CIV55B	Environmental Impact Assessment	22CIV55D	Modern Construction Materials and Technology

22CIV55E	Hydrology and Irrigation Engineering	

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**:Semester End Evaluation. **K :** The letter in the course code indicates common to al the stream of engineering. **PROJ**: Project /Mini Project. **PEC**: Professional Elective Course.

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practical of the same course. Credit for IPCC can be 04 and its Teaching– Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall
not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

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 the development of small systems/applications etc. Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.

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 ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

No SEE component for Mini-Project.

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. Each group will provide an option to select one course. The minimum number of students' strengths for offering a professional elective is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

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B.E. in Civil Engineering Scheme of Teaching and Examinations 2023

Outcome Based Education (OBE) and Choice Based Credit System (CBCS) (Effective from the academic year 2023-24)

VI SEMESTER Scheme -A

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical / Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	IPCC	22CIV61	Design & Drawing of steel structural elements	TD: PSB:	2	2	2		03	50	50	100	4
2	PCC	22CIV62	Transportation Engineering	TD: PSB:	3	0	2		03	50	50	100	4
3	PEC	22CIV63X	Professional Elective – II	TD: PSB:	3	0	0		03	50	50	100	3
4	OEC	22CIV64X	Open Elective -I	TD: PSB:	3	0	0		03	50	50	100	3
5	PROJ	22CIVP65	Major Project Phase – I	TD: PSB:	0	0	4		03	100	--	100	2
6	PCCL	22CIVL66	Project management software laboratory	TD: PSB:	0	0	2		03	50	50	100	1
7	AEC/ SDC	22CIV67X	Ability Enhancement Course/ SkillDevelopment Course - III	TD & PSB: Concerned Department	If the course is offered as a Theory 1	0	0		01	50	50	100	1
					If course is offered as a practical 0	0	2						
8	MC	22UHK68	National Service Scheme (NSS)	NSS coordinator	0	0	2			100	---	100	0
		22PEK68	Physical Education (PE) (Sports and Athletics)	PED									
		22YOK68	Yoga	Yoga Teacher									
9	IKS	22CIVK69	Indian Knowledge System		1	0	0		01	50	50	100	0
10	MC	22UHV69	Universal Human Values	Any department	1	0	0		01	50	50	100	0
									Total	**600**	**400**	**10000**	**18**

Professional Elective Course			
22CIV63A	Structural Dynamics & Earthquake Engineering	22CIV63C	Water resources Engineering
22CIV63B	Ground Improvement Techniques	22CIV63D	Geospatial Surveying
22CIV63E	Advanced Geotechnical Engineering		
Open Elective Course			
22CIV64A	Environmental Pollution & Control	22CIV64C	Sustainable Development Goals
22CIV64B	Smart Cities and Digital Infrastructure	22CIV64D	Cyber-Physical Systems for Infrastructure
Ability Enhancement Course / Skill Enhancement Course - III			
22CIV67A	Quality Control and assurance	22CIV67C	Visual Basic Analysis & Microsoft project
22CIV67B	Applications of AI in Civil Engineering	22CIV67D	Forensics and rehabilitation

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **K :** The letter in the course code indicates common to al the stream of engineering. **PROJ**: Project /Mini Project. **PEC**: Professional Elective Course. **PROJ**: Project Phase -I, **OEC**: Open Elective Course

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practical of the same course. Credit for IPCC can be 04 and its Teaching– Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulationgoverning the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

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. Each group will provide an option to select one course. The minimum number of students' strengths for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

Open Elective Courses: Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they can opt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor. The minimum numbers of students' strength for offering Open Elective Course is 10. However, this condition shall not be applicable to class where the admission to the program is less than 10.

Project Phase-I : Students have to discuss with the mentor /guide and with their help he/she has to complete the literature survey and prepare the report and finally define the problem statement for the project work.

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B.E. in Civil Engineering Scheme of Teaching and Examinations 2023

Outcome Based Education (OBE) and Choice Based Credit System (CBCS) (Effective from the academic year 2023-24)

VI SEMESTER- Scheme -B

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practica/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	IPCC	22CIV61	Design & Drawing of steel structural elements	TD: PSB:	2	2	2		03	50	50	100	4
2	PCC	22CIV62	Transportation Engineering	TD: PSB:	3	0	2		03	50	50	100	4
3	PEC	22CIV63X	Professional Elective – II	TD: PSB:	3	0	0		03	50	50	100	3
4	OEC	22CIV64X	Open Elective -I	TD: PSB:	3	0	0		03	50	50	100	3
5	PCCL	22CIVL66	Project management software laboratory	TD: PSB:	0	0	2		03	50	50	100	1
6	AEC/ SDC	22CIV67X	Ability Enhancement Course/ Skill Development Course - III	TD & PSB: Concerned Department	If the course is offered as a Theory: 1	0	0		01	50	50	100	1
					If course is offered as a practical: 0	0	2						
7	MC	22UHK68	National Service Scheme (NSS)	NSS coordinator	0	0	2			100	---	100	0
		22PEK68	Physical Education (PE) (Sports and Athletics)	PED									
		22YOK68	Yoga	Yoga Teacher									
8	IKS	22CIVK69	Indian Knowledge System		1	0	0		01	50	50	100	0
9	MC	22UHV69	Universal Human Values	Any department	1	0	0		01	50	50	100	0
									Total	**500**	**400**	**900**	**16**

GLOBAL ACADEMY OF TECHNOLOGY

(An Autonomous Institute under VTU, Belgaum)

DEPARTMENT OF CIVIL ENGINEERING

SEMESTER – V

Course: Construction Management

Course Code	**22CIV51**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites: -

Course Objectives: Students will be taught:

CLO1	Understand the concept of planning, scheduling, cost and quality control, organization, and use of project information necessary for construction project.
CLO2	Efficient acquisition, utilization, and distribution of finance.
CLO3	Inculcate entrepreneurial vision and will.
CLO4	Keep up ethical conduct and discharge professional duties.

Content	No. of Hours/ RBT levels
Module-1 – Construction Management and Scheduling **Management** - Characteristics of management, functions of management, Importance and purpose of planning process, types of plans. **Construction Project Formulation:** Introduction to construction management, project organization, management functions, management styles. **Construction Planning and Scheduling:** Introduction, types of project plans, work breakdown structure, Grant Chart, preparation of network diagram- event and activity based and its critical path-critical path method, PERT method – Problems. Concept of activity on arrow and activity on node.	**8 Hours L2**
Module 2 - Resource Management **Resource Management:** Basic concepts of resource management, class of lab our, Wages & statutory requirement, Labor Production rate or Productivity, Factors affecting labor output or productivity. **Construction Equipment:** classification of construction equipment, estimation of productivity for- excavator, dozer, compactors, graders and dumpers. Estimation of ownership cost, operational and maintenance cost of construction equipment. Selection of construction equipment and basic concept on equipment maintenance Materials- material management functions, inventory management.	**8 Hours L2, L3**

Module 3- Construction Quality, safety, and Human Values: Construction quality process, inspection, quality control and quality assurance, cost of quality, ISO standards. Introduction to concept of Total Quality Management HSE: Introduction to concepts of HSE as applicable to Construction. Importance of safety in construction, Safety measures to be taken during Excavation, Explosives, drilling and blasting , hot bituminous works , scaffolds / platforms / ladder , form work and equipment operation. Storage of materials. Safety through legislation, safety campaign. Insurances. **Ethics** - Morals, values and ethics, integrity, trustworthiness, work ethics, need of engineering ethics, Professional Duties, Professional and Individual Rights, Confidential and Proprietary Information, Conflict of Interest Confidentiality, Gifts and Bribes, Price Fixing, Whistle Blowing.	**8 Hours L2, L3**
Module 4 – Entrepreneurship **Introduction to Entrepreneurship** – Learn how entrepreneurship has changed the world. Identify six entrepreneurial myths and uncover the true facts. Explore E-cells on Campus. **Listen to Some Success Stories:** - Global legends Understand how ordinary people become successful global entrepreneurs, their journeys, their challenges, and their success stories. Understand how ordinary people from their own countries have become successful entrepreneurs. **Characteristics of a Successful Entrepreneur** Understand the entrepreneurial journey and learn the concept of different entrepreneurial styles. Identify your own entrepreneurship style based on your personality traits, strengths, and weaknesses. Learn about the 5M Model, each of the five entrepreneurial styles in the model, and how they differ from each other. Communicate Effectively: Learn how incorrect assumptions and limiting our opinions about people can negatively impact our communication. Identify the barriers which cause communication breakdown, such as miscommunication and poor listening, and learn how to overcome them. **Business Planning Process:** Business planning process, marketing plan, financial plan, project report and feasibility study, guidelines for preparation of model project report for starting a new venture. Introduction to international entrepreneurship opportunities, entry into international business, exporting, direct foreign investment, venture capital.	**8 Hours L2**
Module 5 – Economy in Construction **Introduction:** Principles of Engineering Economy, Engineering Decision- Makers, Engineering and Economics, Problem solving and Decision making, Intuition and Analysis, Tactics and Strategy. Interest and Interest Factors: Interest rate, Simple interest, Compound interest, Cash- flow diagrams, Exercises and Discussion.	**8 Hours L2, L3**

Comparison of alternatives: Present worth, annual equivalent, capitalized and rate of return methods, Minimum Cost analysis and break-even analysis. **Replacement Analysis:** Replacement studies, replacement due to deterioration, obsolescence, inadequacy, economic life for cyclic replacements, Exercises, Problems. Break- Even Analysis: Basic concepts, Linear Break- Even analysis, Exercises, Problems. **Depreciation:** Causes of Depreciation, Basic methods of computing depreciation charges, Exercises, Problems	

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV51.1	Discuss the importance of management and its approaches.
22CIV51.2	Classify planning and resources required in a construction project.
22CIV51.3	Understand the importance of quality control and safety concept in construction industry.
22CIV51.4	Summarize entrepreneurship types, characteristics, schemes, and policies.
22CIV51.5	Evaluate alternatives to develop capital budget in different scenarios.

Textbooks:

1. P C Tripathi and P N Reddy, "Principles of Management", 6th edition, Tata McGraw-Hill Education, 2017.
2. Poornima M. Charantimath, "Entrepreneurship Development and Small Business Enterprise", 3rd edition, Dorling Kindersley (India) Pvt. Ltd., Licensees of Pearson Education, 2018.
3. Bureau of Indian standards – IS 7272 (Part-1)- 1974: Recommendations for labour output constant for building works
4. Peurifoy R L, "Construction Planning, Equipment and Methods", 7th edition, Mc Graw Hill, 2010.

References:

1. Harold Koontz, Heinz Weihrich, "Essentials of Management: An International, Innovation, and Leadership perspective", 10th edition, T.M.H. Edition, New Delhi, 2012.
2. Frank Harris, Ronald McCaffer with Francis Edum-Fotwe, "Modern Construction Management", 7th edition, Wiley-Blackwell, 2018.

3. Mike Martin, Roland Schinzinger, "Ethics in Engineering", 4th edition, McGraw-Hill. Education, 2004
4. Chris Hendrickson and Tung Au, "Project Management for Construction - Fundamentals Concepts for Owners, Engineers, Architects and Builders", Prentice Hall,Pitsburgh, 1988.

Web Reference:
https://archive.nptel.ac.in/courses/105/104/105104161/

Scheme of Examination:

Semester End Examination (SEE):
SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any five full questions choosing at least one full question from each module.

Continuous Internal Evaluation (CIE):
Three Tests are to be conducted for 30 marks each for integrated and 40 marks for non-integrated subjects. Average of three test marks will be added to test component and laboratory assessment to be finalized for 10 marks for integrated subjects. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs). **Some possible AATs:** seminar / assignments / mini projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses.

Component		Marks	Total Marks
CIE	CIE Test-1	40	**50**
	CIE Test-2	40	
	CIE Test-3	40	
	Average of CIE	**40**	
	Quiz/AAT	05	
	Quiz/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e., A minimum marks of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV51.1						1		1	2	2	3				
22CIV51.2									1	1	1	2			
22CIV51.3											2	1			
22CIV51.4		1				1		1	2	2		2			
22CIV51.5		1	1			1		1	1			1	1		
Average		**1**	**1**			**1**		**1**	**1.5**	**1.67**	**2**	**1.5**	**1**		

SEMESTER – V

Course: Design and Drawing of RCC Elements

Course Code	**22CIV52**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**2:2:2**	**SEE Marks**	**50**
No. of Credits	**4**	**Examination Hours**	**3**

Prerequisites: Strength of Materials, Structural Analysis

Course Objectives: Students will be taught:

CLO1	To describe the concepts of RCC, Materials, Philosophy, and principles of RCC, Design Methods, Load Construction as per relevant codal Provisions (L2)
CLO2	To estimate load on structural elements namely slabs, beams, columns, footing and staircase, analyse to obtain BM & SF and Draw SFD and BMD(L3)
CLO3	To design Various Structural elements and apply checks for safety (L3)
CLO4	To prepare Reinforcement drawings/detailing of structural elements (L3)

Content	**No. of Hours/ RBT levels**
Module-1 **General features of Reinforced Concrete:** Introduction, design loads, materials for reinforced concrete, code requirements of reinforcements, moment of resistance of section, balanced, under reinforced and over reinforced sections. **Principles of Limit State Design:** Philosophy of limit state design, principles of limit states, factor of safety, characteristic and design loads, characteristic and design strength, Analysis of sections for flexure and shear.	**10 Hours L2, L3**
Module 2 **Flexure and serviceability limit states:** General Specification for flexure design of beams-practical requirements, size of beam, and cover to reinforcement spacing of bars. General aspects of Serviceability-Deflection limits in IS: 456 – 2018-Calculation of deflection and crack width. **Design of Beams**: Design procedures of critical sections for moment and shear. Anchorage value, development length, steel requirements, and lateral stability of beam, Design examples for simply supported, Cantilever beams, continuous beams and T-Beam with rectangular sections. **Practice:** Use AUTOCAD for detailed drawings of above designed numerical.	**10 Hours L2, L3**

Module 3 **Design of slabs:** General consideration of design of slabs, (one way and Two-way slab), for various boundary conditions. Design examples of simply supported cantilever and continuous slabs as per code. **Practice:** Use AUTOCAD for detailed drawings of above designed numerical.	**10 Hours** **L2, L3**
Module 4 **Design of columns:** General aspects, effective length, loads, slenderness ratio, Minimum eccentricity. Concept of long and short columns and Design of short columns subjected to axial load, Uniaxial and biaxial bending moment using SP – 16 charts. **Design of footings:** Introduction, load consideration. Design of isolated rectangular footing for axial load, Uniaxial and biaxial moments. **Practice:** Use AUTOCAD for detailed drawings of above designed numerical.	**10 Hours** **L2, L3**
Module 5 **Design of staircases:** Design of staircases with waist slabs (Dog legged and Open well) as per IS code provisions. **Design of Water Tanks:** Design of rectangular water tanks resting on ground. As per IS: 3370. **Practice:** Use AUTOCAD for detailed drawings of above designed numerical.	**10 Hours** **L2, L3**

Learning Assignments (Not for SEE)

Details of Drawing sheets to be prepared and submitted.

i) Longitudinal Section and Cross Section at prominent point (at mid span and support section) with flexure and shear details

1) Beam- Plan, L/S and C/S showing reinforcement details
   - i) Simply Supported beam
   - ii)Continuous beam
   - iii) Cantilever beam
   - iv) T-Beam

2)Slab- Plan, L/S and C/S showing reinforcement details
   - i) One way slab
   - ii)Two-way slab
   - iii) One-way continuous slab

3) Column with Footing- Plan, L/S and showing reinforcement details
   - i) Rectangular or Square Column
   - ii)Circular Column

4)Staircase-Plan, L/S and C/S showing reinforcement details
   - i) Dog legged Staircase
   - ii)Open well Staircase

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV52.1	Describe design philosophies, stress block parameters and limit state criterion
22CIV52.2	Design of RC Beams for Strength and serviceability requirements.
22CIV52.3	Design of RC Slabs for Strength and serviceability requirements under various boundary conditions.
22CIV52.4	Calculate the axial and bending moment to design columns and footings.
22CIV52.5	Design of Footing and water tank as per codal provisions.

Textbooks:

1. Unnikrishnan Pillai and Devdas Menon, " Reinforced Concrete Design" , 3rd edition, McGraw Hill, New Delhi, 2017.
2. Subramanian, " Design of Concrete Structures" , 1st edition, Oxford university Press, 2013.
3. H J Shah, "Reinforced Concrete Vol. 1 (Elementary Reinforced Concrete)", 11th edition, Charotar Publishing House Pvt. Ltd, 2016.

References:

1. P C Varghese, "Limit State design of reinforced concrete", 2nd edition, PHI, New Delhi, 2008.
2. Kong and Evans, "Reinforced and Pre-Stressed Concrete", Springer Publications.
3. A W Beeby and Narayan R S, "Introduction to Design for Civil Engineers", CRC Press
4. Robert Park and Thomas Paulay, "Reinforced Concrete Structures", 1st edition, John Wiley & Sons, Inc, 1975.
5. IS 456-2018 (Reaffirmed 2011, 2016) plain and reinforced concrete -code of practice (Fourth Revision)
6. SP:34(S&T)-1987- Handbook on concrete Reinforcement and Detailing
7. SP16:1980, Design Aids for Reinforced Concrete to IS: 456-1978, Bureau of Indian Standards, New Delhi, 1992

Web Reference:

NPTEL Course: https://onlinecourses.nptel.ac.in/noc18_ce24/preview

Introduction to Design of RCC Elements	https://youtu.be/pIdaC_I6H_M
Design of Beams	https://youtu.be/zVKf6hZfrhA https://youtu.be/DjT5G6Klf1M

	https://youtu.be/0fTvE8aSsiE https://youtu.be/JwiHgkC-6Ic https://youtu.be/WaAWYM6HDWs
Design for Torsion	https://youtu.be/AyRgeA65oI0 https://youtu.be/aTGeCoGkh3M
Design for shear	https://youtu.be/AfHmpWlcqq4
Design of Slabs	https://youtu.be/PDJPcQq3PZE
Design of Columns	https://youtu.be/wJWt0dcgafs
Design of Footings	https://youtu.be/8ATp13mOhvg
Design of Staircases	https://youtu.be/hxakW1miEcM

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any five full questions choosing at least one full question from each module.

The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE on a scale of 30, the CIE would also include laboratory evaluation for 20 marks. The laboratory marks of 20 would comprise of 10 marks for regular laboratory assessment to include lab record and observation. 10 marks would be exclusive for laboratory internal assessment test to be conducted at the end of the semester**.**

Typical Evaluation pattern for integrated courses is shown in the Table below.

Table 1: Distribution of weightage for CIE & SEE of Regular courses:

Component		Marks	Total Marks
CIE	CIE Test-1	30	**50**
	CIE Test-2	30	
	CIE Test-3	30	
	Laboratory	20	
SEE	Semester End Examination	100	50
Grand Total			100

Eligibility requirements: Students to secure a minimum of 40% of the marks in both the CIE for theory and lab courses (i.e. A minimum marks of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV52.1	3	3			2									3	
22CIV52.2	3	3			2							1		3	
22CIV52.3	3	3			2							1		3	
22CIV52.4	3	3			2							1		3	
22CIV52.5	3	3			2							1		3	
Average	**3**	**3**			**2**							1		**3**	

SEMESTER – V

Course: Basic Geotechnical Engineering

Course Code	**22CIV53**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:2**	**SEE Marks**	**50**
No. of Credits	**4**	**Examination Hours**	**3**

Prerequisites:

Course Objectives: Students will be taught:

CLO1	To understand the importance of soil and its properties in Civil Engineering applications
CLO2	To understand the Index properties and engineering properties of different soils and Soil Structure
CLO3	To understand the geotechnical engineering problems - flow of water through soil medium and terminologies associated with geotechnical engineering.
CLO4	To understand the improvement in mechanical behavior by densification of soil deposits using compaction and Measure consolidation and shear strength properties
CLO5	To conduct experiments and determine Index and engineering properties of soil

Content	**No. of Hours/ RBT levels**
Module-1 **Introduction:** Origin and formation of soil, regional soil deposits in India, Phase Diagram, phase relationships, definitions, and their interrelationships. Determination of Index properties: Specific gravity, water content, in-situ density, relative density, particle size analysis (sieve and Hydrometer analysis) Atterberg's Limits, consistency indices. Activity of clay, Field identification tests.	**10 Hours L2, L3**
Module 2 **Soil Structure and Clay Mineralogy** Single grained, honey combed, flocculent and dispersed structures, Valence bonds, Soil-Water system, Electrical diffuse double layer, adsorbed water, base-exchange capacity, Isomorphous substitution. Common clay minerals in soil and their structures- Kaolinite, Illite and Montmorillonite and their application in Engineering. BIS soil classification (IS: 1498-1970), Unified classification, Plasticity chart.	**10 Hours L2, L3**

Module 3 **Permeability:** Darcy‟s law- assumption, coefficient of permeability and its determination in laboratory, factors affecting permeability, permeability of stratified soils, Seepage velocity, Superficial velocity and coefficient of percolation Effective Stress Geostatic stresses, Effective stress concept-total stress, effective stress and Neutral stress and impact of the effective stress in construction of structures, quick sand phenomena.	**10 Hours L2, L3**
Module 4 **Compaction:** Principle of compaction, Standard and Modified proctor's compaction tests, factors affecting compaction, effect of compaction on soil properties. **Consolidation:** Definition, Mass-spring analogy, Terzaghi's one dimensional consolidation theory-assumption, Consolidation characteristics of soil (Cc, av, mv and Cv). Laboratory one dimensional consolidation test, characteristics of e-log (σ') curve, Pre-consolidation pressure and its determination by Casagrande's method. Over consolidation ratio.	**10 Hours L2, L3**
Module 5 **Shear Strength of Soil:** Concept of shear strength, Mohr–Coulomb Failure Criterion, Modified Mohr–Coulomb Criterion Total and effective shear strength parameters, factors affecting shear strength of soils. Thixotropy and sensitivity, Measurement of shear strength parameters - Direct shear test, unconfined compression test, triaxial compression test and field Vane shear test, Test under different drainage conditions.	**10 Hours L2, L3**

Geotechnical Engineering Laboratory

Content	Content No. of Hours/ RBT levels
1. Specific gravity test i. Pycnometer ii. Density bottle method	**2 Hours L2, L3**
2.Water content determination i. Oven drying. ii. Pycnometer method. iii. Rapid moisture meter method.	**2 Hours L2, L3**
3. Grain size analysis i. Sieve analysis ii. Hydro meter analysis	**2 Hours L2, L3**

4. In-situ density tests i. Core-cutter method ii. Sand replacement method	**2 Hours** **L2, L3**
5. Consistency limits i. Liquid limit test (by Casagrande's and cone penetration method) ii. Plastic limit test iii. Shrinkage limit test	**2 Hours** **L2, L3**
6.Compaction test i. Light compaction ii. Heavy compaction	**2 Hours** **L2, L3**
7. Co-efficient of permeability test Constant head test Variable head test	**2 Hours** **L2, L3**
8. Shear strength tests (undrained conditions) i. Unconfined compression test ii. Direct shear test iii. Triaxial test (unconsolidated undrained test only **iv.** Laboratory vane shear test	**2 Hours** **L2, L3**
9. Consolidation test: To determine pre consolidation pressure only (half an hour per loading-test)	**2 Hours** **L2, L3**
10. Demonstration Experiments: Field identification of soil, Hydrometer analysis, Rapid moisture meter method, Swell pressure test, Standard penetration test and boring equipment	**2 Hours** **L2, L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV53.1	Describe the properties, inter relationships of soil and classify based on its index properties
22CIV53.2	Explain the concepts of clay mineralogy and soil structures and their applications
22CIV53.3	Explain the concepts of permeability, seepage flow of soil, effective stress based on assumptions and validity of Darcy's law
22CIV53.4	Determine the characteristics of compaction and consolidation of soil by principle of compressibility.
22CIV53.5	Apply the Mohr-Coulomb failure concepts to determine the shear strength parameters from various laboratory shear tests under different drainage conditions
22CIV53.6	Conduct experiments and determine Index, engineering properties of soil

Textbooks:

1. Braja, M. Das, "Principles of Geotechnical Engineering" 9th Edition, Cengage India Private Limited, New Delhi, 2017
2. Gopal Ranjan and Rao A.S.R., "Basic and Applied Soil Mechanics", 4th Edition, New Age International Pvt Ltd., New Delhi,2022
3. Punmia B C, "Soil Mechanics and Foundation Engineering", 17th Edition, Laxmi Publications, New Delhi, 2021

References:

1. Murthy V.N.S.," Principles of Soil Mechanics and Foundation Engineering", CBS Publishers and Distributors, New Delhi, 2018
2. C. Venkatramaiah., Geotechnical Engineering", 6th Edition, New Age International, New Delhi,2018

Web Reference:

https://nptel.ac.in/courses/105101201
https://nptel.ac.in/courses/105105168

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE on a scale of 30, the CIE would also include laboratory evaluation for 20 marks. The laboratory marks of 20 would comprise of 10 marks for regular laboratory assessment to include lab record and observation. 10 marks would be exclusive for laboratory internal assessment test to be conducted at the end of the semester**.**

Typical Evaluation pattern for integrated courses is shown in the Table below.

Table 1: Distribution of weightage for CIE & SEE of Regular courses:

Component		Marks	Total Marks
CIE	CIE Test-1	30	**50**
	CIE Test-2	30	
	CIE Test-3	30	
	Laboratory	**20**	
SEE	**Semester End Examination**	**100**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e. A minimum marks of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV53.1	3	2	2	1										2	
22CIV53.2	3	2	2	1										2	
22CIV53.3	3	2	2	1										2	
22CIV53.4	3	2	2	1										2	
22CIV53.5	3	2	2	1										2	
22CIV53.6	3	2	2	1										2	
Average	3	2	2	1										2	

SEMESTER – V

Course: Green Audit Laboratory

Course Code	**22CIVL54**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**0:0:2**	**SEE Marks**	**50**
No. of Credits	**1**	**Examination Hours**	**3**

Course Objectives: Students will be taught:

CLO1	To understand the Green building and carbon rating concepts
CLO2	To calculate energy consumption of individual components in a building
CLO3	To understand global Green building Certifications mechanisms
CLO4	To understand Rating of buildings as per various national and international standards

Sl. No.	**Experiments**	**No. of Hours/ RBT levels**
1	Green Building Components & Carbon Rating concept	2 (L2)
2	Various Green building Certifications	2 (L2)
3	Introduction & Components - GRIHA	2 (L2)
4	Calculations - GRIHA	4 (L3)
5	Introduction & Components - LEED	2 (L2)
6	Calculations - LEED	4 (L3)
7	Introduction & Components - IGBC	2 (L2)
8	Calculations - IGBC	4 (L3)
9	Calculations of the Green buildings – Commercial - Case Study 1	4 (L3)
10	Calculations of the Green buildings – Non-commercial - Case Study 2	4 (L3)
11	Computation of carbon foot print using REVIT	4 (L3)
12	Case Study Presentation – 1	3 (L3)
13	Case Study Presentation – 2	3 (L3)

Course Outcomes: Upon successful completion of this course, student will be able to:

22CIVL54.1	Understand green building and carbon rating concepts
22CIVL54.2	Calculate energy of individual components of a building

22CIVL54.3	Analyze various Green building Certifications mechanisms
22CIVL54.4	Rate a building based on LEED, GRIHA and IGBC Guidelines

References:

1. IGBC Manual
2. LEED Manual
3. GRIHA User Manual

Scheme of Examination:

Semester End Examination (SEE):

Presentation of commercial and non-commercial green building audit

Continuous Internal Evaluation (CIE):

CIE will be conducted for 50 Marks. This will include reports and one practical test.

CO/PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIVL54.1	3	-	1	-	-	2	2	-	-	-	-	-	-	-	3
22CIVL54.2	3	2	1	-	-	2	2	-	-	-	-	-	2	-	3
22CIVL54.3	3	2	1	-	-	2	2	-	2	1	-	-	2	1	3
22CIVL54.4	3	2	1	-	-	2	2	-	2	1	-	2	2	1	3
Average	3	2	1	-	-	2	2	-	2	1	-	2	2	1	3

SEMESTER – V

Course: Advanced Mechanics of solids

Course Code	**22CIV55A**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites: Engineering Mechanics, Mechanics of solids, Structural Analysis

Course Objectives: Students will be taught:

CLO1	To develop differential equations for beams on elastic foundation
CLO2	To construct differential equations for beam-column for different loads with various end conditions
CLO3	To determine the buckling load for prismatic and non-prismatic columns
CLO4	To find stresses, deflections and shear center in symmetric and unsymmetrical sections.
CLO5	To compute buckling load on plates using energy and finite difference method

Content	**No. of Hours/ RBT levels**
Module-1 **Beams on elastic foundations:** Differential equations of elastic line interpretation of constants of integration, infinite beam with concentrated load, moment and UDL and problems related to infinite beams. Semi-infinite beams with concentrated load, moment and UDL, semi-infinite beam with fixed and hinged conditions, problems on semi-infinite beams.	**8 Hours L3**
Module 2 **Beam-Column:** Governing differential equation for axial and lateral loads, analysis of beam columns subjected to axial and concentrated loads, axial and UDL, beam column with different end conditions.	**8 Hours L3**
Module 3 **Buckling of Columns:** Assumptions, Euler's theory of buckling governing differential equation, prismatic columns with different end conditions, obtaining the characteristic equation for the critical load for non- prismatic columns, buckling of frames.	**8 Hours L3**
Module 4	**8 Hours L3**

Unsymmetrical bending of beams: Introduction, stresses in beams, deflections of beams subjected to unsymmetrical bending, problems related to unsymmetrical bending. **Shear Centre:** introduction, shear center for symmetrical and unsymmetrical sections, problems related to shear center.	
Module 5 **Buckling of plates** – Differential equation of plate buckling – critical load on plates for various boundary conditions – Energy method – Finite difference method.	**8 Hours** **L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV55A.1	**Construct** differential equations for beams on elastic foundation
22CIV55A.2	**Construct** differential equations for beam-column for different loads with various end conditions
22CIV55A.3	**Calculate** the critical load for prismatic and non-prismatic columns
22CIV55A.4	**Compute** stresses, deflections, and shear center in symmetric and unsymmetrical sections.
22CIV55A.5	**Determine** buckling load on plates using energy and finite difference method

Textbooks:

1. Ashwini Kumar, "Stability Theory of Structures", Allied publishers Ltd., New Delhi, 2003.
2. Gambhir, "Stability Analysis and Design of Structures", 1st edition, springer, New York, 2004.
3. N. Krishna Raju, and D.R. Guru raja, "Advanced Mechanics of solids and structures", Narosa Publishing House, New Delhi,1997.
4. Timoshenko.S.P, and Gere.J.M, "Theory of Elastic Stability", McGraw Hill Book Company,1963

References:

1. Boresi A.P., and Sidebottom O.M, "Advanced Mechanics of Materials", John Wiley and Sons in N.Y, 1985.
2. Simitser.G.J and Hodges D.H, "Fundamentals of Structural Stability", Elsevier Ltd., 2006.
3. Chajes, A. "Principles of Structures Stability Theory", Prentice Hall, 1974.

Web Reference:

https://onlinecourses.nptel.ac.in/noc22_ce91/preview

Scheme of Examination:

Semester End Examination (SEE):
SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any five full questions choosing at least one full question from each module.

Continuous Internal Evaluation (CIE):
Three Tests are to be conducted for 40 marks each. Average of three test marks will be added to test component and laboratory assessment to be finalized for 10 marks for integrated subjects. CIE is executed by way of two quizzes/Alternate Assessment Tools (AAT's). some possible AAT's: Seminar/ assignments/ mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.
Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	**50**
	CIE Test-2	40	
	CIE Test-3	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 1/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e. A minimum marks of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV55A.1	3	2	-	-	-	-	-	-	-	-	-	1	1	-	-
22CIV55A.2	3	3	1	-	-	-	-	-	-	-	-	1	1	-	-
22CIV55A.3	2	3	2	-	-	-	-	-	-	-	-	1	1	-	-
22CIV55A.4	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-
22CIV55A.5	2	2	1	-	-	-	-	-	-	-	-	1	1	-	-
Average	**2.4**	**2.4**	**1.25**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**-**

SEMESTER – V

Course: Environmental Impact Assessment

Course Code	**22CIV55B**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites: Environmental Engineering

Course Objectives: Students will be taught:

CLO1	To study the importance of Environmental Impact Assessment
CLO2	To know the role of public in Environmental Impact Assessment studies
CLO3	To Understand phenomena of impacts in the environment
CLO4	To Know the impact quantification of various projects on the environment

Content	No. of Hours/ RBT levels
Module 1 **Environmental Impact Assessment:** Introduction, definition of EIA, need for EIA, EIS, FONSI, REIA, CEIA, Utility of EIA, Scope of EIA, Step-by-step procedure for conducting EIA, limitations of EIA, Framework of EIA, EIA guidelines for developmental projects.	**8 Hours L2**
Module 2 **Developmental Projects:** Description of affected environment with factors and indices, methodologies of EIA – Ad hoc method, Checklist method, Matrices method, Network method and Overlay method. EIA guidelines for Development Projects	**8 Hours L2**
Module 3 **Assessment and Prediction of Impacts on Attributes:** Air, Water, Noise, Land Ecology, Soil, Cultural and Socio-economic Environment. Public Participation in Environmental Decision making.	**8 Hours L2**
Module 4 **Salient Features of the Project Activity:** Environmental Parameter Activity Relationships- Matrices. Practical Considerations in preparing Environmental Impact Assessment and Statements.	**8 Hours L2**
Module 5 **EIA for Projects:** Water resource developmental projects, Highway projects:	

Nuclear Power plant projects, Mining project (Coal, Iron ore), Thermal Power Plant, Infrastructure Construction Activities.	**8 Hours L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV55B.1	Describe the fundamental concepts of Environmental Impact Assessment.
22CIV55B.2	Identify various attributes and methods of Environmental Impact Assessment.
22CIV55B.3	Apply prediction and assessment methods to Environmental Impact Assessment of air, water, land and noise environment.
22CIV55B.4	Understand the Environmental Parameter Activity Relationships in preparing EIA and Settlement.
22CIV55B.5	Apply suitable method of EIA for developmental projects.

Textbooks:

1. Jain, R.K., Urban, L.V., Stracy, G.S., "Environmental Impact Analysis", Van Nostrand Reinhold Co., New York, 1991.
2. Rau, J.G. and Wooten, D.C., "Environmental Impact Assessment", McGraw Hill Pub. Co., New York, 1996.

References:

1. Guidelines for EIA of developmental Projects Ministry of Environment and Forests, GOI.
2. Larry W. Canter, "Environment Impact Assessment", McGraw Hill Publication, 2014.
3. "Environmental pollution & Control in Chemical process Industries by S.C. Bhatia "Khanna Publishers", Delhi

Web Reference:

http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv104-Page1.htm

nptel.ac.in/courses/105101084/https://ay14-15

moodle.wisc.edu/prod/course/view.php?id=499

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any five full questions choosing at least one full question from each module.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. Average of three test marks will be added to test component and laboratory assessment to be finalized for 10 marks for integrated subjects. CIE is executed by way of two quizzes/Alternate Assessment Tools (AAT's). some possible AAT's: Seminar/ assignments/ mini projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	**50**
	CIE Test-2	40	
	CIE Test-3	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 1/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e. A minimum marks of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV55B.1	1	1	2							1		1			
22CIV55B.2	1	1	2							1		1			
22CIV55B.3	1	1	2							1		1			
22CIV55B.4	1	1	2							1		1			
22CIV55B.5	1	1	2							1		1			
Average	1	1	2							1		1			

SEMESTER – V

Course: Groundwater Hydrology

Course Code	**22CIV55C**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites: Hydrology and Water Supply Engineering

Course Objectives: Students will be taught to:

CLO1	Understand the water-bearing strata and determine the aquifer parameters.
CLO2	Study of Ground Water flow phenomenon in steady & unsteady strata
CLO3	Apply Geophysics for the determination of Ground Water Resources.
CLO4	Understanding the subsurface groundwater modeling.

Content	No. of Hours/ RBT levels
Module-1 Vertical distribution of subsurface water. Types of water-bearing formation. Aquifer and its types. Aquifer parameters, specific yield, specific retention, porosity, storage coefficient, land subsidence due to withdrawal of groundwater, Groundwater movement - Darcy's law, intrinsic permeability, Hydraulic conductivity, Transmissivity, permeability determination	**08 Hours L1, L2**
Module 2 Well Hydraulics. Steady unidirectional flows in confined aquifers, unconfined aquifers- Dupit's equation, Baseflow to a stream, Steady Radial flow to well – Confined aquifer, unconfined aquifer with uniform recharge. Unsteady radial flow in a confined aquifer – non-equilibrium pumping equation, Theis method, Cooper-Jacob method and Chow method, unsteady radial flow in an unconfined aquifer, Image well theory	**08 Hours L2**
Module 3 Groundwater prospecting. –Remote Sensing methods, geophysical investigation: Electrical Resistivity method, Seismic refraction method, Ground-penetrating Radar. Well design- design of diameter, depth, spacing, and casing. Well losses. Groundwater modelling: Finite difference and finite element models, Applications	**08 Hours L2**

of groundwater models. Regional groundwater flow modelling.	
Module 4 Groundwater contamination and remediation: Sources Attenuation of pollution (Filtration, Sorption, Dilution) Mass transport of pollution - Fick's law. Advection-Dispersion equation in Saturated porous media. Monitoring of groundwater quality and methods of remediation. Saline Water Intrusion in Aquifers: Ghyben-Herzberg relation between fresh & saline waters, shape & structure of the fresh & saline water interface, upcoming of saline water, saline water intrusion control.	**08 Hours L2**
Module 5 Groundwater management – Concept of basin management, Conjunctive use of surface water and groundwater, Groundwater management techniques. Managed aquifer recharge – Objectives, purpose, and methods. Groundwater provinces and resources of India. Impacts of climate change on groundwater – Hydrological components affecting the groundwater, direct and indirect impacts of climate change on groundwater. Climate change impacts on the water availability in an aquifer.	**08 Hours L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV55C.1	Describe the concepts of the groundwater flow phenomenon.
22CIV55C.2	Understand the different flow conditions and problems associated with groundwater pollution.
22CIV55C.3	Understanding the subsurface using geophysical techniques.
22CIV55C.4	Apply the concepts and techniques necessary to determine aquifer parameters.
22CIV55C.5	Analyze the various aspects of groundwater assessment, development, and management

Textbooks:

1. Todd, D. and Mays, L. "Groundwater Hydrology" 3rd Edition, John Wiley and Sons, Inc., Hoboken, 2005.
2. K. R. Karanth, "Hydrogeology", Tata McGraw Hill Publishing Company, 2017.
3. Fetter, C W., Applied Hydrogeology, 2nd edition, CBS Publishers and Distributors,2007.

References:

1. Freeze and Cherry, "Ground Water", Pearson Publications, 1979.

2. Raghunath H.M., "Ground Water Hydrology", Wiley Eastern Ltd., Second reprint, 2000.
3. Bear J., "Hydraulics of Groundwater", Vol 5, McGraw-Hill International, 1979.
4. Willis, R. and W.W.G. Yeh, "Groundwater Systems Planning and Management", Prentice-Hall, 1987.
5. S.P. Garg, "Groundwater and Tube Wells", Oxford & IBH Publishing Co., 1993

Web Reference:
https://archive.nptel.ac.in/courses/105/101/105101214/

Scheme of Examination:

Semester End Examination (SEE):
SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any five full questions choosing at least one full question from each module.

Continuous Internal Evaluation (CIE):
Three Tests are to be conducted for 30 marks each for integrated and 40 marks for non-integrated subjects. Average of three test marks will be added to test component and laboratory assessment to be finalized for 10 marks for integrated subjects. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs). **Some possible AATs:** seminar / assignments / mini projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses.

Component		Marks	Total Marks
CIE	CIE Test-1	40	**50**
	CIE Test-2	40	
	CIE Test-3	40	
	Average of CIE	**40**	
	Quiz/AAT	05	
	Quiz/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e., A minimum marks of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV55C.1	2	3				2	2						1		
22CIV55C.2	2	2				1							1		
22CIV55C.3	2					2	2						1		
22CIV55C.4	2					2			2				1		
22CIV55C.5	2	2				2			2				1		
Average	2	2.7				1.8	2		2				1		

SEMESTER – V

Course: Modern Construction Materials and Technology

Course Code	**22CIV55D**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites: Concrete Technology, Building material planning and drawing

Course Objectives: Students will be taught to:

CLO1	To understand Various equipment's and fundamentals for earth work operation
CLO2	To understand The concept of shuttering and bar bending
CLO3	To understand equipment's used for shoring and soil stabilization
CLO4	To understand Methods to improve acoustics and thermal insulation in a building

Content	No. of Hours/ RBT levels
Module-1 **Thermal insulation**- Types of materials, Heat transfer and basic definition, methods of thermal insulations for roof, exposed walls, doors and windows in building construction. **Acoustics**- Types of materials for improvement of acoustics in building construction, audible sound, behaviour of sound, reflection of sound, reverberation and absorption, sound insulation and acoustic design of hall.	**8 Hours L1, L2**
Module 2 **Smart Materials**: concept and types, sensing technology-types of sensors -physical measurement using piezoelectric strain measurement, piezoelectric and electro strictive material - magneto structure material, shape memory alloys, electro rheological fluids	**8 Hours L2, L3**
Module 3 **Shuttering and bar bending:** Scaffolding & formwork - Definitions of common technical terms used in Scaffolding, formwork. Types & applications Different materials used in formwork. Methods and tools used for formwork. Safety precautions to be observed in scaffolding and formwork Defects in formwork Shuttering /removal of formwork. Maintenance & repair of formwork Type of rebar, size of rebar, cover to reinforcement, spacing, Insertion and fixing	**8 Hours L2, L3**

sequence for different types of R.C.C structures (Slab, Beam, Column, Footing, Wall, Staircase), Computation of cutting length of rebars,	
Module 4 **Equipment's:** Dozers, Scrapers, Excavators, Finishing equipment's, Trucks, Forklifts and related equipment - Portable Material Bins – Conveyors – Hauling Equipment. Fundamentals of Earth Work Operations - Earth Moving Operations - Types of Earth Work Equipment - Tractors, Motor Graders, Scrapers, Front end Waders, Earth Movers.	**8 Hours L2, L3**
Module 5 **Soil stabilization technique:** Geotechnical materials, Compaction and stabilization, Machine power, Equipment for Dredging, Trenching, Tunneling, Drilling, Blasting - Equipment for Compaction - Erection Equipment - Types of pumps used in Construction - Equipment for Dewatering and Grouting – Foundation and Pile Driving Equipment – Equipment for Demolition	**8 Hours L2, L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV55D.1	Understand the need for acoustics and thermal insulation in a building.
22CIV55D.2	Explain the concepts and types of Smart materials used in civil engineering.
22CIV55D.3	Recognize various methods and materials used for shuttering and bar bending.
22CIV55D.4	Understand fundamentals and Various equipment's used for Earth work operations
22CIV55D.5	Describe various equipment's used for shoring and soil stabilization

Textbooks:

1. Shan Somayaji, "Civil Engineering Materials", 2nd Edition, Prentice Hall Inc., 2001
2. Santhakumar A.R., "Concrete Technology", Oxford University Press, New Delhi. 2007
3. Dr. B. C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, "Building Construction", 11th edition, Laxmi Publications (P) ltd., New Delhi, 2016.

References:

1. S. K. Duggal, "Building Materials", (Fourth Edition) New Age International (P) Limited, 2016
2. P C Vergese, "Building Materials", PHI Learning Pvt.Ltd Building Materials and Components, CBRI, 1990
3. Ranga Wala S. C. "Engineering Materials", Charter Publishing House, Anand, India.

Web Reference:

https://nptel.ac.in/courses/105102088

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any five full questions choosing at least one full question from each module**.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 30 marks each for integrated and 40 marks for non integrated subjects. Average of three test marks will be added to test component and laboratory assessment to be finalized for 10 marks for integrated subjects. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs). **Some possible AATs:** seminar / assignments / mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	**50**
	CIE Test-2	40	
	CIE Test-3	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 2/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e. A minimum marks of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV55D.1	3					1		1				2			
22CIV55D.2	3					1		1				2			
22CIV55D.3	3					1		1				2			
22CIV55D.4	3					1		1				2			
22CIV55D.5	3					1		1				2			
Average	3					1		1				2			

SEMESTER – V

Course: Hydrology and Irrigation Engineering

Course Code	**22CIV55E**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**2:2:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites:

Course Objectives: Students will be taught:

CLO1	To understand the concept of hydrology and components of hydrologic cycle.
CLO2	To quantify runoff and apply unit hydrograph methods for hydrological applications.
CLO3	To understand different methods of irrigation, methods of application of water and irrigation procedure.
CLO4	To design canals and canal network based on the water requirement of various crops
CLO5	To determine the reservoir capacity

Content	**No. of Hours/ RBT levels**
Module-1 **Hydrology:** Introduction, Importance of hydrology, Global distribution of water and Indian water availability, Practical application of hydrology, Hydrologic cycle (Horton's) qualitative and engineering representation. **Precipitation:** Definition, Forms and types of precipitation, measurement of rain fall using Symon's and Syphon type of rain gauges, optimum number of rain gauge stations, consistency of rainfall data (double mass curve method), computation of mean rainfall, estimation of missing data, presentation of precipitation data, moving average curve, mass curve, rainfall hyetographs. **Case history –** Modern techniques for measurement of precipitation.	**8 Hours L2**
Module 2 **Losses: Evaporation:** Introduction, Process, factors affecting evaporation, measurement using IS class-A Pan, estimation using empirical formulae (Meyer's and Rohwer's equations) Reservoir evaporation and control. **Evapotranspiration:** Introduction, Consumptive use, AET, PET, Factors affecting, Measurement, Estimation by Blaney-Criddle equation. **Infiltration:** Introduction, factors affecting infiltration capacity, measurement by double ring infiltrometer, Horton's infiltration equation, infiltration indices.	**8 Hours L3**

Case history – Modern techniques used for the measurement and monitoring of losses.	
Module 3 **Runoff:** Definition, the concept of the catchment, factors affecting runoff, rainfall-runoff relationship using regression analysis. **Hydrographs:** Definition, components of the hydrograph, base flow separation, unit hydrograph, assumption, application and limitations, derivation from simple storm hydrographs, S curve and its computations, Conversion of UH of different durations. Case history – Measurement of runoff in urban and rural areas.	**8 Hours L3**
Module 4: **Irrigation:** Definition. Benefits and ill effects of irrigation. System of irrigation: surface and groundwater, flow irrigation, lift irrigation, Bandhara irrigation. **Case history:** Irrigation practice in India **Water Requirements of Crops:** Duty, delta and base period, the relationship between them, actors affecting duty of water crops and crop seasons in India, irrigation efficiency, frequency of irrigation.	**8 Hours L3**
Module 5: **Canals:** Types of canals. Alignment of canals. Definition of gross command area, cultural command area, the intensity of irrigation, time factor, crop factor. Unlined and lined canals. Standard sections. Design of canals by Lacey's and Kennedy's method. **Reservoirs:** Definition, investigation for reservoir site, storage zones determination of storage capacity using mass curves, the economical height of the dam.	**8 Hours L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV55E.1	Understand the importance of hydrology and its components.
22CIV55E.2	Measure precipitation and analyze the data and losses in precipitation
22CIV55E.3	Estimate runoff and develop unit hydrographs.
22CIV55E.4	Estimate the benefits and ill-effects of irrigation and the water requirement of crops.
22CIV55E.5	Design canal and estimate the canal and reservoir capacity.

Textbooks:

1. K. C. Patra "Hydrology And Water Resources Engineering" 2nd Edition, Alpha Science International Ltd Publisher, 2008.
2. Subramanya, K. (2013). Engineering Hydrology, 4th Edition, Tata McGraw Hill Education (India) Pvt. Ltd., New Delhi, India, 2017.
3. Jayarami Reddy, "A Text Book of Hydrology", 3rd edition, Lakshmi Publications, New Delhi, 2016.

References:

1. Punmia and LalPandey, "Irrigation and Water Power Engineering", 16th edition, Lakshmi Publications, New Delhi, 2009.
2. Sharma R.K., "Irrigation Engineering and Hydraulics", Oxford & IBH Publishing Co., New Delhi.
3. Modi P.N, "Water Resources and Water Power Engineering", 11th edition, Standard book house, Delhi, 2019.
4. Garg S.K, "Irrigation Engineering and Hydraulic Structures", 38th edition, Khanna publications, New Delhi, 1976.

Web Reference:

https://onlinecourses.nptel.ac.in/noc22_ce19/preview#:~:text=Sreeja%20Pekkat,-IIT%20Guwahati&text

Scheme of Examination:

Semester End Examination (SEE):
SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any five full questions choosing at least one full question from each module.

Continuous Internal Evaluation (CIE):
Three Tests are to be conducted for 40 marks each. Average of three test marks will be added to test component and loboratory assessment to be finalized for 10 marks for integrated subjects. CIE is executed by way of two quizzes/Alternate Assessment Tools(AAT's). some possible AAT's: Seminar/ assignments/ mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	**50**
	CIE Test-2	40	
	CIE Test-3	40	
	Average of CIE	**40**	
	Quiz 1/AAT	**05**	
	Quiz 2/AAT	**05**	
SEE	**Semester End Examination**	**100**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e. A minimum marks of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV55E.1	3	2	1												
22CIV55E.2	3	2	1	1									2		
22CIV55E.3	3	2											1		
22CIV55E.4	3	2		1			1						1		
22CIV55E.5	3	2		1			1						1		
Average	3	2	1	1			1						1.25		

SEMESTER – V

Course: Mini Project/ Extensive Survey

Course Code	**22CIVP56**	**CIE Marks**	**100**
Hours/Week (L: T: P)	**0:0:4**	**SEE Marks**	**-**
No. of Credits	**2**	**Examination Hours**	**-**

Prerequisites: Engineering Survey, Building Materials, Hydraulics, Environmental Engineering, Highway Engineering.

Course Objectives: Students will be taught:

CLO1	Understand the practical applications of Survey and survey tools for civil engineering projects.
CLO2	Evaluation and interpretation of field data to develop solution to meet societal needs
CLO3	Work in teams and learn time management, communication, and presentation skills

Content	**No. of Hours/ RBT levels**
NEW TANK PROJECT The work shall consist of: a. Reconnaissance survey for selection of site and conceptualization of project. b. Alignment of centerline of the proposed bund, Longitudinal and cross-sections of the centerline. c. Detailed survey required for project execution like Capacity surveys, Details at Waste weir and sluice points, Canal alignment etc. as per requirement. d. Design and preparation of drawing with report. e. Design to raise the bund height and to increase the capacity of an existing old tank.	**8 Hours L3**
WATER SUPPLY AND SANITARY PROJECT The work shall consist of. a. Reconnaissance survey for selection of site and conceptualization of project. b. Examination of sources of water supply, Calculation of quantity of water required based on existing and projected population. c. Preparation of village map by using total station. d. Survey work required for laying of water supply and UGD. e. Location of sites for water tank. Selection of type of water tank to be provided. (Ground level, overhead and underground)	**8 Hours L3**

f. Design of all elements and preparation of drawing with report.	
HIGHWAY PROJECT: The work shall consist of. a. Reconnaissance survey for selection of site and conceptualization of project. b. Preliminary and detailed investigations to align a new road (min. 1 to 1.5 km stretch) between two obligatory points. The investigations shall consist of topographic surveying of strip of land for considering alternate routes and for final alignment. Surveying by using total station. c. Report should justify the selected alignment with details of all geometric designs for traffic and design speed assumed. d. Drawing shall include key plan initial alignment, final alignment, longitudinal section along final alignment, typical cross sections of road.	**8 Hours L3**
TOWN/HOUSING / LAYOUT PLANNING: The work shall consist of. a. Reconnaissance survey for selection of site and conceptualization of project. b. Detailed survey required for project execution like contour surveys. c. Preparation of layout plans as per regulations. d. Design of all elements and preparation of drawing with report as per regulations.	**8 Hours L3**
CENTRE LINE MARKING: The work shall consist of: a. Plan a commercial building of G+4 story. b. Centerline marking transfer of centerlines from plan to ground using total station. c. Drawings shall include blueprint of the commercial building. d. Developing plan from the measurements of an existing building.	**8 Hours L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIVP56.1	Understand the type of survey to be carried out for different civil works.
22CIVP56.2	Use appropriate surveying equipment to carry out required survey work.
22CIVP56.3	Analyze the field data and prepare necessary drawings.
22CIVP56.4	Design the components of required civil engineering work based on procured data and drawings.
22CIVP56.5	Compute the bills of quantities for various survey work as per the designs.

Note: To be conducted between 4th & 5th Semester for a period of 2 weeks including training on total station.

Use of Total Station is compulsory for minimum of TWO projects.

- The student shall submit a project report consisting of designs and drawings.
- Drawings should be done using CAD and survey work using total station.
- Students should learn data download from total station, generation of contours, block levelling, longitudinal and cross-sectional diagrams, and capacity volume calculation by using relevant software.
- The course coordinators should give exposure and simulate activities to achieve the course outcomes.

References:

1. Training Manuals and User Manuals

Web Reference:

https://www.youtube.com/watch?v=wQBWh75lG1E&t=487s

Scheme of Examination:

Semester End Examination (SEE):

- Viva voce conducted along with 5th semester exams.
- An extensive project preparation training involving investigation, collection of data is to be conducted.

Continuous Internal Evaluation (CIE):

- Presentation on all the projects.

Component		Marks	Total Marks
CIE	Presentation	**50**	**50**
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e., A minimum marks of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIVP56.1	3	3	3	2	3	2	2	1	2	1	1	1	1	1	1
22CIVP56.2	3	3	3	2	3	2	2	1	2	1	1	1	1	1	1
22CIVP56.3	3	3	3	2	3	2	2	1	2	1	1	1	1	1	1
22CIVP56.4	3	3	3	2	3	2	2	1	2	1	1	1	1	1	1
22CIVP56.5	3	3	3	2	3	2	2	1	2	1	1	1	1	1	1
Average	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**1**

SEMESTER – V

Course: Research Methodology and IPR

Course Code	**22RMIK57**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**2:2:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

Course Objectives:

CLO1	To make the student understand the foundations of Research and problem solution
CLO2	Knowledge in Research design, Qualitative and Quantitative Research
CLO3	Knowledge to formulate and derive static and dynamic aero elastic equations of motion.
CLO4	To understand the different types of IPR

Content
Module 1 (08 hours)
RESEARCH METHODOLOGY: Introduction, Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Significance of Research, Research and Scientific Method, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India. **DEFINING THE RESEARCH PROBLEM:** Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration
Module 2 (08 hours)
REVIEWING THE LITERATURE: Place of the literature review in research, bringing clarity and focus to research problem, improving research methodology, broadening knowledge base in research area, enabling contextual findings, Review of the literature, searching the existing literature, reviewing the selected literature, developing a theoretical framework, developing a conceptual framework, writing about the literature reviewed. **RESEARCH DESIGN**: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs
Module 3 (08 hours)
DESIGN OF SAMPLE SURVEYS: Design of Sampling: Introduction, Sample Design, Sampling and Non-Sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs. **MEASUREMENT AND SCALING:** Qualitative and Quantitative Data,

DATA COLLECTION: Introduction, Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method.

Module 4 (08 hours)

TESTING OF HYPOTHESES: Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis.

INTERPRETATION AND REPORT WRITING: Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.

Module 5 (08 hours)

INTELLECTUAL PROPERTY: Principles of IPR, Kinds of IPR, Patent- Concepts, Novelty, Utility Inventiveness/Non-obviousness, Procedure for granting and obtaining patents; Copyright- conditions for grant of copyright, Copyright in Literary, Dramatic and Musical ,Works, Sound Recording, Cinematograph Films, Copyright in Computer Programme, Author Special Rights, Right of Broadcasting and performers, Trademark Law and Practices - Procedure of registration of trademark; Emerging Issues and Challenges; Few Future Aspects of Intellectual Property Rights;

Textbook:

1. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
2. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.
3. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.
4. Lionel Bently., Brad Sherman-Intellectual Property Law, 3rd Edition

Reference Books:

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Ess Publications. 2 volumes.
3. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.
4. Wadehra, B.L. 2000. Law relating to patents, trademarks, copyright designs and geographical indications. Universal Law Publishing.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22RMIK57.1	Understand the research problem by literature review to solve problems
22RMIK57.2	Develop skills in qualitative and quantitative data analysis and presentation.
22RMIK57.3	Develop advanced critical thinking skills.
22RMIK57.4	Understand to write the report writing and awareness about IPR

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. Average of Marks scored in all three tests is added to test component. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests. **Some possible AATs:** seminar/assignments/ mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern for regular courses is shown in Table 2.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2	**40**	
	CIE Test-3	**40**	
	Assignments	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

CO/PO	PO6	PO8	PO12
22RMIK57.1	3	3	3
22RMIK57.2	3	3	3
22RMIK57.3	3	3	3
22RMIK57.4	3	3	3
Average	3	3	3

Low-1: Medium-2: High-3.

SEMESTER – V

Course: Environmental Studies

Course Code	**22CIVK58**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**2:0:0**	**SEE Marks**	**50**
No. of Credits	**2**	**Examination Hours**	**3**

Prerequisites:

Course Objectives: Students will be taught:

CLO1	To understand ecosystem functions and 17 SDG's for sustainable development
CLO2	To understand advanced energy systems and natural resource management.
CLO3	To understand global environmental issues, related policies and solutions.
CLO4	To understand key environmental legislation related to water, air, waste and environmental protection.
CLO5	To understand e-waste management.

Content	No. of Hours/ RBT levels
Module 1 – Ecosystem and Sustainability Ecosystem: Structure of Ecosystem, Types: Forest, Desert, Wetlands, Riverine, Oceanic ecosystems. Sustainability: 17SDG targets and possible actions. Self-Study **Component (SSC): Components of the environment.**	**6 Hours L2**
Module 2 - Natural Resource Management Natural Resources: Water resources – Availability & Quality aspects, Energy: Different types of energy, Conventional sources & non-conventional sources of Energy, Solar energy, OTEC Wind Energy, Hydrogen as an alternative energy Self-Study Component (SSC): Alternative Energy sources Disaster Management, Sustainable Mining - case studies and Carbon Trading **Self-Study Component (SSC): Alternative Energy sources.**	**6 Hours L2**
Module 3 – Environmental Pollution & Waste Management Environmental Pollution: Environmental Pollution (Sources, Impacts, Corrective and Preventive measures, Relevant Environmental Acts, Case-studies): Water Pollution, Water borne diseases & water induced diseases, Noise pollution, Soil Pollution, Air pollution (Sources, Impacts, Preventive measures and Public Health Aspects. Waste Management: Bio-medical Wastes; Solid waste; Hazardous wastes;	**6 Hours L2**

Industrial and Municipal Sludge Solid Waste Management , types and sources, functional elements of SWM, Biomedical Waste Management - Sources, Characteristics **Self-Study Component (SSC): Case studies of air pollution episodes.**	
Module 4 - Global Environmental Issues and Environmental Legislation Global Environmental Concerns (Concept, policies and case-studies): Ground water depletion/recharging, Climate Change; Acid Rain; Ozone Depletion; Radon and Fluoride problem in drinking water; Resettlement and rehabilitation of people, Environmental Toxicology **Environmental Legislation** Environmental Legislation: Water Act 1974, Air Act 1981, Environmental Protection Act 1984, Solid Waste Management Rules-2016, E- Waste management Rule - 2022, Biomedical Waste management- 2016 **Self-Study Component (SSC): Case studies on waste management options**	**6 Hours L2**
Module 5 - E - Waste Management E - Waste Management**:** Introduction of E- waste; composition and generation. Global context in e- waste; E-waste pollutants, E waste hazardous properties, Effects of pollutant (E- waste) on human health and surrounding environment, domestic e-waste disposal, Basic principles of E waste management, Component of E waste management. E-waste (Management and Handling) Rules, 2011; and E-Waste (Management) Rules, 2022 - Salient Features and its implications. **Self-Study Component (SSC): E-Waste (Management) Amendment Rules, 2023, 2024**	**6 Hours L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIVK58.1	**Analyze** ecosystem dynamics to formulate strategies for addressing sustainability challenges and implementing the SDGs.
22CIVK58.2	**Evaluate** energy technologies to design effective resource management strategies.
22CIVK58.3	**Evaluate** the impacts of pollution to develop effective waste management strategies.
22CIVK58.4	**Evaluate** global environmental issues to design solutions for sustainable management.
22CIVK58.5	**Interpret** environmental laws and regulations for sustainable management practices.

22CIVK58.6	**Understand** e-waste management in a global scenario.

Suggested Learning Resources:

Textbooks

1. S M Prakash , "Environmental Studies" 3rd Edition, Elite Publishing House, Mangalore, 2018.
2. Hester R.E., and Harrison R.M, Electronic Waste Management. Science, 2009.

Reference Books:

1. EarchBarucha, "Environmental Studies for UG students", 2004.
2. Benny Joseph (2005), "Environmental Studies", Tata McGraw – Hill Publishing Company Limited.
3. R. Rajagopalan, "Environmental Studies- From Crisis to Cure", 2nd Edition, Oxford university press, New Delhi, 2013.
4. Johri R., E-waste: implications, regulations, and management in India and current global best practices, TERI Press, New Delhi.
5. Raman Sivakumar, "Principles of Environmental Science and Engineering", 2nd edition, Cengage learning Singapur, 2005.
6. G. Tyler Miller Jr., "Environmental Science – working with the Earth", Eleventh Edition, Thomson Brooks /Cole, 2006
7. Dr. Pratiba Singh, Dr.Anoop Singh and Dr. PiyushMalaviya, "Text Book of Environmental and Ecology", Acme Learning Pvt. Ltd. New Delhi.

Web Reference:

- https://www.hzu.edu.in/bed/E%20V%20S.pdf
- https://onlinecourses.nptel.ac.in/noc23_hs155/preview
- https://onlinecourses.swayam2.ac.in/cec19_bt03/preview
- https://sdgs.un.org/goals
- https://kspcb.karnataka.gov.in/waste-management/biomedical-waste E Waste (Management) Rules, 2022.
- https://kspcb.karnataka.gov.in/sites/default/files/inlinefiles/E%20Waste%20%28Management%29%20Rules%2C%202022.pdf

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any five full questions choosing at least one full question from each module.

Continuous Internal Evaluation (CIE):
Three Tests are to be conducted for 40 marks each. Average of three test marks will be added to test component. CIE is executed by way of two quizzes/Alternate Assessment Tools(AAT's), some possible AAT's: Seminar/ assignments/ mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	**50**
	CIE Test-2	40	
	CIE Test-3	40	
	Average of CIE	**40**	
	Quiz 1/AAT	**05**	
	Quiz 2/AAT	**05**	
SEE	**Semester End Examination**	**100**	**50**
Grand Total			**100**

Understand e-waste management in a global scenario.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIVK58.1	2					1	1	1				2			3
22CIVK58.2	2	2	2			1	3	1				1			3
22CIVK58.3		2	2	2		1	3	1							2
22CIVK58.4		2	2	2		1	3	1				1			2
22CIVK58.5	1	2	2	2		1	2	1						1	2
22CIVK58.6	2	2	1			2	2	1				1			2
Average	1.75	2	1.8	2		1.16	2.3	1				1.25		1	2.33

SEMESTER – VI

Course: Design and Drawing of Steel Structural Elements

Course Code	**22CIV61**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**2:2:2**	**SEE Marks**	**50**
No. of Credits	**4**	**Examination Hours**	**3**

Prerequisites: Engineering Mechanics, Mechanics of Solids.

Course Objectives: Students will be taught to,

CLO1	Analyze the Plastic behavior of structural steel.
CLO2	Design Bolted connections and Welded connections.
CLO3	Design Compression members, Built-up columns and Column Splices.
CLO4	Design Tension members, Simple Slab Base and Gusseted Base.
CLO5	Design Laterally supported and Un-supported steel beams.

Content	No. of Hours/ RBT levels
Module-1 **Introduction:** Limit state method, Loading and load combinations, IS code provisions, Specifications, and section classification. **Bolted Connections:** Introduction, Design of High Strength Friction Grip (HSFG) bolts, Design of simple Bolted connections- Lap and Butt joints and Bracket connections. **Welded Connections:** Introduction, Simple welded joints for truss member and bracket connections. **Practice:** Use AUTOCAD for detailed drawings of above designed numerical.	**10 Hours L3**
Module 2 **Design of Compression members:** Introduction, Failure modes, Behaviour of compression members, Sections used for compression members, Effective length of compression members, Design of compression members and built up Compression members, Design of Laced and Battened Systems. **Practice:** Use AUTOCAD for detailed drawings of above designed numerical.	**10 Hours L3**
Module 3 **Design of Tension members:** Introduction, Types of Tension members, Slenderness ratio, Modes of Failure, Factors affecting the strength of tension	**10 Hours L3**

members, Design of tension members and Lug angles, Shear lag effect on tension members, Splices, Gussets. **Design of Column Bases:** Design of Simple Slab Base and Gusseted Base. **Practice:** Use AUTOCAD for detailed drawings of above designed numerical.	
Module 4 **Design of Beams:** Introduction, Types of Beams, Lateral stability of Beams, Factors affecting lateral stability, Behavior of Beams in Bending, Design strength of laterally supported beams in Bending, Design of Laterally Unsupported Beams, Shear Strength of Steel Beams. Beam to Beam Connections, Beam to Column Connection and Column Splices. **Practice:** Use AUTOCAD for detailed drawings of above designed numerical.	**10 Hours L3**
Module 5 **Plastic Behaviour of Structural Steel:** Introduction, Plastic theory, Plastic hinge concept, Length of plastic hinge, Plastic collapse load, Load factor, Shape factor, Theorems of plastic collapse. Methods of Plastic analysis, Plastic analysis of Continuous Beams, Portal frames. **Practice:** Use SAP2000 for above numerical.	**10 Hours L2, L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV61.1	Evaluate the collapse load, plastic moment for continuous beams and portal frames subjected to various types of loads.
22CIV61.2	Estimate number of bolts, welded strength properties for bolted and welded connections in steel structures.
22CIV61.3	Design of Compression members, built-up columns, laced and battened systems as per IS:800 codal provisions.
22CIV61.4	Design of tension members, lug angles, splices and gusseted base as per IS:800 codal provisions.
22CIV61.5	Determine the Strength of laterally supported and unsupported steel beams.

Textbooks:

1. N. Subramanian, “Design of Steel Structures” ,1st Edition, Oxford University press, New Delhi,2016.
2. Duggal S.K, “Limit State Method of Design of Steel Structures”, 3rd Edition , Tata Mc Graw Hill, New Delhi,2019.
3. M.L Gambhir, “Fundamentals of Structural Steel Design” 1st Edition, Mc Graw Hill, New Delhi, 2017.

References:

1. Dayarathnam P, "Design of Steel Structures" Reprint Edition, S Chand Publisher, 2020.
2. Kazim S M A and Jindal R S, "Design of Steel Structures", 2nd Edition (International Edition), Prentice Hall of India, New Delhi, 1990.
3. M Bil Wong,"Plastic Analysis and Design of Steel Structures", Butterworth-Heinemann Publications, 2011.
4. IS 800-2007: General Construction in Steel Code Practice (Third Revision) , Bureau of Indian Standards, New Delhi.

Web Reference:

https://archive.nptel.ac.in/courses/105/106/105106216/
https://www.steel-insdag.org/

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any five full questions choosing at least one full question from each module.

The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE on a scale of 30, the CIE would also include laboratory evaluation for 20 marks. The laboratory marks of 20 would comprise of 10 marks for regular laboratory assessment to include lab record and observation. 10 marks would be exclusive for laboratory internal assessment test to be conducted at the end of the semester**.**

Typical Evaluation pattern for integrated courses is shown in the Table below.

Table 1: Distribution of weightage for CIE & SEE of Regular courses:

Component		Marks	Total Marks
CIE	CIE Test-1	30	**50**
	CIE Test-2	30	
	CIE Test-3	30	
	Laboratory	**20**	
SEE	**Semester End Examination**	**100**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for

theory and lab courses (i.e. A minimum marks of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV61.1	2	3	2		2							1		3	
22CIV61.2	2	3	3		2							1		3	
22CIV61.3	2	3	3		2							1		3	
22CIV61.4	1	2	2		2							1		3	
22CIV61.5	3	2	2		3							1		3	
Average	**2**	**2.6**	**2.4**		**2.2**							**1**		**3**	

SEMESTER – VI

Course: Transportation Engineering

Course Code	**22CIV62**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:2**	**SEE Marks**	**50**
No. of Credits	**4**	**Examination Hours**	**3**

Prerequisites: Surveying

Course Objectives: Students will be taught to:

CLO1	Understand the importance of transportation in the present scenario of road development
CLO2	Design different geometric elements of a highway network.
CLO3	Explore various components and features of elements in Railway Engineering.
CLO4	Understand the various elements of airport layout, design requirements for runway and taxiway facilities, and gain insight into the use of visual aids.
CLO5	Understand properties of pavement materials and its tests.

Content	**No. of Hours/ RBT levels**
Module-1 **Importance of transportation:** Different modes of transportation and comparison, Ideal Alignment, Factors affecting the alignment, Engineering surveys- Map study, Reconnaissance, Preliminary and Final location & detailed survey, Present scenario of road development in India (NHDP & PMGSY) and in Karnataka (KSHIP & KRDCL), IRC and Road development plan - vision 2023.	**8 Hours L2**
Module 2 **Highway Geometric Design:** Cross sectional elements, Sight distances–SSD, OSD, ISD, Radius of curve, Transition curve, Design of horizontal and vertical alignment– curves, super-elevation, widening, gradients, summit and valley curves. Highway Drainage: Significance and requirements, Surface drainage system	**8 Hours L2, L3**
Module 3 **Railway Engineering:** Elements of Permanent way - Rails, Sleepers, Ballast, Rail fixtures and fastenings, Track Stress, Coning of wheels, Creep in rails, Defects in rails - Geometric Design of Railways, gradient, super elevation, widening of gauge on curves – Points and crossings, turnouts.	**8 Hours L2, L3**
Module 4	

Airport Planning and Design: Air transport characteristics, airport classification, airport planning, criteria for airport site selection, Runway Design: Orientation, Wind Rose Diagram, Runway length, Problems on basic and Actual Length, Geometric design of runways, Elements of Taxiway Design, Runway and Taxiway Markings and lighting.	**8 Hours L2, L3**
Module 5 **Pavement Materials**: Sub grade soil, Determination of CBR and modulus of sub grade reaction, Road Aggregates - Desirable properties and Tests Bituminous materials - Desirable properties - Explanation on Tar, Bitumen, Cutback and Emulsion	**8 Hours L2**

COURSE OUTCOMES:
Upon completion of this course, student will be able to:

22CIV62.1	Develop the ability to propose new road alignments or re-align existing roads, and perform necessary field investigations to collect relevant data.
22CIV62.2	Design road geometrics, structural components of pavement and drainage
22CIV62.3	Understand and apply geometric design principles of railway systems.
22CIV62.4	Develop the ability to determine airport runway orientation, considering design aspects, and identify the appropriate types of visual and navigational aids required.
22CIV62.5	Evaluate the engineering properties of the materials and suggest the suitability of the same for pavement construction

Content	**No.of Hours/ RBTlevels**
Tests on Soil: CBR test	**2 Hours L2**
Tests on aggregates: 1. Shape tests 2. Aggregate impact value and Crushing test. 3. Los Angeles abrasion value test 4. Specific gravity & Water absorption test	**4 Hours L2**

Tests on bitumen: 1. Penetration test 2. Viscosity test 3. Specific gravity test 4. Flash and fire point test 5. Ductility test 6. Softening point test	**4 Hours L2**
Tests on bituminous mixes 1. Proportioning of materials by Rothfutch's method and Mix design by Marshall Method.	**4 Hours L2**

Textbooks:

1. S.K. Khanna, C.E.G. Justo and Veeraraghavan A "Highway Engineering", 10th Edition, Nem Chand & Bros, 2013.
2. S.C.Saxena and S.P. Arora, A Text book of Railway Engineering,8th Ed Dhanpat Rai Publications, Delhi.2015.
3. Khanna S K, Arora M G and Jain S S,Airport Planning and Design, 4th Edition Nem Chand & Bros 1990

References:

1. Relevant IRC Codes. IRC002 1968, IRC003 1983 , IRC005 2015, IRC035 2015, IRC 038 1988, IRC086-1983, ITC092-1985, IRCSP023-1993., IRCSP99 2013.Publisher Indian Roads Congress, New Delhi
2. Specifications for Roads and Bridges-MoR T&H, IRC2013, New Delhi.
3. C. Jotin Khisty, B. Kent Lall, "Transportation Engineering", 3rd Ed., Pearson Prentice-Hall, India (2008).
4. Khanna and Justo, S.K. Khanna, C.E.G. Justo and Veeraraghavan A "Highway Materials Testing"- NemChand &Bros,2013.

Web Reference:

https://nptel.ac.in/courses/105105107

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any five full questions choosing at least

one full question from each module.

The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE on a scale of 30, the CIE would also include laboratory evaluation for 20 marks. The laboratory marks of 20 would comprise of 10 marks for regular laboratory assessment to include lab record and observation. 10 marks would be exclusive for laboratory internal assessment test to be conducted at the end of the semester**.**

Typical Evaluation pattern for integrated courses is shown in the Table below.

Table 1: Distribution of weightage for CIE & SEE of Regular courses:

Component		Marks	Total Marks
CIE	CIE Test-1	30	**50**
	CIE Test-2	30	
	CIE Test-3	30	
	Laboratory	**20**	
SEE	**Semester End Examination**	**100**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e. A minimum marks of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV62.1	2	2												2	
22CIV62.2	2	2	2											2	
22CIV62.3	2	2	2											2	
22CIV62.4	2	2												2	
22CIV62.5	2	2												2	
Average	2	2	2											**2**	

SEMESTER – VI

Course: Structural Dynamics and Earthquake Engineering

Course Code	**22CIV63A**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites: Engineering Mechanics, Structural Analysis

Course Objectives: Students will be taught to:

CLO1	Formulate the equation of motion for SDOF system
CLO2	Understand the response of SDOF system to harmonic loading
CLO3	Analyze the behavior of multi degree of freedom systems subjected to free and forced vibrations
CLO4	Understand the basic concepts of earthquake engineering
CLO5	Computation of seismic forces in multistoried buildings as per IS-1893

Content	**No. of Hours/ RBT levels**
Module-1 **Introduction:** Introduction to Dynamic problems in Civil Engineering, Concept of degrees of freedom, D'Alembert's principle, Dynamics of Single degree-of-freedom systems: Mathematical models of Single-degree-of-freedom systems, Free vibration response of damped and undamped systems.	**8 Hours L3**
Module 2 Response of Single-degree-of-freedom systems to harmonic loading including support motion, vibration isolation, transmissibility. Numerical methods applied to Single-degree-of-freedom systems – Duhamel integral. Principle of vibration measuring instruments–seismometer and accelerometer.	**8 Hours L3**
Module 3 **Dynamics of multi-degree freedom systems:** Free vibration of undamped multi-degree-of freedom systems – Natural frequencies and mode shapes –Orthogonality of modes. Response of Shear buildings for harmonic loading with and without damping using normal mode approach.	**8 Hours L3**

Module 4 **Introduction to Engineering Seismology**: Geological and tectonic features of India, Origin and propagation of seismic waves, characteristics of earthquake and its quantification – Magnitude and Intensity scales, Earthquake Hazards in India, Earthquake Risk Evaluation and Mitigation. Structural behavior under gravity and seismic loads, Lateral load resisting structural systems, damping devises, base isolation systems	**8 Hours L3**
Module 5 Structural Configuration for earthquake resistant design, Concept of plan irregularities and vertical irregularities, Soft storey, Torsion in buildings. Design provisions for these in IS-1893. Computation of seismic forces in multi-storeyed buildings – using procedures (Equivalent lateral force and dynamic analysis) as per IS-1893	**8 Hours L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV63A.1	**Construct** mathematical model for free vibration of SDOF systems under damped and undamped conditions.
22CIV63A.2	**Compute** the response of single degree of freedom systems for various types of excitations.
22CIV63A.3	**Determine** natural frequencies and mode shapes of multi degree of freedom systems under free and forced vibration conditions.
22CIV63A.4	**Understand** the causes of earthquakes, associated risk and mitigation methods
22CIV63A.5	**Compute** seismic forces in multistoried buildings as per IS-1893

Textbooks:

1. John Biggs, “Introduction to Structural Dynamics” McGraw-Hill Education Publisher, 1964
2. Madhujit Mukophadhyay, “Structural Dynamics: Vibrations and Systems”, Publisher: ANE Books, 2008
3. Roy R. Craig. “Fundamentals of Structural Dynamics” 2nd Edition, ohn Wiley & Sons Inc Publisher, 2006.
4. Dr. Vinod Hosur, “Earthquake-Resistant Design of Building Structures”, Wiley India Pvt Ltd, 2012

References:

1. Mario Paz, "Structural Dynamics: Theory and Computation", 2nd Edition, , CBS Publisher, 2004.
2. Anil K. Chopra, "Dynamics of Structures: "Theory and Application to Earthquake Engineering"- 2nd edition.,Pearson Education, 2007.
3. R,W.Clough and J.Penzien, "Dynamics of Structures", 2nd edition, McGraw– Hill Education, 1993.
4. William Thomson, "Theory of vibration with applications", 4th edition, CRC Press, 1996.
5. S.R.Damodarasamy and S.Kavitha, Phi, "Basics of Structural Dynamics and Aseismic Design", Learning Private Ltd, 2009

Web Reference:

https://eerc.iiit.ac.in/
https://www.nicee.org/
https://isr.gujarat.gov.in/
https://www.eri.u-tokyo.ac.jp/en/

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 30 marks each for integrated and 40 marks for non-integrated subjects. Average of three test marks will be added to test component and laboratory assessment to be finalized for 10 marks for integrated subjects. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs). **Some possible AATs:** seminar / assignments / mini projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses.

Component		Marks	Total Marks
CIE	CIE Test-1	40	**50**
	CIE Test-2	40	
	CIE Test-3	40	
	Average of CIE	**40**	
	Quiz/AAT	05	
	Quiz/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e. A minimum marks of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV63A.1	3	2	3												
22CIV63A.2	2	3	1												
22CIV63A.3	2	3	2									1	2		
22CIV63A.4	2	3	2			1						1	2		
22CIV63A.5	1	2	1											1	
Average	**2**	**2.6**	**1.8**			**1**						**1**	**2**	**1**	

SEMESTER – VI

Course: Ground Improvement Techniques

Course Code	**22CIV63B**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites: Geotechnical Engineering, Foundation Engineering

Course Objectives: Students will be taught:

CLO1	To understand the fundamental concepts of ground improvement techniques
CLO2	To understand the methods of ground improvement techniques for civil engineering structures.
CLO3	To understand concepts of chemical compaction, and grouting methods.
CLO4	To understand the applications of Geo synthetics, vibrations and injections on ground improvement.

Content	No. of Hours/ RBT levels
Module-1 **Introduction:** Definition, Objectives of soil improvement, classification of ground improvement techniques, factors to be considered in the selection of suitable soil improvement technique. **Compaction:** Introduction, compaction mechanics, Field procedure, surface compaction, Dynamic Compaction, selection of field compaction procedures, compaction quality control.	**8 Hours L2**
Module 2 **Drainage Methods:** Introduction, Seepage, filter requirements, ground water and seepage control, methods of dewatering systems, Design of dewatering system including pipeline effects of dewatering. Drains, different types of drains. **Pre-compression and Vertical Drains:** Importance, Vertical drains, Sand drains, Drainage of slopes, Electro kinetic dewatering, Preloading.	**8 Hours L2**
Module 3 **Chemical Modification-I:** Definition, cement stabilization, sandwich technique, admixtures. Hydration – effect of cement stabilization on permeability, Swelling and shrinkage and strength and deformation characteristics. Criteria for cement	**8 Hours L2**

stabilization. Stabilization using Fly ash. **Chemical Modification-II:** Lime stabilization – suitability, process, criteria for lime stabilization. Other chemicals like chlorides, hydroxides, lignin and hydrofluoric acid. Properties of chemical components, reactions and effects. Bitumen, tar or asphalt in stabilization.	
Module 4 **Vibration Methods:** Introduction, Vibrio compaction – blasting, vibratory probe, Vibro displacement compaction – displacement piles, vibro flotation, sand compaction piles, stone columns, heavy tamping **Grouting and Injection**: Introduction, Effect of grouting. Chemicals and materials used. Types of grouting. Grouting procedure, Applications of grouting.	**8 Hours** **L2**
Module 5 **Geosynthetics:** Introduction, Geo-synthetic types, properties of Geosynthetics – materials and fiber properties, Geometrical aspects, mechanical properties, Hydraulic properties, Durability; Applications of Geosynthetics - Separation, Filtration and Fluid Transmission, Reinforcement, **Miscellaneous Methods (Only Concepts & Uses):** Soil reinforcement, Thermal methods, Ground improvement by confinement – Crib walls, Gabions and Mattresses, Anchors, Rock bolts and soil nailing, Micro piles.	**8 Hours** **L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV63B.1	Understand the importance of ground improvement techniques and methods in civil engineering construction activities
22CIV63B.2	Describe dewatering and its methods, pre-compression, vertical drains.
22CIV63B.3	Elucidate methods of chemical stabilization using cement, lime, fly-ash and other chemicals
22CIV63B.4	Explain vibration and grouting techniques and their applications.
22CIV63B.5	Explain the applications of Geosynthetics on ground improvement techniques.

Textbooks:

1. Purushothama Raj P, "Ground Improvement Techniques", 2nd edition, Laxmi Publications, New Delhi, 2016.
2. Koerner R.M, "Construction and Geotechnical Method in Foundation Engineering", McGraw Hill Pub. Co.

References:

1. Manfred Hausmann , "Engineering principles of ground modification", McGraw Hill Pub. Co.,1989
2. Ingles, C.G and Metcalf.J.B., "Soil Stabilization; Principles and Practice", Butterworths, London
3. Bell, F.G., "Methods of treatment of unstable ground", Butterworths, London

Web Reference:

https://nptel.ac.in/courses/105108075
https://nptel.ac.in/courses/105105210

Scheme of Examination:

Semester End Examination (SEE):
SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):
Three Tests are to be conducted for 30 marks each for integrated and 40 marks for non-integrated subjects. Average of three test marks will be added to test component and laboratory assessment to be finalized for 10 marks for integrated subjects. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs). **Some possible AATs:** seminar / assignments / mini projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses.

Component		Marks	Total Marks
CIE	CIE Test-1	40	**50**
	CIE Test-2	40	
	CIE Test-3	40	
	Average of CIE	**40**	
	Quiz/AAT	05	
	Quiz/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e. A minimum marks of 12 out of 30 in theory and 8 out 20 in the Lab)

Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV63B.1	3				1									2	
22CIV63B.2	3	2			1										
22CIV63B.3	3				1										
22CIV63B.4	3	2			1										
22CIV63B.5	3				1								1		
Average	3	2			1								1	2	

SEMESTER – VI

Course: Water Resources Engineering

Course Code	**22CIV63C**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites: Hydrology and Irrigation Engineering

Course Objectives: Students will be taught:

CLO1	To Analyze various components of the hydrologic cycle and world water budget
CLO2	To understand the types of droughts and its measurement.
CLO3	To Identify various aspects of flood and storm water control.
CLO4	To understand urban floods and Design of storm water network systems
CLO5	Statistical analysis of hydrological data.

Content	No. of Hours/ RBT levels
Module-1 Hydrologic cycle, atmospheric and ocean circulation. Water use data: classification of uses water for energy. Water for agriculture: irrigation trends and needs, irrigation infrastructures, irrigation system selection and performance, water requirement for irrigation, impacts of irrigation	**8 Hours L2**
Module 2 **Drought Management** - Options, severity, and economic aspects of water storage. Analysis of surface water supply: surface water reservoir systems, storage firm yield analysis for water supply reservoir simulation. Types of droughts and its measurement.	**8 Hours L2**
Module 3 **Floods** - Flood plain management, flood plain definition, hydrologic and hydraulic analysis of floods, storm water management. Flood control alternatives: structural and non-structural measures. Flood damage and net benefit estimation: damage relationships, expected damages, risk-based analysis. Operation of reservoir systems for flood control	**8 Hours L2**
Module 4 **Urban Floods:** Basic approaches to urban drainage – runoff quantity and quality – wastewater and storm water reuse – major and minor systems. Elements of drainage	

systems – open channel – underground drains – appurtenances – pumping – source control. Storm water Analysis Calculation of runoff and peak – Design of storm water network systems	**8 Hours L2, L3**
Module 5 **Statistics for Water resources studies** - Probabilistic and statistical methods for hydrologic data, Fitting probability distribution. Probability distributions for hydrologic variables, Frequency analysis, and Extreme value distributions. Correlation, simple regression, and trend analysis. Risk and reliability analysis	**8 Hours L2, L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV63C.1	Analyze components of the hydrological cycle.
22CIV63C.2	Estimate the extent of drought and its management.
22CIV63C.3	Analyze flood risk and recommend flood management solutions
22CIV63C.4	Identify different aspects of urban flood and storm water control.
22CIV63C.5	Analyze water resource data through statistical techniques.

Textbooks:

1. Ralph A Wurbs, Wesley P. James, "Water Resources Engineering", Old Edition, Pearson Publishers, New Delhi.,2022.
2. Larry W. Mays, John Wiley & sons, "Water Resources Engineering", Wiley Publishers, New Delhi.,2019.

References:

1. Sathya Narayana Murthy Challa, "Water Resources Engineering: Principles and Practice",2nd Edition, New Age International Publishers, New Delhi,2020
2. Water resources engineering, lecture notes, IIT Kharagpur.
3. David A.Chin, "Water Resources- Engineering" International 3rd Edition, Pearson Publishers,2013

Web Reference:

https://nptel.ac.in/courses/105105110
https://nptel.ac.in/courses/105105110
NOC | Water Economics and Governance (nptel.ac.in)

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):
Three Tests are to be conducted for 30 marks each for integrated and 40 marks for non-integrated subjects. Average of three test marks will be added to test component and laboratory assessment to be finalized for 10 marks for integrated subjects. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs). **Some possible AATs:** seminar / assignments / mini projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses.

Component		Marks	Total Marks
CIE	CIE Test-1	40	**50**
	CIE Test-2	40	
	CIE Test-3	40	
	Average of CIE	**40**	
	Quiz/AAT	05	
	Quiz/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e., A minimum marks of 12 out of 30 in theory and 8 out 20 in the Lab)
Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV63C.1	3	2				1	1						1		
22CIV63C.2	3	2	1			1							1		
22CIV63C.3	3	2	1			1							1		
22CIV63C.4	3	2				1							1		
22CIV63C.5	3	2	1			1							1		
Average	3	2	1			1	1						1		

SEMESTER – VI

Course Code	**22CIV63D**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Course: Geo Spatial Engineering

Prerequisites: Engineering Survey

Course Objectives: Students will be taught to

CLO1	Understand the Basic components, and working principles of remote sensing and GIS
CLO2	Understand the objective and procedure of image enhancement and image processing.
CLO3	Apply Practically the image enhancement and processing

Content	No. of Hours/ RBT levels
Module 1 **Remote sensing:** Introduction, basic principle – Electromagnetic radiation, electromagnetic spectrum, different bands and their applications in remote sensing - Stages / components of remote sensing, ideal remote sensing system and real remote sensing system – Source of EMR – Energy interaction with the atmosphere and the surface features, reflection, absorption, scattering, atmospheric window, albedo, spectral reflectance curve - Types of remote sensing, classification based on platforms, energy sources, wavelength regions, number of bands – Satellite orbits, geosynchronous, near polar and sun synchronous orbits, swath, inclination, orbital period, repeat cycle, revisit period – Image format – Resolutions in remote sensing – Remote sensing applications – Characteristics of Indian Remote Sensing Satellites , sources of remote sensing data	**8 Hours L2**
Module 2 **Image rectification and enhancement:** Image geometric corrections, Ground control points, atmospheric corrections, color composites, Digital Image analysis, Image enhancement.	**8 Hours L2**
Module 3 **Image classification:** Classification methods, vegetation indices, band combinations, Users accuracy, producer accuracy and overall accuracy.	**8 Hours L2**
Module 4 **Geographic information system:** Definitions, components, functions of GIS, Spatial and attribute data, Data models: raster and vector data, topology, Sources of data and	**8 Hours L2**

data structures, Geodatabase and metadata, Errors in GIS, GIS applications, link with remote sensing, introduction to web GIS, free and open source GIS tools.	
Module 5 **Maps:** Introduction to maps, components of maps, map projections and coordinate reference system. Introduction to drone survey. **Spatial analysis**: Introduction to spatial analysis, raster and vector operations, neighborhood analysis, spatial interpolation, DEM, generation of contours.	**8 Hours** **L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV63D.1	Comprehend different geospatial techniques in the construction industry.
22CIV63D.2	Understand the principles and components of remote sensing and GIS
22CIV63D.3	Apply principles of image enhancement and digital image processing.
22CIV63D.4	Understand the practical application of remote sensing and GIS to real world scenarios.

Textbooks:

1. Lillesand TM, Keifer RW, Chipman JW, "Remote sensing and image interpretation " Wiley Publications, 7th edition, 2015.
2. B Bhatta, "Remote Sensing and GIS" , Oxford Publications, 3rd edition, 2021.
3. M Anji Reddy, "Remote Sensing and GIS" , BS Publications, 4th edition, 2012.

References:

1. Paul R Wolf, "Elements of Photogrammetry", McGraw International, Indian Edition, 2013.
2. Peter A Burrough, "Principles of GIS" , Oxford Publications, 3rd edition, 2016.
3. Bemhardsen, " Geographic Information Systems – an Introduction", Wiley Publications, 3rd edition, 2002.
4. Gibson P.J, Routledge, "Introductory Remote Sensing- Principles and Concepts" Routledge, 1st edition, 2000.

Web Reference:

NPTEL Lectures:
Modern Surveying Techniques by Prof. Onkar Dikshit, IIT Kanpur
http://nptel.ac.in/courses/Webcourse-contents/IITKANPUR/ModernSurveyingTech/ui/TOC1.htm
NPTEL Lectures:
Remote Sensing by Prof. D Nagesh Kumar, IISc Bangalore

http://www.nptel.ac.in/syllabus/105108077/

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any five full questions choosing at least one full question from each module.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. Average of three test marks will be added to test component and loboratory assessment to be finalized for 10 marks for integrated subjects. CIE is executed by way of two quizzes/Alternate Assessment Tools(AAT's). some possible AAT's: Seminar/ assignments/ mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Component		Marks	Total Marks
CIE	CIE Test 1	**40**	**50**
	CIE Test 2	**40**	
	CIE Test 3	**40**	
	Average of CIE	**40**	
	Quiz 1/AAT	**05**	
	Quiz 2/AAT	**05**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e. A minimum marks of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV63D.1	3	-	-	-	1	-	-	-	-	-	-	-	-	-	-
22CIV63D.2	3	-	-	-	1	-	-	-	-	-	-	-	1	-	-
22CIV63D.3	3	-	-	-	1	-	-	-	-	-	-	-	1	-	-
22CIV63D.4	3	1	1	-	1	-	-	-	1	-	-	1	-	-	-
Average	**3**	**1**	**1**	**-**	**1**	**-**	**-**	**-**	**1**	**-**	**-**	**1**	**1**	**-**	**-**

SEMESTER – VI

Course: Advanced Geotechnical Engineering

Course Code	**22CIV63E**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**2:2:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites: Geotechnical Engineering

Course Objectives: Students will be taught:

CLO1	To prepare a detailed site investigation report based on geotechnical data.
CLO2	To estimate internal stresses in the soil mass and the Probable settlement of foundation.
CLO3	To assess stability of slopes and earth pressure on rigid retaining structures
CLO4	To Understand various theories related to bearing capacity of soil and their application in the design of shallow and Deep foundation.
CLO5	To study the classification of pile and estimate load carrying capacity of single and group of piles.

Content	**No. of Hours/ RBT levels**
Module 1 **Soil Exploration:** Introduction, Objectives and Importance, Stages and Methods of exploration- Test pits, Borings, Geophysical methods, stabilization of boreholes, Sampling techniques, Undisturbed, disturbed, and representative samples, Geophysical exploration and Bore hole log. **Drainage and Dewatering** methods, estimation of depth of GWT (Hvorslev's method). Design of dewatering system.	**8Hours L2, L3**
Module 2 **Stress in Soils:** Introduction, Boussinesq's theory on concentrated load, line load and uniformly distributed loads, Newmark's Chart, Contact Pressure, Pressure bulbs. **Foundation Settlement:** Types of settlements and importance, Computation of immediate and consolidation settlement, permissible differential, and total settlements (IS 8009 part 1). Factors influence the settlement of foundation.	**8Hours L2, L3**
Module 3 **Lateral Earth Pressure:** Active, Passive and earth pressure at rest, Rankine's	**8Hours L2, L3**

theory for cohesionless and cohesive soils, Coulomb's theory, Rebhann's and Culmann's graphical construction. Geotechnical design of gravity and cantilever retaining walls. **Stability of Slopes:** Assumptions, infinite and finite slopes, factor of safety, Swedish slip circle method for C and C-ø (Method of slices) soils, Fellineous method for critical slip circle, use of Taylor's stability charts, Bishop's rigours analysis And Numerical Problems.	
Module 4 **Bearing Capacity of Shallow Foundation:** Types of foundations, Determination of bearing capacity by Terzaghi's, Meyerhof's, Brinch Hansen's and BIS method (IS: 6403), Modes of shear failure, Factors affecting Bearing capacity of soil. Effect of water table and/or eccentricity on bearing capacity of soil, field methods of determining bearing capacity of soil: SPT and plate load test.	**8Hours L2, L3**
Module 5 **Pile Foundations**: Types and classification of piles, single loaded pile capacity in cohesionless and cohesive soils by static and Dynamic formulas, efficiency of Pile group, group capacity of piles in cohesionless and cohesive soils, negative skin friction, pile load tests, Settlement of piles, under reamed piles (only introductory concepts – no derivation).	**8Hours L2, L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV63E.1	Understand the geotechnical site investigation program for different civil engineering projects
22CIV63E.2	Understand stress distribution and estimate the settlement of footings on soils.
22CIV63E.3	Analyze the factor of safety against failure of slopes and compute lateral pressure distribution of earth retaining structures.
22CIV63E.4	Determine bearing capacity of soil and study the effect of ground water table on the same.
22CIV63E.5	Classify types of piles and estimate the load carrying capacity of single and group of piles.

Textbooks:

1. Punmia B C, "Soil Mechanics and Foundation Engineering", 16th edition, Laxmi Publications co., New Delhi. B.C. 2005.
2. Murthy V.N.S., "Principles of Soil Mechanics and Foundation Engineering", UBS Publishers and Distributors, New Delhi, 2018.

3. Gopal Ranjan and Rao A.S.R.,"Basic and Applied Soil Mechanics", 4th edition, New Age International (P) Ltd., New Delhi, 2022.

References:

1. P C Varghese, "Foundation Engineering", PHI India Learning Private Limited, New Delhi, 2005.
2. Bowles J E , "Foundation analysis and design", McGraw- Hill Publications,2017
3. T.W. Lambe and R.V. Whitman, "Soil Mechanics" -, 1st edition, John Wiley & Sons, 1969.
4. Donald P Coduto, "Geotechnical Engineering"- Phi Learning Private Limited, New Delhi
5. Bureau of Indian Standards: IS-1904, IS-6403, IS-8009, IS-2950, IS-2911 and all other relevant codes

Web Reference:

https://nptel.ac.in/courses/105105176
https://nptel.ac.in/courses/105101201
https://nptel.ac.in/courses/105105168

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately Reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any five full questions choosing at least one full question from each module.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 30 marks each for integrated and 40 marks for non-integrated subjects. Average of three test marks will be added to test component and laboratory assessment to be finalized for 10 marks for integrated subjects. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs). Some possible AATs: seminar / assignments / miniprojects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	**50**
	CIE Test-2	40	
	CIE Test-3	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 1/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e. A minimum marks of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV63E.1	3	2	1	1	1	-	-	-	-	-	-	-	1	1	-
22CIV63E.2	3	2	1	1	-	-	-	-	-	-	-	-	-	1	-
22CIV63E.3	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
22CIV63E.4	3	2	1	1	1	-	-	-	-	-	-	-	-	1	-
22CIV63E.5	3	2	1	1	-	-	-	-	-	-	-	-	-	1	-
Average	**3**	**2**	**1**	**1**	**1**	-	-	-	-	-	-	-	**1**	**1**	-

SEMESTER – VI

Course: Environmental Pollution and Control

Course Code	**22CIV64A**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites: Environmental Science

Course Objectives: Students will be taught:

CLO1	**To understand the aspects of air pollution, its control and noise pollution**
CLO2	To comprehend the concepts of treating wastewater from industrial sources.
CLO3	To differentiate between solid and hazardous waste based on their characterization.
CLO4	To understand the Concept of Soil pollution
CLO5	To acquire basic knowledge of sustainable development.

Content	**No. of Hours/ RBT levels**
Module 1 **Air pollution:** Introduction to the different aspects of air pollution, Sources and effects of particulate and gaseous air pollutants, Photochemical reactions, Air pollution sampling and measurement Air pollution Control Methods: Particulate control devices –Methods of Controlling Gaseous Emissions –Air quality standards. (NAAQ) Noise Pollution: Noise standards, Measurement, and control methods –Reducing residential and industrial noise –ISO:14000.	**10Hours L2**
Module 2 **Water pollution:** Introduction to various aspects of water pollution and water quality standards **Industrial wastewater**: Management: Strategies for pollution control –Volume and Strength reduction –Neutralization –Equalization –Proportioning –Common Effluent Treatment Plants –Recirculation of industrial wastes –Effluent standards	**8Hours L2**
Module 3 **Solid Waste Management:** Characteristics of solid waste, Overview of solid waste	**8Hours L2**

generation and management techniques, Hazardous wastes; definition and classification, Hazardous waste management techniques, Treatment and management of hazardous waste-Disposal and Control methods.	
Module 4 **Soil Pollution:** Introduction, soil Contamination. soil pollution and types. causes and effects of soil pollution. Remedial measures and Control methods.	**6Hours L2**
Module 5 **Sustainable Development:** Sustainable Development: Definition-elements of sustainable developments-Indicators of sustainable development-Sustainability Strategies-Barriers to Sustainability–Industrialization and sustainable development –Cleaner production in achieving sustainability-sustainable development.	**8Hours L2**

COURSE OUTCOMES:
Upon completion of this course, student will be able to:

22CIV64A.1	Identify the air pollutant control devices and have knowledge on the NAAQ standards and Noise pollution standards.
22CIV64A.2	Identify the sources of water pollution and differentiate between the treatment techniques used for sewage and industrial wastewater.
22CIV64A.3	Understand the fundamentals of solid waste management, including practices adopted in towns or villages, and its importance for maintaining urban health.
22CIV64A.4	Describe methods of soil contamination and identify various remediation techniques.
22CIV64A.5	Appreciate the importance of incorporating sustainable development principles when planning a project or executing an activity.

Textbooks:

1. Peavy, H. S., Rowe, D.R, Tchobanoglous, "Environmental Engineering", Indian edition, G.Mc-Graw Hill International Editions, New York 1985.
2. J. G. Henry and G.W. Heinke, "Environmental Science and Engineering", 2nd edition, Pearson Education, 1988.
3. .M. N. Rao and H. V. N. Rao, "Air pollution", 1st edition, Tata Mc.Graw Hill Company, 2017.

References:

1. K. V. S. G. Murali Krishna, "Air Pollution and Control"by, Kousal & Co. Publications, New Delhi.

2. LaGrega, M. D., Buckingham, P. L. and Evans, J. C. - Hazardous Waste Management, New York: McGraw-Hill, 2001.
3. G. L. Karia and R.A. Christian, "Waste water treatment-concepts and design approach", Prentice Hall of India

Web Reference:

https://www.sciencedirect.com/book/9780750698993/environmental-pollution-and-control
https://cpcb.nic.in/env-protection-act/
https://archive.nptel.ac.in/courses/123/105/123105001/
https://archive.nptel.ac.in/courses/105/107/105107213/

Scheme of Examination:

Semester End Examination (SEE):

Semester End Examination (SEE): SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any five full questions choosing at least one full question from each module.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 30 marks each for integrated and 40 marks for non-integrated subjects. Average of three test marks will be added to test component and laboratory assessment to be finalized for 10 marks for integrated subjects. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs). Some possible AATs: seminar / assignments / miniprojects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern for integrated courses is shown in the Table1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	**50**
	CIE Test-2	40	
	CIE Test-3	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 1/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e. A minimum marks of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV64A.1	2	2	2							1		1	1		
22CIV64A.2	2	2	2							1		1	1		
22CIV64A.3	2	2	2			1				1		1	1		
22CIV64A.4	2	2	2							1		1	1		
22CIV64A.5	2	2	2				1			1		1	1		
Average	2	2	2	1		1	1			1		1	1		

SEMESTER – VI

Course: Smart Cities and Digital Infrastructures

Course Code	**22CIV64B**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites: -

Course Objectives: Students will be taught:

CLO1	Conduct feasibility studies for the planning of urban infrastructure.
CLO2	Understand the concept of sustainable development with changing pattern of urban growth.
CLO3	Apply IOT (Internet of Things) for the planning of smart cities.
CLO4	Understand the concept of smart transportation.
CLO5	Understand the fundamentals of E governance and suitability for implementation of the same in smart cities

Content	No. of Hours/ RBT levels
Module-1 Understanding Smart Cities Introduction to smart cities- Definition, dimensions, scope Smart Cities –Global Standards and Performance Benchmarks, Practice Code. India "100 Smart Cities" Policy and Mission. Planning for Urban Infrastructure Urban Infrastructure, Role of Planner in the provision of urban networks and services, feasibility studies for infrastructure projects, planning for major infrastructure projects, Various Infrastructure Programs and policies by MOUD, PPP (DBOOT, BOOT, etc.) in infrastructure projects	**8 Hours L2**
Module 2 Introduction to Sustainable Development Concepts History, definitions, and perspectives on Sustainability Theory and Background to Sustainability Planning Changing patterns of urban growth, Quality of life in the city. Efficiencies and inefficiencies in cities; challenges and opportunities. Eco challenges in the contemporary cities; Principles of green and smart cities, international initiatives including UN and EU level; Corporate social and environmental strategies in cities; The Three E's: Environment, Economics, ethics, and ecology of sustainable Green	**8 Hours L2**

technologies in cities,	
Module 3 Internet of Things (IoT) in Smart Cities IOT fundamentals, protocols, design and development, data analytics and supporting services, Surveillance Systems, Smart Street Lighting, ICCC platforms, Command Control Center,Sensors/ Devices, Connectivity, Data Processing, An IoT Strategy for Smarter Cities, Smart City IoT Architecture, Smart City Security Architecture, Smart City Use-Case Examples.	**8 Hours L2**
Module 4 Introduction to smart transport, Intelligent transportation system (ITS) components, Introduction to traffic sensors GIS and GPS positioning Navigation and Identification system, Smart Automobiles smart pedestrian walkways and cycle tracks, solar roads, electronic fee payment technology, electronic speed determination technology, smart signaling technology. Types of Public Mass transport: Mass Rapid Transit System (MRTS), BRTS, LRT, RRTS and its role in the transport system.	**8 Hours L2**
Module 5 E- GOVERNANCE Smart Governance Introduction to smart E-governance, Smart E-governance for citizen services, Smart E-governance within Government agencies, Smart E-governance for industries and commerce, Emerging trends in Smart Egovernance, Implementation models for E-Governance, Regulatory guidelines for E-Governance.	**8 Hours L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV64B.1	Adopt urban infrastructures policies and programs for the development of smart cities.
22CIV64B.2	Plan sustainable city addressing prevailing environmental concern.
22CIV64B.3	Plan smart cities using IoT.
22CIV64B.4	Implement intelligent transport system for smart cities.
22CIV64B.5	Adopt E-governance to provide a platform for digital infrastructure in smart cities.

Textbooks:

1. Choudury M A and Sadek A, "Fundamentals of Intelligent Transportation Systems Planning" Artech House, 2003.
2. AMDA, 1999, Urban Governance and Management of Urban Environment. New Delhi.
3. T.N. Chaturvedi (ed.), 2000, Urban Governance, IIPA, New Delhi.
4. CSR Prabhu, 2013, E-Governance- Concepts and Case Studies, PHI Learning Pvt. Ltd.

5. Institute of Transportation Engineers, 1982, Transportation and Traffic Engineering Handbook, Prentice-Hall. Inc., New Jersey.

References:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, 1 st Edition, Pearson Education.
2. Steve Austakalnis, "Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR, Addison"- Wesley Professional, 2016.
3. HMSO, Roads in Urban Areas, HMSO London.
4. Khanna S K. and CEG Justo, 1987, Highway Engineering, Nemichand and Bros., Roorkee, 2018.
5. Timothy and Kristy Manning, "The Ecology of Place: Planning for Environment, Economy, and Community", Washington, D.C. Island Press, 1997.

Web Reference:

https://www.coursera.org/learn/smart-cities
www.smartcitiescouncil.com

Scheme of Examination:

Semester End Examination (SEE):
SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any five full questions choosing at least one full question from each module.

Continuous Internal Evaluation (CIE):
Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE on a scale of 30, the CIE would also include laboratory evaluation for 20 marks. The laboratory marks of 20 would comprise of 10 marks for regular laboratory assessment to include lab record and observation. 10 marks would be exclusive for laboratory internal assessment test to be conducted at the end of the semester.

Typical Evaluation pattern for integrated courses is shown in the Table below

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	**50**
	CIE Test-2	40	
	CIE Test-3	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 1/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e. A minimum marks of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV64B.1	2													1	
22CIV64B.2	2	2	1				2							1	1
22CIV64B.3	2	2	1	1	2	2			1	2		2			
22CIV64B.4	2	2	1	1			2		1						
22CIV64B.5	2	2		1	1	2									
Average	2	2	1	1	1.5	2	2		1	2		2		**1**	**1**

SEMESTER – VI

Course: Sustainable Development Goals

Course Code	**22CIV64C**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites: -

Course Objectives: Students will be taught:

CLO1	To understand the fundamental concepts of Sustainable Development
CLO2	To provide details of Sustainable Cities.

Content	No. of Hours/ RBT levels
Module-1 Sustainable Development: Introduction to Sustainable Development Economic Growth and Progress, Continuing Poverty, Environmental Threats, Business as Usual Versus Sustainable Development	**8 Hours L2**
Module 2 Sustainable Cities: The Patterns of Urbanization Around the World, development of Sustainable city, Smart Infrastructure, Urban Resilience, Planning for Sustainable Development.	**8 Hours L2**
Module 3 Curbing Climate Change The Basic Science of Climate Change, Consequences, Mitigation, Adaptation, Mitigation Policies:	**8 Hours L2**
Module 4 Saving Biodiversity: Concept of Biodiversity, Biodiversity Under Threat, Oceans and Fisheries, Deforestation International Dynamics.	**8 Hours L2**
Module 5 Sustainable Development Goals Introduction to Sustainable Development Goals, Goal-Based Development, Financing for Sustainable Development, Principles of Good Governance, Feasibility of Sustainable Development.	**8 Hours L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV64C.1	Understand the concept of sustainable development and its impact on economic growth, poverty, and the environment.
22CIV64C.2	Analyze urbanization patterns and explore strategies for developing sustainable, resilient cities with smart infrastructure.
22CIV64C.3	Examine the science behind climate change and evaluate mitigation and adaptation policies.
22CIV64C.4	Assess the threats to biodiversity and explore global efforts to conserve ecosystems, forests, and marine life.
22CIV64C.5	Understand the Sustainable Development Goals and the frameworks for financing and governance to achieve global sustainability.

Textbooks:

1. Ram Kumar Mishra, Ch Lakshmi Kumari, Sandeep Chachra, P.S. Janaki Krishna "Smart Cities for Sustainable Development" Springer, 2022 Edition
2. The Sustainable Development Goals Report 2020 Kindle Edition, Department of Economic and Social Affairs

References:

1. 'The Sustainable Development Goals" Hardcover – December 4, 2018 United Nations.

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE on a scale of 30, the CIE would also include laboratory evaluation for 20 marks. The laboratory marks of 20 would comprise of 10 marks for regular laboratory assessment to include lab record and observation. 10 marks would be exclusive for laboratory internal assessment test to be conducted at the end of the semester**.**

Typical Evaluation pattern for integrated courses is shown in the Table below.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	**50**
	CIE Test-2	40	
	CIE Test-3	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 1/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e. A minimum marks of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV64C.1	2	2				2	1						1		
22CIV64C.2	2	2				2	1						1		
22CIV64C.3	2	2				2	1						1	1	
22CIV64C.4	2	2				2	1			1			1		
22CIV64C.5	2	2				2	1						1		
Average	2	2				2	1			1			1	**1**	

SEMESTER – VI

Course: Cyber-Physical Systems for Infrastructure

Course Code	**22CIV64D**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites: - None

Course Objectives: Students will be taught:

CLO1	To understand the concept of Cyber-physical systems (CPS) in civil and infrastructure engineering
CLO2	To understand the Basic aspects of instrumentation and wireless communications.
CLO3	To apply cyber-physical system principles to civil engineering applications

Content	**No. of Hours/ RBT levels**
Module-1 **Introduction to Cyber-Physical Systems in Civil Engineering:** Overview of Cyber-Physical Systems (CPS) and their Importance in Civil Engineering, Applications of CPS in Infrastructure: Smart Cities, Building Automation, Case Study: Role of CPS in Enhancing Infrastructure Efficiency.	**8 hours L2**
Module 2 **Sensing Technologies and Data Acquisition:** Types of Sensors used in Civil Engineering and Infrastructure. Data Collection Techniques: Remote Sensing, GPS, and GIS. Wireless Sensor Networks for Real-time Monitoring.	**8 hours L2**
Module 3 **Communication and Networking for CPS in Civil Engineering:** Communication Protocols and Standards for CPS, Introduction to Internet of Things (IoT) in Infrastructure, Ensuring Cybersecurity in CPS: Challenges and Solutions	**8 hours L2**

Module 4 **Control Systems and Automation in Infrastructure:** Basics of Control Systems and Automation, Smart Transportation Systems: Traffic Control and Management, Building Automation and Energy Efficiency	**8 hours** **L2**
Module 5 **Advanced Applications and Future Trends:** Role of Artificial Intelligence and Machine Learning in CPS, Robotics in Construction and Infrastructure Maintenance, Ethical Considerations and Societal Impact of CPS in Civil Engineering.	**8 hours** **L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV64D.1	Explore the concept of Cyber-Physical Systems (CPS) in civil engineering, including their applications in smart cities and infrastructure efficiency.
22CIV64D.2	Understand various sensing technologies and data acquisition methods used in civil engineering, including remote sensing, GPS, GIS, and wireless sensor networks.
22CIV64D.3	Examine the communication protocols and networking standards for CPS in civil engineering, with a focus on IoT integration and cybersecurity challenges.
22CIV64D.4	Analyze the basics of control systems and automation in infrastructure, including their applications in smart transportation and building energy efficiency.
22CIV64D.5	Investigate advanced applications of CPS, including the roles of artificial intelligence, robotics in construction, and the ethical implications and societal impacts of these technologies in civil engineering.

Textbooks:

1. Rajeev A, “Principles of cyber-physical systems”, 1st edition, The MIT Press, 2016.
2. Lee,E.A., & Seshia, S.A, “Introduction to embedded systems:A cyber physical systems approach”, 2nd edition, The MIT Press, 2017.
3. "Smart Cities: Applications, Technologies, Standards, and Driving Factors" edited by Casimiro Antonio Rodrigues and Paulo Pereira.

References:

1. "Wireless Sensor Networks for Civil Infrastructure Monitoring: A Best Practice Guide" by Neil Hoult and Robert J. Piechocki
2. "Infrastructure Monitoring with Fiber Optic Sensors" by Branko Glisic and Kai Wang

Web Reference:

https://inl.gov/secure-and-resilient-cyber-physical-systems/

https://digitaltwinhub.co.uk/forums/topic/571-cyber-physical-infrastructure-vision-launch/

Scheme of Examination:

Semester End Examination (SEE):
SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any five full questions choosing at least one full question from each module.

The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):
Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE on a scale of 30, the CIE would also include laboratory evaluation for 20 marks. The laboratory marks of 20 would comprise of 10 marks for regular laboratory assessment to include lab record and observation. 10 marks would be exclusive for laboratory internal assessment test to be conducted at the end of the semester**.**

Typical Evaluation pattern for integrated courses is shown in the Table below.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	**50**
	CIE Test-2	40	
	CIE Test-3	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 1/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e. A minimum marks of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV64D.1	3		1		1							1			
22CIV64D.2	3	2	1		1							1			
22CIV64D.3	3	2	1		1	2						1			
22CIV64D.4	3	2	1		1	2						1			
22CIV64D.5	3	2	1		1	2						1			
Average	3	2	1		1	2						1			

SEMESTER – VI

Course: Project work Phase 1

Course Code	**22CIVP65**	**CIE Marks**	**100**
Hours/Week (L: T: P)	**0:0:4**	**SEE Marks**	**-**
No. of Credits	**2**	**Examination Hours**	**-**

Course Learning Objective (CLOs): Major Project work phase-I is carried out under the guidance of a faculty. In this course, the students will finalize the project title, collect the data required by indirect and direct methods and carry out literature review and formulate the methodology.

The project report shall be presented in the following for

1) Definition of the problem.
2) Exhaustive literature survey.
3) State of Project work.
4) References.

Course: Project Management Software Laboratory

Course Code	**22CIVL66**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**0:0:2**	**SEE Marks**	**50**
No. of Credits	**1**	**Examination Hours**	**3**

Prerequisites: -

Course Objectives: Students will be taught:

CLO1	To learn project planning and scheduling with Microsoft Project.
CLO2	To Understand the critical path method using work breakdown structure.
CLO3	To add and assign resources and costs to the project
CLO4	To Compare between different PMP software.

Content	No. of Hours/ RBT levels
Module 1 **Introduction:** Project structure in MS Project, Interface backstage view, Interface options, tabs, customized ribbon and quick access	4 Hours L2
Module 2 **Project Creation:** Project creation, WBS and tasks, different types of relationship, CPM, task constraints	2 Hours L2
Module 3 **Resources:** create and assign – resources and cost, resource leveling	2 Hours L2
Module 4 Project progress, Reporting and Exporting	6 Hours L2
Module 5 Comparison between different PMP software. (Demo)	2 Hours L2

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIVL66.1	Describe a project life cycle, and skillfully map each stage in the cycle.
22CIVL66.2	Understand project management terminologies
22CIVL66.3	Identify the resources needed for each stage, stakeholders, tools and supplementary materials.

22CIVL66.4	Provide internal stakeholders with information regarding project costs by considering estimated cost, variances and profits
22CIVL66.5	Develop a project scope while considering factors like customer requirements and goals

Textbooks:

1. Verzuh, E, "The fast forward MBA in project management", 4th edition, New York: J. Wiley., 2011.
2. Adrinne Watt, "Project Management", BC campus, 2014.

References:

1. Scott Berkun, "Making Things Happen: Mastering Project Management (Theory and Practice), O'Reilly
2. Carl Chatfield, "Microsoft Project 2016 Step by Step", Microsoft Press.

Web Reference:

https://www.coursera.org/learn/smart-cities
www.smartcitiescouncil.com

Scheme of Examination:

Continuous Internal Evaluation (CIE):

WEEK WISE CIE (WEEK WISE EVALUATION OF EACH EXPERIMENT)

SL.NO	ACTIVITY	MARKS
1	Record	25
2	Viva	05
	Total	30

END OF SEMESTER CIE (INTERNAL ASSESSMENT EVALUATION)

SL.NO	ACTIVITY	MARKS
1	Writeup	20
2	Conduction	40
3	Results, graphs, discussions	20
4	Viva-voce	20
	Total	100
	Reduced to	20

FINAL CIE CALCULATIONS

SL.NO	ACTIVITY	MARKS

1	Average of weekly entries	30
2	Internal Assessment Evaluation	20
Total		50

SEE EVALUATION OF LAB COURSES

PARTICULARS	MARKS
Writeup	20
Experimentation program	40
Results/Graphs/Discussions	20
Viva-voce	20
Total	100

Complete project report to be prepared for the following cases:

1. Residential building – G+3 floors with Lift and parking facility included.
2. Commercial complex.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIVL66.1	2	1			3				1		3	1	1		1
22CIVL66.2	2											1			
22CIVL66.3		1			3				1		2				1
22CIVL66.4	1				3				1		3			1	
22CIVL66.5	1	1			2				2	2	2				
Average	1.5	1			2.75				1.25	2	2.5	1	1	1	1

SEMESTER – V

Course: Quality Control and Assurance

Course Code	**22CIV67A**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**0:2:0**	**SEE Marks**	**50**
No. of Credits	**01**	**Examination Hours**	**01**

Prerequisites:

Course Objectives: students will be taught to:

CLO1	Understand the elements of quality planning and the implication.
CLO2	Become aware of objectives and advantage of quality assurance.
CLO3	Study the relationship between quality and safety management

Content	No. of Hours/ RBT levels
Module-1 Construction Quality, Inspection and Testing, Quality control, Quality Assurance, Quality Certification for companies and laboratories (ISO Certification, NABL certification) Total Quality Management, Critical factors of TQM, TQM in Projects, Benchmarking, concepts of quality policy, standards, and manual.	**8 Hours** **L2**
Module 2 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	**8 Hours** **L2**
Module 3 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 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.	**8 Hours** **L2**

Site safety programmes - JSA, JHA, Root cause analysis, meetings, safety policy, manuals, training & orientation. Safety legislation regard to violation	

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV67A.1	Comprehend the principles of construction quality management, including inspection, testing, quality control, quality assurance, and the significance of certifications such as ISO and NABL in achieving total quality management.
22CIV67A.2	Analyse the meaning and scope of third-party certification in construction safety, focusing on technological, organizational, and behavioral aspects, as well as relevant safety legislation and standards in civil engineering projects.
22CIV67A.3	Evaluate safety measures in construction by understanding the causes and classifications of accidents, implementing safety programs and protective equipment, and strategizing for personal and structural safety throughout the construction process.

Textbooks:

1. N. Logothetis, "Management for Total Quality", Prentice Hall
2. David Gold Smith, "Safety Management in construction and Industry", Mc Graw Hill
3. K N Vaid, "Construction Safety Management", NICMAR, Bombay

Reference books:

1. D S Rajendra Prasad, "Quality Management System in Civil Engineering", Sapna Book House, Bangalore
2. "The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996, Universal Law Publishing Co. Pvt. Ltd.
3. Robert (QMP) " Bench Marking", " The search for industry Best Practices that led to superior performance" American Society of Quality 1995
4. Break Joseph and Susan Joseph " Total Quality Management", Excel Books , New Delhi, 1995.

5. Juran Frank, J.M. and Gryna, F.M. "Quality Planning and Analysis", Tata McGraw Hill 2002.
6. James, J.O Brian, "Construction Inspection Handbook –Quality" 2009

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 50 marks. The pattern of the question paper is MCQ's with 50 questions of 1 mark each. The time allotted for SEE is 1 hour.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. Average marks scored in all three tests is added to the test component. The pattern of the question paper is MCQ's questions of 1 mark each. Some possible AATs: Seminar/assignments/ mini projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	**50**
	CIE Test-2	40	
	CIE Test-3	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 2/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV67A.1	2	2	2		1			1		1		1		2	
22CIV67A.2	2		2					1		1	2	1			
22CIV67A.3	2	2	2					1			2	1		2	
Average	**2**	**2**	**2**		**1**			**1**		**1**	**2**	**1**		**2**	

SEMESTER – VI

Course: Applications of AI in Civil Engineering

Course Code	**22CIV67B**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**0:2:0**	**SEE Marks**	**50**
No. of Credits	**01**	**Examination Hours**	**01**

Prerequisites:

Course Objectives: Students will be taught:

CLO1	To understand different approaches, techniques and branches of AI
CLO2	To understand different applications of AI

Content	No. of Hours/ RBT levels
Introduction to Artificial Intelligence, topics: Definitions, goals, approaches, techniques, and branches;	**3 Hours L2**
Intelligent behavior, understanding AI, hard or strong AI, soft or weak AI, cognitive science. General, engineering and science-based AI Goals. AI approaches - cognitive science, laws of thought, turing test, and rational agent.	**4 Hours L2**
AI Techniques that make system to behave as intelligent describe and match, goal reduction, constraint satisfaction, tree searching, generate and test, rule-based systems. Biology-inspired AI techniques - neural networks, genetic algorithms, reinforcement learning.	**4 Hours L2**
Branches of AI - logical AI, search in AI, pattern recognition, knowledge representation, inferencing, common sense knowledge and reasoning, learning, planning, epistemology, ontology, heuristics, genetic programming.	**3 Hours L2**
Applications of AI - game playing, speech recognition, understanding natural language, computer vision, expert systems	**3 Hours L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV67B.1	Understand different approaches, techniques and branches of AI understand different approaches, techniques and branches of AI
22CIV67B.2	Understand different applications of AI

Textbooks:

Artificial Intelligence A Modern Approach Third Edition, PRENTICE HALL SERIES IN ARTIFICIAL INTELLIGENCE Stuart Russell and Peter Norvig, Editors

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 50 marks. The pattern of the question paper is MCQ's with 50 questions of 1 mark each. The time allotted for SEE is 1 hour.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. Average marks scored in all three tests is added to the test component. The pattern of the question paper is MCQ's questions of 1 mark each. Some possible AATs: Seminar/assignments/ mini projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	**50**
	CIE Test-2	40	
	CIE Test-3	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 2/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV67B.1	3	3	3		2							3	-	2	
22CIV67B.2	3	3	3		2							3	-	2	
Average	**3**	**3**	**3**		**2**							3	-	2	

SEMESTER – VI

Course: Visual Basic Analysis and Microsoft Project

Course Code	**22CIV67C**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**0:2:0**	**SEE Marks**	**50**
No. of Credits	**01**	**Examination Hours**	**01**

Prerequisites:

Course Objectives: Student will be taught to:

CLO1	Understand the VBA Programming
CLO2	Understand planning using MSP

Content	No. of Hours/ RBT levels
Macro recording, VBA procedures, and debugging Introduction to visual basic for applications (VBA) and foundational tools required to create basic procedures in VBA. Different data types and the scope of variables, troubleshooting code, and how to record basic macros using both absolute and relative referencing modes.	**4 Hours L2**
User-Defined VBA Functions Basic VBA expression entry, creating user-defined functions, functions to Add-Ins in Excel, how to borrow Excel's built-in functions, how to troubleshoot VBA functions when not working.	**4 Hours L2**
Exchanging Information Between Excel and VBA Reference and move information to VBA from Excel and vice versa. types of objects, properties, methods, and events in VBA. Dealing with errors that arise in subroutines.	**4 Hours L2**
Programming structures in VBA problem solving using programming in VBA. common programming structures in VBA (sequence, selection, and repetition) .	**4 Hours L2**
Introduction to Project Management and Project Life Cycle Management Integration Management, Schedule Management, Cost Management, Quality Management, Resource Management, Stakeholder Management	**4 Hours L2**

COURSE OUTCOMES:
Upon completion of this course, student will be able to:

22CIV67C.1	Apply VBA programming to solve civil Engineering problems.
22CIV67C.2	Plan effectively construction activities using MSP.

Textbooks:

1. Excel 2016 Power Programming With VBA, Micheal Alexander and Dick Kudeika, Willey Publications.

Reference books:

1. Learning Microsoft Project 2019, Srikanth Shirodkar.

Scheme of Examination:

Continuous Internal Examination (CIE): One CIE will be conducted at the end of the semester for 50 marks and proportionately reduced to 30.

Week wise CIE Evaluation		
Sl.no	**Activity**	**Marks**
1	Conduction	15
2	Viva voce	05
Total		20

Continuous Internal Examination		
Sl.no	**Activity**	**Marks**
1	Write-up	5
2	Conduction	20
3	Viva voce	5
Total		30

Final CIE Evaluation		
Sl.no	**Activity**	**Marks**
1	Week wise CIE Evaluation	20
2	Continuous Internal Examination	30
Total		50

Semester End Examination (SEE):

1. All laboratory experiments are to be included for practical examination.
2. Students can pick one experiment from the questions lot prepared by the examiners.
3. Change of experiment is allowed only once and 20% marks allotted to the conduction part to be made zero.

Semester End Examination Evaluation		
Sl.no	**Activity**	**Marks**
1	Write-up	15
2	Conduction	70
3	Viva voce	15
Total		100

Note: The marks scored will be proportionately reduced to 50.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV67C.1	2	1			2				1		1	1			
22CIV67C.2	2				2				1	1	1	1			
Average	**2**	**1**			**2**				**1**	**1**	**1**	**1**			

SEMESTER – V

Course: Forensics and Rehabilitation

Course Code	**22CIV67D**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**0:2:0**	**SEE Marks**	**50**
No. of Credits	**01**	**Examination Hours**	**01**

Prerequisites:

Course Objectives: Students will be taught:

CLO1	To understand structural failures and causes of distress in structural members
CLO2	To understand different methods of visual and non destructive testings

Content	No. of Hours/ RBT levels
Module-1 **Forensics and Rehabilitation:** Failure of Structures, review of the construction theory, performance problems, responsibility and accountability, case studies, learning from failures, causes of distress in structural members, design and material deficiencies, over loading.	**8 Hours** **L2**
Module 2 **Diagnosis and Assessment of Distress**: Visual inspection, non- destructive tests, ultrasonic pulse velocity method, rebound hammer technique, ASTM classifications, pullout tests, Bremor test, Windsor probe test, crack detection techniques, case studies, single and multistorey buildings, fibreoptic method for prediction of structural weakness	**8 Hours** **L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV67D.1	Understand material deficiencies and causes of failures
22CIV67D.2	Understand various nondestructive tests to predict structural weakness

Textbooks:

1. Philip W. (1994) Industrial sensors and applications for condition monitoring, MEP
2. Armer G S T (2001) Monitoring and assessment of structures, Spon, London

Reference books:

1. Raikar,R.N., (1994) Learning from failures – Deficiencies in design, construction and service – R&D Centre (SDCPL), Raikar Bhavan

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 50 marks. The pattern of the question paper is MCQ's with 50 questions of 1 mark each. The time allotted for SEE is 1 hour.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. Average marks scored in all three tests is added to the test component. The pattern of the question paper is MCQ's questions of 1 mark each. Some possible AATs: Seminar/assignments/ mini projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	**50**
	CIE Test-2	40	
	CIE Test-3	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 2/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV67D.1	2	2	1	1				1				1			
22CIV67D.2	2	2	1	1				1			2				
Average	**2**	**2**	**1**	**1**				**1**			**2**	**1**			

SEMESTER – VI

Course: Indian Knowledge System

Course Code	**22CIVK69**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**1:0:0**	**SEE Marks**	**50**
No. of Credits	**0**	**Examination Hours**	**1**

Prerequisites: - None

Course Objectives:

CLO1	To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system
CLO2	To make the students understand the traditional knowledge and analyse it and apply it to their day-to-day life.

Content
Module 1 (05 hours)
Introduction to Indian Knowledge Systems (IKS): Overview, Vedic Corpus, Philosophy, Character scope and importance, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge vs. western knowledge.
Module 2 (05 hours)
Traditional Knowledge in Humanities and Sciences: Lingistics, Number and measurements-Mathematics, Chemistry, Physics, Art, Astronomy, Astrology, Crafts and Trade in India and Engineering and Technology
Module 3 (05 hours)
Traditional Knowledge in Professional domain: Town planning and architecture Construction, Health, wellness and Psychology-Medicine, Agriculture, Governance and public administration, United Nations Sustainable development goals.

Reference Books:

1. Introduction to Indian Knowledge System- concepts and applications, B Mahadevan, Vinayak Rajat Bhat, Nagendra Pavana R N, 2022, PHI Learning Private Ltd, ISBN-978-93- 91818-21-0
2. Traditional Knowledge System in India, Amit Jha, 2009, Atlantic Publishers and Distributors (P) Ltd., ISBN-13: 978-8126912230,
3. Knowledge Traditions and Practices of India, Kapil Kapoor, Avadesh Kumar Singh, Vol. 1, 2005, DK Print World (P) Ltd., ISBN 81-246-0334,

COURSE OUTCOMES:

Upon completion of this course, student would:

22CIVK69.1	Provide an overview of the concept of the Indian Knowledge System and its importance.
22CIVK69.2	Appreciate the need for and importance of protecting traditional knowledge.
22CIVK69.3	Recognize the relevance of Traditional knowledge in different domains.
22CIVK69.4	Establish the significance of Indian Knowledge systems in the contemporary world

Scheme of Examination:

Semester End Examination (SEE):
SEE paper shall be set for 50 questions, each of the 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is 01 hour.
Continuous Internal Evaluation (CIE):
Three Tests are to be conducted for 40 marks each. Average of Marks scored in all three tests is added to test component. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests.
Typical Evaluation pattern for regular courses is shown in Table 2.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2	**40**	
	CIE Test-3	**40**	
	Assignments	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

CO/PO Mapping

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
22CIVK69.1						3									
22CIVK69.2						3									
22CIVK69.3						3									
22CIVK69.4						3									
Average						3									

SEMESTER – VI

Course: Universal Human Values

Course Code	**22UHV69**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**1:0:0**	**SEE Marks**	**50**
No. of Credits	**0**	**Examination Hours**	**1**

Prerequisites: - None

Course Objectives:

CLO1	To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
CLO2	To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
CLO3	To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.
CLO4	To provide a much-needed orientation input in value education to the young enquiring minds.

Content
Module 1 (03 hours)
Introduction to Value Education: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations
Module 2 (03 hours)
Harmony in the Human Being : Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health
Module 3 (03 hours)
Harmony in the Family and Society : Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order
Module 4 (03 hours)
Harmony in the Nature/Existence: Understanding Harmony in the Nature, Interconnectedness,

self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence
Module 5 (03 hours)
Implications of the Holistic Understanding – a Look at Professional Ethics: Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession

Reference Books:

4. The Textbook A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978- 93-87034- 47-1
5. The Teacher‟s Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G

COURSE OUTCOMES:

Upon completion of this course, student would:

22UHV69.1	Become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
22UHV69.2	Have better critical ability
22UHV69.3	Become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
22UHV69.4	Apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction

Scheme of Examination:

Semester End Examination (SEE):
SEE paper shall be set for 50 questions, each of the 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is 01 hour.
Continuous Internal Evaluation (CIE):
Three Tests are to be conducted for 40 marks each. Average of Marks scored in all three tests is added to test component. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests.
Typical Evaluation pattern for regular courses is shown in Table 2.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2	**40**	
	CIE Test-3	**40**	
	Assignments	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

CO/PO Mapping															
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
22UHV69.1						3									
22UHV69.2						3									
22UHV69.3						3									
22UHV69.4						3									
Average						3									

SCHEME AND SYLLABUS

Department of Civil Engineering

Head of Department
Civil Engineering
Global Academy of Technology
Rajarajeshwarinagar Bangalore - 98

VII - VIII Semester Scheme (2022-23)

Civil Engineering

GLOBAL ACADEMY OF TECHNOLOGY
(Autonomous institution affiliated to VTU, Belagavi.
Accredited by NAAC with 'A' grade,
NBA Accredited Civil, CS, E&C, E&E, MECH and IS branches)
Ideal Homes Township,
Raja Rajeshwari Nagar, Bengaluru-560098.

H.V. Rajashekhar Aneas
Dean Academic
Global Academy of Technology,
Rajarajeshwarinagar, Bengaluru-98

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B.E. in CIV Engineering Scheme of Teaching and Examinations 2023

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023-24)

Scheme A- VII SEMESTER (Swappable VII and VIII SEMESTER)

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecturer	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	IPCC	22CIV71	Estimation & Contract Management	TD: CIV, PSB:CIV	3	2	0		03	50	50	100	4
2	IPCC	22CIV72	Design & drawing of irrigation and Bridge Structures	TD: CIV, PSB:CIV	3	0	2		03	50	50	100	4
3	PCC	22CIV73	Design & drawing of RCC & Steel structures	TD: CIV, PSB:CIV	3	2	0		03	50	50	100	4
4	PEC	22CIV74x	Professional Elective-III	TD: CIV, PSB:CIV	3	0	0		03	50	50	100	3
5	OEC	22CIV75x	Open Elective- II		3	0	0		01	50	50	100	3
6	PROJ	22CIVP76	Major Project Phase-II		0	0	12		03	100	100	200	6
									Total	**350**	**350**	**700**	**24**

Professional Elective Course

22CIV74A	Finite Element Method	22CIV74C	Pavement Design & Maintenance
22CIV74B	Design of PSC & RCC Bridge	22CIV74D	Integrated Water Resources Management
22CIV74E	Advanced Foundation Engineering		

Open Elective Course

22CIV75A	AI/ML in infrastructure Engineering	22CIV75C	Engineering Economics
22CIV75B	Disaster Mitigation and management	22CIV75D	Sensor Technologies for Infrastructure

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **PEC**: Professional Elective Course, **OEC**: Open Elective Course PR: Project Work, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **TD**-Teaching Department, **PSB**: Paper Setting department, **OEC**: Open Elective Course, **PEC**: Professional Elective Course. **PROJ**: Project work

Note: VII and VIII semesters of IV years of the program

(1) Institutions can swap the VII and VIII Semester Schemes of Teaching and Examinations to accommodate research internships/ industry internships after the VI semester.

(2) Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether the VII or VIII semesters is completed during the beginning of the IV year or the later part of IV years of the program.

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. Each group will provide an option to select one course. The minimum number of students' strengths for offering professional electives is 10. However, this conditional shall
not be applicable to cases where the admission to the program is less than 10.

Open Elective Courses:

Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they can opt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor. The minimum numbers of students' strength for offering Open Elective Course is 10. However, this condition shall not be applicable to class where the admission to the program is less than 10.

PROJECT WORK (21MEP75): The objective of the Project work is

(i) To encourage independent learning and the innovative attitude of the students.

(ii) To develop interactive attitude, communication skills, organization, time management, and presentation skills.

(iii) To impart flexibility and adaptability.

(iv) To inspire team working.

(v) To expand intellectual capacity, credibility, judgment and intuition.

(vi) To adhere to punctuality, setting and meeting deadlines.

(vii) To install responsibilities to oneself and others.

(viii) To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas.

CIE procedure for Project Work:

(1) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

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

(2) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the college. Participation of external
guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

SEE procedure for Project Work: SEE for project work will be conducted by the two examiners appointed by the University. The SEE marks awarded for the project work
shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25.

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B.E. in CIV Engineering Scheme of Teaching and Examinations 2023

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023-24)

Scheme A- VIII SEMESTER (Swappable VII and VIII SEMESTER)

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory	Tutorial	Practical Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	PEC	22CIV81x	Professional Elective -IV (Online Courses)	TD: CIV,PSB:CIV	3	0	0		03	50	50	100	3
2	OEC	22CIV82x	Open Elective - III (Online Courses)	TD: CIV, PSB:CIV	3	0	0		03	50	50	100	3
3	INT	22CIVI83	Internship (Industry/Research) (14 - 20 weeks)	TD: CIV, PSB:CIV	0	0	12		03	100	100	200	10
									Total	**200**	**200**	**400**	**16**

Professional Elective Course (Online courses)

22CIV81A	Urban transport & Intelligent Transportation System	22CIV81E	Deep Excavation and Tunnels
22CIV81B	Solid waste management	22CIV81F	Metro and Seaports Engineering
22CIV81C	Economic evaluation & DPR	22CIV81G	Geo environmental Engineering
22CIV81D	Pavement construction, maintenance and management	22CIV81H	Advanced Design of Steel Structures

Open Elective Courses (Online Courses)

22CIV82A	Energy Conservation in Buildings	22CIV82C	Green Buildings
22CIV82B	Occupational Health and Safety	22CIV82D	Integrated Building Services

L: Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **TD**-Teaching Department, **PSB**:

Paper Setting department, **OEC**: Open Elective Course, **PEC**: Professional Elective Course. **PROJ**: Project work, **INT**: Industry Internship / Research Internship / Rural Internship

Note: VII and VIII semesters of IV years of the program Swapping Facility

- Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate **research internships/ industry internships / Rural Internship** after the VI semester**.**
- Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the program.

Elucidation:

At the beginning of IV years of the program i.e., after VI semester, VII semester classwork and VIII semester **Research Internship /Industrial Internship / Rural Internship** shall be permitted to be operated simultaneously by the University so that students have ample opportunity for an internship. In other words, a good percentage of the class shall attend VII semester classwork and a similar percentage of others shall attend to Research Internship or Industrial Internship or Rural Internship.

Research/Industrial /Rural Internship shall be carried out at an Industry, NGO, MSME, Innovation centre, Incubation centre, Start-up, centre of Excellence (CoE), Study Centre established in the parent institute and /or at reputed research organizations/institutes.

The mandatory Research internship /Industry internship / Rural Internship is for 14 to 20 weeks. The internship shall be considered as a head of passing and shall be considered for the award of a degree. Those, who do not take up/complete the internship shall be declared to fail and shall have to complete it during the subsequent University examination after satisfying the internship requirements.

Research internship: A research internship is intended to offer the flavour of current research going on in the research field. It helps students get familiarized with the field and imparts the skill required for carrying out research.

Industry internship: Is an extended period of work experience undertaken by students to supplement their degree for professional development. It also helps them learn to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with contingencies helps students recognize, appreciate, and adapt to organizational realities by tempering their knowledge with practical constraints.

Rural Internship: Rural development internship is an initiative of Unnat Bharat Abhiyan Cell, RGIT in association with AICTE to involve students of all departments studying in different academic years for exploring various opportunities in techno-social fields, to connect and work with Rural India for their upliftment.

The faculty coordinator or mentor has to monitor the student's internship progress and interact with them to guide for the successful completion of the internship.The students are permitted to carry out the internship anywhere in India or abroad. University shall not bear any expenses incurred in respect of the internship.

With the consent of the internal guide and Principal of the Institution, students shall be allowed to carry out the internship at their hometown (**within or outside the state or abroad**), provided favorable facilities are available for the internship and the student remains regularly in contact with the internal guide. **University shall not bear any cost involved in carrying out the internship by students.** However, students can receive any financial assistance extended by the organization.

Professional Elective /Open Elective Course: These are ONLINE courses suggested by the respective Board of Studies. Details of these courses shall be made available for students on the VTU web portal.

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B.E. in CIVCIV Engineering Scheme of Teaching and Examinations 2023

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2022-23)

Scheme B- VII SEMESTER (Swappable VII and VIII SEMESTER)

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lectue	Tutorial	Practical / Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	IPCC	22CIV71	Estimation & Contract Management(To be completed in the 6 th semester)	TD: PSB:	2	2	0		03	50	50	100	3
2	IPCC	22CIV72	Design & drawing of irrigation and Bridge Structures (To be completed in 5th/6th semester)	TD: PSB:	3	0	2		03	50	50	100	4
3	PCC	22CIV73	Design & drawing of RCC & Steel structures (To be completed in 5th/6th semester)	TD: PSB:	2	2	2		03	50	50	100	4
4	PEC	22CIV74x	**Professional Elective-III**	TD: PSB:	3	0	0		03	50	50	100	3
5	OEC	22CIV75x	**Open Elective- II**	TD: PSB:	3	0	0		01	50	50	100	3
								Total		**250**	**250**	**500**	**17**

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B.E. in CIVXX Engineering Scheme of Teaching and Examinations 2023

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023-24)

Scheme B- VIII SEMESTER (Swappable VII and VIII SEMESTER)

Sl. No	Course and Course Code		Course Title	Teaching Department (TD)and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lectue	Tutorial	Practica/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	PEC	22CIV81x	**Professional Elective -IV (Online Courses)**	TD: PSB:	3	0	0		03	50	50	100	3
2	OEC	22CIV82x	**Open Elective - III (Online Courses)**	TD: PSB:	3	0	0		03	50	50	100	3
3	PROJ	22CIVP84	**Project - outcome of training**		0	0	12		03	100	100	200	9
4	INT	22CIVI83	**Internship (Industry/Research)**	TD:	0	0	12		03	100	100	200	10
									Total	**300**	**300**	**600**	**25**

SEMESTER – VI

Course: Estimation and Contract Management

Course Code	**22CIV71**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:2:0**	**SEE Marks**	**50**
No. of Credits	**4**	**Examination Hours**	**3**

Prerequisites: Engineering Survey, Building Materials, Environmental Engineering, Hydraulics, Irrigation Engineering

Course Objectives: Students will be taught:

CLO1	Estimation of the quantities of various items of Civil Engineering works, prepare the abstract for the estimated cost of civil engineering project.
CLO2	Standard procedure of writing specification and the method of analysis of rate for various civil engineering items.
CLO3	Efficient acquisition, utilization, and distribution of finance.
CLO4	Create the tender and contract documents.

Content	**No. of Hours/ RBT levels**
Module – 1 **Quantity Estimation for Building:** study of various drawing attached with estimates, important terms, units of measurements, abstract, Types of estimates. Estimation of building by Short wall and long wall method - centre line method. Estimate of R.C.C structures including Slab, beam, column, footings.	**8 Hours L3**
Module – 2 Estimate of Steel truss, manhole and septic tanks and slab culvert. Quantity **Estimation for Roads:** Computation of volume of earthwork fully in banking, cutting, partly cutting and partly Filling by mid-section, trapezoidal and Prismoidal Methods.	**8 Hours L3**
Module – 3 **Specification for Civil Engineering Works:** Objective of writing specifications essentials in specifications, general and detail specifications of different items of works in buildings and roads.	**8 Hours L2**

Analysis of Rates: Factors Affecting Cost of Civil Works , Concept of Direct Cost , Indirect Cost and Project Cost Rate analysis and preparation of bills, Data analysis of rates for various items of Works, Sub-structure components, Rate analysis for R.C.C. slabs, columns and beams.	
Module – 4 **Contract Management-Tender and its Process:** Invitation to tender, Prequalification, administrative approval & Technical sanction. Bid submission and Evaluation process. Contract Formulation: Letter of intent, Award of contract, letter of acceptance and notice to proceed. Features / elements of standard Tender document (source: PWD / CPWD / International Competitive Bidding – NHAI / NHEPC / NPC). Law of Contract as per Indian Contract act 1872, Types of Contracts, Joint venture. **Contract Forms:** FIDIC contract Forms, CPWD, NHAI, NTPC, NHEPC	**8 Hours L2**
Module 5 **Contract Management-Post award:** Basic understanding on definitions, Performance security, Mobilization and equipment advances, Secured Advance, Suspension of work, Time limit for completion, Liquidated damages and bonus, measurement and payment, additions and alterations or variations and deviations, breach of contract, Escalation, settlement of account or final payment, claims, Delay's and Compensation, Disputes & its resolution mechanism, Contract management and administration. **Valuation:** Definitions of terms used in valuation process, Purpose of valuation, Cost, Estimate, Value and its relationship, Capitalized value. Freehold and lease hold and easement, Sinking fund, depreciation–methods of estimating depreciation, Outgoings, Process and methods of valuation: Rent fixation, valuation for mortgage, valuation of land.	**8 Hours L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV71.1	Compute quantities, cost and prepare abstract for building components
22CIV71.2	Compute quantities, cost and prepare abstract for various structural works: water supply, Sanitary and road works.
22CIV71.3	Prepare specifications and rate of analysis for various items of work.
22CIV71.4	Assess Contract and tender documents for various construction works.
22CIV71.5	Demonstrate role and importance of finance function.

Textbooks:

1. Datta B.N "Estimation and Costing", 28th edition, UBSPD Publishing house, New Delhi, 2021
2. B S Patil, "Civil Engineering contracts and Estimates", 4th edition, Universities press, 2015.
3. M Chakraborthi; "Estimation, costing and specifications", 29th edition, Lakshmi publications, 2006.
4. MORTH Specifications for Roads and Bridge works – IRC New Delhi.

References:

1. Rangwala C "Estimating, Costing and valuation", 17th edition, Charotar Publishing House Pvt Ltd, 2017.
2. Martin Books, "Estimation and Tendering for Construction Work", 5th edition, A Butterworth – Heinemann publishers, 2017
3. P W D Data Book, CPWD Schedule of Rate (SoR) and NH SoR – Karnataka FIDIC Contract forms.
4. B S Ramaswamy "Contracts and their Management",5th edition Lexis Nexis (a division of Reed Elsevier India Pvt Ltd), 2016.

Web Reference:

https://www.youtube.com/watch?v=IcmigyqQcEw&list=PLZmv_MNQCMBi7gXQe_bGAFPlrfM7qlX47

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 30 marks each for integrated and 40 marks for non-integrated subjects. Average of three test marks will be added to test component and laboratory assessment to be finalized for 10 marks for integrated subjects. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs). **Some possible AATs:** seminar / assignments / mini projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses.

Component		Marks	Total Marks
CIE	CIE Test-1	40	**50**
	CIE Test-2	40	
	CIE Test-3	40	
	Average of CIE	**40**	
	Quiz/AAT	05	
	Quiz/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e., A minimum marks of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV71.1	3	2	1								1			3	
22CIV71.2	3	2	1			1					1			3	
22CIV71.3	3	2												2	
22CIV71.4	3	2						1			1			1	
22CIV71.5											2	1			
Average	**3**	**2**	**1**			1		1			**1.25**	**1**		**2.25**	

SEMESTER – VII

Course: Design & Drawing of Irrigation and Bridge Structures

Course Code	**22CIV72**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:2**	**SEE Marks**	**50**
No. of Credits	**4**	**Examination Hours**	**4**

Prerequisites: Fluid Mechanics, Hydrology and Irrigation Engineering and Design and Drawing of RC structural Elements,

Course Objectives: Students will be taught:

CLO1	Apply principles of Hydraulics and Empirical formula for design and drawings of hydraulic structures associated with irrigation.
CLO2	Analyze and design slab culvert, box culvert and pipe culvert as per IRC specifications

Content	**No. of Hours/ RBT levels**
Module-1 **Design and drawing of the following hydraulic structures.** i. Surplus Weir ii. Tank sluice with tower head iii. Canal drop iv. Canal Regulator	**25 Hours L3**
Module 2 **Design Principles of Transportation Sub-Structures** i. General-features, piers and Abutments-materials, types, forces, design of piers. ii. Design of Reinforced cement concrete slab culvert, box culvert and pipe culvert.	**25 Hours L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV72.1	**Design** of Tank sluice, Canal drop, Canal regulator and Direct sluice for Strength and serviceability requirements.
22CIV72.2	**Design** of Slab culvert, Box, Pipe culvert, Piers and Abutments for Strength and serviceability requirements.

Textbooks:

1. C Satyanarayana Murthy "water Resources Engineering: Principles and Practice"- 2nd edition, New age International Publishers-2000
2. N Krishna Raju, "Design of Bridges", 5th edition, Oxford & IBH Publishing Co New Delhi, 2019.
3. T R Jagadeesh and M A Jayaram, "Design of Bridge Structures", 2nd Edition, Eastern Economy Edition, 2009.
4. D Johnson Victor, "Essentials of Bridge Engineering", 6th edition, Oxford & IBH Publishing Co New Delhi, 2019.

References:

1. Arora KR "Irrigation Water Power & Water Resources Engineering"- Standard Publishers Distributors-2010
2. P.N Modi, "Irrigation Water Power & Water Resources Engineering"- Standard book houseDistributors-2010
3. C.Punima and PandeLal, "Irrigation Water Power & Water Resources Engineering"- Lakshmi Publications, New Delhi-2009.
4. Ponnuswamy. S, "Bridge Engineering", 3rd edition, Tata McGraw Hill, 2017.
5. IRC 6 – 1966 "Standard Specifications and Code of Practice for Road Bridges"- Section II Loads and Stresses, the Indian Road Congress New Delhi
6. IRC 21 – 1966 "Standard Specifications and Code of Practice for Road Bridges"-Section III Cement Concrete (Plain and reinforced) The Indian Road Congress New Delhi
7. IS 456 – 2018 "Indian Standard Plain and Reinforced Concrete Code of Practice"- (Fourth Revision) BIS New Delhi

Web Reference:

Design of Beams	www.youtube.com/watch?v=RXWImcb73Y&list=PLXKZsEFKU__HHtsCMaAIPB3tr5Ht2Bdge&index=12 www.youtube.com/watch?v=Llg1rYoZMfU&list=PLXKZsEFKU__HHtsCMaAIPB3tr5Ht2Bdge&index=13 www.youtube.com/watch?v=3UBrBrpW-uY&list=PLXKZsEFKU__HHtsCMaAIPB3tr5Ht2Bdge&index=14 www.youtube.com/watch?v=7HXF3oGWRlA&list=PLXKZsEFKU__HHtsCMa AIPB3tr5Ht2Bdge&index=15
Design of Box culvert	www.youtube.com/watch?v=tVrp4M9HoxY
Design of Abutment and Piers	www.youtube.com/watch?v=VHlaD0lEMhQ

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. Two questions shall be asked with one question from each module. There can be a maximum of three subdivisions in each question, if necessary. One full question should be answered from each module. Each question carries 50 marks.

The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks reduced to 20 marks each. Average of three test marks will be added to test component. CIE is executed by way of Lab Assessment Tools (AATs)

Some possible AATs: seminar/assignments/ mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern for integrated courses is shown in the Table below

Table 1: Distribution of weightage for CIE & SEE of Regular courses:

Component		Marks	Total Marks
CIE	CIE Test-1	20	**50**
	CIE Test-2	20	
	CIE Test-3	20	
	Laboratory	**30**	
SEE	**Semester End Examination**	**100**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e. A minimum marks of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV72.1	3	2			2			1				2		3	
22CIV72.2	3	2			2			1				2		3	
Average	**3**	**2**			**2**			1				**2**		**3**	

SEMESTER – VIII

Course: Design and Drawing of RCC and Steel Structures

Course Code	**22CIV73**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**2:2:2**	**SEE Marks**	**50**
No. of Credits	**4**	**Examination Hours**	**3**

Prerequisites: Design and Drawing of RCC Elements, Design and Drawing of Steel Elements.

Course Objectives: Students will be taught:

CLO1	Concept of Design and Steel structures.
CLO2	Solve Engineering problems in RC and Steel Structures.
CLO3	Design a Retaining wall, Footing, Water tanks, Portal frames as per the specifications of IS Codal Provisions.
CLO4	Design a Roof Truss, Plate Girder and Gantry Girder as per the specifications of IS Codal Provisions.

Content	**No. of Hours/ RBT levels**
Module-1 **Footings:** Design of rectangular slab, slab-beam type combined footing. **Retaining Walls:** Design of cantilever Retaining wall and counter fort retaining wall. **Water Tanks:** Design of circular water tanks resting on ground (Rigid and Flexible base). Design of portal frames with fixed and hinged based supports.	**25 Hours L3**
Module 2 **Roof Truss:** Design of roof truss for different cases of loading, forces in members to given. **Plate Girder:** Design of welded plate girder with intermediate stiffener, bearing stiffener and necessary checks. **Gantry Girder:** Design of gantry girder with all necessary checks.	**25 Hours L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV73.1	Design of combined footing, retaining wall, Portal frame and water tank for Strength and serviceability requirements.
22CIV73.2	Design of Roof Truss, Plate Girder and Gantry Girder for Strength and serviceability requirements.

Textbooks:

1. N Krishna Raju, "Structural Design and Drawing of Reinforced Concrete and Steel", 3rd edition, University Press, 2021.
2. Subramanian N, "Design of Steel Structures", Oxford University Press, New Delhi, 2008
3. K S Duggal, "Design of Steel Structures" 3rd Edition, Tata McGraw Hill, New Delhi, 2019.

References:

1. Charles E Salman, Johnson & Mathas, "Steel Structure Design and Behavior",Pearson Publications
2. Nether Cot, et.al, "Behavior and Design of Steel Structures to EC-III" 4th Edition, CRC Press, 2007
3. P C Verghese, "Limit State Design of Reinforced Concrete", 2nd Edition, PHI Publications, New Delhi, 2008
4. S N Sinha, "Reinforced Concrete Design" 3rd Edition, McGraw Hill Publication, 2017.

IS Codes

1. IS:456-2000 – Plain and Reinforced Concrete- Code of Practice, Bureau of Indian Standards, New Delhi.
2. IS:800-2007- General Construction in Steel- Code of Practice, Bureau of Indian Standards, New Delhi.
3. SP-6 – Steel Tables
4. IS:3370 (part-4) – Code of Practice for Concrete Structures for the storage of liquids, Bureau of Indian Standards, New Delhi.

Web Reference:

https://archive.nptel.ac.in/courses/105/106/105106112/

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. Two questions shall be asked with one question from each module. There can be a maximum of three subdivisions in each question, if necessary. One full question should be answered from each module. Each question carries 50 marks.

The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE on a scale of 30, the CIE would also include laboratory evaluation for 20 marks. The laboratory marks of 20 would comprise of 10 marks for regular laboratory assessment to include lab record and observation. 10 marks would be exclusive for laboratory internal assessment test to be conducted at the end of the semester**.**

Typical Evaluation pattern for integrated courses is shown in the Table below.

Table 1: Distribution of weightage for CIE & SEE of Regular courses:

Component		Marks	Total Marks
CIE	CIE Test-1	30	**50**
	CIE Test-2	30	
	CIE Test-3	30	
	Laboratory	**20**	
SEE	**Semester End Examination**	**100**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e. A minimum marks of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV73.1	3	3	2		2									3	
22CIV73.2	3	3	2		2									3	
Average	**3**	**3**	**2**		**2**									**3**	

SEMESTER – VII

Course: Finite Element Method

Course Code	**22CIV74A**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**2:2:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites: Structural Analysis

Course Objectives: Students will be taught:

CLO1	To learn basic principles of finite element analysis procedure
CLO2	To understand discretisation and shape functions for beam and truss problems
CLO3	To determine element stiffness matrix for finite elements
CLO4	To apply numerical integration techniques to various dimensional structures
CLO5	To learn solution techniques for geometric and material nonlinearity problems

Content	**No. of Hours/ RBT levels**
Module-1 Basic concepts of elasticity, Energy principles, Rayleigh - Ritz Method, Galerkin method, Difference between Finite Difference Method and Finite Element Method, Steps in finite element analysis, advantages & disadvantages, displacement approach, stiffness matrix and boundary conditions.	**8 Hours L3**
Module 2 Discretisation; finite representation of infinite bodies and discretisation of very large bodies, Element aspect ratio – mesh refinement vs. higher order elements. Natural Coordinates, Shape functions; polynomial, Lagrange and Serendipity, one dimensional formulation; beam and truss with numerical examples.	**8 Hours L3**
Module 3 2D formulations; Constant Strain Triangle, Linear Strain Triangle, 4 and 8 nodded quadrilateral elements, Numerical Evaluation of Element Stiffness -Computation of Stresses, Static Condensation of nodes, Degradation technique, Axisymmetric element.	**8 Hours L3**
Module 4	**8 Hours**

Isoperimetric concepts; isoperimetric, sub parametric and super parametric elements, Jacobian transformation matrix, Stiffness Matrix of Isoperimetric Elements, Numerical integration by Gaussian quadrature rule for one, two- and three-dimensional problems.	**L3**
Module 5 Techniques to solve nonlinearities in structural systems; material, geometric and combined nonlinearity, incremental and iterative techniques. Structure of computer program for FEM analysis, description of different modules, exposure to FEM software.	**8 Hours** **L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV74A.1	**Understand** the basic concepts of finite element analysis
22CIV74A.2	**Construct** mesh and shape functions for beam and truss problems
22CIV74A.3	**Compute** element stiffness matrix for various types of finite elements
22CIV74A.4	**Apply** Gaussian quadrature rule for one, two and three dimensional problems.
22CIV74A.5	**Explain** the solution techniques for geometric and material non linearity problems

Textbooks:

1. Krishnamoorthy C.S., "Finite Element analysis" 2nd edition - Tata McGraw Hill, 2017.
2. S Rajashekharan, "Finite Element Analysis", S Chand, S Chand & Company, 2006

References:

1. Desai C & Abel J F.," Introduction to Finite Element Method", East West Press Pvt. Ltd.

Web Reference:

1. https://ocw.mit.edu/courses/res-2-002-finite-element-procedures-for-solids-and-structures-spring-2010/
2. https://www.coursera.org/projects/finite-element-analysis-convergence-and-mesh-independence-study-mw7ah
3. https://www.coursera.org/projects/finite-element-method-linear-nonlinear-analysis-post-processing
4. https://nptel.ac.in/courses/112104193
5. https://onlinecourses.nptel.ac.in/noc22_me43/preview

Scheme of Examination:

Semester End Examination (SEE):
SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any five full questions choosing at least one full question from each module.

Continuous Internal Evaluation (CIE):
Three Tests are to be conducted for 30 marks each for integrated and 40 marks for non-integrated subjects. Average of three test marks will be added to test component and laboratory assessment to be finalized for 10 marks for integrated subjects. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs). **Some possible AATs:** seminar / assignments / mini projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses.

Component		Marks	Total Marks
CIE	CIE Test-1	40	**50**
	CIE Test-2	40	
	CIE Test-3	40	
	Average of CIE	**40**	
	Quiz/AAT	05	
	Quiz/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of 40% of the marks in both the CIE for theory and lab courses (i.e. A minimum marks of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV74A.1	3	1											1		
22CIV74A.2	3	2			2							1	1		1
22CIV74A.3	2	3	3		1							1	1		1
22CIV74A.4	2	2											1		
22CIV74A.5	3	3	3		2							1	1		1
Average	**2.6**	**2.2**	**3**		**1.67**							**1**	**1**		**1**

SEMESTER – VIII

Course: Design of PSC and RCC Bridges

Course Code	**22CIV74B**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites: Advanced Design of RCC Structures

Course Objectives: Students will be taught:

CLO1	Design of slab culvert as per IRC Specifications.
CLO2	Design of box culvert as per IRC Specifications.
CLO3	Design of T Beam and PSC Bridge as per IRC Specifications.
CLO4	Design of Balanced cantilever bridge as per IRC Specifications.

Content	**No. of Hours/ RBT levels**
Module-1 **Introduction & Design of Slab Culvert:** Bridge Engineering and its development in past, Ideal site selection for Bridges, Bridge classifications, Forces acting on Bridge. Analysis for maximum BM and SF at critical sections for Dead and Live load as per IRC class A, B, AA tracked and wheeled vehicles. Structural design of slab culvert using limit state method with reinforcement details	**08 Hours L3**
Module 2 **Box Culvert:** Introduction to box culvert, advantage of structural continuity, Analysis for maximum BM and SF at critical sections using moment distribution method for various load combinations such as Dead, Surcharge, Soil, Water and Live load as per IRC class A, B, AA tracked and wheeled vehicles. Structural design of box culvert using limit state method with reinforcement details.	**08 Hours L3**
Module 3 **T Beam Bridge Slab Design:** Proportioning of Components Analysis of interior Slab & Cantilever Slab Using IRC Class AA Tracked, Wheeled Class A Loading, Structural Design of Slab, with Reinforcement Detail. T Beam Bridge Cross Girder Design: Analysis of Cross Girder for Dead Load & Live Load Using IRC Class AA Tracked, Wheeled Class A Loading A Loads, Structural Design of beam with	**08 Hours L3**

Reinforcement Detail using Courbon's Method.	
Module 4 **PSC Bridge:** Introduction to Pre-& Post Tensioning, Proportioning of Components, Analysis & Structural Design of Slab, Analysis of Main Girder Using Courbon's Method for IRC Class AA, tracked vehicle, Calculations of Prestressing Force, Calculations of Stresses, Cable profile, Design of End Block, Detailing of Main Girder.	**08 Hours L3**
Module 5 **Balanced Cantilever Bridge:** Introduction & Proportioning of Components, Analysis of Main Girder Using Courbon's Method for IRC Class AA, tracked vehicle Design of Simply Supported Portion, Cantilever Portion, Articulation, using limit state method with reinforcement details.	**08 Hours L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV74B.1	Understand the concepts of bridges, IRC loadings and distribution theory as per IRC standards.
22CIV74B.2	Design slab culvert and box culvert subjected to various loading combinations and IRC standards.
22CIV74B.3	Analyse the maximum bending moment and shear force for T Beam bridge and PSC bridge as per COURBON'S method.
22CIV74B.4	Evaluate the maximum bending moment and shear force for Balanced Cantilever bridge as per IRC Codal provisions.

Textbooks:

1. N Krishna Raju, "Design of Bridges"- Oxford & IBH Publishing Co New Delhi-2013
2. Raina V.K., "Concrete Bridge Practice"- Tata McGraw Hill 200
3. D Johnson Victor "Essentials of Bridge Engineering"-, Oxford & IBH Publishing Co New Delhi 199

References:

1. N. Rajagopalan, Bridge Superstructure, Narosa Publishing House, 2006.
2. Ponnu Swamy. S, "Bridge Engineering"- Tata McGraw Hill 200
3. W. F. Chen and L. Duan, Bridge Engineering Handbook, CRC press, 2003

IS Code Books:

1. IS 456-2018 (Reaffirmed 2011, 2016) Plain and Reinforced Concrete -Code of Practice (4th Edition)
2. SP:34(S&T)-1987- Handbook on concrete Reinforcement and Detailing
3. SP16:1980, Design Aids for Reinforced Concrete to IS: 456-1978, Bureau of Indian Standards, New Delhi, 1992
4. IRC6,18,21,112-2015 (Code of Practice for Concrete Road Bridges)

Web Reference:

Introduction to Bridge Engineering IRC Loadings	• www.youtube.com/watch?v=RB2k5hSYO3U&list=PLXKZsEFKU__HHtsCMaAIPB3tr5Ht2Bdge&index=2 • www.youtube.com/watch?v=U4a0q4hYUWw&list=PLXKZsEFKU__HHtsCMaAIPB3tr5Ht2Bdge&index=6
Design of Beams	• www.youtube.com/watch?v=RXWImcb73Y&list=PLXKZsEFKU__HHtsCMaAIPB3tr5Ht2Bdge&index=12 • www.youtube.com/watch?v=Llg1rYoZMfU&list=PLXKZsEFKU__HHtsCMaAIPB3tr5Ht2Bdge&index=13 • www.youtube.com/watch?v=3UBrBrpW-uY&list=PLXKZsEFKU__HHtsCMaAIPB3tr5Ht2Bdge&index=14 • www.youtube.com/watch?v=7HXF3oGWRlA&list=PLXKZsEFKU__HHtsCMa • AIPB3tr5Ht2Bdge&index=15
Design T-Beam Bridge	• www.youtube.com/watch?v=TDuvNevZwp0&list=PLXKZsEFKU__HHtsCMaAIPB3tr5Ht2Bdge&index=17 • www.youtube.com/watch?v=xh876dxfLnE&list=PLXKZsEFKU__HHtsCMaAIPB3tr5Ht2Bdge&index=18 • www.youtube.com/watch?v=BllNVVo2HnM&list=PLXKZsEFKU__HHtsCMaAIPB3tr5Ht2Bdge&index=19 • www.youtube.com/watch?v=KDXVQ3TMTlo&list=PLXKZsEFKU__HHtsCMaAIPB3tr5Ht2Bdge&index=22

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module

carrying 20 marks each. Students are required to answer any five full questions choosing at least one full question from each module.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 30 marks each for integrated and 40 marks for non integrated subjects. Average of three test marks will be added to test component and laboratory assessment to be finalized for 10 marks for integrated subjects. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs). Some possible AATs: seminar / assignments / mini projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test 1	**40**	**50**
	CIE Test 2	**40**	
	CIE Test 3	**40**	
	Average of CIE	**40**	
	Quiz 1/AAT	**05**	
	Quiz 2/AAT	**05**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e. A minimum marks of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV74B.1	3	3			2									3	
22CIV74B.2	3	3			2							1		3	
22CIV74B.3	3	3			2							1		3	
22CIV74B.4	3	3			2							1		3	
Average	**3**	**3**			**2**							**1**		**3**	

SEMESTER – VII

Course: Pavement Design and Maintenance

Course Code	**22CIV74C**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites: Transportation engineering

Course Objectives: Students will be taught:

CLO1	To understand components of pavement and factors affecting pavement design and performance
CLO2	To understand stresses & deflection in flexible pavements under the action of wheel loads and various design methods of flexible pavement.
CLO3	To understand stresses & deflection in rigid pavements under the action of wheel loads and various design methods of rigid pavement.
CLO4	To understand different flexible pavement failures and methods of evaluation and maintenance
CLO5	To understand different rigid pavement failures and methods of evaluation and maintenance

Content	**No. of Hours/ RBT levels**
Module-1 **Introduction:** Desirable characteristics of pavement, Comparison of Flexible and Rigid Pavements, Components and Functions of pavement layers. **Fundamentals of design of pavements:** Pavement design factors, loads, Design life, Traffic factors, climatic factors, Evaluation of Subgrade soil strength	**8 Hours L2**
Module 2 **Stresses in flexible pavement** Stresses and deflections, Boussinesq's Elastic Theory – principle, Assumptions – Limitations, Burmister two-layer Elastic theory and Problems using vertical stress charts and deflection charts. **Flexible pavement design:** Assumptions, Mcleod Method, Kansas method, CSA method using IRC-37-2001, problems on above. , Plate load Test, CBR Test, (Numericals). Outline of other common design methods such as AASHTO and Asphalt Institute methods.	**8 Hours L3**

Module 3 **Stresses in rigid pavement:** Design factors, Analysis of stresses, Assumptions, Westergaard's Analysis, Critical stress Locations, Wheel load stresses, Temperature stress, combined stresses (using chart / equations) – Problems. **Design of rigid pavement:** Design of C.C. Pavement by IRC: 58 – 2015 for dual loads (Problems) , Concept of White topping.	**8 Hours L3**
Module 4 **Flexible pavement failures, maintenance and evaluation**: Types of failures, Causes, Remedial/Maintenance measures in flexible pavements, Functional Evaluation by unevenness measurements, Structural evaluation by Merlin, Benkleman beam deflection method(problems), Bump integrator, Falling weight deflectometer, GPR method	**8 Hours L2,L3**
Module 5 **Rigid pavement failures, maintenance, and evaluation**: Types of failures, causes, remedial/maintenance measures in rigid pavements, Functional evaluation by unevenness measurements, VFD, Wheel load and its repetition, properties of subgrade, properties of concrete.	**8 Hours L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV74C.1	Analyze the components and factors considered in fundamental design of pavements.
22CIV74C.2	Design the thickness of flexible pavements by different methods and compute the stresses and deflection under the action of wheel load.
22CIV74C.3	Design the thickness of concrete pavements and joints associated with CC pavements in addition to the computation of stresses in CC pavements.
22CIV74C.4	Analyze the types of flexible pavement failures and propose suitable remedies.
22CIV74C.5	Analyze the types of rigid pavement failures and propose suitable remedies.

Textbooks:

1. Yoder and Witczak, "Principles of Pavement Design", 2nd edition, John Wiley and sons 1975.
2. Yang Huang, "Pavement Analysis and Design",2nd Edition, Pearson, 2004.
3. S.K. Khanna, C.E.G. Justo and Veeraraghavan A, "Highway Engineering", 10th Edition, Nem Chand & Bros, 2013.
4. Haas, R., W.R. Hudson and J.P. Zaniewski., "Modern Pavement Management", Krieger Publishing Company, Florida, USA, 1994

References:

1. Nai C. Yang, "Design of Functional Pavements", McGraw-Hill Book Company, New York, USA, 1972.
2. "Hand Book on Cement Concrete Roads"- Cement Manufacturers Association, New Delhi.
3. MoRTH "Specifications for Roads and Bridge Works"- 2001, fourth revision, Indian Roads Congress.
4. MoRTH "Manual for Construction and Supervision of Bituminous Works"- 2001, Indian Roads Congress.
5. MoRTH "Manual for Maintenance of Roads"- 1989, Indian Roads Congress.
6. IRC 37-2001, IRC 81-1997, IRC 58 – 2002, IRC 59 – 1976, IRC 101-1988, Indian Roads Congress

Web Reference:

https://nptel.ac.in/courses/105104098

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any five full questions choosing at least one full question from each module**.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 30 marks each for integrated and 40 marks for non-integrated subjects. Average of three test marks will be added to test component and laboratory assessment to be finalized for 10 marks for integrated subjects. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs). **Some possible AATs:** seminar / assignments / mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	**50**
	CIE Test-2	40	
	CIE Test-3	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 2/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e., A minimum marks of 12 out of 30 in theory and 8 out 20 in the Lab)
Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV74C.1	2	2													
22CIV74C.2	2	2						2					2		
22CIV74C.3	2	2	1					2					2		
22CIV74C.4	2	2	1												
22CIV74C.5	2	2	1												
Average	2	2	1					2					2		

SEMESTER – VII

Course: Integrated Water Resources Management

Course Code	**22CIV74D**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites:

Course Objectives: Students will be taught:

CLO1	To develop the ability among students to synthesize data and technical concepts for application in Integrated Water Resources Management.
CLO2	To provide a basic knowledge of contemporary problems in integrated management of water.
CLO3	To provide practical experience in using water management modelling tools.
CLO4	To provide an understanding of the role of Geographic Information System (GIS) in water resources management

Content	**No. of Hours/ RBT levels**
Module-1 Introduction to Integrated Water Resources Management (IWRM): IWRM - Definition – Objectives – Principles - Evolution of IWRM - IWRM relevance in water resources management Water Sustainability: Concept of sustainable water uses; The Dublin statement; Sustainable water management with economical, engineering, ecological and social viewpoints; Emerging Issues - Drinking water management in the context of climate change - IWRM and irrigation - Flood – Drought – Pollution – Linkages between water, health and poverty	**08 Hours L1, L2**
Module 2 Watershed: Planning and Management: Watershed concepts: Watershed- Topographic divide, Groundwater divide, Stream patterns, Soil erosion- Problems, Types, Conservation Technology, Watershed approach, Watershed Management,	**08Hours L2**

Factors influencing watershed operations, Watershed characteristics, Deterioration of watershed, Watershed delineation, Prioritizing watersheds, Coding of the watershed, Morphometric analysis of watershed-Linear, Areal and Relief aspects, Channel networks, Hypsometric analysis. River Basin – Concept	
Module 3 IWRM and water resources development in India: Rural Development - Ecological sustainability- -Watershed development and conservation - Ecosystem regeneration – Wastewater reuse - Sustainable livelihood - Food security. Problems and policy issues - Solutions for effective integrated water management - Case studies	**08 Hours L2**
Module 4 Modelling and Decision Support Systems (DSS) in IWRM: Introduction, Types of models – hydrological, hydrodynamic, water quality, DSS. Case studies – IWRM in urban areas, lakes, rivers, Interlinking of rivers, Desalination	**08 Hours L2**
Module 5 Geoinformatics for IWRM: Basics of Geoinformatics – Use of GIS and image processing software's, Preparation of thematic layers required for water resources modelling. Introduction to WEAP (Water Evaluation and Planning system): Basic Tools, Inputs, Scenarios. Introduction to Open Data for Water resources management – Understanding open data for processing and accessing. Case studies on the implementation of WEAP model – Policy, management, and financial aspects of implementation	**08 Hours L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV74D.1	Understand water management system components, their characteristics and functioning of such systems
22CIV74D.2	Analyse integrated water management scenarios and implementation
22CIV74D.3	Utilize the Geographic Information System (GIS) in water resources management
22CIV74D.4	Apply appropriately the water management modelling software.

Textbooks:

1. David A. Chin. "Water-Resources Engineering" 3rd Edition, Pearson Publisher, 2013.

2. Mollinga P. et al. "Integrated Water Resources Management", Water in South Asia Volume I, Sage Publications, 2006.
3. Cech Thomas V., "Principles of Water Resources: History, Development, Management and Polic", 3rd edition, John Wiley and Sons Inc., New York. 2003.
4. Murthy, J.V.S., "Watershed Management in India", Wiley Eastern Ltd., New York, 1995.

References:

1. Heathcote, I. W. "Integrated Watershed Management: Principles and Practice", John Wiley and Sons, Inc., New York, 1988

2. Koudstaal R., and al, "Water and Sustainable Development", Proc. Int. Conf. On Water and the Environment. Dublin, 1992

Web Reference:

1. https://www.weap21.org/index.asp?action=213
2. https://www.gwptoolbox.org/learn/iwrm-tools
3. https://archive.nptel.ac.in/courses/105/101/105101214/

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 30 marks each for integrated and 40 marks for non-integrated subjects. Average of three test marks will be added to test component and laboratory assessment to be finalized for 10 marks for integrated subjects. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs). **Some possible AATs:** seminar / assignments / mini projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses.

Component		Marks	Total Marks
CIE	CIE Test-1	40	**50**
	CIE Test-2	40	
	CIE Test-3	40	
	Average of CIE	**40**	
	Quiz/AAT	05	
	Quiz/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e. A minimum marks of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV74D.1	2	2				1	1					1	1		
22CIV74D.2	2	2				1	1					1	1		
22CIV74D.3	2	2				1	1					1	1		
22CIV74D.4	2	2				1	1					1	1		
Average	2	2				1	1					1	1		

SEMESTER – VII

Course: Advanced Foundation Engineering

Course Code	**22CIV74E**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**2:2:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites: Geotechnical Engineering, Foundation Engineering

Course Objectives: Students will be taught:

CLO1	Understanding geotechnical site investigation program for different civil engineering projects
CLO2	Ability to determine bearing capacity of soil by different methods
CLO3	Understanding of shallow and deep foundation analyses
CLO4	Understanding of choice of foundation design parameters

Content	**No. of Hours/ RBT levels**
Module-1 **Introduction**: Importance of soil investigations, Subsoil exploration, Types of samples (undisturbed, disturbed, representative and non-representative samples, Types of Samplers (Standard split spoon sampler, Shell by tubes, Thin-walled samplers, and Piston sampler), Design features affecting sample disturbance (area ratio, Recovery ratio, inside and outside clearances), Typical bore log. Number and depth of borings for various Civil engineering structures, Soil exploration report, In-situ testing of soils Classification of foundations systems. General requirement of foundations, Selection of foundations.	**8 Hours L2, L3**
Module 2 **Modes of shear failure**: Concept of soil shear strength parameters, Terzaghi's and IS: 6403 and 1981 method, Shallow foundations in clay, sand & C-Φ soils, Settlement analysis of footings, Design for Eccentric or Moment Loads, Footings on layered soils and sloping ground.	**8 Hours L2, L3**
Module 3 **Shallow foundations**: Proportion of shallow foundation for equal settlement,	**8 Hours**

Computation of design loads, design of combined footings (rectangular and trapezoidal), strap footings and strip footings, Types of rafts, bearing capacity and settlements of raft foundation, Rigid methods, Flexible methods, coefficient of sub grade reaction.	**L2, L3**
Module 4 **Deep Foundations**, Types of Deep Foundations, Ultimate bearing capacity of different types of piles, laterally loaded piles, tension piles & batter piles, Pile groups: Bearing capacity, settlement, uplift capacity, load distribution between piles. Negative skin friction, Pile load Test.	**8 Hours** **L2, L3**
Module 5 **Types of caissons**: Analysis of well foundations, Design principles, well construction and sinking. Foundations in special cases: Foundations for tower structures: Introduction, Forces on tower foundations, Selection of foundation type, Stability, and design considerations, Foundation on expansive soils, under reamed pile foundation.	**8 Hours** **L2, L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV74E.1	Understand the principles of subsoil exploration and concepts of Settlement analysis
22CIV74E.2	Classify the different types of foundation and their suitability for particular site and structures.
22CIV74E.3	Evaluate the soil shear strength parameters and bearing capacity for various sub-soil profile
22CIV74E.4	Analyse shallow foundation, deep foundations and special foundations depending on the type of soil.

Textbooks:

1. Braja, M. Das, "Principles of Geotechnical Engineering",8th edition, Cengage Learning, India, 2013.
2. SwamiSaran, "Analysis & Design of Substructures", Oxford & IBHPub. Co.Pvt.Ltd, 2006.
3. J.E.Bowles, "Foundation Analysis and Design", 5th edition, McGraw-Hill Int. Editions, 2001.

References:

1. W.C. Teng, "Foundation Design", Prentice Hall of India Pvt. Ltd, 2003.
2. R.B. Peck, W.E. Hanson & T.H. Thornburn, "Foundation Engineering", 2nd Edition, Wiley Eastern Ltd, 1984.
3. Bureau of Indian Standards: IS-1904, IS-6403, IS-8009, IS-2950, IS-2911 and all other relevant codes.

Web Reference:

https://nptel.ac.in/courses/105105207
https://nptel.ac.in/courses/105105185

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any five full questions choosing at least one full question from each module**.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 30 marks each for integrated and 40 marks for non integrated subjects. Average of three test marks will be added to test component and laboratory assessment to be finalized for 10 marks for integrated subjects. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs). **Some possible AATs:** seminar / assignments / mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	**50**
	CIE Test-2	40	
	CIE Test-3	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 2/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e. A minimum marks of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV74E.1	2	3	2		2							1		3	
22CIV74E.2	2	3	3		2							1		3	
22CIV74E.3	2	3	3		2							1		3	
22CIV74E.4	1	2	2		2							1		3	
Average	**1.75**	**2.75**	**2.5**		**2**							**1**		**3**	

SEMESTER – VII

Course: AI&ML in Infrastructure Engineering

Course Code	**22CIV75A**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites: -

Course Objectives: Students will be taught:

CLO1	The fundamental concepts and working principle of machine learning in civil & infrastructure engineering
CLO2	Concepts of machine learning algorithms in civil & infrastructure engineering
CLO3	Application of artificial intelligence in civil engineering

Content	**No. of Hours/ RBT levels**
Module-1 **Introduction:** Definitions and scope of AI and ML, Historical overview and key concepts, fundamental concepts and working principle of ANN; network training models; Types of Machine Learning (Supervised, Unsupervised, Reinforcement); Data preprocessing and feature engineering	**8 hours L2**
Module 2 **Data Collection for Infrastructure Projects:** Sensors and data sources in infrastructure engineering; Data quality assurance and integrity; Data acquisition and storage **Data Preprocessing and Feature Engineering:** Data cleaning and outlier detection; Feature selection and dimensionality reduction; Data normalization and transformation	**8 hours L2**

Module 3 **Overview of Deep networks:** Building deep networks for classification: Stacked autoencoders, liner decoders with autoencoders, liner decoder, feature extraction using convolution, CNN, pooling, classification layer.	**8 hours** **L2**
Module 4 **Applications in civil & infrastructure engineering:** Scope of applications in structural engineering, water resource engineering, geotechnical engineering, transportation engineering, construction engineering etc. Examples for application of AI/ML in material modelling, traffic management and safety, foundation settlement.	**8 hours** **L2**
Module 5 **Other applications:** Examples for application of AI/ML in structural control system identification, structural health monitoring, damage assessment, surrogate modelling, uncertainty quantification etc	**8 hours** **L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV75A.1	Understand the concepts of deep networks and data collection
22CIV75A.2	Understand machine learning algorithms in civil & infrastructure engineering
22CIV75A.3	Analyze problems in deterministic and random environments
22CIV75A.4	Understand applications of AI & ML in infrastructure engineering

Textbooks:

1. J.A.Goulet "Probabilistic machine learning for civil engineers", the MIT Press, 2020
2. P.C.Deka , "A primer on machine learning applications in civil engineering", CRC Press, 2020.

References:

1. C.M. Bishop, Pattern recognition and machine learning, Springer, 2006.
2. By Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep learning", MIT Press, 2016.

Web Reference:

https://www.viktor.ai/blog/40/artificial-intelligence-machine-learning-engineering-construction

https://www.arup.com/services/digital/artificial-intelligence-and-machine-learning

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 30 marks each for integrated and 40 marks for non-integrated subjects. Average of three test marks will be added to test component and laboratory assessment to be finalized for 10 marks for integrated subjects. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs). **Some possible AATs:** seminar / assignments / mini projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses.

Component		Marks	Total Marks
CIE	CIE Test-1	40	**50**
	CIE Test-2	40	
	CIE Test-3	40	
	Average of CIE	**40**	
	Quiz/AAT	05	
	Quiz/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

CO/PO Mapping															
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
22CIV75A.1	3	2	2		3							3	1		
22CIV75A.2	3	2	3	2	3							3	1		
22CIV75A.3	3	2	3	2	3							3	1		
22CIV75A.4	3	2	3	2	3							3	1		
Average	3	2	2.75	2	3							3	1		

SEMESTER – VII

Course: Disaster Mitigation and Management

Course Code	**22CIV75B**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites:

Course Objectives: Students will be taught:

CLO1	Basic concepts in Disaster Management
CLO2	Types and categories of disasters
CLO3	The role of individual and various organization during and after disaster
CLO4	Challenges posed by Disaster
CLO5	Impacts of Disasters Key Skills

Content	No. of Hours/ RBT levels
Module-1 **Introduction -** Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change.	**8 Hours L2**
Module 2 **Natural Disaster and Manmade disasters:** Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion **Manmade Disasters:** Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.	**8 Hours L2**
Module 3 **Disaster Management, Policy and Administration-** Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management. Policy and administration:	**8 Hours L2**

Importance and principles of disaster management policies, command and coordination of in disaster management, rescue operations-how to start with and 06 how to proceed in due course of time, study of flowchart showing the entire process.	
Module 4 **Institutional Framework for Disaster Management in India:** Importance of public awareness, Preparation and execution of emergency management programme. Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India. Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations. Use of Internet and software for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard	**8 Hours** **L2**
Module 5 **Preventive and Mitigation Measures**- Pre-disaster, during disaster and post-disaster measures in some events in general Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. Do's and Don'ts in case of disasters and effective implementation of relief aids	**8 Hours** **L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV75B.1	Explain the application of Disaster Concepts to Management
22CIV75B.2	Identify extent and damaging capacity of a disaster
22CIV75B.3	Understand the means of losses and methods to overcome /minimize it.
22CIV75B.4	Describe role of individual and various organization during and after disaster
22CIV75B.5	Understand the emergency government response structures before, during and after disaster

Textbooks:

1. Coppola D P, "Introduction to International Disaster Management", 4th edition, Elsevier Science (B/H), London, 2021.
2. O S Dagur, "Disaster Management: An Appraisal of Institutional Mechanisms in India", new edition, 2011
3. Jack Pinkowski, "Disaster Management Handbook", 1st edition, CRC Press Taylor and Francis group, 2008

References:

1. Dr Ravikant Pagnis, "Disaster Management and Mitigation measures", 1st edition, TechKnowledge Publications, Pune, 2023.
2. http://ndma.gov.in/ (Home page of National Disaster Management Authority)
3. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs)

Web Reference:

https://onlinecourses.swayam2.ac.in/cec19_hs20/preview

Scheme of Examination:

Semester End Examination (SEE):
SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):
Three Tests are to be conducted for 30 marks each for integrated and 40 marks for non-integrated subjects. Average of three test marks will be added to test component and laboratory assessment to be finalized for 10 marks for integrated subjects. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs). **Some possible AATs:** seminar / assignments / mini projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses.

Component		Marks	Total Marks
CIE	CIE Test-1	40	**50**
	CIE Test-2	40	
	CIE Test-3	40	
	Average of CIE	**40**	
	Quiz/AAT	05	
	Quiz/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e. A minimum marks of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV75B.1	2	1	1		3	3	2			2			1		
22CIV75B.2	2	1	1		3	3	2			2			1		
22CIV75B.3	2	1	1		3	3	2						1		
22CIV75B.4	2	1	1	1	3	3	2						1		
22CIV75B.5		1	1	1	3	3	2						1		
Average	1.6	1	1	1	3	3	2			1			1		

SEMESTER – VII

Course: Engineering Economics

Course Code	**22CIV75C**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites:

Course Objectives: Students will be taught:

CLO1	The role of economics in engineering.
CLO2	To compare between alternatives.
CLO3	To learn how to construct and interpret a breakeven graph.

Content	No. of Hours/ RBT levels
Module 1 **Economic Decisions Making –** Overview, Problems, Role, Decision making process. **Engineering Costs & Estimation** – Fixed, Variable, Marginal & Average Costs, Sunk Costs, Opportunity Costs, Recurring and Nonrecurring Costs, Incremental Costs, Cash Costs vs Book Costs, Life-Cycle Costs; Types of Estimate, Estimating Models - Per-Unit Model, Segmenting Model, Cost Indexes, Power-Sizing Model, Improvement & Learning Curve, Benefits. Case Study - Price and Income Elasticity of Demand in the real world	**8 Hours L2**
Module 2 **Time value of money:** Simple and compound interest, Time value equivalence, Compound interest factors, Cash flow diagrams, Calculation, Calculation of time – value equivalences. Present worth comparisons, Comparisons of assets with equal, unequal and infinite lives, comparison of deferred investments, Future worth comparison, pay back period comparison.	**8 Hours L2**
Module 3 Comparison of alternatives using equivalent annual worth method, Comparison of assets of equal and unequal life. Rate of return, Internal rate of return, comparison	**8 Hours L2**

of IIR with other methods, IRR misconceptions. Analysis of public Projects: Benefit/ Cost analysis, quantification of project, cost and benefits, benefit/ cost applications, Cost –effectiveness analysis.	
Module 4 Depreciation, Computing depreciation charges, after tax economic comparison, Break-even analysis; linear and non-linear models. Sensitivity analysis: single and multiple parameter sensitivity	**8 Hours L2**
Module 5 Fixed and variable cost, Product and Process Costing, Standard Costing, Cost estimation, Relevant Cost for decision making, Cost estimation, Cost control and Cost reduction techniques.	**8 Hours L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV75C.1	Describe the principles of economics that govern the operation of any organization under diverse market conditions.
22CIV75C.2	Comprehend macroeconomic principles and decision making in diverse business set up
22CIV75C.3	Explain the inflation and price change as well as present worth analysis.
22CIV75C.4	Apply the principles of economics through various case studies.

Textbooks:

1. Horn green, C.T., "Cost Accounting",16th edition, Prentice Hall of India, 2017.
2. Sullivan and Wicks: "Engineering Economy", 17th edition, Pearson, 2019.

References:

1. James L.Riggs,David D. Bedworth, Sabah U. Randhawa, "Economics for Engineers", 4th edition, Tata McGraw-Hill, 1996.
2. Donald Newnan, Ted Eschembach, Jerome Lavelle, "Engineering Economics Analysis", 12th edition, Oxford University Press, 2013.
3. John A. White, Kenneth E.Case,David B.Pratt, "Principle of Engineering Economic Analysis", 6th edition, John Wiley, 2012.
4. R.Paneer Seelvan, "Engineering Economics", PHI, 13th edition, 2012.
5. Michael R Lindeburg, "Engineering Economics Analysis", Professional Pub, 1993.

Web Reference:

www.finmin.nic.in ,
www.rbi.org.in ,
www.planningcommission.nic.in

Scheme of Examination:

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any five full questions choosing at least one full question from each module.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 30 marks each for integrated and 40 marks for non integrated subjects. Average of three test marks will be added to test component and laboratory assessment to be finalized for 10 marks for integrated subjects. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs). Some possible AATs: seminar / assignments / miniprojects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test 1	**40**	**50**
	CIE Test 2	**40**	
	CIE Test 3	**40**	
	Average of CIE	**40**	
	Quiz 1/AAT	**05**	
	Quiz 2/AAT	**05**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e. A minimum marks of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV75C.1	2										1		1		
22CIV75C.2	2	1													
22CIV75C.3	2														
22CIV75C.4	2							1			1				
Average	2							1			1		1		

SEMESTER – VII

Course: Sensor Technologies for Infrastructure

Course Code	**22CIV75D**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites: Structural Analysis, Smart Materials

Course Objectives: Students will be taught:

CLO1	To learn basic principles of sensor technologies
CLO2	To understand instruments and sensors for Structural Health Monitoring
CLO3	To understand the different methods of Structural Health Monitoring
CLO4	To apply sensing solutions to various civil engineering facilities

Content	**No. of Hours/ RBT levels**
Module-1 Sensor data acquisition systems and architectures, Commonly used sensors for civil infrastructures and their associated algorithms, Piezoelectric transducers for assessing and monitoring civil infrastructures, Fiber optic sensors for assessing and monitoring civil infrastructures, Acoustic emission sensors for assessing and monitoring civil infrastructures, Electromagnetic sensors for assessing and monitoring civil infrastructures, Corrosion sensing for assessing and monitoring civil infrastructures	**8 Hours L3**
Module 2 **Instrumentations & Sensors for SHM:** Basics of Instrumentations & Measurements, Classifications, Input-Output Configurations of Instruments, Static & Dynamic Characteristics, Functions. Various Types of Electromechanical, Electronics & Digital Instruments for SHM. Data Acquisition Systems-Types, Hardware & It's Components. Basics of Sensors, Transducers & Actuators, Classification of Sensors, Characteristics & Working Principles of Various Types of Sensors like Strain Gauges, LVDT, Accelerometers etc. Concept of Smart	**8 Hours L3**

Materials & Smart Structures with SHM, Basics of Smart Materials like Piezoelectric, Shape Memory Alloys, ER & MR Fluids etc.	
Module 3 **Methods of SHM:** Methodologies and Monitoring Principles, Local & Global Techniques for SHM, Static & Dynamic Field Testing, Short & Long-Term Monitoring, Active & Passive Monitoring. Vibration Based SHM Techniques - Use & Demonstration of Dynamic Properties of Structures for Damage Detection & SHM, Ambient Vibration Test, Acoustic Emission Technique, Electromechanical Impedance Technique, Wave Propagation Based Techniques, Fibre Optics Based Techniques, Remote & Wireless SHM Techniques, IoT Application in SHM, Artificial Intelligence & Machine Learning in SHM.	**8 Hours L3**
Module 4 **Sensing Solutions:** Sensing solutions for assessing and monitoring of bridges, Sensing solutions for assessing and monitoring supertall structures, Seismic monitoring solutions for buildings, Sensing solutions for assessing and monitoring dams, Sensing solutions for assessing and monitoring tunnels	**8 Hours L3**
Module 5 Mapping subsurface utilities with mobile electromagnetic geophysical sensor arrays, Sensing solutions for assessing the stability of levees, sinkholes and landslides, Sensing solutions for assessing and monitoring pipeline systems, Sensing solutions for assessing and monitoring roads, Sensing solutions for assessing and monitoring high-speed railroads, Sensing solutions for assessing and monitoring underwater systems, Sensor solutions for assessing and monitoring offshore structures	**8 Hours L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV75D.1	**Understand** the basic concepts of sensor data acquisition systems
22CIV75D.2	**Apply** instruments and sensors for structural health monitoring
22CIV75D.3	**Explain** various methods of structural health monitoring
22CIV75D.4	**Apply** sensing solutions to various civil engineering facilities

Textbooks:

1. M.L. Wang, J.P. Lynch and H. Sohn, "Sensor Technologies for civil infrastructures",2nd edition, Springer, 2022
2. Gandhi and Thompson, "Smart Materials and Structures", Springer, 1992.

References:

1. Fu Ko Chang, "Structural Health Monitoring: Current Status and Perspectives", 1st edition, CRC Press, 1998.
2. Journal Papers on this subject

Web Reference:

1. https://nptel.ac.in/courses/114106046
2. https://www.serc.res.in/structural-health-monitoring-life-extension-research-areas

Scheme of Examination:

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any five full questions choosing at least one full question from each module.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 30 marks each for integrated and 40 marks for non integrated subjects. Average of three test marks will be added to test component and laboratory assessment to be finalized for 10 marks for integrated subjects. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs). Some possible AATs: seminar / assignments / Mini projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test 1	**40**	**50**
	CIE Test 2	**40**	
	CIE Test 3	**40**	
	Average of CIE	**40**	
	Quiz 1/AAT	**05**	
	Quiz 2/AAT	**05**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e. A minimum marks of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV75D.1	3	1			1								1		
22CIV75D.2	3	2			1								1		1
22CIV75D.3	2	3			1								1		1
22CIV75D.4	2	2			1								1		1
Average	**2.5**	**2.0**			**1**								**1**		**1**

SEMESTER – VII

Course: Major Project Phase 1I

Course Code	**22CIVP76**	**CIE Marks**	**100**
Hours/Week (L: T: P)	**0:0:12**	**SEE Marks**	**100**
No. of Credits	**6**	**Examination Hours**	**3**

Major Project Guidelines:

- Continuous monitoring of project work will be carried out and cumulative evaluation will be done.
- The students are required to meet their internal guides once in a week to report their progress in project work.
- **Weekly Activity Report** (WAR) has to be maintained in the form of a diary by the project batch and the same has to be discussed with the Internal Guide regularly.
- In case of ***Industry project,*** during the course of project work, the internal guides will have continuous interaction with external guides and will visit the industry at least twice during the project period.
- For CIE assessment the project groups must give a final seminar with the draft copy of the project report.
- The presentation by each group will be for 20-30 minutes and every member of the team needs to justify the contributions to the project.
- The project team is required to submit Hard copies of the detailed Project Report in the prescribed format to the department.
- For CIE 40% weightage should be given to the project guide, 40% weightage to the project evaluation committee and 20% weightage to HoD.
- Before the final evaluations the project group is required to produce a No dues certificate from Industry, Central Library and Department.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV76.1	Apply knowledge of mathematics, science and engineering to solve respective engineering domain problems.
22CIV76.2	Design, develop, present and document innovative/multidisciplinary modules for a complete engineering system.
22CIV76.3	Use modern engineering tools, software and equipment to solve problem and engage in life-long learning to follow technological developments.
22CIV76.4	Function effectively as an individual, or leader in diverse teams, with the understanding of professional ethics and responsibilities

Scheme of Evaluation:

Continuous Internal Evaluation (CIE):

The following are the weightings given for the various stages of the project

Sl No.	Activity	Weightage
1	Execution of Project	30%
2	Presentation, Demonstration and Results Discussion	40%
3	Report Writing & Publication	30%

Semester End Evaluation (SEE):

The following are the weightings given during Viva Examination

Sl No.	Activity	Weightage
1	Presentation/Demonstration of the project	30%
2	Methodology and Experimental Results & Discussion	30%
3	Report	20%
4	Viva Voce	20%

SEMESTER – VIII

Course: Urban Transport and Intelligent Transportation Systems

Course Code	**22CIV81A**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites: Highway Engineering

Course Objectives: Students will be taught:

CLO1	Understand and apply basic concepts and methods of urban transportation planning, methods of designing, conducting, and administering surveys to provide the data required for transportation planning
CLO2	Understand the process of developing an organized mathematical modelling approach to solve select urban transportation planning problem
CLO3	Excel in use of various types of models used for travel forecasting, prediction of future travel patterns
CLO4	Have an awareness and scope of transport issues, such as, traffic safety, public transport, advanced vehicle management and control
CLO5	What Intelligent transport systems (ITS) involve the application of information technology and telecommunications to control traffic.

Content	**No. of Hours/ RBT levels**
Module-1 **Urban transport planning:** Urbanization, urban class groups, transportation problems and identification, impacts of transportation, urban transport system planning process, modeling techniques in planning. Urban mass transportation systems: urban transit problems, travel demand, types of transit systems, public, private, para-transit transport, mass and rapid transit systems, BRTS and Metro rails, capacity, merits and comparison of systems, coordination, types of coordination	**8Hours L2**
Module 2 **Data Collection and Inventories:** Collection of data – Organization of surveys and Analysis, Study Area, Zoning, Types and Sources of Data, Road Side	**8Hours** L2,L3

Interviews, Home Interview Surveys, Commercial Vehicle Surveys, Sampling Techniques, Expansion Factors, Accuracy Checks, Use of Secondary Sources, Economic data – Income – Population – Employment – Vehicle Owner Ship	
Module 3 **Trip Generation, Distribution & Traffic Assignment:** UTPS Approach, Trip Generation Analysis: Zonal Models, Category Analysis, Household Models, Trip Attraction models, Commercial Trip Rates; Trip Distribution by Growth Factor Methods. Gravity Models, Opportunity Models, Time Function Iteration Models. Travel demand modeling: gravity model, opportunity models, Desire line diagram. Modal split analysis. Problems on above. Diversion Curves; Basic Elements of Transport Networks, Coding, Route Properties, Path Building Criteria, Skimming Tree, All-or-Nothing Assignment, Capacity Restraint Techniques, Introduction to land use planning models, land use and transportation interaction.	**8Hours L2,L3**
Module 4 **Introduction to ITS:** Basic elements of intelligent transportation systems (ITS), focusing on technological, systems and institutional aspects. Benefits of ITS -ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection Advanced traveler information systems; transportation network operations; commercial vehicle operations and intermodal freight	**8Hours L2,L3**
Module 5 **Public transportation applications,** ITS and regional strategic transportation planning, including regional architectures. ITS and changing transportation institutions, ITS and safety, ITS and security, ITS as a technology deployment program, research, development and business models, ITS and sustainable mobility. Travel demand management, electronic toll collection, and ITS and road-pricing. Automated Highway SystemsVehicles in Platoons –ITS in World – Overview of ITS Implementations in developed countries, ITS in developing countries	**8Hours L2,L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV81A.1	Design, conduct and administer surveys to provide the data required for transportation planning.
22CIV81A.2	Supervise the process of data collection about travel behavior and analyze the data for use in transport planning.

22CIV81A.3	Develop and calibrate modal split, trip generation rates for specific types of land use developments and adopt the steps that are necessary to complete a long-term transportation plan.
22CIV81A.4	Suggest the appropriate system/s in various functional areas of transportation. Would be able to amalgamate the various systems, plan and implement the applications of ITS.
22CIV81A.5	Understand the application of information technology and telecommunication to control traffic and also provide advance information to the travelers, automatic handling of emergencies and to improve safety.

Textbooks:

1. Kadiyali. L. R., "Traffic Engineering and Transportation Planning", Classic Edition, Khanna Publishers, New Delhi,1999
2. Khisty C.J., "Transportation Engineering – An Introduction", 3rd Edition, Pearson Education,2017
3. Papacostas, "Fundamentals of Transportation Planning", Prentice Hall,1987
4. Choudury M A and Sadek A, "Fundamentals of Intelligent Transportation Systems Planning" Artech House, 2003

References:

1. Mayer M and Miller E, "Urban Transportation Planning: A decision oriented Approach", McGraw Hill, 2001
2. Bruton M.J., "Introduction to Transportation Planning", Hutchinson of London,2001
3. Dicky, J.W., "Metropolitan Transportation Planning", 2nd Edition, Tata McGraw Hill. 2108
4. Sussman, J. M., "Perspective on ITS", Artech House Publishers, 2005
5. Turban. E and Aronson. J. E, "Decision Support Systems and Intelligent Systems", 6th Edition,Pearson Publishers, 2000.
6. Kan Paul Chen, John Miles, "Recommendations for World Road Association (PIARC)" ITS Hand Book, 2000.
7. US Department of Transportation, "National ITS Architecture Documentation", 2007 (CDROM).

Web Reference:

1. https://archive.nptel.ac.in/courses/105/107/105107067/
2. https://archive.nptel.ac.in/courses/105/105/105105208/
3. https://nptel.ac.in/courses/105107210
4. https://www.civil.iitb.ac.in/tvm/nptel/591_ITS_1/web/web.html

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any five full questions choosing at least one full question from each module.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 30 marks each for integrated and 40 marks for non-integrated subjects. Average of three test marks will be added to test component and laboratory assessment to be finalized for 10 marks for integrated subjects. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs). **Some possible AATs:** seminar / assignments / mini projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses.

Component		Marks	Total Marks
CIE	CIE Test-1	40	**50**
	CIE Test-2	40	
	CIE Test-3	40	
	Average of CIE	**40**	
	Quiz/AAT	05	
	Quiz/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e. A minimum mark of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV81A.1	2	2	2										2		
22CIV81A.2	2	2	2										2		
22CIV81A.3	2	2	2										2		
22CIV81A.4	2	2	2										2		
22CIV81A.5	2	2	2										2		
Average	2	2	2										2		

SEMESTER – VIII

Course: Solid Waste Management

Course Code	**22CIV81B**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites:

Course Objectives: Students will be taught:

CLO1	To study the present methods of solid waste management system and to analyze their draw backs comparing with statutory rules
CLO2	To understand and different elements of solid waste management from generation of solid waste to disposal.
CLO3	To analyze different processing technologies and to study conversion of municipal solid waste to compost or biogas.
CLO4	To evaluate landfill site and to study the sanitary landfill reactions

Content	**No. of Hours/ RBT levels**
Module-1 **Introduction; -** Functional elements of municipal solid waste (MSW) management system, Sources: Sources of Solid waste, Types of solid waste, Physical and Chemical composition of municipal solid waste. Generation rate, Numerical Problems. Environmental implications of open dumping of MSW, Construction debris – management & handling. Rag pickers and their role, Solid waste management 2000 rules with 2016 amendments	**8 Hours L2**
Module 2 **Collection:** Collection of solid waste- services and systems Haul and stationary container system numericals, equipment's, Transportation: Need of transfer operation, transfer station, transport means and methods, route optimization.	**8 Hours L2**
Module 3 **Treatment / Processing Techniques:** Components separation, volume reduction, size reduction, chemical reduction and biological processing problems.	**8 Hours L2**

Composting: Aerobic and anaerobic composting, factors affecting composting, Indore and Bangalore processes, mechanical and semi mechanical composting processes. Vermicomposting	
Module 4 **Sanitary Land Filling:** Different types, trench area, Ramp and pitmethod, site selection, basic steps involved, cell design, prevention of site pollution, leachate & gas collection and control methods, geosynthetic fabrics in sanitary land fills. **Incineration:** Process – 3 T's, factors affecting incineration process,incinerators – types, prevention of air pollution, pyrolsis, design criteria for incineration.	**8 Hours L2**
Module 5 **Sources, Collection, Treatment and Disposal: -** Biomedical waste and E-waste, **Recycle and Reuse**: Material and energy recovery operations, reusein other industries, plastic wastes, environmental significance and reuse.	**8 Hours L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV81B.1	Identify improper practices of solid waste disposal and their environmental implications. Know the basic engineering principles of solid waste management
22CIV81B.2	Describe the need for economics in collection and transportation of solid waste and clearly discuss various types of collection systems and analyse system dynamics
22CIV81B.3	Understand the management concepts, define 4 R approach, apply PPP model and community involvement for effective management of solid waste
22CIV81B.4	Develop a concise idea on various conventional and advanced treatment options for solid waste
22CIV81B.5	Conceive the design aspects of engineered disposal options and apply the gained knowledge

Textbooks:

1. George Tchobanoglous, Hilary Theisen , Samuel A Vigil, "Integrated Solid Waste Management : Engineering principles and management issues", 2nd edition, M/c Graw hill Education . Indian edition, 1993.
2. Howard S Peavy, Donald R Rowe and George Tchobanoglous, "Environmental Engineering", Tata Mcgraw Hill Publishing Co ltd, 1984.
3. Mantell C.L.,"Solid Waste Management", John Wiley, 1975.

References:

1. Municipal Solid Wastes (Management and Handling) Rules, 2000.Ministry of Environment and Forests Notification, New Delhi, the 25th September, 2000. Amendment – 1357(E) – 08-04-2016
2. Municipal Solid waste management manual, Part II published under Swachh Bharat Mission, Central Public Health and Environmental Engineering Organization (CPHEEO), 2016, Ministry of Urban Development, Government of India.
3. Handbook of Solid waste management, second edition, George Tchobanoglous, Frank Kreith, published by M/c Graw hill Education, 2002, ISBN-13 978-0071356237 ISBN -10 0071356231

Web Reference:

1. https://onlinecourses.nptel.ac.in/noc23_ce66/preview
2. https://archive.nptel.ac.in/courses/105/103/105103205/
3. https://nptel.ac.in/courses/105103205

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any five full questions choosing at least one full question from each module.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 30 marks each for integrated and 40 marks for non-integrated subjects. Average of three test marks will be added to test component and laboratory assessment to be finalized for 10 marks for integrated subjects. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs). **Some possible AATs:** seminar / assignments / mini projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses.

Component		Marks	Total Marks
CIE	CIE Test-1	40	**50**
	CIE Test-2	40	
	CIE Test-3	40	
	Average of CIE	**40**	
	Quiz/AAT	05	
	Quiz/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e. A minimum mark of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV81B.1	3	2				1									
22CIV81B.2	3	2				1	2								
22CIV81B.3	3	2			1	2	1					1			
22CIV81B.4	3	2			1	2						1	1		
22CIV81B.5	3	2			1	1	2					1			
Average	**3**	**2**			1	1.4	1.7					1	1		

SEMESTER – VIII

Course: Economic Evaluation and DPR

Course Code	**22CIV81C**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites:

Course Objectives: Students will be taught:

CLO1	Develop and interpret cash flow diagrams and discuss their applications in effective financial management of projects
CLO2	Evaluate the opportunities and pitfalls of alternative engineering investments from an economic point of view by reducing them to a common platform
CLO3	Analyze, interpret and present accounting information in order to assist management in the process of decision making, creation of policy and day to day operation of a project/ organization
CLO4	Derive compound interest factors and their corresponding formulae to determine unknown amounts from known values of varying cash flows
CLO5	Understand the need of a detailed project report.

Content	**No. of Hours/ RBT levels**
Module 1 Definition and scope of economics, fundamental concepts in business economics. **Basics of Microeconomics**: Demand and supply analysis, elasticity of demand, theory of production, cost analysis, market structure, perfect competition, monopoly, monopolistic competition and oligopoly market. **Basics of Macroeconomics:** National economy, national income accounting, business cycle, monetary policy, fiscal policy, inflation, employment, price indices- wholesale price index- consumer price index. **Economics of Development**: Causes and characteristics of underdevelopment,	**8 Hours L2**

general theories of development, five - year planning and social development. **The Construction Industry**: Nature, characteristics, size and structure; Role in economic development and employment generation, input industries, clients, contractors, consultants and workers and their organizations; Economics of ecology and environment, local material selection, form and functional designs. **Economics of Infrastructure in India**: Roads and buildings, transportation and communications, irrigation and power, ports and aviation, health and education services; Economics of Civil and Social infrastructure, building service, facilities and services, urban infrastructure in India, Issues in developing, funding and managing infrastructure; International and national constraints and incentives, unique features of this business and their impact on savings, investments and other economic phenomena; Support matters of economy as related to top Engineering, choice of technology, quality control and quality production, audit in economic law of returns.	
Module 2 **Types of finance**- long term and short-term finance, leasing, equity financing, internal generation of funds, external commercial borrowings, assistance from government budgeting support, international finance corporations, investment financing decision, financial control, job control and centralized management. **Funds management**- working capital management, inventory valuation, mortgage financing, international finance management, foreign currency management, budgeting and budgetary control, performance budgeting	**8 Hours** **L2**
Module 3 **Time value of money:** Nominal and effective interest, formulation of interest computation, single payment, equal payments and unequal payments, cash flow analysis. **Comparing the Alternatives:** Present worth comparison, future worth comparison, annual cost and return method, rate of return method, incremental rate of return, discounted cash flow, net present value, profitability index, ratio analysis, replacement analysis, break-even analysis.	**8 Hours** **L2**
Module 4 **Evaluating** Alternative Investments: Real estate, work pricing, contract bidding and award, revision due to unforeseen causes, depreciation and amortization, taxation and inflation, escalation, risks and uncertainties and management decision in capital budgeting, turnkey activities, project appraisal and project yield **Management Accounting:** Basic financial and accounting concepts and methods, the company as an economic unit, project as a profit center; Basic concepts:- capital	**8 Hours** **L2**

and revenue, financial accounting, cost accounting, management accounting; Accounting process: General Accepted Accounting Principles, double entry system, ten point Programme in book keeping; Journal, ledger, cash book, trial balance, final balance, depreciation accounting provisions and reserves; Preparation of profit and loss account, balance sheet, income statement, cash flow and fund flow statements.	
Module 5 **Budget:** Types of budgets, procedure for master budget, budgetary control system, budget as a system of management control and corporate growth; Balance sheet reading, understanding health of an enterprise by study of its balance sheet; Interpretation of financial statements, balance sheet, Profit and Loss account, balance sheet as a valuation statement. **Lending to Contractors:** Loans to contractors, interim construction financing, security and risk aspects. **Detailed Project Report: Need and significance of project report,** Contents of DPR, Project Formulation, Case Study of sample DPR.	**8 Hours L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV81C.1	Discuss the basics of Micro and macroeconomics in the economic development of a country
22CIV81C.2	Understand types of funds associated with finance management.
22CIV81C.3	Compare the various alternatives and selection criteria.
22CIV81C.4	Understand different accounting in finance management
22CIV81C.5	Formulate detailed project report.

Textbooks:

1. D.M.Mithani, " Managerial Economics, Himalaya Publishing House, 7th edition, 2013.
2. R.Winfrey, "Economic Analysis for Highway", International Textbook Co., Pennsylvania. USA,1969

References:

1. IRC– 30, Manual on Economic Evaluation of Highways In India.

2. Fair and Williams, Economics of Transportation, Harper and Brothers, Publishers, New York, 1959.
3. G.Harrl Clell, A Manual for the Economic Appraisal of Transport Projects, World Bank Report, Washington D.C.1980.

Web References:

https://especia.co.in/post/what-is-dpr/
https://hppwd.hp.gov.in/sites/default/files/documents/ES.PDF

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any five full questions choosing at least one full question from each module.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 30 marks each for integrated and 40 marks for non integrated subjects. Average of three test marks will be added to test component and laboratory assessment to be finalized for 10 marks for integrated subjects. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs). Some possible AATs: seminar / assignments / miniprojects/ concept videos/ partial reproduction of research work/ group activity/ any other. Typical Evaluation pattern is shown in Table 1.

Typical Evaluation pattern is shown in Table 1.

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CIE	CIE Test-1	40	**50**
	CIE Test-2	40	
	CIE Test-3	40	
	Average of CIE	**40**	
	Quiz/AAT	05	
	Quiz/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e. A minimum mark of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV81C.1	1														
22CIV81C.2	1														
22CIV81C.3	1														
22CIV81C.4	1													1	
22CIV81C.5	1													1	
Average	**1**													**1**	

SEMESTER – VIII

Course: Pavement Construction, Maintenance & Management

Course Code	**22CIV81D**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites: Transportation Engineering, Pavement design and maintenance.

Course Objectives: Students will be taught:

CLO1	To understand the drainage system for different components of road and pavement structure.
CLO2	To understand characteristics of different types of bituminous layers and design of bituminous surfacing along with safety aspects needed for roads.
CLO3	To understand the characteristics of different types of CC pavements and design of along with safety aspects needed for CC pavements.
CLO4	To understand different equipment's used for preparation of subgrade in cutting or filling and also the preparation steps for base and sub base layers.
CLO5	To understand Components and framework of Pavement Management Systems

Content	**No. of Hours/ RBT levels**
Module-1 Components of road and pavement structure including subgrade, drainage system, functions, requirements and sequence of construction operations. Drainage – Assessment of drainage requirements for the road and design of various components, drainage materials, Construction of surface and subsurface drainage system and design of filter materials for roads. Drainage of urban roads, problems.	**8 Hours L2**
Module 2 Different types of granular base course – WMM, CRM, WBM, specifications, construction method and quality control tests. Different types of bituminous layers for binder and surface courses, their specifications (as per IRC and MORTH), construction method and quality control tests. Special structural courses like stone matrix asphalt and mastic asphalt and construction of porous asphalt.	**8 Hours L2**

Module 3 Different types of sub-base and base course for cement concrete (CC) pavement and construction method. Construction of cement concrete (PQC) pavements and joints, quality control during construction. Construction of special Cement concrete pavements like interlocking concrete block pavements (ICBP), Continuously reinforced cement concrete pavements (CRCP), Fiber reinforced cement concrete pavements (FRCP), General Aspects: Quality assurance, statistical approach, quality system for road construction. Safety aspects during road construction and maintenance works. Installation of various traffic safety devices and information system	**8 Hours** **L2**
Module 4 Road construction equipment – different types of excavators, graders, soil compactors / rollers, pavers and other equipment for construction of different pavement layers – their uses and choice Problem on equipment usage charges. Specifications and steps for the construction of road formation in embankment and cut, construction steps for subgrade (preparation of subgrade) in cutting, filling and at grade. Construction of subgrade in marshy areas and weak / expansive soils and water- logged - areas.	**8 Hours** **L2**
Module 5 Introduction: Definition - Components of Pavement Management Systems, Essential features. Pavement Management Levels and functions: Ideal PMS-Network and Project levels of PMS-Influence Levels- PMS Functions- Function of Pavement evaluation. Introduction to HDM : Objectives & Principles.	**8 Hours** **L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV81D.1	Design the drainage requirements for different components of the road structure and maintenance with suitable remedies.
22CIV81D.2	Design bituminous surfacing and other layers along with safety aspects needed during construction.
22CIV81D.3	Design CC pavements with appropriate base course thickness and along with safety aspects needed during construction.
22CIV81D.4	Select suitable equipment for preparation of subgrade in cutting or filling and also the preparation steps for base and subbase layers.
22CIV81D.5	Compute the framework of Pavement Management Systems and pavement evaluation through HDM.

Textbooks:

1. S.K. Khanna, C.E.G. Justo and Veeraraghavan A "Highway Engineering", 10th Edition, Nem Chand & Bros, 2013.
2. Sharma S.C., "Construction Equipment and its Management",5th Edition, Khanna Publishers,2008.
3. Ralph Hass, Ronald Hudson and Zanieswki, "Modern Pavement management"-Krieger Publications.

References:

1. Freddy L Roberts, Prithvi S Kandhal et al, "Hot Mix Asphalt Materials, mixture design and construction"- (2nd Edition), National Asphalt Pavement Association Research and Education Foundation, Maryland, USA.
2. S.K. Khanna, C.E.G. Justo and Veeraraghavan A "Highway Materials Testing"- New Chand &Bros,2013
3. MoRTH 'Specifications for Roads and Bridges Works'- Indian Roads Congress
4. State of art, special report 3 – "compaction of earthwork and subgrade"- IRC, HRB, 1999
5. Highway Hand Book by FAW, Publication from NUS, Singapore.
6. "Guidelines for use of Geotextiles in Road Pavements and Associated works"- 2002, Indian Roads Congress
7. "Soil Mechanics for Road Engineers"- HMSO Publication
8. "Bituminous materials in Road Construction"- HMSO Publication.
9. IS 73, revised 2006, IS 2720, IS 2386, IS 1201 to 1220, IS 8887- 1995, IS 217- 1986.
10. IRC: 51-1992, 63-1976, 74 –1979, 88-1984, "Indian Roads Congress".
11. IRC SP : 53 – 2002, IRC SP: 58 – 2000, "Indian Roads Congress".

Web Reference:

https://onlinecourses.nptel.ac.in/noc22_ce93/preview

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any five full questions choosing at least one full question from each module.

Continuous Internal Evaluation (CIE):
Three Tests are to be conducted for 30 marks each for integrated and 40 marks for non integrated subjects. Average of three test marks will be added to test component and laboratory assessment to be finalized for 10 marks for integrated subjects. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs). Some possible AATs: seminar / assignments / miniprojects/ concept videos/ partial reproduction of research work/ group activity/ any other. Typical Evaluation pattern is shown in Table 1.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	**50**
	CIE Test-2	40	
	CIE Test-3	40	
	Average of CIE	**40**	
	Quiz/AAT	05	
	Quiz/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e. A minimum mark of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV81D.1	3	2												2	
22CIV81D.2	3	2												2	
22CIV81D.3	3	2												2	
22CIV81D.4	3	2												2	
22CIV81D.1	3	-												2	
Average	3	2												**2**	

SEMESTER – VIII

Course: Deep Excavation and Tunnels

Course Code	**22CIV81E**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites:

Course Objectives: Students will be taught:

CLO1	Introduce various underground structures such as tunnels, caverns, shafts, and stations
CLO2	Explain the construction methodology, support systems and challenges in the construction of Tunnels, caverns, shafts, and stations.
CLO3	Explain design aspects in the field on geotechnical/rock engineering and tunnelling, Instrumentation, and monitoring of tunnels
CLO4	Impart knowledge on the field challenges to the students through introduction of problem statements in each module and to assess the comprehension of course through case studies as project work

Content	**No. of Hours/ RBT levels**
Module-1 **Introduction to underground constructions and tunnelling:** General Description of Various Tunnels and other underground structures, Components of a tunnel, Stress around an underground opening, Methods of excavations, Subsurface investigation Surface investigation, Sampling Techniques, Laboratory and in-situ testing of soil and rock, Indian standard codes.	**10 Hours L3**
Module 2 **Construction, challenges and solutions for Caverns, shaft and underground stations:** Factors affecting the choice of method of tunnel construction, Cut and cover method, Bored method, Drill and blast method, Sequential excavation method and shaft method, Norwegian tunnel boring method (NTM), New Austrian tunnel boring method (NATM), Methods of construction of caverns and shafts and	**10 Hours L3**

underground stations, Challenges and solutions for execution of these methods, Different types of Tunnel boring machines.	
Module 3 Design methodology, Instrumentation and monitoring for tunnels: Rock mass classification, Geotechnical and geological inputs for design, Empirical, semi empirical and joint set analysis, Numerical 2D modelling and final support recommendations, Need for Instrumentation and monitoring in tunnels, Types of Instruments - Planning and execution	**10 Hours L3**
Module 4 **Support systems and design software for tunnels:** Need for pre-excavation support system, Fore piling, Bolts and Anchors, Shotcrete, wire meshes, lattice girders and integrated support systems, Different types of retaining structures and their applicability. Secant piles, Sheet piles, contiguous piles and soldier piles and D wall. Requirement of investigation to be carried out for underground structure, Preparation geotechnical interpretation report for design of retaining structure, Numerical analysis to be performed for temporary / permanent retaining system, Introduction to software to be used in embedded retaining system, Case studies.	**10 Hours L3**
Module 5 **Indian and International Code provisions:** Introduction to interpretation using Rock data, Introduction to Wallap, Introduction to Plaxis Introduction to RS-2, Introduction to CIRIA 143, Wallap and their application Practical application & case studies	**10 Hours L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV81E.1	Analyze unrestrained beams and beam column behavior in frames as per IS:800 codal provisions
22CIV81E.2	Design steel beams with web openings and Vierendeel girders.
22CIV81E.3	Evaluate the behavior of Light gauge steel members.
22CIV81E.4	Design steel structures subjected to fire resistance.

Textbooks:

1. CIRIA -C760 “Guidance on Embedded retaining wall design”
2. David Chapman, Nicole Metje, Alfred Stark ” Introduction to Tunnel Construction “2017 , CRC Press

Scheme of Examination:

Semester End Examination (SEE):
SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any five full questions choosing at least one full question from each module.

Continuous Internal Evaluation (CIE):
Three Tests are to be conducted for 30 marks each for integrated and 40 marks for non-integrated subjects. Average of three test marks will be added to test component and laboratory assessment to be finalized for 10 marks for integrated subjects. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs). **Some possible AATs:** seminar / assignments / mini projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses.

Component		Marks	Total Marks
CIE	CIE Test-1	40	**50**
	CIE Test-2	40	
	CIE Test-3	40	
	Average of CIE	**40**	
	Quiz/AAT	05	
	Quiz/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e. A minimum mark of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV81E.1	2	2	2		2									3	
22CIV81E.2	2	2	2		2									3	
22CIV81E.3	2	2	2		2									3	
22CIV81E.4	2	2	2		2									3	
Average	**2**	**2**	**2**		**2**									**3**	

SEMESTER – VIII

Course: Metros and Seaports Engineering

Course Code	**22CIV81F**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites: Environmental Engineering, Geotechnical Engineering

Course Objectives: Students will be taught:

CLO1	Elaborate on the salient features and types of Transit oriented development and its significance
CLO2	Explain the planning, Analysis, design and execution of elevated and underground Metro viaducts, tunnels including monitoring systems and stations
CLO3	Explain the design and Analysis of Earth retaining structures used in Metro systems
CLO4	Introduce the future trends and technologies in Transportation systems.
CLO5	Introduce the salient features of seaports
CLO6	Explain the different permanent and enabling structures in seaports

Content	No. of Hours/ RBT levels
Module 1 **Introduction to Mass Rapid Transit System (MRTS) and Planning of Metros:** Overview of Metro, Transit Oriented Development, Feasibility Study for MRTS Project, Sustainable and Smart Technologies, Recent Advancements & Future Technologies (High Speed Rail Technology, 'Maglev & Ground Effect Trains etc.). Basic Interfacing Principles – Alignment, Urban level planning, constraints and restrictions, Building Information Modelling in Metros, HVAC Systems, Tunnel Ventilation System, Public Health Engineering, Fire Alarm System etc.	**8Hours L2**
Module 2 **Design, Construction and Quality Control:** Introduction to Contracts, Overview of FIDIC standards, Introduction to Quality Systems, Precasting Yard Development, Types of Precast Super Structure, Precast Mould development, Formwork System Overview, introduction to Precast Erection, Superstructure launching Methods, Obligatory Spans, substructure and foundation Construction	**8Hours L2**

Methodology, Challenges in Foundation Construction Alignment / Span configuration of elevated structures, Soil condition and type of foundations, Substructure system, Choosing type of Pier based on alignment profile, Rail / Over Head Equipment mast, Station overall layout, Pier arm - spine wing / cantilever and Platform- precast/cast-in-situ system. Erection methods and case studies Overview of Elevated station, Analysis and Design, Spine beam method, Design of station components, Loads and introduction to IRC/IRS Codes, 'Analysis and Design of superstructure, Substructure and foundation, 'Introduction to Modelling Software - STAAD Pro .	
Module 3 **Earth Retaining systems, Underground Metro Stations, Tunnels and monitoring systems:** Underground Stations and its configurations, Shoring Systems, supporting systems, Construction Methodology (Bottom Up method/ Top Down method), Tunnelling methods and monitoring systems, Earth retaining structures, Secant pile wall design, Guide walls, Introduction to Loads, Load combinations, Fire resistant criteria and Floatation check, 2D & 3D model generation, SOD restrictions & Element sizing for UG Stations, Design of all the components of UG station	**8Hours L2**
Module 4 **Introduction to Seaports:** Introduction and evolution of Ports and Harbors, Terminologies, Overview of Marine Structures, Operation and components of Ports, Site investigation and survey, Approach facilities and navigational aids. Design considerations and functional requirements of typical port structures, Breakwater Structures, Berthing structures, Piers, Wharfs, Jetties, Quays, Dolphins, Fenders, Dredging facilities, Shipyard structures (dry dock and floating dock), Shore protection and Reclamation	**8Hours L2**
Module 5 **Enabling structures:** Cofferdams and Dewatering – Case study, Load Out Jetty (LOJ) – Design of retaining structure, Elevated platform and Hydraulic ramp. Casting Yard Planning and Mould Optimisation. Piling Gantry – Layout, Loading. Rock Works – Breakwater construction, Revetment. Floating Stability/Caisson launching – Casting bed, Ballasting. Modular Construction – Modularisation, Erection.	**8Hours L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV81F.1	Create the basic layout of elevated and underground metro stations as per laid down codes and regulations.
22CIV81F.2	Interpret design recommendations and Codes of Practice for Elevated and Underground Metros and select suitable construction practices
22CIV81F.3	Design the earth retaining systems for the excavations of underground stations
22CIV81F.4	Comprehend the different permanent and enabling structures of seaports and harbors
22CIV81F.5	Design Enabling structures of Ports and Harbors.

Textbooks:

1. Indian Standard code - IS 456, Guidance on embedded retaining wall design CIRIAC760
2. David Chapman, Nicole Metje, Alfred Stark " Introduction to Tunnel Construction "2017 , CRC Press
3. M. Ramachandran ,"Metro Rail Projects in India- A Study in Project Planning "2011, Oxford University Press

References:

1. Srinivasan, R., Harbour, Dock & Tunnel Engineering, Charotar Publishing House
2. Bindra, S.P., A course in Docks and Harbour Engineering, Dhanpat Rai & Sons
3. Port Design - Guidelines and recommendations by C. A. Thoresen, Tapir Publications

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any five full questions choosing at least one full question from each module.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 30 marks each for integrated and 40 marks for non integrated subjects. Average of three test marks will be added to test component and laboratory assessment to be finalized for 10 marks for integrated subjects. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs). Some possible AATs: seminar / assignments / miniprojects/ concept videos/ partial reproduction of research work/ group activity/ any other. Typical Evaluation pattern is shown in Table 1.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	**50**
	CIE Test-2	40	
	CIE Test-3	40	
	Average of CIE	**40**	
	Quiz/AAT	05	
	Quiz/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e. A minimum mark of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV81F.1	2	1	2							1					
22CIV81F.2	2	1	2				1			1					
22CIV81F.3	2	1	2							1					
22CIV81F.4	2	1	2	1						1					
22CIV81F.5	2	1	2							1					
Average	2	1	2	1			1			1					

SEMESTER – VIII

Course: Geo-Environmental Engineering

Course Code	**22CIV81G**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites: Environmental Engineering, Geotechnical Engineering

Course Objectives: Students will be taught:

CLO1	The importance Geo-environmental Engineering
CLO2	Understand the environmental Concerns with waste management strategies.
CLO3	Understand phenomena of Contaminant Transport in landfill site.
CLO4	The objectives and methods of site Remediation,

Content	No. of Hours/ RBT levels
Module 1 **Sources and Site Characterization**: Scope of Geo-environmental Engineering, Various Sources of Contaminations, Need for contaminated site characterization; and Characterization methods.	**8Hours L2**
Module 2 Solid and Hazardous Waste Management: Classification of waste, Characterization solid wastes, Environmental Concerns with waste, waste management strategies.	**8Hours L2**
Module 3 **Contaminant Transport:** Transport process, Mass-transfer process, Modeling, Bioremediation, Phytoremediation.	**8Hours L2**
Module 4 **Remediation Techniques**: Objectives of site remediation, various active and passive methods, remediation NAPL sites, Emerging Remediation Technologies.	**8Hours L2**
Module 5 **Landfills:** Types of landfills, Site Selection, Waste Containment Liners, Leachate collection system, Cover system, Gas collection system.	**8Hours L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV81G.1	Identify various Sources of Contaminations.
22CIV81G.2	Describe the Characterization solid wastes with respect to waste management strategies.
22CIV81G.3	Understand the contaminant transport process like Bioremediation, Phytoremediation.
22CIV81G.4	Identify various active and passive methods of Remediation Techniques.
22CIV81G.5	Understand the concept of Landfills.

Textbooks:

1. Phillip B. Bedient, Refai, H. S. & Newell C. J, "Ground Water Contamination" - Prentice Hall Publications, 4th Edition, 2008.
2. Sharma, H. D. and Reddy, K. R, "Geoenvironmental Engineering", John Wiley & Sons, 2004.
3. Rowe, R. K, "Geotechnical & Geoenvironmental Engineering Handbook", Kluwer Academic, 2001.

References:

1. Reddi, L. N. and Inyang, H. I. - Geoenvironmental Engineering Principles and Applications, Marcel. Dekker, Inc., New York, 2000.
2. LaGrega, M. D., Buckingham, P. L. and Evans, J. C. - Hazardous Waste Management, New York: McGraw-Hill, 2001.

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any five full questions choosing at least one full question from each module.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 30 marks each for integrated and 40 marks for non integrated subjects. Average of three test marks will be added to test component and laboratory assessment to be finalized for 10 marks for integrated subjects. CIE is executed by way of two quizzes /

Alternate Assessment Tools (AATs). Some possible AATs: seminar / assignments / miniprojects/ concept videos/ partial reproduction of research work/ group activity/ any other. Typical Evaluation pattern is shown in Table 1.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	**50**
	CIE Test-2	40	
	CIE Test-3	40	
	Average of CIE	**40**	
	Quiz/AAT	05	
	Quiz/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e. A minimum mark of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV81G.1	2	1	2							1					
22CIV81G.2	2	1	2				1			1					
22CIV81G.3	2	1	2							1					
22CIV81G.4	2	1	2	1						1					
22CIV81G.5	2	1	2							1					
Average	2	1	2	1			1			1					

SEMESTER – VIII

Course: Energy Conservation in Buildings

Course Code	**22CIV82A**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites: -

Course Objectives: Students will be taught:

CLO1	To facilitate learners to understand climatology, heat ingress in building and energy efficiency.
CLO2	To expose the learners to comfort in buildings.
CLO3	To impart fundamental knowledge on Life cycle assessment and Energy conservation.

Content	No. of Hours/ RBT levels
Module-1 Introduction to Climatology and heat ingress in building: Basics of climatology, Earth – Sun relationship, Solar angles and sun path diagram, Design of shading systems. Basics of Thermodynamics, Convection/radiation heat transfer, Heat gain through various elements of a building, Thermal comfort models and case studies.	**8 Hours L2**
Module 2 Building acoustics, Indoor air quality and Lighting in buildings: Basics of sound and Building acoustics – Acoustic defects, prevention of sound transmission and acoustic measure for office building. Indoor Air Quality – Effects, control of contaminants and moisture in indoor environment, Integrated approach for IAQ management. Fundamentals of lighting- Daylighting and its metrics – Strategies for daylighting and its control. Artificial lighting – Design and control strategies – Visual comfort enhancement.	**8 Hours L2**
Module 3 Energy efficient buildings, Water and Waste management in buildings: Energy efficiency – Energy efficiency in building envelope and energy efficient HVAC and Lighting as per Energy conservation building code (ECBC) 2017, Energy	**8 Hours L2**

simulation, Energy management system – Renewable energy and Energy Audit. (demand control ventilation) Water Efficiency – Planning and design of water management system, Rain water harvesting, Water efficient design and fixtures, Treatment and reuse and Water efficient landscape system. Waste management – Types of waste and its treatment methods, Construction and demolition waste management, Waste management in residential, commercial buildings, healthcare facilities.	
Module 4 Life Cycle Assessment of Buildings and Green project management: Materials – Green product certifications, features of sustainable building materials and sustainable alternatives for structural, envelope and finishing materials. Low carbon cement, Zero emission bricks and lean construction practices. Life cycle assessment and its types – Modelling and Analysis, Greenhouse gas emission. Different phases of Green building project management.	**8 Hours** **L2**
Module 5 Energy conservation: Energy efficiency rating for distribution transformers, diesel generator set, motors, pumps, electrical appliances, lighting fixtures and lifts as per Bureau of Energy Efficiency (BEE). Energy efficiency in HVAC system – Variable Frequency Drive (VFD), Air volume drive. Roof top solar installations and solar water heaters, Heat recovery system in buildings, Building Management System (BMS) – Occupancy sensors and energy efficient lighting controls, Smart Buildings	**8 Hours** **L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV82A.1	Comprehend climatology, shading system and analyze heat transfer mechanism in buildings.
22CIV82A.2	Assess the design considerations and parameters for lighting, acoustics and indoor air quality.
22CIV82A.3	Develop solutions for energy efficiency, water efficiency and waste management in buildings.
22CIV82A.4	Calculate energy savings and CO2 mitigation using web tools such as ECONIWAS and Solar rooftop calculator
22CIV82A.5	Adopt green project management methodology and evaluate building life cycle assessment.
22CIV82A.6	Implement energy conservation measures in buildings.

Textbooks:

1. HarharaIyer G, Green Building Fundamentals, Notion Press
2. Dr. Adv. HarshulSavla, Green Building: Principles & Practices
3. The Sustainable Habitat Handbook (6 Volume Set), GRIHA Version 2019

References:

1. National Building Code – 2016, Volume 1&2, Bureau of Indian Standards
2. Energy Conservation Building Code – 2017 (with amendments up to 2020), Bureau of Energy Efficiency

Web Reference:

https://nptel.ac.in/courses/114106017
https://www.youtube.com/watch?v=8nbOI-0U9Co
https://www.youtube.com/watch?v=Be9inw8xlw8
https://www.youtube.com/watch?v=n7oUOUCIblg
https://www.youtube.com/watch?v=gzgNLvHTrfY
https://www.slideshare.net/engkhanmsh/introduction-to-osha-50289682

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE on a scale of 30, the CIE would also include laboratory evaluation for 20 marks. The laboratory marks of 20 would comprise of 10 marks for regular laboratory assessment to include lab record and observation. 10 marks would be exclusive for laboratory internal assessment test to be conducted at the end of the semester**.**

Typical Evaluation pattern for integrated courses is shown in the Table below.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	**50**
	CIE Test-2	40	
	CIE Test-3	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 1/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e. A minimum marks of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV82A.1	2	2				2	1						1		
22CIV82A.2	2	2				2	1						1		
22CIV82A.3	2	2				2	1						1	1	
22CIV82A.4	2	2				2	1			1			1		
22CIV82A.5	2	2				2	1						1		
22CIV82A.6	2	2				2	1						1		
Average	2	2				2	1			1			1	**1**	

SEMESTER – VIII

Course: Occupational Health and Safety

Course Code	**22CIV82B**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites: -

Course Objectives: Students will be taught:

CLO1	Gain an historical, economic, and organizational perspective of occupational safety and health
CLO2	Investigate current occupational safety and health problems and solutions
CLO3	Identify the forces that influence occupational safety and health
CLO4	Demonstrate the knowledge and skills needed to identify workplace problems and safe work practice

Content	No. of Hours/ RBT levels
Module-1 Occupational Hazard and Control Principles: Safety, History and development, National Safety Policy. Occupational safety and Health Act (OSHA), Occupational Health and Safety administration - Laws governing OSHA and right to know. Accident – causation, investigation, investigation plan, Methods of acquiring accident facts, Supervisory role in accident investigation	**8 Hours L2**
Module 2 Ergonomics at Workplace: Ergonomics Task analysis, Preventing Ergonomic Hazards, Workspace Envelops, Visual Ergonomics, Ergonomic Standards, Ergonomic Programs. Hazard cognition and Analysis, Human Error Analysis, Fault Tree Analysis – Emergency Response - Decision for action – purpose and considerations	**8 Hours L2**
Module 3 Fire Prevention and Protection: Fire Triangle, Fire Development and its severity, Effect of Enclosures, early detection of Fire, Classification of fire and Fire Extinguishers. Electrical Safety, Product Safety: Technical Requirements of	**8 Hours L2**

Product safety	
Module 4 Health Considerations at Workplace: types of diseases and their spread, Health Emergency. Personal Protective Equipment (PPE) – types and advantages, effects of exposure and treatment for engineering industries, municipal solid waste. Environment management plans (EMP) for safety and sustainability	**8 Hours L2**
Module 5 Occupational Health and Safety Considerations: Water and wastewater treatment plants, Handling of chemical and safety measures in water and wastewater treatment plants and labs, Construction material manufacturing industries like cement plants, RMC Plants, precast plants and construction sites. Policies, roles and responsibilities of workers, managers and supervisors	**8 Hours L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV82B.1	Identify hazards in the workplace that pose a danger or threat to their safety or health, or that of others.
22CIV82B.2	Control unsafe or unhealthy hazards and propose methods to eliminate the hazard.
22CIV82B.3	Present a coherent analysis of a potential safety or health hazard both verbally and in writing, citing the occupational Health and Safety Regulations as well as supported legislation
22CIV82B.4	Discuss the role of health and safety in the workplace pertaining to the responsibilities of workers, managers, supervisors
22CIV82B.5	Identify the decisions required to maintain protection of the environment, workplace as well as personal health and safety.

Textbooks:

1. Goetsch D.L., "Occupational Safety and Health for Technologists, Engineers and Managers", 9th Edition, Pearson Publications.2018
2. Heinrich H.W., "Industrial Accident Prevention - A Scientific Approach", McGraw-Hill Book Company, US,2018
3. National Safety Council and Associate (Data) Publishers Pvt. Ltd., "Industrial Safety and Pollution Control Handbook,1991

References:

1. Colling D.A., "Industrial Safety Management and Technology", Prentice Hall, New Delhi, 1990.
2. Della D.E., and Giustina, "Safety and Environmental Management", Van Nostrand Reinhold International Thomson Publishing Inc, 1996.

Web Reference:

https://nptel.ac.in/courses/114106017
https://www.youtube.com/watch?v=8nbOI-0U9Co
https://www.youtube.com/watch?v=Be9inw8xlw8
https://www.youtube.com/watch?v=n7oUOUCIblg
https://www.youtube.com/watch?v=gzgNLvHTrfY
https://www.slideshare.net/engkhanmsh/introduction-to-osha-50289682

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE on a scale of 30, the CIE would also include laboratory evaluation for 20 marks. The laboratory marks of 20 would comprise of 10 marks for regular laboratory assessment to include lab record and observation. 10 marks would be exclusive for laboratory internal assessment test to be conducted at the end of the semester**.**

Typical Evaluation pattern for integrated courses is shown in the Table below.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	**50**
	CIE Test-2	40	
	CIE Test-3	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 1/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e. A minimum marks of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV82B.1	2	2				2	1						1		
22CIV82B.2	2	2				2	1						1		
22CIV82B.3	2	2				2	1						1	1	
22CIV82B.4	2	2				2	1			1			1		
22CIV82B.5	2	2				2	1						1		
Average	2	2				2	1			1			1	**1**	

SEMESTER – VIII

Course: Green Buildings

Course Code	**22CIV82C**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites: -

Course Objectives: Students will be taught:

CLO1	Understand the Definition, Concept & Objectives of the terms cost effective construction and green building
CLO2	Apply cost effective techniques in construction
CLO3	Apply cost effective Technologies and Methods in Construction
CLO4	Understand the Problems due to Global Warming
CLO5	State the Concept of Green Building 6. Understand Green Buildings

Content	**No. of Hours/ RBT levels**
Module-1 Introduction to the concept of cost effective construction -Uses of different types of materials and their availability -Stone and Laterite blocks- Burned Bricks- Concrete Blocks- Stabilized Mud Blocks Lime Poszolana Cement- Gypsum Board- Light Weight Beams- Fiber Reinforced Cement Components Fiber Reinforced Polymer Composite- Bamboo- Availability of different materialsRecycling of building materials – Brick- Concrete- Steel- Plastics - Environmental issues related to quarrying of building materials	**8 Hours L2**
Module 2 Environment friendly and cost effective Building Technologies - Different substitute for wall construction Flemish Bond - Rat Trap Bond – Arches – Panels - Cavity Wall - Ferro Cement and Ferro Concrete constructions – different pre cast members using these materials - Wall and Roof Panels – Beams – columns - Door and Window frames - Water tanks - Septic Tanks - Alternate roofing systems - Filler Slab - Composite Beam and Panel Roof -Pre-engineered and ready to use building elements - wood products - steel and plastic - Contributions of agencies -	**8 Hours L2**

Costford - Nirmithi Kendra - Habitat	
Module 3 Global Warming – Definition - Causes and Effects - Contribution of Buildings towards Global Warming - Carbon Footprint – Global Efforts to reduce carbon Emissions Green Buildings – Definition – Features Necessity – Environmental benefit - Economical benefits - Health and Social benefits - Major Energy efficient areas for buildings – Embodied Energy in Materials Green Materials - Comparison of Initial cost of Green V/s Conventional Building - Life cycle cost of Buildings.	**8 Hours L2**
Module 4 Green Building rating Systems- BREEAM – LEED - GREEN STAR -GRIHA (Green Rating for Integrated Habitat Assessment) for new buildings – Purpose - Key highlights - Point System with Differential weight age. Green Design – Definition - Principles of sustainable development in Building Design - Characteristics of Sustainable Buildings – Sustainably managed Materials - Integrated Lifecycle design of Materials and Structures (Concepts only)	**8 Hours L2**
Module 5 Utility of Solar Energy in Buildings Utility of Solar energy in buildings concepts of Solar Passive Cooling and Heating of Buildings. Low Energy Cooling. Case studies of Solar Passive Cooled and Heated Buildings. Green Composites for Buildings Concepts of Green Composites. Water Utilisation in Buildings, Low Energy Approaches to Water Management. Management of Solid Wastes. Management of Sullage Water and Sewage. Urban Environment and Green Buildings. Green Cover and Built Environment.	**8 Hours L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV82C.1	Understand cost effective building materials
22CIV82C.2	Choose environment friendly construction procedure
22CIV82C.3	Design eco-friendly buildings to reduce global warming
22CIV82C.4	Understand the different green rating of buildings
22CIV82C.5	Estimate energy saving in construction

Textbooks:

1. Harhara Iyer G, Green Building Fundamentals, Notion Press 2. Dr. Adv. Harshul Savla, Green Building: Principles & Practices

Web Reference:

https://www.youtube.com/watch?v=THgQF8zHBW8
https://www.youtube.com/watch?v=DRO_rIkywxQ

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE on a scale of 30, the CIE would also include laboratory evaluation for 20 marks. The laboratory marks of 20 would comprise of 10 marks for regular laboratory assessment to include lab record and observation. 10 marks would be exclusive for laboratory internal assessment test to be conducted at the end of the semester**.**

Typical Evaluation pattern for integrated courses is shown in the Table below.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	**50**
	CIE Test-2	40	
	CIE Test-3	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 1/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e. A minimum marks of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIV82C.1	2	2				2	1						1		
22CIV82C.2	2	2				2	1						1		
22CIV82C.3	2	2				2	1						1	1	
22CIV82C.4	2	2				2	1			1			1		
22CIV82C.5	2	2				2	1						1		
Average	2	2				2	1			1			1	**1**	

SEMESTER – VIII

Course: Integrated Building Services

Course Code	**22CIV82D**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites: -

Course Objectives: Students will be taught:

CLO1	Understand Electrical System along with substation for a building infrastructure
CLO2	Learn ELV System and its interface with other allied services
CLO3	Design and implement HVAC System
CLO4	Learn and implement Fire Alarm System (PAS)
CLO5	Understand and implement importance of Public Health Services

Content	**No. of Hours/ RBT levels**
Module-1 Advanced Electrical System Design for Buildings: Basics of Electrical System, Electrical terminologies, Major Electrical equipment, Building power distribution and its schemes, Fundamentals of Power& distribution transformers, HT, LT, DG Sets, Cables & Wires, UPS and its importance, Introduction of HT, LT switchgears systems, Importance of Lighting design & different Light fixtures used in buildings – Interior, external, street & offices, RMU, HT consumer, Substation Building in Master plan - Space planning for RMU,HT, DG set, HSD yard, Space provision for Electrical Equipment including Substation, Various equipment clearance requirements, HVAC, PHE, FPS service-electrical load input for designing electrical power distribution, Pedestals & ceiling support requirement for all Electrical equipment.	**8 Hours L2**
Module 2 Extra Low Voltage System for Infrastructure: Introduction & Brief of ELV Systems, Concept of Building Management System (BMS) & Fire Alarm System, Interface with Architecture/ Structure, Access control, CCTV & Public address system - Brief and purpose, BMS - Brief and purpose, BMS interfaces with	**8 Hours L2**

Electrical, HVAC, Fire & Life Safety and PHE, BMS interfaces with airport systems.	
Module 3 Heating, Ventilation & Air conditioning systems: Basics of HVAC - Psychrometry and its importance - Major Components of Air conditioning System - Fundamental concepts of Heat transfer, Air-conditioning system, Ventilation system, Pressurization Systems and their importance to Life safety, Chilled water system, Cooling towers and major HVAC equipment, Pumping system in HVAC, Importance of Thermal and Acoustic Insulation, Introduction and basics of Variable Refrigerant Flow (VRF) systems, Radiant cooling, Underfloor distribution, Chilled beams – Space planning - Importance of Static weight / Operating weights of mechanical equipment - Importance of Floor slab and Terrace roof slab openings / cut-outs	**8 Hours** **L2**
Module 4 Fire Protection and Life Safety System: Basics of Fire Protection System - Active Fire protection system - Passive Fire protection system - Basics of Smoke Control and Fire Stop Systems - Codes & Standards and Statutory Compliance - Fire and its Classes - Hazard Classification based on building occupancy - Means of Egress and its components - Importance of Life Safety - Refuge Area, Fire Tower and Fire Lift - Occupant Load and Capacity factors - Fire Stopping Materials - Compartmentation in a building - Smoke control & management in Fire Zoning - Components of Fire Compartments.	**8 Hours** **L2**
Module 5 Public Health Engineering: Scope of works in Public Health Engineering - Sanitary fixtures and types - Water supply and treatment - Rain water drainage system - Landscape irrigation features – Water demand calculation based on building occupancy – Piping for different plumbing systems in buildings – Pump selection – Plant room sizing - Sewage treatment process - External water supply, storm drainage & sewerage system - Solid waste management - Interfacing PHE system with Architect and Structural engineers.	**8 Hours** **L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIV82D.1	Understand Electrical System along with substation for a building infrastructure
22CIV82D.2	Learn ELV System and its interface with other allied services.
22CIV82D.3	Design and implement HVAC Systems
22CIV82D.4	Learn and implement Fire Alarm System (PAS)
22CIV82D.5	Understand and implement importance of Public Health Services

Textbooks:

1. Building Services Integration, P K Barton, Barry G Fryer, David Highfield, ISBN-13 978-0419120308, SPON Press, 1983

Web Reference:

https://www.youtube.com/watch?v=THgQF8zHBW8
https://www.youtube.com/watch?v=DRO_rIkywxQ

Scheme of Examination:

Semester End Examination (SEE):

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Continuous Internal Evaluation (CIE):

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Typical Evaluation pattern for integrated courses is shown in the Table below.

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	CIE Test-2	40	
	CIE Test-3	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 1/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

Eligibility requirements: Students to secure a minimum of40% of the marks in both the CIE for theory and lab courses (i.e. A minimum marks of 12 out of 30 in theory and 8 out 20 in the Lab) Students not scoring the minimum as stipulated above both in theory and laboratory would be termed as NSSR for that course and be awarded a grade of "NE" for that course alone.

CO/PO Mapping															
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22CIV82D.1	2	2				2	1						1		
22CIV82D.2	2	2				2	1						1		
22CIV82D.3	2	2				2	1						1	1	
22CIV82D.4	2	2				2	1			1			1		
22CIV82D.5	2	2				2	1						1		
Average	2	2				2	1			1			1	**1**	

SEMESTER – VIII

Course: Internship

Course Code	**22CIV83**	**CIE Marks**	**100**
Hours/Week (L: T: P)	**0:0:12**	**SEE Marks**	**100**
No. of Credits	**10**	**Examination Hours**	**3**

Guidelines for Internship

1. The duration of the internship shall be for a period of 14-20 weeks on full time basis after VII semester final exams.
2. The student must submit letters from the industry clearly specifying his / her name and the duration of the internship on the company letter head with authorized signature.
3. Internship must be related to the field of specialization of the respective UG programme in which the student has enrolled.
4. Students undergoing internship training are advised to report their progress and submit periodic progress reports to their respective guides.
5. Students have to present the internship activities carried out to the departmental committee and only upon approval by the committee, the student can proceed to prepare and submit the hard copy of the final internship report. However, interim or periodic reports as required by the industry / organization can be submitted as per the format acceptable to the respective industry /organizations.
6. The reports shall be printed on A4 size with 1.5 spacing and Times New Roman with font size 12, outer cover of the report (wrapper) has to be Ivory color for UG circuit Programs and Light Blue for Non-Circuit Programs.
7. The broad format of the internship final report shall be as follows
   - Cover Page
   - Certificate from College
   - Certificate from Industry / Organization
   - Acknowledgement
   - Synopsis

- Table of Contents
- ✓ Chapter 1 - Profile of the Organization: Organizational structure, Products, Services, Business Partners, Financials, Manpower, Societal Concerns, Professional Practices,
- ✓ Chapter 2 - Activities of the Department
- ✓ Chapter 3 - Tasks Performed: summaries the tasks performed during 8-week period
- ✓ Chapter 4 – Reflections: Highlight specific technical and soft skills that you acquired during internship
- ✓ References & Annexure

Scheme of Evaluation

The evaluation committee shall consist of Guide, Professor/Associate Professor and Assistant Professor. The committee shall assess the presentation and the progress reports in two reviews.

The evaluation criteria shall be as per the rubrics given below:

Continuous Internal Evaluation (CIE):

Reviews	**Activity**	**Weightage**
Review-I	Explanation of the application of engineering knowledge in industries, ability to comprehend the functioning of the organization/ departments	45%
Review- II	Importance of resource management, environment and sustainability presentation skills and report writing	55%

Semester End Evaluation (SEE):

The SEE examination shall be conducted by an external examiner (domain expert) and an internal examiner. Evaluation shall be done in batches.