Bachelor of Technology

4-YEAR PROGRAMME
B.TECH CIVIL ENGG
Choice Based Credit System with
Learning Outcomes based Curricular Framework
w. e. f. 2023-24

Faculty of Engineering and Technology
Chaudhary Devi Lal University
Sirsa-125055

Contents

1. Faculty of Engineering & Technology

The faculty covers the professional and academic programmes/courses run in the university teaching department of computer science and engineering, university school of graduate studies, affiliated general degree colleges, institute of computer applications and engineering colleges. BTech and MTech programmes in major disciplines and MCA, MSc Data Science, BSc Data Science, BCA programmes are managed by the faculty.

2. Learning Outcome based Curriculum Framework

The CBCS evolved into learning outcome-based curriculum framework and provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective/minor or skill-based courses. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Grading system provides uniformity in the evaluation and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations which enables the student to move across institutions of higher learning. The uniformity in evaluation system also enables the potential employers in assessing the performance of the candidates.

2.1 Objectives of the programme

Programme objectives of B. Tech. in different disciplines will be different. Programme objectives shall be specified with the full 8-semester curriculum of individual stream of engineering.

2.2 Programme Outcomes (POs)

PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis**: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
PO3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
PO4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
PO6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
PO11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

2.3 Programme Specific Outcomes (PSOs)

Programme objectives of B. Tech. in different disciplines will be different. Programme objectives shall be specified with the full 8-semester curriculum of individual stream of engineering.

3. Programme Structure

B. Tech. (All major disciplines/branches) programme an eight-semester (4-year) graduate programme comprises of various types of courses, namely, Basic Science Courses (BSC), Programme Core Courses (PC), Programme Elective Courses (PE), Engineering Science Courses (ESC), Humanities, Social Sciences and Management Courses (HSMC), Open Elective Courses (OE), Employability Enhancement Courses (EEC) and Mandatory Courses (MC).

Course code and definition:

Course code	Definitions
HSMC	Humanities, Social Science and Management Courses
BSC	Basic Science Courses
ESC	Engineering Science Courses
PC	Program Core Courses
PE	Programme Elective Courses
OE	Open Elective Courses
MC	Mandatory Courses
EEC	Employment Enhancement Courses (Project/Summer Internship/Seminar, etc.)

Note 1: All B.Tech. Programmes running in the University and in Affiliated Colleges/Institutes are divided into following two groups:

Group	Engineering disciplines
A	Electronics and Communication Engineering
	Electrical Engineering
	Mechanical Engineering
B	Computer Science and Engineering
	Artificial Intelligence and Machine learning
	Civil Engineering
	Information Technology

Note 2: New branch/disciplines of Engineering & Technology to be added to the Faculty of Engineering & Technology may be placed in the relevant Groups A/B keeping in mind the balancing of human resource load.

Table 3(a): Courses' codes, titles, and credits (Group–A)

Course Code	Course Title	Workload/Credit			
	Semester I	Theory	Tutorial	Practical	Total
BSC/1-T BSC/1-T(i) BSC/1-T(iv)	Physics: Introduction to Electromagnetic Theory (EE/ECE) Oscillations, Waves and Optics (ME)	3/3	1/1	-	4/4
BSC/3-T	Mathematics-I	3/3	1/1	-	4/4
ESC/1-T	Basic Electrical Engineering	3/3	1/1	-	4/4
ESC/4-T	Workshop/Manufacturing Practices	3/3	-	-	3/3
BSC/1-P BSC/1-P(i) BSC/1-P(iv)	Physics Lab: Introduction to Electromagnetic Theory (EE/ECE) Oscillations, Waves and Optics (ME)	-	-	4/2	4/2
ESC/1-P	Basic Electrical Engineering Lab	-	-	2/1	2/1
ESC/4-P	Workshop/Manufacturing Practices Lab	-	-	4/2	4/2
MC/1	Induction Training	-	-	-	-
		12/12	**3/3**	**10/5**	**25/20**
	Semester II	Theory	Tutorial	Practical	Total
BSC/2-T	Chemistry	3/3	1/1	-	4/4
BSC/4-T	Mathematics-II	3/3	1/1	-	4/4
ESC/3-T	Programming for Problem Solving	4/4	-	-	4/4
HSMC/1-T	English	2/2	-	-	2/2
MC/2-T	Environmental Science	3/-	-	-	3/-
BSC/2-P	Chemistry Lab	-	-	4/2	4/2
ESC/2-P	Engineering Graphics and Design Lab	-	-	4/2	4/2
ESC/3-P	Programming for Problem Solving Lab	-	-	4/2	4/2
HSMC/1-P	English Lab	-	-	2/1	2/1
Total		**15/12**	**2/2**	**14/7**	**31/21**

Table 3(b): Courses' codes, titles, and credits (Group–B)

Course Code	Course Title	Workload/Credit			
	Semester I	Theory	Tutorial	Practical	Total
BSC/2-T	Chemistry	3/3	1/1	-	4/4
BSC/3-T BSC/5-T	Mathematics-I Mathematics-I (for CSE/IT/AI&ML)	3/3	1/1	-	4/4
ESC/3-T	Programming for Problem Solving	4/4	-	-	4/4
HSMC/1-T	English	2/2	-	-	2/2
BSC/2-P	Chemistry Lab	-	-	4/2	4/2
ESC/2-P	Engineering Graphics and Design Lab	-	-	4/2	4/2
ESC/3-P	Programming for Problem Solving Lab	-	-	4/2	4/2
HSMC/1-P	English Lab	-	-	2/1	2/1
MC/1	Induction Training	-	-	-	-
Total		**12/12**	**2/2**	**14/7**	**28/21**
	Semester II	Theory	Tutorial	Practical	Total
BSC/1-T BSC/1-T(ii) BSC/1-T(v)	Physics: Introduction to Mechanics (for CE) Semiconductor Physics (CSE/IT/AI &ML)	3/3	1/1	-	4/4
BSC/4-T BSC/6-T	Mathematics-II Mathematics-II (for CSE/IT/AI&ML)	3/3	1/1	-	4/4
ESC/1-T	Basic Electrical Engineering	3/3	1/1	-	4/4
ESC/4-T	Workshop/Manufacturing Practices	3/3	-	-	3/3
MC/3-T	Indian Constitution	3/-	-	-	3/-
BSC/1-P BSC/1-P(ii) BSC/1-P(v)	Physics Lab: Introduction to Mechanics (for CE) Semiconductor Physics (CSE/IT/AI&ML)	-	-	4/2	4/2
ESC/1-P	Basic Electrical Engineering Lab	-	-	2/1	2/1
ESC/4-P	Workshop/Manufacturing Practices Lab	-	-	4/2	4/2
Total		**15/12**	**3/3**	**10/5**	**28/20**

Note 3: The following non-credit mandatory courses taught in 2nd semester to group A disciplines will be taught to group B disciplines in 3rd semester, and vice versa.

Mandatory non-credit courses to be taught during 3rd semester	
Environmental Sciences	Group B
Indian Constitution	Group A

Note 4: Each discipline of Engineering & Technology has opted one of the following seven options in Physics Course most suitable to their students/disciplines (Table 4). However, keeping the logistics in mind, the College/Institute may opt a different Physics Course for different disciplines.

Sr. No.	Course name
(i)	Introduction to Electromagnetic Theory
(ii)	Introduction to Mechanics
(iii)	Optics, Fibre Optics, Magnetism, and Nuclear Physics
(iv)	Oscillations, Waves and Optics
(v)	Semiconductor Physics
(vi)	Waves Optics, Quantum Mechanics and Solids
(vii)	Introduction to Quantum Physics

Table 4. Discipline-wise Physics Course options

Discipline	Option
Mechanical Engineering	Oscillation, Waves and Optics
Electrical Engineering	Introduction to Electromagnetic Theory
Electronics and Communication Engineering	Introduction to Electromagnetic Theory
Civil Engineering	Introduction to Mechanics
Computer Science and Engineering, Information Technology, Artificial Intelligence and Machine Learning	Semiconductor Physics

Note 5: Induction Programme (MC/1)

It is mandatory to conduct an induction programme for newly admitted students right at the beginning of the first semester. The objective of the induction programme is to create a bond between the institution and the newly admitted students.

The new students enter an institution with diverse backgrounds and expectations. It is important to help them adjust to the new environment. To meet this purpose, there will be three week-long induction programme before the normal classes start. The induction program shall provide students the opportunity to settle down and be comfortable in the new environment. The new students will come to know their seniors, faculty members, department and university. The student would be engaged in the following activities.

1. Familiarization with the Department and the University
2. Physical activities like morning walks, cycling or playing one or the other games.
3. Creative arts like painting, music and dancing etc.
4. Talks and lectures by eminent people, and group discussion on universal Human values
5. Literary activities like reading writing or debating

The schedule for organizing the induction programme shall be prepared every year at university level. Students will be engaged in diverse activities at the level of Department. Depending on the interest, every student must opt for one of the activities during all the semesters. For this purpose, the following clubs shall be established in the Department.

1. Sports Club
2. Green Club
3. Culture, Literature and Film Club
4. Social Service Club
5. Technology Innovation Club

Each student will spend 3 to 5 hours for these activities per week.

Programme Specific Outcomes (PSO)	
PSO1	Able to analyze various Civil Engineering structures and systems by using basic and advanced technologies.
PSO2	Able to design civil engineering facilities and their elements and also use of modem software tools for the same
PSO3	Able to plan, monitor and supervise construction activities to complete civil engineering facilities satisfactorily.

Course Code	Definition/ Category
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management Courses
MC	Mandatory Audit Courses
PC	Program Core
PE	Program Elective Courses
OE	Open Elective Courses
EEC	Employability Enhancement Courses (Project work/ Summer Training/ Industrial Training/ Practical Training/ Internship/Seminar, etc.)

Credit Scheme for B. Tech. Civil Engineering 2nd Year (3rd & 4th Sem)

Semester	Basic Science Courses BSC		Engineering Science' Core/ Elective/ Open Elective Courses (PC/PE/OE)		Humanities, Social Sciences Courses (HSMC)		Mandatory Courses		Grand Total Credit
	No. of Courses	Total Credits	No. of Courses	Total Credits	No. of Courses	Total Credits	No. of Courses	Total Credits	
3rd	01	03	07	19	00	00	01	00	22
4th	00	00	09	23	01	02	00	00	25

Scheme B.Tech. (Civil Engineering) 2nd year

SEMESTER-3					
Course Code	**Course Title**	**Workload/Credit**			
		Theory	**Tutorial**	**Practical/ Drawing**	**Total**
*MC/2-T	Environmental Sciences	3/-	-	-	3/-
BSC/7-T	Mathematics-III	3/3	-	-	3/3
PC/CE/31-T	Structural Analysis-I	4/4	-	-	4/4
PC/CE/32-T	Fluid Mechanics-I	4/4	-	-	4/4
PC/CE/33-T	Surveying-I	4/4	-	-	4/4
PC/CE/34-T	Building Construction, Materials & Drawing	3/3	-	2/1**	5/4
PC/CE/31-P	Structural Analysis-I Lab	-	-	2/1	2/1
PC/CE/32-P	Fluid Mechanics-I Lab	-	-	2/1	2/1
PC/CE/33-P	Surveying-I Lab	-	-	2/1	2/1
Total		**21/18**	**-**	**8/4**	**29/22**
SEMESTER-4					
Course Code	**Course Title**	**Workload/Credit**			
		Theory	**Tutorial**	**Practical/ Drawing**	**Total**
HSMC/3-T	Fundamentals of Management for Engineers	2/2	-	-	2/2
PC/CE/41-T	Structural Analysis-II	4/4	-	-	4/4
PC/CE/42-T	Fluid Mechanics-II	4/4	-	-	4/4
PC/CE/43-T	Soil Mechanics	4/4	-	-	4/4
PC/CE/44-T	Surveying-II	4/4	-	-	4/4
PC/CE/45-T	Engineering Geology	3/3	-	-	3/3
PC/CE/42-P	Fluid Mechanics-II Lab	-	-	2/1	2/1
PC/CE/43-P	Soil Mechanics Lab	-	-	2/1	2/1
PC/CE/44-P	Surveying-II Lab	-	-	2/1	2/1
PC/CE/45-P	Geology –Lab	-	-	2/1	2/1
Total		**21/21**	**-**	**8/4**	**29/25**
***EEC/CE/51-P	2-4 Week Survey Camp	-/-	-/-	-/4	-/4

*Non-credit qualifying mandatory course.

** Internal evaluation.

*** The students shall devote 2-4 Weeks to Survey Camp (EEC/CE/51-P) after 4th semester examinations and shall submit a report. The evaluation of survey camp will be taken up in the 5th semester.

Note: Students will be allowed to use non-programmable scientific calculators only; however, sharing of calculator should not be permitted.

Course Code	Definition/ Category
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management Courses
MC	Mandatory Audit Courses
PC	Program Core
PE	Program Elective Courses
OE	Open Elective Courses
EEC	Employability Enhancement Courses (Project work/ Summer Training/ Industrial Training/ Practical Training/ Internship/Seminar, etc.)

Credit Scheme for B. Tech. Civil Engineering 3rd Year (5th & 6th Sem)

Semester	Basic Science Courses BSC		Engineering Science' Core/ Elective/ Open Elective Courses (PC/PE/OE)		Humanities, Social Sciences Courses (HSMC)		Mandatory Courses		Grand Total Credit
	No. of Courses	Total Credits	No. of Courses	Total Credits	No. of Courses	Total Credits	No. of Courses	Total Credits	
5th	00	00	09	24	00	00	00	00	24
6th	00	00	09	19	00	00	01	00	19

Scheme B.Tech. (Civil Engineering) 3rd year

SEMESTER-5					
Course Code	**Course Title**	**Workload/Credit**			
		Theory	**Tutorial**	**Practical/ Drawing**	**Total**
PC/CE/51-T	Design of Steel Structures-I	3/3	-	-	3/3
PC/CE/52-T	Structural Analysis-III	3/3	-	-	3/3
PC/CE/53-T	Hydrology	3/3	-	-	3/3
PE/CE/51-T to PE/CE/54-T	**Program Elective-I**	3/3	-	-	3/3
PE/CE/55-T to PE/CE/58-T	**Program Elective-II**	3/3	-	-	3/3
	Open Elective-I to be opted from courses offered by other Department	3/3	-	-	3/3
PC/CE/52-P	Structural Analysis-II Lab	-	-	2/1	2/1
ESC/7-P	Civil Engineering Materials Testing & Evaluation –I Lab	-	-	2/1	2/1
EEC/CE/51-P	Survey Camp*	-	-	-	-/4
Total		**18/18**	**-**	**4/2**	**22/24**
Open Elective-I :- Students are required to study one elective subject from any other Department in 5th Semester					

*Internal Evaluation.

Program Elective-I

Course Code	Course Name	L	T	P/D	Credits
PE/CE/51-T	Highway Engineering	3	-	-	3.0
PE/CE/52-T	Highway Construction & Management	3	-	-	3.0
PE/CE/53-T	Highway and Traffic Engineering	3	-	-	3.0
PE/CE/54-T	Pavement Materials and Design	3	-	-	3.0

Program Elective-II

Course Code	Course Name	L	T	P/D	Credits
PE/CE/55-T	Geotechnology	3	-	-	3.0
PE/CE/56-T	Foundation Engineering	3	-	-	3.0
PE/CE/57-T	Geotechnical Design	3	-	-	3.0
PE/CE/58-T	Analysis and Design of Sub-Structures	3	-	-	3.0

SEMESTER-6					
Course Code	**Course Title**	**Workload/Credit**			
		Theory	**Tutorial**	**Practical/ Drawing**	**Total**
PC/CE/61-T	Design of Steel Structures-II	3/3	-	-	3/3
PC/CE/62-T	Design of Concrete Structures-I	3/3	-	-	3/3
PE/CE/61-T to PE/CE/64-T	**Program Elective-III**	3/3	-	-	3/3
PE/CE/65-T to PE/CE/68-T	**Program Elective-IV**	3/3	-	-	3/3
	Open Elective-II to be opted from courses offered by other Department	3/3	-	-	3/3
MC/7-T*	Disaster Preparedness & Planning Management	3/-	-	-	3/-
PC/CE/62-P	Concrete Testing Lab	-	-	2/1	2/1
PC/CE/63-P	Environmental Engg.-I Lab	-	-	2/1	2/1
PC/CE/64-P	Irrigation Engineering (Drawing)	-	-	2/1	2/1
ESC/8-P	Civil Engineering Materials Testing & Evaluation –II Lab	-	-	2/1	2/1
Total		**18/15**	**-**	**8/4**	**26/19**
Note: Students shall devote 4-6 weeks to Internship/Training after 6th semester examination outside the College campus at approved works.					
Open Elective-II :- Students are required to study one elective subject from any other Department in 6th Semester					

*Non-credit qualifying mandatory courses. The assessment will be completely internal.

Note: Students will be allowed to use non-programmable scientific calculators only; however, sharing of calculator should not be permitted.

Program Elective-III

Course Code	Course Name	L	T	P/D	Credits
PE/CE/61-T	Water Supply & Treatment	3	-	-	3.0
PE/CE/62-T	Environment Engineering	3	-	-	3.0
PE/CE/63-T	Environmental Impact Assessment and Life Cycle Analysis	3	-	-	3.0
PE/CE/64-T	Water and Air Quality Modelling	3	-	-	3.0

Program Elective-IV

Course Code	Course Name	L	T	P/D	Credits
PE/CE/65-T	Irrigation Engineering	3	-	-	3.0
PE/CE/66-T	Design of Hydraulic Structures	3	-	-	3.0
PE/CE/67-T	Urban Hydrology and Hydraulics	3	-	-	3.0
PE/CE/68-T	Groundwater Engineering	3	-	-	3.0

Course Code	Definition/ Category
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management Courses
MC	Mandatory Audit Courses
PC	Program Core
PE	Program Elective Courses
OE	Open Elective Courses
EEC	Employability Enhancement Courses (Project work/ Summer Training/ Industrial Training/ Practical Training/ Internship/Seminar, etc.)

Credit Scheme for B. Tech. Civil Engineering 4th Year (7th & 8th Sem)

Semester	Basic Science Courses BSC		Engineering Science' Core/ Elective/ Open Elective Courses (PC/PE/OE)		Humanities, Social Sciences Courses (HSMC)		Mandatory Courses		Grand Total Credit
	No. of Courses	Total Credits	No. of Courses	Total Credits	No. of Courses	Total Credits	No. of Courses	Total Credits	
7th	00	00	09	21	00	00	00	00	21
8th	00	00	08	17	00	00	00	00	17

Scheme B.Tech. (Civil Engineering) 4th year

SEMESTER-7					
Course Code	**Course Title**	**Workload/Credit**			
		Theory	**Tutorial**	**Practical/ Drawing**	**Total**
PC/CE/71-T	Design of Concrete Structures-II	3/3	-	-	3/3
PE/CE/71-T to PE/CE/74-T	**Program Elective-V**	3/3	-	-	3/3
PE/CE/75-T to PE/CE/78-T	**Program Elective-VI**	3/3	-	-	3/3
	Open Elective-III to be opted from courses offered by other Department	3/3	-	-	3/3
PC/CE/71-P	Concrete Structures-II (Drawing)	-	-	2/1	2/1
PC/CE/72-P	Highway Material Testing-I Lab	-	-	2/1	2/1
EEC/CE/71-P	Estimation, Accounts & Valuation	-	-	4/2	4/2
EEC/CE/72-P	PROJECT-I	-	-	6/3	6/3
EEC/CE/73-P	Internship/Training	-	-	4/2	4/2
Total		**12/12**	**-**	**18/9**	**30/21**
Open Elective-III: - Students are required to study one elective subject from any other Department in 7th Semester.					

Program Elective-V

Course Code	Course Name	L	T	P/D	Credits
PE/CE/71-T	Railway & Airport Engineering	3	-	-	3.0
PE/CE/72-T	Intelligent Transport System	3	-	-	3.0
PE/CE/73-T	Transportation Engineering	3	-	-	3.0
PE/CE/74-T	Airport Planning & Design	3	-	-	3.0

Program Elective-VI

Course Code	Course Name	L	T	P/D	Credits
PE/CE/75-T	Project Planning & Management	3	-	-	3.0
PE/CE/76-T	Construction Engineering & Management	3	-	-	3.0
PE/CE/77-T	Construction Planning, Scheduling and Control	3	-	-	3.0
PE/CE/78-T	Contract Laws and Regulations	3	-	-	3.0

SEMESTER-8					
Course Code	**Course Title**	**Workload/Credit**			
		Theory	**Tutorial**	**Practical/ Drawing**	**Total**
PC/CE/81-T	Pavement Analysis & Design	3/3	-	-	3/3
PE/CE/81-T to PE/CE/84-T	**Program Elective-VII**	3/3	-	-	3/3
PE/CE/85-T to PE/CE/88-T	**Program Elective-VIII**	3/3	-	-	3/3
PC/CE/81-P	Highway Material Testing-II Lab	-	-	2/1	2/1
PC/CE/82-P	Environmental Engg.- II Lab	-	-	2/1	2/1
EEC/CE/81-P	PROJECT-II	-	-	8/4	8/4
EEC/CE/82-P	SEMINAR*	-	-	2/1	2/1
EEC/CE/83-P	General Fitness & Professional Aptitude	-	-	-	-/1
Total		**9/9**	**-**	**14/7**	**23/17**

* Internal evaluation

Note: Students will be allowed to use non-programmable scientific calculators only; however, sharing of calculator should not be permitted.

Program Elective-VII

Course Code	Course Name	L	T	P/D	Credits
PE/CE/81-T	Sewerage & Sewage Treatment	3	-	-	3.0
PE/CE/82-T	Industrial Waste Water Treatment	3	-	-	3.0
PE/CE/83-T	Air and Noise Pollution Control Engg	3	-	-	3.0
PE/CE/84-T	Solid and Hazardous Waste Management	3	-	-	3.0

Program Elective-VIII

Course Code	Course Name	L	T	P/D	Credits
PE/CE/85-T	Concrete Technology	3	-	-	3.0
PE/CE/86-T	Geosynthetics Engineering	3	-	-	3.0
PE/CE/87-T	Bridge Engineering	3	-	-	3.0
PE/CE/88-T	Prestressed Concrete	3	-	-	3.0

OPEN ELECTIVE COURSES OFFERED FOR VARIOUS B.TECH PROGRAMMES (2023 onwards scheme)

Open Elective Course –I for B.Tech 5th Semester

S.No	Course code	Course Name	Offered by	Credits
01	OE/CE/51-T	Introduction to Civil Engineering	Civil Engineering	3.0
02	OE/CE/52-T	Introduction to Fluid Mechanics	Civil Engineering	3.0
03	OE/CE/53-T	Disaster Preparedness and Planning Management	Civil Engineering	3.0
04	OE/CE/54-T	Civil Engg-Societal & Global Impact	Civil Engineering	3.0

Open Elective Course –II for B.Tech 6th Semester

S.No	Course code	Course Name	Offered by	Credits
01	OE/CE/61-T	Project Planning & Management	Civil Engineering	3.0
02	OE/CE/62-T	Introduction to Irrigation Engineering	Civil Engineering	3.0
03	OE/CE/63-T	Introduction to Intelligent Transport System	Civil Engineering	3.0
04	OE/CE/64-T	Remote Sensing and GIS	Civil Engineering	3.0

Open Elective Course –III for B.Tech 7th Semester

S.No	Course code	Course Name	Offered by	Credits
01	OE/CE/71-T	Environmental Engineering	Civil Engineering	3.0
02	OE/CE/72-T	Environmental Impact Assessment	Civil Engineering	3.0
03	OE/CE/73-T	Introduction to Industrial Waste Water Treatment	Civil Engineering	3.0
04	OE/CE/74-T	Introduction to Geosynthetics Engineering	Civil Engineering	3.0

Scheme of Examination & Detailed Syllabus of B.Tech (CE) 2nd Year

(3rd & 4th Semester)

Scheme B.Tech. (Civil Engineering) 2nd year

SEMESTER-3					
Course Code	**Course Title**	**Workload/Credit**			
		Theory	**Tutorial**	**Practical/ Drawing**	**Total**
*MC/2-T	Environmental Sciences	3/-	-	-	3/-
BSC/7-T	Mathematics-III	3/3	-	-	3/3
PC/CE/31-T	Structural Analysis-I	4/4	-	-	4/4
PC/CE/32-T	Fluid Mechanics-I	4/4	-	-	4/4
PC/CE/33-T	Surveying-I	4/4	-	-	4/4
PC/CE/34-T	Building Construction, Materials & Drawing	3/3	-	2/1**	5/4
PC/CE/31-P	Structural Analysis-I Lab	-	-	2/1	2/1
PC/CE/32-P	Fluid Mechanics-I Lab	-	-	2/1	2/1
PC/CE/33-P	Surveying-I Lab	-	-	2/1	2/1
Total		**21/18**	**-**	**8/4**	**29/22**
SEMESTER-4					
Course Code	**Course Title**	**Workload/Credit**			
		Theory	**Tutorial**	**Practical/ Drawing**	**Total**
HSMC/3-T	Fundamentals of Management for Engineers	2/2	-	-	2/2
PC/CE/41-T	Structural Analysis-II	4/4	-	-	4/4
PC/CE/42-T	Fluid Mechanics-II	4/4	-	-	4/4
PC/CE/43-T	Soil Mechanics	4/4	-	-	4/4
PC/CE/44-T	Surveying-II	4/4	-	-	4/4
PC/CE/45-T	Engineering Geology	3/3	-	-	3/3
PC/CE/42-P	Fluid Mechanics-II Lab	-	-	2/1	2/1
PC/CE/43-P	Soil Mechanics Lab	-	-	2/1	2/1
PC/CE/44-P	Surveying-II Lab	-	-	2/1	2/1
PC/CE/45-P	Geology –Lab	-	-	2/1	2/1
Total		**21/21**	**-**	**8/4**	**29/25**
***EEC/CE/51-P	2-4 Week Survey Camp	-/-	-/-	-/4	-/4

*Non-credit qualifying mandatory course.

** Internal evaluation.

*** The students shall devote 2-4 Weeks to Survey Camp (EEC/CE/51-P) after 4th semester examinations and shall submit a report. The evaluation of survey camp will be taken up in the 5th semester.

Note: Students will be allowed to use non-programmable scientific calculators only; however, sharing of calculator should not be permitted.

Course code	**MC/2-T**			
Category	**Mandatory Courses**			
Course title	**Environmental Sciences**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**0**	**0.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course Outcomes

By the end of the course students will be able to:

CO1. Enhance and analyze human impacts on the environment.

CO2. Integrate concepts & methods from multiple discipline and apply to environmental problems.

CO3. Design and evaluate strategic terminologies and methods for subs table management of environmental systems.

CO4. Create knowledge on various local environment aspects which forms an irreplaceable tool in the entire learning process.

Course Contents

UNIT-I

Multidisciplinary nature of Environmental studies: Definition, scope and importance, need for public awareness; Concept, Structure and function of an ecosystem: Producers, consumers and decomposers, Energy flow in the ecosystem ,Ecological succession ,Food chains, Food webs and ecological pyramids; Introduction, types, characteristics features, structure and function of Forest ecosystem, Grassland ecosystem ,Desert ecosystem, Aquatic ecosystem (Ponds, Stream, lakes, rivers, oceans, estuaries); Biodiversity: Introduction, Definition: genetic, species and ecosystem diversity, Bio-geographical classification of India, Value of biodiversity: consumptive use, productive use, social ethical, aesthetic and option values; Biodiversity at global, national and local level, India as a mega-diversity nation, Hot-spot of biodiversity, Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT-II

Renewable and non-renewable resources, Natural resources and associated problems, Forest resources: Use and over-exploitation, deforestation, case studies, Timber extraction, mining, dams and their effects on forests and tribal people; Water resources: Use and over utilization of surface and ground water, floods, droughts conflicts over water, dams benefits and problems; Mineral resources: Use and exploitation, environmental effects of extracting and mineral resources; Food resources:

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World food problem, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity; Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies; Land resources: Land as a resource, land degradation, main induced landslides, soil erosion and desertification, Role of an individual in conservation of natural resources, Equitable use of resources for suitable lifestyle.

UNIT-III

Definition of Environment Pollution; Causes, effects and control measures of: Air Pollution, Water Pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards; Solid waste Management: Causes effects and control measures of urban and industrial wastes; Role of and individual in prevention of pollution, Pollution case studies; Disaster management: floods, earthquake, cyclone and landslides; Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Case studies; different laws related to environment: Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and Control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act.; Issues involved in enforcement of environmental legislation, Public awareness

UNIT-IV

Social issues and the Environment: From unsustainable to Sustainable development, Urban problems related to energy; Water conservation, rain water harvesting, watershed management; Resettlement and rehabilitation of people; its problem and concern, case studies; Environment ethics: Issues and possible solutions; Wasteland reclamation; Consumerism and waste products; Human Population growth, variation among nation, Population explosion- Family Welfare Programme, Environment and human health , Human Rights, Value Education, HIV/AIDS, Women and Child Welfare, Role of Information Technology in Environment and human health, Case Studies.

Books

1. Fundamental concepts in Environmental studies by Dr. D.D. Mishra. S. Chand publications.
2. Essentials of Ecology and Environmental Science by Dr. S. V.S. Rana, PHI Learning Pvt. Ltd, Delhi
3. Environmental Chemistry by Anil Kumar De, Wiley Eastern Limited.
4. Environmental Science by T.G. Miller, Wadsworth Publishing Co, 13th edition.
5. Ecology and Environment by P. D. Sharma, Rastogi publications

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1.	-	-	-	-	-	1	3	-	-	-	-	-
CO2.	-	-	-	-	-	1	3	-	-	-	-	-
CO3.	-	-	-	-	-	1	3	-	-	-	-	-
CO4.	-	-	-	-		1	3	-	-	-	-	-
3 –High 2-Medium 1-Low												

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Course code	**BSC/7-T**			
Category	**Basic Science Courses**			
Course title	**Mathematics-III**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**0**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Pre-requisites: Mathematics I and Mathematics II

About the Course

This is an advanced mathematics course that offers the knowledge of Fourier Series, Fourier Transforms, Functions of Complex Variables. These concepts are essential for students to solve problems in image processing, digital signal processing and other related engineering fields.

Course Outcomes:

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Define concepts and terminology of Fourier series and Fourier transforms, Functions of complex variables, Power Series and, Probability distributions and hypothesis testing.	**L1 (Remembering)**
CO2.	Solve problems using Fourier transforms in domains like digital electronics and image processing.	**L3 (Apply)**
CO3.	Apply mathematical principles to solve computational problems	**L3 (Apply)**
CO4.	Compare various probability distributions	**L4 (Analysis)**
CO5.	Select suitable hypothesis testing methods for given problems and interpret the respective outcomes.	**L5 (Evaluating)**
CO6.	Integrate the knowledge of Fourier series and Fourier transforms, Functions of complex variables, Power Series and, Probability distributions and hypothesis testing for solving real world problems.	**L6 (Creating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

Course Content

UNIT- I

Fourier Series and Fourier Transforms: Euler's formulae, conditions for a Fourier expansion, change of interval, Fourier expansion of odd and even functions, Fourier expansion of square wave, rectangular wave, saw-toothed wave, half and full rectified wave, half range sine and cosine series.

UNIT-II

Fourier integrals, Fourier transforms, Shifting theorem (both on time and frequency axes), Fourier transforms of derivatives, Fourier transforms of integrals, Convolution theorem, Fourier transform of Dirac delta function.

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Linear Programming Problem (LPP): Introduction, Formulation of linear programming problem (LPP); Graphical method for its solution; Standard form of LPP; Basic feasible solutions; Simplex Method and Dual Simplex Method for solving LPP.

UNIT-III

Functions of Complex Variable: Definition, Exponential function, Trigonometric and Hyperbolic functions, Logarithmic functions. Limit and Continuity of a function, Differentiability and Analyticity. Cauchy-Riemann equations, necessary and sufficient conditions for a function to be analytic, polar form of the Cauchy-Riemann equations. Harmonic functions.

UNIT-IV

Complex integral, Cauchy Goursat theorem (without proof), Cauchy integral formula (without proof), Power series, radius and circle of convergence, Taylor's Maclaurin's and Laurent's series. Zeroes and singularities of complex functions, Residues. Evaluation of real integrals using residues (around unit and semi-circle only).

T**ext and Reference Books:**

1. F. Kreyszig, *Advanced Engineering Mathematics*, 10th edition, Wiley, 2015.
2. B. S. Grewal, *Higher Engineering Mathematics*, Khanna Publishers, 44th edition, 1965.
3. R. K. Jain, S.R.K. Iyenger. *Advance Engineering. Mathematics*, 4th edition, Narosa Publishing House, 2012.
4. Michael D. Greenberg, *Advanced Engineering Mathematics*, 2nd edition, Pearson Education, 2002.
5. Johnson and Miller *Probability and statistics for Engineers*, 8th edition, Pearson Education India, 2015.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1.	1	-	-	-	-	-	-	-	-	-	-	-
CO2.	2	2	2	2	-	-	-	-	-	-	-	-
CO3.	2	2	2	2	-	-	-	-	-	-	-	-
CO4.	2	3	2	3	-	-	-	-	-	-	-	-
CO5.	3	3	2	3	-	-	-	-	-	-	-	-
CO6.	3	3	2	3	-	-	-	-	-	-	-	-
3 –High 2-Medium 1-Low												

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Course code	**PC/CE/31-T**			
Category	**Program Core**			
Course title	**Structural Analysis-I**			
Scheme and credits	**L**	**T**	**Credits**	
	4	**-**	**4.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Basic application of mechanics involved commonly in the structures.	**L1(Remembering)**
CO2.	Get the desired values of the resultant action in response to the agitation on the structures.	**L2(Understanding)**
CO3.	Various techniques to analyse the structures following the slope and deflection approach.	**L3(Applying)**
CO4.	Analysis of trusses or forces in each member of trusses using simplified approach.	**L4(Analyzing)**

***Revised Bloom's Taxonomy Action verbs/Levels**

Course Content:

Unit-I

Introduction: Concept of Equilibrium, General Equilibrium equations, concept of free body diagrams, Concept of stress and strain, Hooke's law, Stress-strain curve of steel and concrete, compound and composite bars, thermal stresses.

Centroid: Introduction and significance, Centroid of regular shapes, Symmetrical sections, Unsymmetrical sections, hollow sections.

Moment of Inertia: Parallel axis theorem, Perpendicular axis theorem, Mass moment of inertia, Area moment of inertia of regular shapes: L-sections, T-sections, I-sections, Moment of inertia of unsymmetrical sections, hollow sections.

Analysis of stresses and strains:

Analysis of simple states of stresses and strains, elastic constraints, bending stresses, theory of simple bending, flexure formula, combined stresses in beams, shear stresses, Mohr's circle, Principle stresses and strains. Torsion in shafts and closed thin walled sections, stresses and strains in cylindrical shells and spheres under internal pressure.

Unit-II

Bending moment and shear force in determinate beams and frames:

Types of load on beam and frames, classification of beams, shear force and bending moment diagrams: simply supported, overhang and cantilever beams subjected to any combination of point loads, uniformly distributed and varying load and moment, relationship between load, shear force and bending moment.

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Three hinged arches:

Arch subjected to any combination of point loads, uniformly distributed and varying load and moment, calculating Horizontal thrust, radial shear force and bending moment diagrams.

Unit-III

Deflections in beams:

Introduction, slope and deflections in beams by differential equations, moment area method and conjugate beam method, unit load method, Principle of virtual work, Maxwell's Law of Reciprocal Deflections.

Unit-IV

Theory of Columns:

Slenderness ratio, end connections, short columns, Euler's critical buckling loads, eccentrically loaded short columns, cylinder columns subjected to axial and eccentric loading.

Analysis of statically determinate trusses:

Introduction, various types, stability, analysis of plane trusses by method of joints and method of sections. Analysis of space trusses using tension coefficient method.

TEXT BOOK:

1 Strength of Materials Part-I, S.Timoshenko, Affiliated East-West Press, New.Delhi

REFERENCE BOOKS:

1 Mechanics of Solids, Prasad, V. S. Gakgotia Pub., New Delhi.
2 Elementary Structural Analysis, Jain, A. K., Nem Chand & Bros, Roorkee.
3 Elementary Structural Analysis, Wibur & Nooris, McGraw Hill Book Co., Newyork.
4 Structural Analysis, Bhavikatti S.S., Vikas Pub. House, N.Delhi.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	3	2	2	-	-	-	-	-	-	-	-	-	1	2	2
CO2.	1	2	3	-	-	-	-	-	-	-	-	-	3	1	1
CO3.	1	3	1	-	-	-	-	-	-	-	-	-	3	1	2
CO4.	1	3	1	-	-	-	-	-	-	-	-	-	2	1	2
3 – High 2 - Medium 1 - Low															

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Course code	**PC/CE/32-T**			
Category	**Program Core**			
Course title	**Fluid Mechanics-I**			
Scheme and credits	**L**	**T**	**Credits**	
	4	**-**	**4.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Basic properties of fluids and its application.	**L1(Remembering)**
CO2.	Various conditions in respect to the flow of fluids and the concept of floating bodies.	**L2(Understanding)**
CO3.	Flow measuring techniques and equipments with theories of fluid flow.	**L3(Applying)**
CO4.	Formation of hydraulic models and modules and dimension analysis of fluids	**L4(Analyzing)**

***Revised Bloom's Taxonomy Action verbs/Levels**

Unit-I

Introduction:
Fluid properties, mass density, specific weight, specific volume and specific volume and specific gravity, surface tension, capillarity, pressure inside a droplet and bubble due to surface tension, compressibility viscosity, Newtonian and Non-Newtonian fluids, real and ideal fluids.

Fluid Statics:
Pressure-density-height relationship, gauge and absolute pressure, simple differential and sensitive manometers, two liquid manometers, pressure on plane and curved surfaces, center of pressure, Buoyancy, stability of immersed and floating bodies, determination of metacentric height, fluid masses subjected to uniform acceleration, free and forced vortex.

Unit-II

Kinematics of Fluid Flow:
Steady& unsteady, uniform and non-uniform, laminar & turbulent flows, one, two & three dimensional. Flows, stream lines, streak lines and path lines, continuity equation in differential form, rotation and circulation, elementary explanation of stream function and velocity potential, rotational and irrotational flows, graphical and experimental methods of drawing flow nets.

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Unit-III

Dynamic of Fluid Flow:
Euler's equation of motion along a streamline and its integration, limitation of Bernoulli's equation, Pitot tubes, Venturimeter, Orifice meter, flow through orifices & mouth pieces, sharp crested weirs and notches, aeration of Nappe.

Dimensional Analysis and Hydraulic Similude:
Dimensional analysis, Buckingham theorem, important dimensionless numbers and their significance, geometric, kinematic and dynamic similarity, model studies, physical modeling, similar and distorted models.

Unit-IV

Laminar Flow:
Navier Stoke's equation, Laminar flow between parallel plates, Couette flow, laminar flow through pipes-Hagen Poiseuille law, laminar flow around a sphere-Stokes' Law.

Drag and Lift:
Types of drag on a sphere, flat plate, cylinder and airfoil, development of lift on immersed bodies like circular cylinder and airfoil.

TEXT BOOK:

1 Hydraulic and Fluid Mechanic by P.N.Modi&S.M.Seth
2 Fluid Mechanics by Dr. R. K. Bansal.

REFERENCE BOOKS:

1 Introduction to Fluid Mechanics by Robert W.Fox & Alan T.McDonald
2 Fluid Mechanics through Problems by R.J.Garde
3 Engineering Fluid Mechanics by R.J.Garde & A.G.Mirajgaoker

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	3	2	2	-	-	-	-	-	-	-	-	-	1	1	1
CO2.	1	2	3	-	-	-	-	-	-	-	-	-	2	1	1
CO3.	1	3	1	-	-	-	-	-	-	-	-	-	1	1	1
CO4.	1	3	1	-	-	-	-	-	-	-	-	-	1	2	2
3 –High 2-Medium 1-Low															

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Course code	**PC/CE/33-T**			
Category	**Program Core**			
Course title	**Surveying-I**			
Scheme and credits	**L**	**T**	**Credits**	
	4	**-**	**4.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks.			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Use of basic instruments for measurement of distances and angles with corrective measures.	**L3(Applying)**
CO2.	Able to understand the procedure of determining the height of a particular point from mean sea level and to plot the ground features on the sheet.	**L2(Understanding)**
CO3.	Learn the use of digital and accurate instruments to determine the angles and to locate various points on the line.	**L1(Remembering)**
CO4.	Learn the need of locating curves on the highways etc. in the plane areas and at the hills.	**L4(Analyzing)**

***Revised Bloom's Taxonomy Action verbs/Levels**

Unit-I

Introduction to Surveying: Definition, importance, Objectives, History of surveying and mapping, Importance, Maps and maps Numbering systems, Maps, Scale, Principles of survey, Classification of surveys, different techniques of surveying.

Chain Surveying: Ranging, Chaining, Offsets, Errors in Chaining, Corrections to length measured with a tape.

Compass Surveying: Purpose of compass surveying, Comparison of compass surveying and chain surveying, Dip, Magnetic Declination, W.C.B., Q.B., and R.B

Plane Table Surveying: Introduction to plane table surveying, principle, instruments, working operations, setting up the plane table, centering, leveling, Orientation, methods of plane table survey, danger circle, Lehmann's Rules, errors in plane tabling.

Unit-II

Leveling: definitions of terms used in leveling, different types of levels, parallax, staves, adjustments, bench marks, classification of leveling, booking and reducing the levels, rise and fall method, line of collimation method, errors in leveling, permanent adjustments, Two peg test, reciprocal leveling, Corrections to curvature and refraction, cross sections and longitudinal leveling.

Trigonometrically Leveling: Introduction, height and distances-base of the object accessible, base of object inaccessible, Geodetical observation, refraction and curvature, axis signal correction, difference in elevation between two points.

Contours: Definition, representation of reliefs, horizontal equivalent, contour interval, characteristics of contours, methods of contouring, contour gradient, uses of contour maps.

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Unit-III

Theodolite and Theodolite Traversing:
Theodolites, temporary adjustment of theodolite, measurement of angles, repetition and reiteration method, traverse surveying with theodolite, checks in traversing, adjustment of closed traverse, examples.

Tacheometry:
Uses of tacheometry, principle of tacheometric surveying, instruments used in tacheometry, systems of tacheometric surveying-stadia system fixed hair method, determination of tacheometric constants, tangential systems, examples.

Unit-IV

Curves:
Classification of curves, elements of simple circular curve, location of tangent points-chain and tape methods, instrumental methods, examples of simple curves. Transition Curves-Length and types of transition curves, length of combined curve, examples.

Vertical Curves: Necessity and types of vertical curves.

Triangulation:
Triangulation systems, classification, strength of figure, selection of triangulation stations, grade of triangulation, field work of triangulation, triangulation computations

TEXT BOOK:

1 Surveying Vol. I & II by B.C.Punmia
2 Surveying by C. Venkatramaiah

REFERENCE BOOKS:

1 Surveying Vol. I by T.P.Kanitkar
2 Fundamentals of Surveying by S. K. Roy
3 Surveying and levelling by R. Subramaniam

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	3	2	-	-	-	-	-	-	-	-	-	1	1	-
CO2.	3	2	1	-	-	-	-	-	-	-	-	-	2	1	-
CO3.	1	3	2	-	-	-	-	-	-	-	-	-	2	1	3
CO4.	1	3	2	-	-	-	-	-	-	-	-	-	1	1	3
3 –High 2-Medium 1-Low															

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Course code	**PC/CE/34-T**			
Category	**Program Core**			
Course title	**Building Construction, Materials and Drawing**			
Scheme and credits	**L**	**D**	**Credits**	
	3	**2**	**4.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Knowledge of components of structure under construction by different material with their advantages and disadvantages.	**L1(Remembering)**
CO2.	Learn about the different material required in the interior of a structure to make the structure safe and sound.	**L1(Remembering)**
CO3.	Compatible with the information about the bonding agents such as cement etc.	**L2(Understanding)**
CO4.	Information about timber, metals, plastic, paints and varnishes along with their properties.	**L1(Remembering)**

***Revised Bloom's Taxonomy Action verbs/Levels**

Unit-I

A. CONSTRUCTION

Masonry Construction:

Introduction, various terms used, stone masonry-Dressing of stones, Classifications of stone masonry, safe permissible loads, Brick masonry-bonds in brick work, laying brick work, structural brick work-cavity and hollow walls, reinforced brick work, Defects in brick masonry, composite stone and brick masonry, glass block masonry.

Cavity and Partition Walls:

Advantages, position of cavity, types of non-bearing partitions, constructional details and precautions, construction of masonry cavity wall.

Foundation:

Functions, types of shallow foundations, sub-surface investigations, geophysical methods, general feature of shallow foundation, foundations in water logged areas, design of masonry wall foundation, introduction to deep foundations i.e. pile and pier foundations.

Unit-II

Damp-Proofing and Water-Proofing:

Defects and causes of dampness, prevention of dampness, materials used, damp-proofing treatment in buildings, water proofing treatment of roofs including pitched roofs.

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Roofs and Floors:
Floor structures, ground, basement and upper floors, various types of floorings.
Types of roofs, various terms used, roof trusses-king post truss, queen post truss etc.

Doors and Windows:
Locations, sizes, types of doors and windows, fixures and fastners for doors and windows.

Unit-III

B.MATERIALS

Stones:
Classification, requirements of good structural stone, quarrying, blasting and sorting out of stones, dressing, sawing and polishing, prevention and seasoning of stone.

Brick and Tiles:
Classification of bricks, constituents of good brick earth, harmful ingredients, manufacturing of bricks, testing of bricks.
Tiles: Terra-cotta, manufacturing of tiles and terra-cotta, types of terra-cotta, uses of terra-cotta.

Limes, Cement and Mortars:
Classification of lime, manufacturing, artificial hydraulic lime, pozzolona, testing of lime, storage of lime, cements composition, types of cement, manufacturing of ordinary Portland cement, testing of cement, special types of cement, storage of cement.
Mortars: Definition, proportions of lime and cement mortars, mortars for masonry and plastering.

Unit-IV

Timber:
Classification of timber, structure of timber, seasoning of timber, defects in timber, fire proofing of timber, plywood, fiberboard, masonite and its manufacturing, important Indian timbers.

Ferrous Metals:
Definitions, manufacturing of cast iron, manufacturing of steel from pig iron, types of steel, marketable form of steel.

Paints and Varnishes:
Basic constituents of paints, types of paints, painting of wood, constituents of varnishes, characteristics and types of varnishes.

Plastic:
Definition, classification of plastics, composition and raw materials, manufacturing, characteristics and uses, polymerization, classification, special varieties.

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C. DRAWINGS

1. Typical drawings of:

a) Cavity Wall
b) Bonds in brick work
c) Grillage foundation

2. Preparation of building drawing mentioning its salient features including the following details:

a) Ground floor plan
b) Two Sectional Elevations
c) Front and Side Elevations
d) Plan and Sectional Elevation of stair case, doors/ windows/ ventilators, floor and roof.

TEXT BOOK:

1 Building Construction, Sushil Kumar, Standard Pub., N. Delhi
2 Building Material, Rangawala

REFERENCE BOOKS:

1 Construction Engineering, Y.S. Sane
2 Building Construction, Gurcharan Singh, Standard Pub., N. Delhi.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	3	-	-	-	-	-	-	-	-	-	-	-	1	1	-
CO2.	3	-	-	-	-	-	-	-	-	-	-	-	2	1	-
CO3.	3	-	-	-	-	-	-	-	-	-	-	-	2	1	3
CO4.	3	-	-	-	-	-	-	-	-	-	-	-	1	1	3
3 –High 2-Medium 1-Low															

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Course code	**PC/CE/31-P**			
Category	**Program Core**			
Course title	**Structural Analysis-I Lab**			
Scheme and credits	**L**	**P**	**Credits**	
	-	**2**	**1.0**	
Course Assessment Methods	**Course Assessment Methods (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory Sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the Performa (attached herewith as Annexure II and III) to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.			

Course outcomes:

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Conduct investigation on different structural elements.	**L3(Applying)**
CO2.	Apply appropriate techniques to analyze complex problems.	**L3(Applying)**
CO3.	Verify experimental and analytical behaviour of structural elements.	**L4(Analyzing)**
CO4.	Recognize the behaviour of construction materials.	**L4(Analyzing)**

***Revised Bloom's Taxonomy Action verbs/Levels**

LIST OF EXPERIMENTS:

1. Verification of reciprocal theorem of deflection using a simply supported beam.
2. Verification of moment area theorem for slopes and deflections of the beam.
3. Deflections of a truss- horizontal deflection & vertical deflection of various joints of a pin- jointed truss.
4. Elastic displacements (vertical & horizontal) of curved members.
5. Experimental and analytical study of 3 hinged arch and influence line for horizontal thrust.
6. Experimental and analytical study of behaviour of struts with various end conditions.

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7. To determine elastic properties of a beam.
8. Uniaxial tension test for steel (plain & deformed bars)
9. Uniaxial compression test on concrete & bricks specimens.

Note: At-least seven experiments are to be performed by students from the above list. The course coordinator may also design and set experiments in addition to the above list/topic as per the scope and requirement of syllabus.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1.	1	2	-	3	-	-	-	-	-	-	-	-	1	-	1
CO2.	1	2	-	3	-	-	-	-	-	-	-	-	2	-	1
CO3.	-	2	-	3	1	-	-	-	-	-	-	-	3	1	2
CO4.	-	2	-	3	1	-	-	-	-	-	-	-	1	2	3
3 –High 2-Medium 1-Low															

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Course code	**PC/CE/32-P**			
Category	**Program Core**			
Course title	**Fluid Mechanics-I Lab**			
Scheme and credits	**L**	**P**	**Credits**	
	-	**2**	**1.0**	
Course Assessment Methods	**<u>Course Assessment Methods (Internal: 50; External: 50)</u>** The internal and external assessment is based on the level of participation in laboratory Sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the Performa (attached herewith as Annexure II and III) to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.			

Course outcomes:

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Basic properties of fluids and its application.	**L3(Applying)**
CO2.	Various conditions in respect to the flow of fluids and the concept of floating bodies.	**L3(Applying)**
CO3.	Flow measuring techniques and equipments with theories of fluid flow	**L4(Analyzing)**
CO4.	Formation of hydraulic models and modules and dimension analysis of fluids	**L4(Analyzing)**

***Revised Bloom's Taxonomy Action verbs/Levels**

LIST OF EXPERIMENTS:

1 To determine meta-centric height of the ship model.
2 To verify the Bernoulli's theorem.
3 To determine coefficient of discharge for an Orifice-meter.
4 To determine coefficient of discharge of a venture-meter.
5 To determine the various hydraulic coefficients of an Orifice (C_d, Cc, Cv).
6 To determine coefficient of discharge for an Orifice under variable head.

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7 To calibrate a given notch.
8 To determine coefficient of discharge for a mouth piece.
9 Velocity measurements by current meter, float, double float (demonstration only).
10 Experiment on Vortex formation (demonstration only).

Note: At-least seven experiments are to be performed by students from the above list. The course coordinator may also design and set experiments in addition to the above list/topic as per the scope and requirement of syllabus.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1.	3	2	1	-	-	-	-	-	-	-	-	-	1	-	-
CO2.	1	3	2	-	-	-	-	-	-	-	-	-	1	-	2
CO3.	1	2	-	3	-	-	-	-	-	-	-	-	3	2	1
CO4.	-	2	1	-	3	-	-	-	-	-	-	-	1	2	3
3 –High 2-Medium 1-Low															

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Course code	**PC/CE/33-P**			
Category	**Program Core**			
Course title	**Surveying-I Lab**			
Scheme and credits	**L**	**P**	**Credits**	
	-	**2**	**1.0**	
Course Assessment Methods	**Course Assessment Methods (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory Sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the Performa (attached herewith as Annexure II and III) to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.			

Course outcomes:

Sr. No	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Use of basic instruments for measurement of distances and angles with corrective measures.	**L3(Applying)**
CO2.	Able to understand the procedure of determining the height of a particular point from mean sea level and to plot the ground features on the sheet.	**L2(Understanding)**
CO3.	Learn the use of digital and accurate instruments to determine the angles and to locate various points on the line.	**L2(Understanding)**
CO4.	Learn the need of determining the distance between two inaccessible points.	**L2(Understanding)**

***Revised Bloom's Taxonomy Action verbs/Levels**

LIST OF EXPERIMENTS:

1 Chain surveying: Chaining and chain traversing.
2 Compass traversing.
3 Plane tabling: methods of plane table surveying,.
4 To verify two point problem and three point problem.
5 Leveling: Profile leveling
6 Plotting of longitudinal section and cross sections.
7 Permanent adjustment of level.

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8 Reciprocal leveling.
9 Contouring and preparation contour map.
10 Single Plane observation of Trigonometric Levelling
11 Two plane observation of Trigonometric Levelling

Note: At-least seven experiments are to be performed by students from the above list. The course coordinator may also design and set experiments in addition to the above list/topic as per the scope and requirement of syllabus.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1.	3	2	1	-	-	-	-	-	-	-	-	-	-	1	3
CO2.	1	3	2	-	-	-	-	-	-	-	-	-	-	2	3
CO3.	1	2	3	-	-	-	-	-	-	-	-	-	1	2	2
CO4.	3	2	1	-	-	-	-	-	-	-	-	-	1	2	3
3 –High 2-Medium 1-Low															

SEMESTER –IV

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Course code	**HSMC/3-T**			
Category	**Humanities, Social Sciences and Management Courses**			
Course title	**Fundamentals of Management for Engineers**			
Scheme and credits	**L**	**T**	**Credits**	
	2	**0**	**2.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks.			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	To develop the basic understanding of the concept of management and functions of management.	**Level 3 (Applying)**
CO2.	The students will come to know about Human Resource management and Marketing management functions of management.	**Level 2 Understanding**
CO3.	Students will come to know about the production activities of any manufacturing organisations.	**Level 2 Understanding**
CO4.	To know that how finances are arranged and disbursed for all the activities of business organisations.	**Level 4 Analyzing**

***Revised Bloom's Taxonomy Action verbs/Levels**

Unit-I

Concept of Management: Definitions, Characteristics, Significance, Practical Implications; Management Vs. Administration; Management- Art, Science and Profession; Development of Management Thoughts; Managerial Functions.

Unit-II

Concept of Human Resource Management: Human resource planning; Recruitment, Selection, Training and Development, Compensation; Concept of Marketing Management: Objectives and functions of Marketing, Marketing Research, Advertising, Consumer Behavior.

Unit-III

Concept of Production Management, Production Planning and Control, Material management, Inventory Control, Factory location and Production Layout.

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Unit-IV

Concept of Financial Management, Capital Structure and various Sources of Finance, Working Capital, Short term and long term finances, Capital Budgeting.

TEXT BOOK:

1. Principles and Practices of Management: R. S. Gupta, B. D. Sharma, N. S. Bhalla; Kalyani Publishers.
2. Organization and Management: R. D. Aggarwal; Tata McGraw Hill.

REFERENCE BOOKS:

1. Marketing Management: S. A. Sherlikar; Himalaya Publishing House.
2. Financial Management: I.M. Pandey; Vikas Publishing House.
3. Production Management: B. S. Goel; Himalaya Publishing House.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1.	3	2	1		-	-	-	-	-	-	3	-
CO2.	3	2	1	-	-	-	-	-	-	-	3	-
CO3.	1	2	3	-	-	-	-	-	-	-	3	-
CO4.	1	2	3	-	-	-	-	-	-	-	3	-
3 –High 2-Medium 1-Low												

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Course code	**PC/CE/41-T**			
Category	**Program Core**			
Course title	**Structural Analysis-II**			
Scheme and credits	**L**	**T**	**Credits**	
	4	**-**	**4.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks.			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Basic application of mechanics involved in complex structures.	**L1(Remembering)**
CO2.	Get the desired values of the resultant action in response to the agitation on the complex structures.	**L2(Understanding)**
CO3.	Various techniques to analyse the complex structures following different approach.	**L3(Applying)**
CO4.	Analysis of unsymmetrical structures and to determine the stresses in structures like cable and suspension bridges.	**L4(Analyzing)**

***Revised Bloom's Taxonomy Action verbs/Levels**

Unit-I

Statically Indeterminate Structures:
Introduction, Static and Kinematic Indeterminacies, Castigliano's theorems, Strain energy method, Analysis of frames with one or two redundant members using Castigliano's 2^n theorem.

Unit-II

Slope deflection and moment Distribution Methods:
Analysis of continuous beams & portal frames, Portal frames with inclined members.

Unit-III

Column Analogy Method:
Elastic centre, Properties of analogous column, Applications to beam & frames.

Analysis of Two hinged Arches:
Parabolic and circular Arches, Bending Moment Diagram for various loadings, Temperature effects, Rib shortening, Axial thrust and Radial Shear force diagrams.

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Unit-IV

Unsymmetrical Bending

Introduction Centroidal principal axes of sections, Bending stresses in beam subjected to unsymmetrical bending, shear centre, shear centre for channel, Angles and Z sections.

Cable and suspension Bridges:

Introduction, uniformly loaded cables, Temperature stresses, three hinged stiffening Girder and two hinged stiffening Girder.

TEXT BOOK:

1 Statically Indeterminate Structures, C.K. Wang, McGraw Hill Book Co., New York.

2 Advanced Structural Analysis, A.K. Jain, Nem Chand & Bros., Roorkee.

REFERENCE BOOKS:

1 Indeterminate Structures, R.L. Jindal, S. Chand & Co., New Delhi.

2 Theory of Structures, Vol. I, S.P. Gupta & G.S.Pandit, Tata McGraw Hill, New Delhi.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	3	2	2	-	-	-	-	-	-	-	-	-	1	1	1
CO2.	1	2	3	-	-	-	-	-	-	-	-	-	1	1	2
CO3.	1	3	1	-	-	-	-	-	-	-	-	-	2	2	3
CO4.	1	3	1	-	-	-	-	-	-	-	-	-	3	3	3
3 –High 2-Medium 1-Low															

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Course code	**PC/CE/42-T**			
Category	**Program Core**			
Course title	**Fluid Mechanics-II**			
Scheme and credits	**L**	**T**	**Credits**	
	4	**-**	**4.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks.			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Basic flow conditions and their analysis with the help of fluid properties.	**L1(Remembering)**
CO2.	Various forces exerted on the floating and submerged bodies in fluids and application of internal forces of fluids.	**L2(Understanding)**
CO3.	Knowledge of different types of flow.	**L2(Understanding)**
CO4.	Formation, behaviour and response of pumps and turbines.	**L2(Understanding)**

***Revised Bloom's Taxonomy Action verbs/Levels**

Unit-I

Flow through pipes:
Types of flows-Reynold's experiment, shear stress on turbulent flow, boundary layer in pipes-Establishment of flow, velocity distribution for turbulent flow in smooth and rough pipes, resistance to flow of fluid in smooth and rough pipes, Stanton and Moody's diagram. Darcy's Weisbach equation, other energy losses in pipes, loss due to sudden expansion, hydraulic gradient and total energy lines, pipes in series and in parallel, equivalent pipe, branched pipe, pipe networks, Hardy Cross method, water hammer.

Boundary layer analysis:
Boundary layer thickness, boundary layer over a flat plate, laminar boundary layer, turbulent boundary layer, laminar sub-layer, smooth and rough boundaries, local and average friction coefficient, separation and its control.

Unit-II

Flow in Open Channels: Difference between pipe flow and channel flow, Types of channels, Classification of flows, Sub Critical and Supercritical Flows, Velocity distribution in channel.

Flow Measurement: Flow over notches and weirs, Pitot tube floats and current meters for velocity measurement, Flow over Spillways, Sluice gates, Free over fall flow.

Unsteady flow and Hydraulic jump: Froude number and types of hydraulic jump, Applications Jumps in channels. Unsteady flow equation, Pre jump and post jump depths, length of Hydraulic Jump and energy dissipation, Surges.

Unit III

Concepts of Specific energy and specific Force: Specific energy and specific curve, Momentum Equation in open channels, Specific force & specific force curve Critical depth and its computation.

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Gradually Varied Flow: Channel transitions, Non-uniform flow in open channels, Dynamic equation for GVF, Water surface profiles in channels of different slopes GVF flow computations. Design of Channels, Most efficient channel sections.

Unit-IV

Pumps and Turbines:

Reciprocating pumps, their types, work done by single and double acting pumps. Centrifugal pumps, components and parts and working, types, heads of a pump-statics and manometric heads. Force executed by fluid jet on stationary and moving flat vanes, Turbines-classifications of turbines based on head and specific speed, component and working of Pelton wheel and Francis turbines, Cavitation and setting of turbines.

TEXT BOOK:

1 Hydraulics & Fluid Mechanics by P.N.Modi and S.M.Seth
2 Fluid Mechanics by R. K. Bansal

REFERENCE BOOKS:

1 Flow in Open Channels by S.Subraminayam
2 Introduction to Fluid Mechanics by Robert N.Fox & Alan T.Macnold

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1.	3	2	2	-	-	-	-	-	-	-	-	-	1	-	-
CO2.	1	2	3	-	-	-	-	-	-	-	-	-	1	2	-
CO3.	1	3	1	-	-	-	-	-	-	-	-	-	3	2	1
CO4.	1	3	1	-	-	-	-	-	-	-	-	-	2	3	1
3 –High 2-Medium 1-Low															

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Course code	**PC/CE/43-T**			
Category	**Program Core**			
Course title	**Soil Mechanics**			
Scheme and credits	**L**	**T**	**Credits**	
	4	**-**	**4.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks.			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Understand the soil composition, its formation and its classification.	**L2(Understanding)**
CO2.	Able to understand the compaction of soil under loading and comparing the theoretical values with the experimental ones.	**L4(Analyzing)**
CO3.	Learn how to analyse the stresses in the soils in the depth and to find the settlement of soils under loading.	**L3(Applying)**
CO4.	Knowledge to find out the shear strength in soils and to learn different theories o earth pressure.	**L1(Remembering)**

***Revised Bloom's Taxonomy Action verbs/Levels**

Unit-I

Soil Formation and Composition

Introduction, soil and rock, Soil Mechanics and Foundation Engineering, origin of soils, weathering, soil formation, major soil deposits of India, particle size, particle shape, inter particle forces, soil structure, principal clay minerals.

Basic Soil Properties

Introduction, three phase system, weight-volume relationships, soil grain properties, soil aggregate properties, grain size analysis, sieve analysis, sedimentation analysis, grain size distribution curves, consistency of soils, consistency limits and their determination, activity of clays, relative density of sands.

Classification of soils

Purpose of classification, classification on the basis of grain size, classification on the basis of plasticity, plasticity chart, Indian Standard Classification System.

Unit-II

Permeability of Soils

Introduction, Darcy's law and its validity, discharge velocity and seepage velocity, factors affecting permeability, laboratory determination of coefficient of permeability, determination of field permeability, permeability of stratified deposits.

Effective Stress Concept

Principle of effective stress, effective stress under hydrostatic conditions, capillary rise in soils, effective stress in the zone of capillary rise, effective stress under steady state hydro-dynamic conditions, seepage force, quick condition, critical hydraulic gradient, two dimensional flow, Laplace's equation, properties and utilities of flownet, graphical method of construction of flownets, piping, protective filter.

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Unit-III

Compaction

Introduction, role of moisture and compactive effect in compaction, laboratory determination of optimum moisture content, moisture density relationship, compaction in field, compaction of cohesionless soils, moderately cohesive soils and clays, field control of compaction.

Compressibility and Consolidation

Introduction, components of total settlement, consolidation process, one-dimensional consolidation test, typical void ratio-pressure relationships for sands and clays, normally consolidated and over consolidated clays, Casagrande's graphical method of estimating pre-consolidation pressure, Terzaghi's theory of one-dimensional primary consolidation, determination of coefficients of consolidation, consolidation settlement, Construction period settlement, secondary consolidation.

Unit-IV

Shear Strength

Introduction, Mohr stress circle, Mohr-Coulomb failure-criterion, relationship between principal stresses at failure, shear tests, direct shear test, unconfined compression test, triaxial compression tests, drainage conditions and strength parameters, Vane shear test, shear strength characteristics of sands, normally consolidated clays, over-consolidated clays and partially saturated soils, sensitivity and thixotropy.

Earth Pressure

Introduction, earth pressure at rest, Rankine's active & passive states of plastic equilibrium, Rankine's earth pressure theory, Coulomb's earth pressure theory, Culmann's graphical construction, Rebhann's construction.

TEXT BOOK:

1 Basic and Applied Soil Mechanics by Gopal Ranjan, ASR Rao, New Age International (P)Ltd.Pub.N.Delhi.
2 Soil Mechanics and foundation engineering by Dr. K. R. Arora.

REFERENCE BOOKS:

1 Soil Engg. in Theory and Practice, Vol .I, Fundamentals and General Principles by Alam Singh, CBS Pub., N. Delhi.
2 Engg. Properties of Soils by S. K. Gulati, Tata-Mcgraw Hill, N.Delhi.
3 Geotechnical Engg. By P. Purshotam Raj, Tata Mcgraw Hill.
4 Principles of Geotechnical Engineering by B.M.Das, PWS KENT, Boston.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	3	2	1	-	-	-	-	-	-	-	-	-	1	1	2
CO2.	1	3	2	-	-	-	-	-	-	-	-	-	1	1	2
CO3.	1	3	2	-	-	-	-	-	-	-	-	-	1	1	2
CO4.	-	3	1	2	-	-	-	-	-	-	-	-	1	1	2
3 –High 2-Medium 1-Low															

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Course code	**PC/CE/44-T**			
Category	**Program Core**			
Course title	**Surveying-II**			
Scheme and credits	**L**	**T**	**Credits**	
	4	**-**	**4.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks.			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Application of Trigonometry to find the location of the general features of the lar in their proper relative positions.	**L3(Applying)**
CO2.	Able to understand the errors generated in survey process and methods to rectify these.	**L2(Understanding)**
CO3.	Understand the theory of positions: Latitude and longitude of astronomical features.	**L2(Understanding)**
CO4.	Learn new techniques for ease of survey like aerial photographs, GIS and GPS.	**L3(Applying)**

***Revised Bloom's Taxonomy Action verbs/Levels**

Unit-I

Survey Adjustment and Treatment of Observations:
Types of errors, definition of weight of an observation, most probable values, law of accidental errors, law of weights, determination of probable error (different cases with examples) principle of least squares, adjustment of triangulation figures by method of least squares.

Astronomy:
Definitions of astronomical terms, star at elongation, star at prime vertical star at horizon, star at culmination, celestial coordinate systems, Napier's rule of circular parts, various time systems: sidereal, apparent, solar and mean solar time, equation of time-its cause.

Unit-II

Introduction GIS, GPS, DEM, DTED, Large scale mapping, small scale mapping, Components of GIS, Application of GIS in civil engineering
Remote Sensing, Fundamentals, EMS, RS System, Active and Passive radiation – Electromagnetic Radiation – Nomenclature, Reflectance, Transmission and Absorption, Thermal Emission – Plank's formula, Stefan – Boltzman Law, Wein's Displacement Law; Emissivity – Kirchoff's Law, Characteristics of Solar Radiant Energy, Application of remote sensing to various engineering fields.

Unit-III

Interaction of EMR with Atmosphere – Scattering, Refraction, Absorption, Transmission. Atmospheric Windows.
Interaction of EMR with Earth Surface – Spectral Reflectance Curves. Interaction of earth surface with EM radiation in visible, NIR, TIR and Microwave regions. Idealized & Real sequence of remote sensing.

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Unit-IV

Elements of Photo-grammetry:

Introduction: types of photographs, types of aerial photographs, aerial camera and height displacements in vertical photographs, stereoscopic vision and stereoscopies, height determination from parallax measurement, flight planning.

TEXT BOOK:

1 Surveying Vol.2 by B.C.Punmia
2 Surveying Vol.3 by B.C.Punmia

REFERENCE BOOKS:

1 Surveying Vol2 by T.P.Kanitkar
2 Higher Surveying by A M Chandra

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	3	2	3	2	-	-	-	-	-	-	-	-	1	1	1
CO2.	1	2	3	2	-	-	-	-	-	-	-	-	1	2	2
CO3.	2	2	1	3	-	-	-	-	-	-	-	-	2	3	3
CO4.	-	1	2	3	3	-	-	-	-	-	-	-	3	3	3
3 –High 2-Medium 1-Low															

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Course code	**PC/CE/45-T**			
Category	**Program Core**			
Course title	**Engineering Geology**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks.			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	To understand the danger of erosion, earthquake and volcano eruption etc	**L2(Understanding)**
CO2.	Distinguish geological formations.	**L2(Understanding)**
CO3.	Identify geological structures and processes for rock mass quality.	**L3(Applying)**
CO4.	Identify subsurface information and groundwater potential sites through geophysical investigation.	**L3(Applying)**

***Revised Bloom's Taxonomy Action verbs/Levels**

Unit-I

Introduction:
Definition, object, scope and sub division of geology, geology around us. Interior of the earth. Importance of Geology in Civil Engineering projects.

Physical Geology:
The external and internal geological forces causing changes, weathering and erosion of the surface of the Earth. Geological work of ice, water and winds. Soil profile and its importance. Earthquakes and volcanoes.

Unit-II

Mineralogy and Petrology:
Definition of mineral and rocks. Classification of important rock forming minerals, simple description based on physical properties of minerals. Rocks of earth surface, classification of rocks. Mineral composition, Textures, structure and origin of Igneous, Sedimentary and Metamorphic rocks. Aims and principles of stratigraphy. Standard geological/stratigraphical time scale with its sub division and a short description based on engineering uses of formation of India.

Structural Geology:
Forms and structures of rocks. Bedding plane and outcrops Dip and Strike. Elementary ideas about fold, fault, joint and unconformity and recognition on outcrops. Importance of geological structures in Civil Engineering projects.

Unit-III

Applied Geology:
Hydrogeology, water table, springs and Artesian well, aquifers, ground water in engineering projects. Artificial recharge of ground water, Elementary ideas of geological investigations. Remote sensing

techniques for geological and hydrological survey and investigation. Uses of geological maps and interpretation of data, geological reports.

Suitability and stability of foundation sites and abutments:
Geological condition and their influence on the selection, location, type and design of dams, reservoirs, tunnels, highways, bridges etc. Landslides and Hill-slope stability.

Unit-IV

Improvement of foundation rocks:
Precaution and treatment against faults, joints and ground water, retaining walls and other precautions.
Geology and environment of earth.

TEXT BOOK:

1. A Text Book of Geology by P.K. Mukherjee

REFERENCE BOOKS:

1 Physical and General Geology by S.K.Garg
2 Engineering and General Geology by Prabin Singh
3 Introduction of Physical Geology by A.Holmes.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	2	-	3	1	-	-	-	-	-	-	-	-	1	-	-
CO2.	2	3	3	2	-	-	1	-	-	-	-	-	1	-	2
CO3.	2	3	3	3	-	-	1	-	-	-	-	-	2	1	-
CO4.	-	2	2	2	-	-	1	-	-	-	-	-	2	1	-
3 –High 2-Medium 1-Low															

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Course code	**PC/CE/42-P**			
Category	**Program Core**			
Course title	**Fluid Mechanics-II Lab**			
Scheme and credits	**L**	**P**	**Credits**	
	-	**2**	**1.0**	
Course Assessment Methods	**Course Assessment Methods (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory Sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the Performa (attached herewith as Annexure II and III) to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.			

Course outcomes:

Sr. No	**Course outcomes** At the end of the course students will be able to:	**RBT* Level**
CO1.	Basic properties of fluids and its application.	**L2(Understanding)**
CO2.	Employ Various conditions in respect to the flow of fluids and the concept of floating bodies.	**L3(Applying)**
CO3.	Examine Properties and functioning of centrifugal pump.	**L4(Analyzing)**
CO4.	Determining the flow in various pipe fittings.	**L5(Evaluating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

LIST OF EXPERIMENTS:

1 To determine the coefficient of drag by Stoke's law for spherical bodies.
2 To study the phenomenon of cavitation in pipe flow.
3 To determine the critical Reynold's number for flow through commercial pipes.
4 To determine the coefficient of discharge for flow over a broad crested weir.
5 To study the characteristics of a hydraulic jump on a horizontal floor and sloping glacis including friction blocks.

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6 To study the scouring phenomenon around a bridge pier model.
7 To study the scouring phenomenon for flow past a spur.
8 To determine the characteristics of a centrifugal pump.
9 To study the momentum characteristics of a given jet.
10 To determine head loss due to various pipe fittings.

Note: At-least seven experiments are to be performed by students from the above list. The course coordinator may also design and set experiments in addition to the above list/topic as per the scope and requirement of syllabus.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1.	2	1	1	2	1	-	-	-	-	-	-	-	1	1	1
CO2.	2	1	1	2	1	-	-	-	-	-	-	-	1	1	1
CO3.	2	2	2	2	1	-	-	-	-	-	-	-	1	2	2
CO4.	2	2	2	2	1	-	-	-	-	-	-	-	2	3	3
3 –High 2-Medium 1-Low															

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Course code	**PC/CE/43-P**			
Category	**Program Core**			
Course title	**Soil Mechanics Lab**			
Scheme and credits	**L**	**P**	**Credits**	
	-	**2**	**1.0**	
Course Assessment Methods	**Course Assessment Methods (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory Sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the Performa (attached herewith as Annexure II and III) to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.			

Course outcomes:

Sr. No	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Understand the soil composition, its formation and its classification.	**L2(Understanding)**
CO2.	Application of the methods of determination of soil properties useful in various construction activities.	**L3(Applying)**
CO3.	Learn the response of water penetration in the soils and its behaviour to wet conditions under loading.	**L4(Analyzing)**
CO4.	Find out the shear strength in soils and to relate the theoretical theories.	**L5(Evaluating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

LIST OF EXPERIMENTS:

1. Visual Soil Classification and water content determination.
2. Determination of specific gravity of soil solids.
3. Grain size analysis-sieve analysis.
4. Liquid limit and plastic limit determination.
5. Field density by:
   i) Sand replacement method
   ii) Core cutter method
6. Proctor's compaction test.
7. Coefficient of permeability of soils.

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8. Unconfined compressive strength test.
9. Direct shear test on granular soil sample.
10. Unconsolidated undrained (UU) triaxial shear test of fine grained soil sample.

Note: At-least seven experiments are to be performed by students from the above list. The course coordinator may also design and set experiments in addition to the above list/topic as per the scope and requirement of syllabus.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1.	2	1	1	2	1	-	-	-	-	-	-	-	2	1	3
CO2.	2	1	1	2	1	-	-	-	-	-	-	-	2	1	3
CO3.	2	2	2	2	1	-	-	-	-	-	-	-	2	1	3
CO4.	2	2	2	2	1	-	-	-	-	-	-	-	2	1	3
3 –High 2-Medium 1-Low															

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Course code	**PC/CE/44-P**			
Category	**Program Core**			
Course title	**Surveying-II Lab**			
Scheme and credits	**L**	**P**	**Credits**	
	-	**2**	**1.0**	
Course Assessment Methods	**Course Assessment Methods (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory Sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the Performa (attached herewith as Annexure II and III) to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.			

Course outcomes:

Sr. No	**Course outcomes** At the end of the course students will be able to:	**RBT* Level**
CO1.	Use of Theodolite for measurement of distances and angles with corrective measures.	**L3(Applying)**
CO2.	Use Tachometer and tacheometry to determining the height of a particular point and horizontal distance.	**L5(Evaluating)**
CO3.	Learn the use of Triangulation and plot the topographical map.	**L5(Evaluating)**
CO4.	Plot the Base line with different methods meant to provide accuracy in plotting.	**L5(Evaluating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

LIST OF EXPERIMENTS:

Theodilite:

1. Study of theodolite, measurement of horizontal angle.
2. Measurement of vertical angle.
3. Permanent adjustment.

Tacheometry:

4. Tachometric constants,
5. Calculation of horizontal distance and elevation with the help of Tacheometer.

Curves:

6. Setting of simple circular curves by off- set method: off -set from chord produced,

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7. Setting of simple circular curves by off- set method: off -set from long chord.
8. Setting of simple circular curves by deflection angle Method.

Triangulation:

9. An exercise of triangulation
10. Base line measurement.

Note: At-least seven experiments are to be performed by students from the above list. The course coordinator may also design and set experiments in addition to the above list/topic as per the scope and requirement of syllabus.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1.	2	1	1	2	1	-	-	-	-	-	-	-	1	-	1
CO2.	2	1	1	2	1	-	-	-	-	-	-	-	2	-	1
CO3.	2	2	2	2	1	-	-	-	-	-	-	-	3	1	2
CO4.	2	2	2	2	1	-	-	-	-	-	-	-	1	2	3
3 –High 2-Medium 1-Low															

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Course code	**PC/CE/45-P**			
Category	**Program Core**			
Course title	**Geology Lab**			
Scheme and credits	**L**	**P**	**Credits**	
	-	**2**	**1.0**	
Course Assessment Methods	**Course Assessment Methods (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory Sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the Performa (attached herewith as Annexure II and III) to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.			

Course outcomes:

Sr. No	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Describe different types of ores and minerals	**L3(Applying)**
CO2.	Understand and distinguish the geological formations	**L2(Understanding)**
CO3.	Identify the geological structures and processes for rock mass quality.	**L3(Applying)**
CO4.	Define the subsurface information and groundwater potential sites through geophysical investigations.	**L4(Analyzing)**

***Revised Bloom's Taxonomy Action verbs/Levels**

LIST OF EXPERIMENTS:

1 Introduction to Crystallography – Identification of Crystals.
2 Introduction of minerals and the study of Physical properties, Identification of Quartz and feldspars.
3 Identification of pyroxenes and Amphiboles and other silicates.
4 Identification of important economic minerals.
5 Identification of important ore deposits.
6. Identification of Igneous rocks.
7. Identification of Sedimentary rocks.

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8. Identification of metamorphic rocks.
9. Structural geology- strike and dip, three and 3-point problems point problems.

Note: At-least seven experiments are to be performed by students from the above list. The course coordinator may also design and set experiments in addition to the above list/topic as per the scope and requirement of syllabus.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1.	2	1	1	2	1	-	-	-	-	-	-	-	1	-	1
CO2.	2	1	1	2	1	-	-	-	-	-	-	-	2	-	1
CO3.	2	2	2	2	1	-	-	-	-	-	-	-	3	1	2
CO4.	2	2	2	2	1	-	-	-	-	-	-	-	1	2	3
3 –High 2-Medium 1-Low															

Scheme of Examination & Detailed Syllabus of B.Tech (CE) 3rd Year

(5th & 6th Semester)

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Scheme B.Tech. (Civil Engineering) 3rd year

SEMESTER-5					
Course Code	**Course Title**	**Workload/Credit**			
		Theory	**Tutorial**	**Practical/ Drawing**	**Total**
PC/CE/51-T	Design of Steel Structures-I	3/3	-	-	3/3
PC/CE/52-T	Structural Analysis-III	3/3	-	-	3/3
PC/CE/53-T	Hydrology	3/3	-	-	3/3
PE/CE/51-T to PE/CE/54-T	**Program Elective-I**	3/3	-	-	3/3
PE/CE/55-T to PE/CE/58-T	**Program Elective-II**	3/3	-	-	3/3
	Open Elective-I to be opted from courses offered by other Department	3/3	-	-	3/3
PC/CE/52-P	Structural Analysis-II Lab	-	-	2/1	2/1
ESC/7-P	Civil Engineering Materials Testing & Evaluation –I Lab	-	-	2/1	2/1
EEC/CE/51-P	Survey Camp*	-	-	-	-/4
Total		**18/18**	**-**	**4/2**	**22/24**
Open Elective-I :- Students are required to study one elective subject from any other Department in 5th Semester					

*Internal Evaluation.

Program Elective-I

Course Code	Course Name	L	T	P/D	Credits
PE/CE/51-T	Highway Engineering	3	-	-	3.0
PE/CE/52-T	Highway Construction & Management	3	-	-	3.0
PE/CE/53-T	Highway and Traffic Engineering	3	-	-	3.0
PE/CE/54-T	Pavement Materials and Design	3	-	-	3.0

Program Elective-II

Course Code	Course Name	L	T	P/D	Credits
PE/CE/55-T	Geotechnology	3	-	-	3.0
PE/CE/56-T	Foundation Engineering	3	-	-	3.0
PE/CE/57-T	Geotechnical Design	3	-	-	3.0
PE/CE/58-T	Analysis and Design of Sub-Structures	3	-	-	3.0

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SEMESTER-6					
Course Code	**Course Title**	**Workload/Credit**			
		Theory	**Tutorial**	**Practical/ Drawing**	**Total**
PC/CE/61-T	Design of Steel Structures-II	3/3	-	-	3/3
PC/CE/62-T	Design of Concrete Structures-I	3/3	-	-	3/3
PE/CE/61-T to PE/CE/64-T	**Program Elective-III**	3/3	-	-	3/3
PE/CE/65-T to PE/CE/68-T	**Program Elective-IV**	3/3	-	-	3/3
	Open Elective-II to be opted from courses offered by other Department	3/3	-	-	3/3
MC/7-T*	Disaster Preparedness & Planning Management	3/-	-	-	3/-
PC/CE/62-P	Concrete Testing Lab	-	-	2/1	2/1
PC/CE/63-P	Environmental Engg.-I Lab	-	-	2/1	2/1
PC/CE/64-P	Irrigation Engineering (Drawing)	-	-	2/1	2/1
ESC/8-P	Civil Engineering Materials Testing & Evaluation –II Lab	-	-	2/1	2/1
Total		**18/15**	**-**	**8/4**	**26/19**
Note: Students shall devote 4-6 weeks to Internship/Training after 6th semester examination outside the College campus at approved works.					
Open Elective-II :- Students are required to study one elective subject from any other Department in 6th Semester					

*Non-credit qualifying mandatory courses. The assessment will be completely internal.

Note: Students will be allowed to use non-programmable scientific calculators only; however, sharing of calculator should not be permitted.

Program Elective-III

Course Code	Course Name	L	T	P/D	Credits
PE/CE/61-T	Water Supply & Treatment	3	-	-	3.0
PE/CE/62-T	Environment Engineering	3	-	-	3.0
PE/CE/63-T	Environmental Impact Assessment and Life Cycle Analysis	3	-	-	3.0
PE/CE/64-T	Water and Air Quality Modelling	3	-	-	3.0

Program Elective-IV

Course Code	Course Name	L	T	P/D	Credits
PE/CE/65-T	Irrigation Engineering	3	-	-	3.0
PE/CE/66-T	Design of Hydraulic Structures	3	-	-	3.0
PE/CE/67-T	Urban Hydrology and Hydraulics	3	-	-	3.0
PE/CE/68-T	Groundwater Engineering	3	-	-	3.0

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SEMESTER –V

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DESIGN OF STEEL STRUCTURES-I

Course code	**PC/CE/51-T**			
Category	**Program Core**			
Course title	**Design of Steel Structures-I**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Analyze the material properties of steel.	**L4(Analyzing)**
CO2.	Estimate the design parameters for beams, columns, foundations etc.	**L5(Evaluating)**
CO3.	Evaluate the shear capacity of beams and design web bearing stiffeners.	**L5(Evaluating)**
CO4.	Make use of Indian standard code for different steel designs.	**L3(Applying)**
CO5.	Design the components of Industrial roofs using plate and gantry girders.	**L6(Creating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Introduction: Limit State Method of Design based on IS: 800-2007, Properties of structural steel I.S. Rolled sections and I.S. specification.

Connections: Importance, various types of connections, simple and moment resistant, riveted, bolted and welded connections.

Design of Tension Members: Introduction, types of tension members, net sectional areas, design of tension members, lug angles and splices.

UNIT-II

Design of Compression Members: Introduction, effective length and slenderness ratio, various types of sections used for columns, built up columns, necessity, design of built up columns, laced and battened columns including the design of lacing and battens, design of eccentrically loaded compression members.

Column Bases and Footings: Introduction, types of column bases, design of slab base and gusseted base, design of gusseted base subjected to eccentrically loading, design of grillage foundations.

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UNIT-III

Design of Beams: Introduction, types of sections, general design criteria for beams, design of laterally supported and unsupported beams, design of built up beams, web buckling, web crippling and diagonal buckling.

UNIT-IV

Gantry Girders: Introduction, various loads, specifications, design steps of a gantry girder.

Plate Girder: Introduction, elements of plate girder, design steps of a plate girder, necessity of stiffeners in plate girder, various types of stiffeners, web and flange splices (brief introduction), Curtailment of flange plates.

Books:

1. Design of steel structures, A. S. Arya & J. L. Ajmani, Nemchand & Bros., Roorkee.
2. Design of steel structures, M. Raghupati, TMH Pub., New Delhi.
3. Design of steel structures, S. M. A. Kazmi &S. K. Jindal, Prentice Hall, New Delhi.
4. Design of steel structures, S. K. Duggal, TMH Pub., New Delhi.
5. Design of steel structures, Dr. N.R. Chandak, S.K. Kataria & Sons, New Delhi.
6. IS code: 800-2007, General Construction in steel-Code of Practice

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1.	**1**	**3**	**1**	**3**	**1**	**1**	-	-	-	-	-	-	3	2	3
CO2.	**2**	**1**	**1**	**3**	**1**	**1**	-	-	-	-	-	-	3	3	3
CO3.	**2**	**3**	**3**	**1**	**1**	**1**	-	-	-	-	-	-	3	2	3
CO4.	**3**	**1**	**1**	**1**	**1**	**1**	-	-	-	-	-	-	3	3	3
CO5.	**3**	**2**	**2**	**1**	**1**	**1**	-	-	-	-	-	-	3	3	3
3 –High 2-Medium 1-Low															

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SRUCTURAL ANALYSIS-III

Course code	**PC/CE/52-T**			
Category	**Program Core**			
Course title	**Structural Analysis-III**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Understand the basic application of mechanics involved in complex structures.	**L2(Understanding)**
CO2.	Analyze beam and arch structures for different complex load combinations.	**L4(Analyzing)**
CO3.	Estimate the influence lines for statically determinate and indeterminate structures.	**L5(Evaluating)**
CO4.	Analyze statically indeterminate structures using matrix (stiffness) method	**L4(Analyzing)**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Influence Line (I.L.):
Introduction, influence lines for three hinged and two hinged arches, load position for Maximum S.F. and B.M. at a section in the span.

Influence Line for statically indeterminate Beams:
Muller-Breslau Principle, I.L. for B.M. & S.F. for continuous Beams.

UNIT-II

Fixed Arches:
Expression for H and B.M. at a section, Elastic centre.

Rolling Loads:
Introduction, Single concentrated load, uniformly distributed load longer than span, shorter than span, two point loads, several point loads, Max. B.M. and S.F. Absolute, Max. B.M.

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UNIT-III

Kani's Method:
Analysis of continuous beams and simple frames, analysis of frames with different column lengths and end conditions of the bottom storey.

UNIT-IV

Approximate Analysis of frames by Portal method & Cantilever method for:
(i) Vertical loads, (ii) Lateral loads.

Matrix Methods
Introduction, Stiffness Coefficients, Flexibility Coefficients, Development of Flexibility and Stiffness matrices for plane frame, Global axis and local axis, Analysis of plane, pin jointed and rigid jointed frames.

Books Recommended:

1. Indeterminate structures, R. L. Jindal S. Chand & Co., New Delhi.
2. Advanced Structural Analysis-A. K. Jain, Nem Chand & Bros., Roorkee.
3. Theory of Structures- Vol. I&II,-S. P. Gupta & G. S. Pandit, Tata McGraw Hill, New Delhi.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	3	2	2	1	2	1	-	-	-	-	-	-	3	2	1
CO2.	3	1	1	2	1	1	-	-	-	-	-	-	3	2	1
CO3.	3	2	2	2	1	1	-	-	-	-	-	-	3	2	1
CO4.	3	2	2	2	1	1	-	-	-	-	-	-	3	2	1
3 –High 2-Medium 1-Low															

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HYDROLOGY

Course code	**PE/CE/53-T**			
Category	**Program Core**			
Course title	**Hydrology**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Examine hydrologic mass balance in a closed basin.	**L4(Analyzing)**
CO2.	Identify the different types of precipitation/source of water.	**L3(Applying)**
CO3.	Analyze unit hydrographs based on stream-flow data.	**L4(Analyzing)**
CO4.	Analyze and determine groundwater drawdown based on water well withdrawal	**L5(Evaluating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Introduction: Hydrologic cycle, scope and application of hydrology to engineering problems, drainage basins and its characteristics, stream geometry, hypsometric curves.

Precipitation: Forms and types of precipitation, characteristics of precipitation in India, measurement of precipitation, recording and non-recording rain-gauge, rain-gauge station, rain-gauge network, estimation of missing data, presentation of rainfall data, mean precipitation, depth -area -duration relationship, frequency of point rainfall, intensity -duration- frequency curves, probable maximum precipitation.

UNIT-II

Evaporation & Transpiration: Process, evaporimeters and empirical relationships, analytical method, reservoir evaporation and methods of its control, transpiration, evapotranspiration and its measurement, Penman's equation and potential evapotranspiration.

Infiltration: Infiltration process, initial loss, infiltration capacity and measurement of infiltration, infiltration indices.

UNIT-III

Runoff: Factor affecting run-off, estimation of runoff, rainfall-run off relationships, measurement of stage-staff gauge, wire gauge, automatic stage recorder and stage hydrograph, measurement of velocity-current meters, floats, area velocity method, moving boat and slope area method, electromagnetic, ultra-sonic and dilution methods of stream flow measurement, stage discharge relationship.

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Hydrograph: Discharge hydrograph, components and factors affecting shape of hydrograph, effective rainfall, unit hydrograph and its derivation, unit hydrograph of different durations, use and limitations of UH, Flood frequency methods, Gumbel's method, graphical method, design flood.

UNIT-IV

Ground Water: Occurrence, types of aquifers, compressibility of aquifers, water table and its effects on fluctuations , wells and springs, movement of ground water, Darcy's law, permeability and its determination, porosity, specific yield and specific retention, storage coefficient, transmissibility.

Well Hydraulics: Steady state flow to wells in unconfined and confined aquifers.

Books:

1 Engineering Hydrology by K. Subramanya, TMH, New Delhi
2 Hydrology by H. M. Raghunath, New Age International (P) Limited, Publishers, New Delhi.
3 Hydrology for Engineers by Linsely, Kohler, Paulhus.
4 Elementary Hydrology by V.P.Singh, Prentice-Hall of India Private Limited, New Delhi.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	3	3 3	2	2	1	1	-	-	1	-	-	3	2	1	1
CO2.	3	2 2	2	1	1	-	-	-	-	-	-	3	2	1	1
CO3.	2	3 3	2	1	2	-	-	-	-	-	-	2	3	1	1
CO4.	3	2 3	2	1	1	-	-	-	-	-	-	3	3	1	1
3 –High 2-Medium 1-Low															

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STRUCTURAL ANALYSIS –II Lab

Course code	**PC/CE/52-P**			
Category	**Program Core**			
Course title	**Structural Analysis -II Lab**			
Scheme and credits	**L**	**P**	**Credits**	
	-	**2**	**1.0**	
Course Assessment Methods	**Course Assessment Methods (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory Sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the Performa (attached herewith as Annexure II and III) to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.			

Course outcomes:

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Relate the basic application of mechanics involved commonly in the structures.	**L2(Understanding)**
CO2.	Inspect the desired values of the resultant action in response to the agitation on the structures.	**L4(Analyzing)**
CO3.	Analyze the structures using the slope and deflection approach	**L4(Analyzing)**
CO4.	Analyze the trusses using simplified approach.	**L4(Analyzing)**

***Revised Bloom's Taxonomy Action verbs/Levels**

LIST OF EXPERIMENTS:

1. Experiment on a two hinged arch for horizontal thrust & influence line for Horizontal thrust.
2. Experimental and analytical study of a 3-bar pin-jointed Truss.
3. Experimental and analytical study of deflections for unsymmetrical bending of a Cantilever beam.
4. Experimental and analytical study of an elastically coupled beam.
5. Sway in portal frames - demonstration.

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6. To study the cable geometry and statics for different loading conditions.
7. To plot stress-strain curve for concrete.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1.	**2**	**3**	**1**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**1**
CO2.	**2**	**3**	**1**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**1**
CO3.	**2**	**3**	**1**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**1**
CO4.	**2**	**3**	**1**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**1**
3 –High 2-Medium 1-Low															

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CIVIL ENGINEERING MATERIALS TESTING & EVALUATION-I LAB

Course code	**ESC/7-P**			
Category	**Engineering Science Course**			
Course title	**Civil Engineering Materials Testing & Evaluation-I Lab**			
Scheme and credits	**L**	**P**	**Credits**	
	-	**2**	**1.0**	
Course Assessment Methods	**Course Assessment Methods (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory Sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the Performa (attached herewith as Annexure II and III) to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.			

Course outcomes:

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Inspect the size of soil particles at different sites.	**L4(Analyzing)**
CO2.	Compare the density of soil.	**L4(Analyzing)**
CO3.	Deduct the different soil properties under different conditions	**L5(Evaluating)**
CO4.	Determine the ultimate bearing capacity of soil.	**L5(Evaluating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

LIST OF EXPERIMENTS:

1. Grain Size Analysis-Hydrometer method.
2. Shrinkage Limit Determination.
3. Relative Density of Granular Soils.
4. Consolidated Drained (CD) TriaxialTest.

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5. Consolidated Undrained (CU) Triaxial Test with Pore Water Pressure measurement.
6. Consolidation Test.
7. Undisturbed Sampling.
8. Standard Penetration Test.
9. Dynamic Cone Penetration Test.

Books:

1. Soil Testing for Engineers by S.Prakash&P.K.Jain, Nem Chand &Bros.Roorkee.
2. Engineering Soil Testing by Lambi, Wiley-Eastern.
3. Engineering Properties of Soils & Their Measurement by JE Bowles, McGraw-Hill.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1.	**2**	**3**	**1**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**1**
CO2.	**2**	**3**	**1**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**1**
CO3.	**2**	**3**	**1**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**1**
CO4.	**2**	**3**	**1**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**1**
3 –High 2-Medium 1-Low															

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SURVEY CAMP

Course code	**EEC/CE/51-P**			
Category	**Employability Enhancement Courses**			
Course title	**Survey Camp**			
Scheme and credits	**L**	**P**	**Credits**	
	-	**-**	**4.0**	
Course Assessment Methods	**Course Assessment Methods (Internal: 100)** The assessment is based on the level of participation in Field work, timely submission of reports/maps, the quality of topographical map, the performance in VIVA-VOCE, the quality of report work and ethical practices followed. There will be a Viva voce for course evaluation. The course coordinator will conduct this viva voce for evaluation in the slot assigned to the students as per their timetable at the end of fifth semester. The Chairperson of the Department will notify the week for the internal course evaluations. The external examination will be conducted by a team of internal examiners, preferably the laboratory course coordinator and others, appointed by the Chairperson of the Department. The final internal viva voce examination will be conducted only in groups of 5-10 students. The Course Coordinator/Internal Examiners will maintain and submit the bifurcation of marks obtained by the students in internal evaluation in the Performa (attached herewith as Annexure II and III) to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.			

Course outcomes:

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Originate the topographical map of any type of terrain.	**L6(Creating)**
CO2.	Identify the field requirements for different construction activities.	**L3(Applying)**
CO3.	Inspect and plan the requirements of the terrain.	**L4(Analyzing)**
CO4.	Recommend the terrain for type of construction work.	**L5(Evaluating)**
CO5.	Estimate the type of terrain: requirement of filling or excavation.	**L5(Evaluating)**
CO6.	Justify the alignment of Highway, railway or canal etc.	**L5(Evaluating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	**3**	**2**	**3**	**3**	**3**	**1**	**3**	**3**	**3**	**2**	**2**	**1**	**2**	**1**	**2**
CO2.	**3**	**1**	**2**	**3**	**1**	**1**	**3**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
CO3.	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**2**
CO4.	**3**	**2**	**2**	**2**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**2**
CO5.	**3**	**3**	**3**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**2**
CO6.	**3**	**3**	**3**	**3**	**3**	**3**	2	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**2**
3 –High 2-Medium 1-Low															

SEMESTER –VI

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DESIGN OF STEEL STRUCTURES – II

Course code	**PC/CE/61-T**			
Category	**Program Core**			
Course title	**Design of Steel Structures-II**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Analyze the plastic design of steel.	**L4(Analyzing)**
CO2.	Estimate the design parameters for water tank, steel stacks etc.	**L5(Evaluating)**
CO3.	Compare the design analysis of transmission and microwave towers.	**L5(Evaluating)**
CO4.	Make use of Indian standard code for different steel designs.	**L3(Applying)**
CO5.	Design the Industrial buildings and components using purlins and columns.	**L6(Creating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Elementary Plastic Analysis and Design: Introduction, Scope of plastic analysis, ultimate load carrying capacity of tension members and compression members, flexural members, shape factor, mechanisms, plastic collapse, analysis, plastic analysis applied to steel beams and simple portal frames and design.

UNIT-II

Design of Water Tanks: Introduction, permissible stresses, design of circular, rectangular and pressed steel tanks including staging.
Design of Steel Stacks: Introduction, various loads to be considered for the design of steel stacks, design of steel stacks including foundation.

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UNIT-III

Towers: Transmission line towers, microwave towers, Design loads, classification, design procedure and specification.

Cold Formed Sections: Introduction and brief description of various types of cold formed sections, local buckling, concepts of effective width and effective sections, elements with stiffeners, design of compression and bending elements.

UNIT-IV

Industrial Buildings: Loads, general arrangement and stability, design considerations, design of purlins, design of roof trusses, industrial building frames, bracings and stepped columns.

Books:

1. Design of Steel Structures, A. S. Arya & J. L. Ajmani, Nem Chand & Bros., Roorkee.
2. Design of Steel Structures, P. Dayartnam, Wheeler Pub. Allahabad.
3. IS: 800-1984, Indian Standard Code of Practice for General Construction in Steel.
4. IS-801-1975, Indian Standard Code of Practice for Use of Cold formed light gauge steel structural members in general building construction.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	3	1	3	1	1	-	-	-	-	-	-	2	3	1
CO2.	2	1	1	3	1	1	-	-	-	-	-	-	2	3	2
CO3.	2	3	3	1	1	1	-	-	-	-	-	-	2	3	2
CO4.	3	1	1	1	1	1	-	-	-	-	-	-	3	3	2
CO5.	3	2	2	1	1	1	-	-	-	-	-	-	3	3	2
3 –High 2-Medium 1-Low															

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DESIGN OF CONCRETE STRUCTURES-I

Course code	**PC/CE/62-T**			
Category	**Program Core**			
Course title	**Design of Concrete Structures-I**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Analyze the properties of cement, soil, aggregates, concrete etc.	**L4(Analyzing)**
CO2.	Estimate the design parameters for beams, columns, foundations etc.	**L5(Evaluating)**
CO3.	Make use of Indian standard code for different concrete designs.	**L3(Applying)**
CO4.	Design the components of roof slabs and retaining walls.	**L6(Creating)**
CO5.	Construct the detailed drawings of reinforcement for concrete elements.	**L6(Creating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Elementary treatment of concrete technology: Physical requirements of cement, aggregate, admixture and reinforcement, Strength and durability, shrinkage and creep. Design of concrete mixes, Acceptability criterion, I. S. Specifications,

Design Philosophies in Reinforced Concrete: Working stress and limit state methods, Limit state v/s working stress method, Building code, Normal distribution curve, characteristic strength and characteristics loads, design values, Partial safety factors and factored loads, stress -strain relationship for concrete and steel.

UNIT-II

Working Stress Method: Basic assumptions, permissible stresses in concrete and steel, design of singly and doubly reinforced rectangular and flanged beams in flexure, steel beam theory, inverted flanged beams, design examples.

Limit State Method: Basic assumptions, Analysis and design of singly and doubly reinforced rectangular flanged beams, minimum and maximum reinforcement requirement, design examples.

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UNIT-III

Analysis and Design of Sections in shear bond and torsion: Diagonal tension, shear reinforcement, development length, Anchorage and flexural bond, Torsional, stiffness, equivalent shear, Torsional reinforcement, Design examples.

Columns and Footings: Effective length, Minimum eccentricity, short columns under axial compression, Uniaxial and biaxial bending, slender columns, Isolated and wall footings, Design examples.

Serviceability Limit State: Control of deflection, cracking, slenderness and vibrations, deflection and moment relationship for limiting values of span to depth, limit state of crack width, Design examples.

UNIT-IV

One way and Two Ways Slabs: General considerations, Design of one way and two ways slabs for distributed and concentrated loads, Non-rectangular slabs, openings in slabs, Design examples.

Retaining Walls: Classification, Forces on retaining walls, design criteria, stability requirements, Proportioning of cantilever retaining walls, counter-fort retaining walls, criteria for design of counter-forts, design examples.

Concrete Reinforcement and Detailing: Requirements of good detailing cover to reinforcement, spacing of reinforcement, reinforcement splicing, Anchoring reinforcing bars in flexure and shear, curtailment of reinforcement.

Text Books:

1. Reinforced Concrete-Limit State Design, A. K. Jain, Nem Chand & Bros., Roorkee.
2. Reinforced Concrete, I. C. Syal &A. K. Goel, A. H. Wheeler & Co., Delhi.
3. Reinforced Concrete Design, S. N. Sinha, TMH Pub., New Delhi.
4. IS 456: 2000, Plain and Reinforced Concrete –Code of Practice
5. IS 10262-2019, Concrete Mix Proportioning Guidelines.
6. SP-16(S&T)-1980, 'Design Aids for Reinforced Concrete to IS: 456, BIS, New Delhi.
7. SP-34(S&T)-1987 'Handbook on Concrete Reinforcement and Detailing', BIS, New Delhi.
8. Reinforced Cement Concrete Design, by Neelam Sharma, S.K. Kataria & Sons, New Delhi.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	3	1	3	1	1	-	-	-	-	-	-	2	3	1
CO2.	2	1	1	3	1	1	-	-	-	-	-	-	2	3	2
CO3.	2	3	3	1	1	1	-	-	-	-	-	-	2	3	2
CO4.	3	1	1	1	1	1	-	-	-	-	-	-	3	3	2
CO5.	3	2	2	1	1	1	-	-	-	-	-	-	3	3	2
3 –High 2-Medium 1-Low															

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DISASTER PREPAREDNESS & PLANNING MANAGEMENT

Course code	**MC/7-T**			
Category	**Mandatory Course**			
Course title	**Disaster Preparedness & Planning Management**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**0.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
COl	Understand Categories of Disasters	L2(Understanding)
CO2	Realize the responsibilities to society	L3(Applying)
CO3	Analyze relationship between Development and Disasters	L4(Analyzing)
CO4	Apply Disaster Concepts to Management	L5(Creating)

Course Contents

Unit I

Introduction - Concepts and definitions: disaster, hazard, vulnerability, risks- severity, frequency and details, capacity, impact, prevention, mitigation).
Disasters - Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); man-made disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills, transportation accidents, terrorist strikes, etc.); hazard and vulnerability profile of lndia, mountain and coastal areas, ecological fragility.

Unit II

Disaster Impacts - Disaster impacts (environmental, physical, social, ecological, economic, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters.

Unit III

Disaster Risk Reduction (DRR) - Disaster management cycle - its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post-disaster environmental response(water, sanitation, food safety, waste management, disease control,

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security, communications); Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

Unit IV

Disasters, Environment and Development - Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land-use changes, urbanization etc.), sustainable and environmental friendly recovery; reconstruction and development methods.

Books:

1. http://ndma.gov.in/ (Home page of National Disaster Management Authority)
2. Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.
3. Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication.
4. Ghosh G.K., 2006, Disaster Management, APH Publishing Corporation
5. Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June 2003.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	-	-	-	-	-	1	-	-	-	1
CO2	-	-	-	-	-	-	3	-	2	-	-	1
CO3	-	-	-	1	-	3	3	2	2	-	-	1
CO4	-	-	-	-	-	-	-	-	-	1	3	2
3- HIGH 2-MEDIUM 1-LOW												

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CONCRETE TESTING LAB

Course code	**PC/CE/62-P**			
Category	**Program Core**			
Course title	**Concrete Testing Lab**			
Scheme and credits	**L**	**P**	**Credits**	
	-	**2**	**1.0**	
Course Assessment Methods	**Course Assessment Methods (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory Sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the Performa (attached herewith as Annexure II and III) to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.			

Course outcomes:

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Analyze the properties of cement, aggregates and concrete.	**L4(Analyzing)**
CO2.	Compare the properties of cement, aggregates and concrete with the recommended standards, respectively.	**L5(Evaluating)**
CO3.	Recommend for the use of cement, aggregates and concrete in different construction activities	**L5(Evaluating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

LIST OF EXPERIMENTS

Tests on Cement:

1 Specific gravity of cement using specific gravity bottle.
2 Standard consistency of cement and setting time (initial and final) using Vicat's apparatus.
3 Fineness of cement by Sieve analysis method.
4 Soundness of cement by Le-Chatelier's apparatus.
5 Compressive strength of cement.

Tests on Aggregate:

1 Moisture content and bulking of fine aggregate.

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2 Fineness modulus of coarse and fine aggregates.

Tests on Concrete:

1 Workability of cement concrete by Slump test.
2 Compressive strength of concrete by Cube test.

Books Recommended:

1 Concrete Manual-M. L. Gambhir, Dhanpat Rai & Sons, N. Delhi.
2 Concrete Technology-M. L. Gambhir, Tata McGraw Hill, N. Delhi.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	3	2	2	3	1	1	1	-	-	-	-	-	2	1	3
CO2.	3	2	2	3	1	1	1	-	-	-	-	-	2	1	3
CO3.	3	2	2	3	1	1	1	-	-	-	-	-	2	1	3
3 –High 2-Medium 1-Low															

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ENVIRONMENTAL ENGINEERING – I LAB

Course code	**PC/CE/63-P**			
Category	**Program Core**			
Course title	**Environmental Engineering -I Lab**			
Scheme and credits	**L**	**P**	**Credits**	
	-	**2**	**1.0**	
Course Assessment Methods	**Course Assessment Methods (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory Sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the Performa (attached herewith as Annexure II and III) to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.			

Course outcomes:

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Analyze the properties of water and waste water sample.	**L4(Analyzing)**
CO2.	Compare the properties of water and waste water with the recommended standards, respectively.	**L2(Understanding)**
CO3.	Recommend for the use of water in different construction activities	**L5(Evaluating)**
CO4.	Recommend the type of treatment plant required for waste water treatment.	**L5(Evaluating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

LIST OF EXPERIMENTS:

1. To determine the pH value of a given sample of waste water.
2. To determine the turbidity in a given waste water sample.
3. To determine the acidity of given sample of waste water.
4. To determine the alkalinity of given sample of waste water.
5. To determine temporary and permanent hardness in a given water sample.

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6. To determine the chlorine does required for a given water sample.
7. To determine total suspended, suspended, dissolved settable solids in a waste water sample.
8. To determine the chloride concentration of given sample of waste water.
9. To determine the sulphate concentration in given water sample.

REFERENCE BOOKS:-

1. Pant M.K., Laboratory Manual for Civil Engineering, S.K. Kataria & Sons, New Delhi.
2. Moondra H.S. and Rajiv Gupta, Laboratory Manual for Civil Engineering, CBS Publishers.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1.	**3**	**2**	**2**	**3**	**1**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**2**
CO2.	**3**	**2**	**2**	**3**	**1**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**3**
CO3.	**3**	**2**	**2**	**3**	**1**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**3**
CO4.	**3**	**2**	**2**	**3**	**1**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**2**
3 –High 2-Medium 1-Low															

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IRRIGATION ENGINEERING (DRAWING)

Course code	**PC/CE/64-P**			
Category	**Program Core**			
Course title	**Irrigation Engineering (Drawing)**			
Scheme and credits	**L**	**P**	**Credits**	
	-	**2**	**1.0**	
Course Assessment Methods	**Course Assessment Methods (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory Sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the Performa (attached herewith as Annexure II and III) to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.			

Course outcomes:

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Elaborate the sketches of different diversion head works in Canals.	**L6(Creating)**
CO2.	Illustrate the sketches of different cross drainage works in Canals.	**L2(Understanding)**
CO3.	Outline the problems of seepage in Earth dams on impermeable foundation.	**L2(Understanding)**
CO4.	Elaborate the sketches of different regulation works in Canals.	**L6(Creating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

List of Drawings:-

1 Structural drawings of Weirs.
2 Structural drawings of Barrages.
3 Structural drawings of Guide Banks.
4 Cross-section of different cross drainage works.
5 Structural drawings of Sarda type fall.
6 Structural drawings of Sloping glacis fall.

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7 Seepage line in a homogeneous earth dams on impermeable foundation with horizontal drainage.
8 Structural drawings of Ogee Spillway.
9 Structural drawings of Stilling Basin

Note: Emphasis would be given to the computer aided drawings of some of above structures.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1.	**2**	**1**	**2**	**1**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**2**
CO2.	**2**	**1**	**2**	**1**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**2**
CO3.	**2**	**1**	**2**	**1**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**2**
CO4.	**2**	**1**	**2**	**1**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**2**
3 –High 2-Medium 1-Low															

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CIVIL ENGINEERING MATERIALS TESTING & EVALUATION-II LAB

Course code	**ESC/8-P**			
Category	**Engineering Science Course**			
Course title	**Civil Engineering Materials Testing & Evaluation-II Lab**			
Scheme and credits	**L**	**P**	**Credits**	
	-	**2**	**1.0**	
Course Assessment Methods	**Course Assessment Methods (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory Sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the Performa (attached herewith as Annexure II and III) to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.			

Course outcomes:

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Inspect the type of bricks at different sites.	**L4(Analyzing)**
CO2.	Compare the quality of bricks, tiles, pavers etc.	**L4(Analyzing)**
CO3.	Deduct the different properties of bricks, tiles, pavers under different conditions.	**L5(Evaluating)**
CO4.	Determine the strength of already existing concrete structure.	**L5(Evaluating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

LIST OF EXPERIMENTS:

Tests on Bricks:

1. Water absorption test.
2. Crushing or Compressive strength test
3. Hardness, Shape & Size and Efflorescence tests

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Tests on Tiles:

4. Compressive Strength test.
5. Water absorption test.
6. Hardness, Shape & Size and Efflorescence tests.

Tests on Interlocking Pavers:

7. Compressive Strength test.

Non-destructive Testing of Concrete:

8. Rebound Hammer

Reference Books:

1. IS-3495: Methods of Test of burnt clay building.
2. IS-15658: Concrete Paving Block Specifications.
3. Civil Engineering Materials and Testing, by Kaushal Kishore, Standard Publishers Distributors.
4. Laboratory Manual for Civil Engineering students by M.K. Pant, S.K. Kataria & Sons, Daryaganj, New Delhi

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	2	3	1	3	1	1	-	-	-	-	-	-	2	1	3
CO2.	2	3	1	3	1	1	-	-	-	-	-	-	2	1	3
CO3.	2	3	1	3	1	1	-	-	-	-	-	-	2	1	3
CO4.	2	3	1	3	1	1	-	-	-	-	-	-	2	1	3
3 –High 2-Medium 1-Low															

Scheme of Examination & Detailed Syllabus of B.Tech (CE) 4th Year

(7th & 8th Semester)

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Scheme B.Tech. (Civil Engineering) 4th year

SEMESTER-7					
Course Code	**Course Title**	**Workload/Credit**			
		Theory	**Tutorial**	**Practical/ Drawing**	**Total**
PC/CE/71-T	Design of Concrete Structures-II	3/3	-	-	3/3
PE/CE/71-T to PE/CE/74-T	**Program Elective-V**	3/3	-	-	3/3
PE/CE/75-T to PE/CE/78-T	**Program Elective-VI**	3/3	-	-	3/3
	Open Elective-III to be opted from courses offered by other Department	3/3	-	-	3/3
PC/CE/71-P	Concrete Structures-II (Drawing)	-	-	2/1	2/1
PC/CE/72-P	Highway Material Testing-I Lab	-	-	2/1	2/1
EEC/CE/71-P	Estimation, Accounts & Valuation	-	-	4/2	4/2
EEC/CE/72-P	PROJECT-I	-	-	6/3	6/3
EEC/CE/73-P	Internship/Training	-	-	4/2	4/2
Total		**12/12**	**-**	**18/9**	**30/21**
Open Elective-III: - Students are required to study one elective subject from any other Department in 7th Semester.					

Program Elective-V

Course Code	Course Name	L	T	P/D	Credits
PE/CE/71-T	Railway & Airport Engineering	3	-	-	3.0
PE/CE/72-T	Intelligent Transport System	3	-	-	3.0
PE/CE/73-T	Transportation Engineering	3	-	-	3.0
PE/CE/74-T	Airport Planning & Design	3	-	-	3.0

Program Elective-VI

Course Code	Course Name	L	T	P/D	Credits
PE/CE/75-T	Project Planning & Management	3	-	-	3.0
PE/CE/76-T	Construction Engineering & Management	3	-	-	3.0
PE/CE/77-T	Construction Planning, Scheduling and Control	3	-	-	3.0
PE/CE/78-T	Contract Law and Regulations	3	-	-	3.0

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SEMESTER-8					
Course Code	**Course Title**	**Workload/Credit**			
		Theory	**Tutorial**	**Practical/ Drawing**	**Total**
PC/CE/81-T	Pavement Analysis & Design	3/3	-	-	3/3
PE/CE/81-T to PE/CE/84-T	**Program Elective-VII**	3/3	-	-	3/3
PE/CE/85-T to PE/CE/88-T	**Program Elective-VIII**	3/3	-	-	3/3
PC/CE/81-P	Highway Material Testing-II Lab	-	-	2/1	2/1
PC/CE/82-P	Environmental Engg.- II Lab	-	-	2/1	2/1
EEC/CE/81-P	PROJECT-II	-	-	8/4	8/4
EEC/CE/82-P	SEMINAR*	-	-	2/1	2/1
EEC/CE/83-P	General Fitness & Professional Aptitude	-	-	-	-/1
Total		**9/9**	**-**	**14/7**	**23/17**

* Internal evaluation

Note: Students will be allowed to use non-programmable scientific calculators only; however, sharing of calculator should not be permitted.

Program Elective-VII

Course Code	Course Name	L	T	P/D	Credits
PE/CE/81-T	Sewerage & Sewage Treatment	3	-	-	3.0
PE/CE/82-T	Industrial Waste Water Treatment	3	-	-	3.0
PE/CE/83-T	Air and Noise Pollution Control Engg	3	-	-	3.0
PE/CE/84-T	Solid and Hazardous Waste Management	3	-	-	3.0

Program Elective-VIII

Course Code	Course Name	L	T	P/D	Credits
PE/CE/85-T	Concrete Technology	3	-	-	3.0
PE/CE/86-T	Geosynthetics Engineering	3	-	-	3.0
PE/CE/87-T	Bridge Engineering	3	-	-	3.0
PE/CE/88-T	Prestressed Concrete	3	-	-	3.0

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Policy Document for providing exemptions in attendance to the B.Tech. students of the University/affiliated Institute/College, for undertaking various internships/trainings during their final/penultimate semester.

1. Background:

It has been realized that the students pursuing B.Tech. programmes offered by the University/affiliated Institutes/Colleges are facing challenges as under:

i. Students selected in industry during their programme are asked to join the industry for internship/training of duration up to one semester.
ii. The provision is not there in these programmes to allow the students to join the internship by way of getting the required attendance of semester from internship/training.
iii. So, students are not able to join such internship/training consequential to two-fold loss:
   a) Job opportunity.
   b) Skill development in industry environment.

But, presently, in the B.Tech. Programmes run by the University, there is no provision for the students to join the industry for such internship/training of/for more than 6–8-week duration. To facilitate the students for joining longer duration internships/trainings, a need for framing a policy document was felt.

Keeping in view the above challenges/statutory position and to avoid hardship to students and to improve the employability of the students, Ch. Devi Lal University, Sirsa has framed a policy to accord exemptions in attendance to students undertaking various internships/trainings during their final/penultimate semester of the B.Tech. Programmes.

2. Applicability of the policy with following Provisions:

The policy is applicable to the students studying in the final semester/ penultimate semester of B. Tech. programmes.

2.1 Provisions:

Student covered as per section title 'Applicability of the Policy' will be governed by the following provisions:

1. The student will be allowed to join the organization for internship/training in the final semester/ penultimate semester of the course for a period of up to one semester only if he/she must be passed/ cleared in all courses/subjects in all the semester examination whose results have been declared.
2. The student will earn his/her attendance from the organization during the period of internship.
3. Attendance will be certified by the organization, failing which student will be debarred from appearing in the University examinations of that semester.
4. The student will have to give an undertaking that he/she will appear in all the internal/external examination/practical as per requirements of the Programme and as per Schedule of the University examination for that programme. For this he/she will have to do the necessary preparation by himself/herself and Institute/department will not be responsible for the same.
5. If the student is selected in a company/industry/organization etc., and is asked to join the organization in the final semester/ penultimate semester for a period of upto one semester; then formally constituted Internship Facilitation Committee (IFC) will examine and give its recommendation as deemed fit.

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2.2 Composition of Internship Facilitation Committee (IFC):

The composition of IFC will be as under:

1. Dean, Faculty of Engg. & Tech./Director/ Principal (or Nominee) (Chairperson)
2. Chairperson/Head In-charge of the concerned Department/Branch (Member)
3. In-Charge Academic Branch/Academic In-charge of Institute (Member)
4. Senior most faculty of the department other than Chairperson/ Director/Head of the Department/Branch (Member)
5. Training and Placement officer/ In-Charge TPO of the Institute /College/Department (Member Secretary)

Any offer by the organisations providing internship on demanding charges from a student will be discouraged by the Internship Facilitation Committee (IFC). Member Secretary of the IFC will schedule the meeting and maintain all the records.

3. Conclusion:

The students can only be allowed to join the internship/training in company/ industry/ organization etc. with exemptions in attendance on the final recommendation of Internship Facilitation Committee (IFC) of the Institute / Department and permission given by the Department/Institute/College authority.

SEMESTER –VII

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DESIGN OF CONCRETE STRUCTURES-II

Course code	**PC/CE/71-T**			
Category	**Program Core**			
Course title	**Design of Concrete Structures-II**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course Outcomes:

S. No.	**Course outcomes** At the end of the course students will be able to:	**RBT* Level**
CO1	Explain design of special concrete structures like continuous/ curved beams, stair-cases, water tanks, domes, retaining walls and bridges.	**L2(Understanding)**
CO2	Employ the concepts of structural engineering for the construction of special structures.	**L3(Applying)**
CO3	Examine the structural aspects of special structures.	**L4 (Analyzing)**
CO4	Evaluate the structural condition of special structures	**L5 (Evaluating)**
CO5	Design special concrete structures like continuous/ curved beams, stair-cases, water tanks, domes, retaining walls and bridges.	**L6 (Creating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT I

Continuous Beams: Basic assumptions, Moment of inertia, settlements, Modification of moments, maximum moments and shear, redistribution of moments for single and multi-span beams, design examples.

Prestressed Concrete: Basic principles, classification of prestressed members, various prestressing systems, losses in prestress, initial and final stress conditions, analysis and design of sections for flexure and shear, load balancing concept, I:S:Specifications. End blocks-Analysis of stresses, Magnel's method, Guyon's method, Bursting and spalling stresses, design examples

UNIT II

Flat slabs: Advantages of flat slabs, general design considerations, approximate direct design method, design of flat slabs, openings in flat slab, design of various types of staircases, design examples.

Foundations: Combined footings, raft foundation, design of pile cap and piles, under-reamed piles, design examples.

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UNIT III

Water Tanks, Silos and Bunkers: Estimation of Wind and earthquake forces, design requirements, rectangular and cylindrical underground and overhead tanks, Intze tanks, design considerations, design examples.

Silos and Bunkers: Various theories, Bunkers with sloping bottoms and with high side walls, battery of bunkers, design examples.

UNIT IV

Building Frames:

Introduction, Member stiffnesses, Loads, Analysis for vertical and lateral loads, Torsion in buildings, Ductility of beams, design and detailing for ductility, design examples.

Yield Line Theory:

Basic assumptions, Methods of analysis, yield line patterns and failure mechanisms, analysis of one way and two way rectangular and non-rectangular slabs, effect of top corner steel in square slabs, design examples.

Text Books

1. Reinforced Concrete Structures, P. C. Varghese, Tata McGraw Hill.
2. Advanced Reinforced Concrete Structures, P. C. Varghese, Tata McGraw Hill.
3. Reinforced Concrete Design, M.L. Gambhir, Macmillan India Ltd., New Delhi.
4. Limit State Design of Reinforced Concrete, A.K. Jain, Nern Chand and Bros., Roorkee.
5. Pre-Stressed Concrete, N. Krishna Raju, TMH Publishers, New Delhi.
6. IS 456-2000, Indian Standard of Practice for Plain and Reinforced Concrete, IS 1893, 4326 & 13920 Indian Standard Code of Practice for Earthquake Resistant Design of Structures.
7. Plain and Reinforced concrete, Vol. 2, 0 P Jain and J. Krishna, Nern Chand and Bros., Roorkee.
8. Reinforced Concrete Design, SU Pillai and D Menon, Tata McGraw Hill.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	2	2	2	2	1	-	-	-	-	-	-	-	2	2	2
CO2.	2	2	2	2	1	-	-	-	-	-	-	-	2	3	3
CO3.	2	2	2	2	1	-	-	-	-	-	-	-	2	2	3
CO4.	2	2	3	3	1	-	-	-	-	-	-	-	2	3	2
CO5.	2	2	3	3	1	-	-	-	-	-	-	-	2	3	2
3 –High 2-Medium 1-Low															

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CONCRETE STRUCTURES-II (DRAWING)

Course code	**PC/CE/71-P**			
Category	**Program Core**			
Course title	**Concrete Structures-II (Drawing)**			
Scheme and credits	**L**	**P**	**Credits**	
	-	**2**	**1.0**	
Course Assessment Methods	**Course Assessment Methods (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory Sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the Performa (attached herewith as Annexure II and III) to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.			

Course outcomes:

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Illustrate the sketch of reinforcement of Flat Slab.	**L2(Understanding)**
CO2.	Illustrate the sketches of different Water tanks.	**L2(Understanding)**
CO3.	Illustrate the sketches of different types of foundations.	**L2(Understanding)**
CO4.	Elaborate the sketch of component parts of T-Beam Bridge.	**L6(Creating)**
CO5.	Elaborate the sketch of component parts of Bunkers/Silos.	**L6(Creating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

Preparing drawing sheets showing reinforcement details in case of:

1. Flat slabs.
2. Underground Water Tanks.
3. Overhead Water Tanks
4. Combined Footings.
5. Pile Foundations.

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6. Raft foundation.
7. Component Parts of T-Beam Bridge.
8. Component parts of Silo/Bunker.

Note: Emphasis would be given to the computer aided drawings of some of above structures.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1.	**2**	**1**	**2**	**1**	**2**	**2**	**2**	-	-	-	-	-	**1**	**1**	**2**
CO2.	**2**	**1**	**2**	**1**	**2**	**2**	**2**	-	-	-	-	-	**1**	**1**	**2**
CO3.	**2**	**1**	**2**	**1**	**2**	**2**	**2**	-	-	-	-	-	**1**	**1**	**2**
CO4.	**2**	**1**	**3**	**1**	**3**	**3**	**3**	-	-	-	-	-	**1**	**1**	**2**
CO5.	**2**	**1**	**3**	**1**	**3**	**3**	**3**	-	-	-	-	-	**1**	**1**	**2**
3 –High 2-Medium 1-Low															

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HIGHWAY MATERIAL TESTING-I LAB

Course code	**PC/CE/72-P**			
Category	**Program Core**			
Course title	**Highway Material Testing-I Lab**			
Scheme and credits	**L**	**P**	**Credits**	
	-	**2**	**1.0**	
Course Assessment Methods	**Course Assessment Methods (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory Sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the Performa (attached herewith as Annexure II and III) to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.			

Course outcomes

S.No.	**Course outcomes** At the end of the course students will be able to:	RBT* Level
CO1	Identify the properties of aggregates to be used in Highway construction.	**L3 (Applying)**
CO2	Classify the type of aggregates based on requirement.	**L4 (Analyzing)**
CO3	Identify the properties of bitumen to be used in Highway construction.	**L3 (Applying)**
CO4	Classify the type of bitumen based on requirement.	**L4 (Analyzing)**
CO5	Assess the soil properties for suitability or necessary improvement.	**L5 (Evaluating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

List of Experiments:-

1. Flakiness and Elongation Index of aggregates.
2. Specific gravity and water absorption test on aggregates.
3. Specific gravity of bitumen.
4. Proportioning of aggregates.
5. Marshall's stability test.
6. Stripping test on aggregates.

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7. Determination of bitumen content.
8. CBR lab test on soil.

REFERENCE BOOKS:

1. Khanna S.K. and C.E.G. Justo, Highway Engineering, Nemchand Bros.
2. Kadyali L. R.; Highway Engineering, Nem Chand & Brothers, Roorkee.
3. Rao G. V.; Transportation Engineering, Tata McGraw Hill Publisher, New Delhi.
4. LR. Kadiyali, Traffic Engineering and Transportation Planning, Khanna Publishers, New Delhi.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	2	3	2	3	2	2	-	-	-	-	-	-	1	1	2
CO2.	2	3	2	3	2	2	-	-	-	-	-	-	1	1	2
CO3.	2	3	2	3	2	2	-	-	-	-	-	-	1	1	2
CO4.	2	3	2	3	2	2	-	-	-	-	-	-	1	1	2
CO5.	2	3	2	3	2	2	-	-	-	-	-	-	1	1	2
3 –High 2-Medium 1-Low															

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ESTIMATION, ACCOUNTS & VALUATION

Course code	**EEC/CE/71-P**			
Category	**Employability Enhancement Courses**			
Course title	**Estimation, Accounts & Valuation**			
Scheme and credits	**L**	**P**	**Credits**	
	-	**4**	**2.0**	
Course Assessment Methods	**Course Assessment Methods (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory Sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the Performa (attached herewith as Annexure II and III) to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.			

Course outcomes

S. No.	**Course outcomes** At the end of the course students will be able to:	**RBT* Level**
CO1	Explain the basics of preparing estimates, costs and valuation for civil engineering works	**L2 (Understanding)**
CO2	Prepare specifications for different items of civil works	**L3 (Applying)**
CO3	Analyze rates for various items of works	**L4 (Analyzing)**
CO4	Estimate quantities of different items of civil engineering works	**L5 (Evaluating)**
CO5	Prepare tender documents for civil work and perform valuation of different Civil Engineering structures.	**L6 (Creating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

Theoretical portion to be discussed before Submissions.

Module-I

Estimate: Principles of estimation, units, items of work, different kinds of estimates, different methods of estimation, estimation of materials in single room building, two roomed building with different sections of walls, foundation, floors and roofs, R.B. and R.VC.C. works, Plastering, White-washing, Distempering and painting, doors and windows, lump sum items, Estimates of canals, roads etc.

SUBMISSIONS:-

(I) For Given plans and sections determine:-

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1. Earthwork,
2. Concrete works,
3. R.C.C. works,
4. Reinforced brick work.
5. Plastering, painting, finishing (white-washing, distempering).

Module-II

Specification of Works: Necessity of specifications, types of specifications, general specifications, specification for bricks, cement, sand, water, lime, reinforcement; Detailed specifications for Earthwork, Cement, concrete, brick work, floorings, D.P.C., R.C.C., cement plastering, white and color washing, distempering, painting.

SUBMISSIONS:-

(II) Application of Haryana P.W.D. Schedule of Rates and Estimation for Exercise at S.No 1 to 5 in (I).

Module-III

Valuation: Different terms used the role of a valuer, purpose and necessity of the same. Capitalized Value, Years purchase, sinking fund, depreciation, types of values. Purpose of valuation. Different methods of valuation for (i) open plots, (ii) open plots with existing residential & commercial structures, (iii) lease hold properties. Use of valuation tables and formulae.

SUBMISSIONS:-

(III) Valuation of any Existing building.

Module-IV

Rate Analysis: Purpose, importance and requirements of rate analysis, units of measurement, preparation of rate analysis, procedure of rate analysis for items:- Earthwork, concrete works, R.C.C. works, reinforced brick work, plastering, painting, finishing(white-washing, distempering).

Public Works Account: Introduction, function of P.W. department, contract. guidelines, types of contracts, their advantages and disadvantages, Tender and acceptance of tender, Earnest money, security money, retention money, measurement book, cash book, preparation, examination and payment of bins, first and final bills, administrative sanction, technical sanction.

SUBMISSIONS:-

(IV) Preparation of tender document as per (I) and (II).

REFERENCE BOOKS

1. Estimating & Costing in Civil Engg..: Theory & Practice by B.N.Dutta, S.Dutta & Co., Lucknow.
2. Estimating, Costing & Specification in Civil Engg. by M.Chakarborty, Calcutta
3. Estimating and Costing for Building & Civil Engg.Works by P.L.Bhasin, S.Chand & Co., N.Ddhi.
4. Building Construction Estimating by George H.Cooper, McGraw Hill Book Co., New York.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	2	2	-	-	1	1	-	-	-	-	-	-	1	1	2
CO2.	2	2	1	1	1	1	-	-	-	-	-	-	1	1	2
CO3.	2	2	1	1	1	1	-	-	-	-	-	-	1	1	2
CO4.	2	2	1	1	1	1	1	-	-	-	-	-	1	1	2
CO5.	3	3	3	2	1	2	2	-	-	-	-	-	1	1	3
3 –High 2-Medium 1-Low															

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PROJECT – I

Course code	**EEC/CE/72-P**			
Category	**Employability Enhancement Courses**			
Course title	**Project-I**			
Scheme and credits	**L**	**P**	**Credits**	
	-	**6**	**3.0**	
Course Assessment Methods	**Course Assessment Methods (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory Sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the Performa (attached herewith as Annexure II and III) to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.			

Course outcomes

S. No.	**Course outcomes** At the end of the course students will be able to:	**RBT* Level**
CO1	Relate the on-site problem to its category.	**L2 (Understanding)**
CO2	Analyze the problem and find its solution.	**L4 (Analyzing)**
CO3	Prepare the framework to solve the problem	**L6 (Creating)**
CO4	Create the model of prototype of the solution.	**L6 (Creating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1.	**2**	**2**	**1**	**1**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**
CO2.	**2**	**2**	**1**	**1**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**2**
CO3.	**1**	**2**	**3**	**1**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**2**
CO4.	**1**	**2**	**3**	**1**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**
3 –High 2-Medium 1-Low															

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INTERNSHIP/TRAINING

Course code	**EEC/CE/73-P**			
Category	**Employability Enhancement Courses**			
Course title	**Internship/Training**			
Scheme and credits	**L**	**P**	**Credits**	
	-	**4**	**2.0**	
Course Assessment Methods	**Course Assessment Methods (Internal: 100)** The assessment is based on the level of participation in laboratory Sessions, timely submission and presentation of training reports, the quality of presentations, the performance in VIVA-VOCE, the quality of Report file and ethical practices followed. There will be a continuous process for laboratory course evaluation. The course coordinator will conduct the presentation and viva voce examination in the slots assigned to them as per their timetable. The marks for Presentations and viva-voce examinations must be submitted at the end of the semester. The Course Coordinator/Internal Examiners will maintain and submit the bifurcation of marks obtained by the students in internal evaluations, accordingly, in the Performa (attached herewith as Annexure II and III) to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.			

Course outcomes

S. No.	**Course outcomes** At the end of the course students will be able to:	**RBT* Level**
CO1	Compare practical problem with theoretical	**L4 (Analyzing)**
CO2	Analyze the problem and find its solution.	**L4 (Analyzing)**
CO3	Estimate the material, men and machinery	**L5 (Evaluating)**
CO4	Improve the quality and technology	**L6 (Creating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1.	**2**	**2**	**1**	**1**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**
CO2.	**2**	**2**	**3**	**1**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**2**
CO3.	**2**	**2**	**3**	**1**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**2**
CO4.	**2**	**2**	**3**	**1**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**
3 –High 2-Medium 1-Low															

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SEMESTER –VIII

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PAVEMENT ANALYSIS & DESIGN

Course code	**PC/CE/81-T**			
Category	**Program Core**			
Course title	**Pavement Analysis & Design**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes

S. No.	**Course outcomes** At the end of the course students will be able to:	RBT* Level
CO1	Design the flexible and rigid type of pavements.	L6 (Creating)
CO2	Identify the type of machinery for the type of road construction.	L3 (Applying)
CO3	Decide about the type of maintenance required in the pavements.	L5 (Evaluating)
CO4	Evaluate the funds for budget proposal.	L5 (Evaluating)
CO5	Analyze the construction of tunnels.	L4 (Analyzing)

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Design of Flexible Pavements: Types of pavements. Flexible and rigid pavements. Components of a pavement and their functions. Factors affecting design of pavements. Design of thickness of a flexible pavement by Group Index method, CBR method (including latest IRC guidelines), Triaxial method and Burmister's method.

Design of Rigid Pavements: Westergaard's theory, critical locations of loading, load and temperature stresses. Critical combination of stresses. IRC guidelines for determination of thickness of a rigid pavement. Joints: requirements, types, patterns. Spacing of expansion and contraction joints. Functions of dowel and tie bars.

UNIT-II

Highway Construction: Non-Bituminous Pavements: Brief introduction to earthwork machinery: shovel, hoe, clamshell, dragline, bulldozers. Principles of field compaction of subgrade. Compacting equipments. Granular roads. Construction steps of WBM. WMM. Construction of cement concrete pavements. Slip-form pavers. Basic concepts of the following: soil stabilized roads, use of geo-synthetics, reinforced cement concrete pavements, prestress concrete pavements, roller compacted concrete pavements and fibre reinforced concrete pavements.

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Construction of Bituminous Pavements: Various types of bituminous constructions. Prime coat, tack coat, seal coat and surface dressing. Construction of BUSG, Premix carpet, BM, DBM and AC. Brief coverage of machinery for construction of bituminous roads: bitumen boiler, sprayer, pressure distributer, hot-mix plant, cold-mix plant, tipper trucks, mechanical paver or finisher, rollers. Mastic asphalt. Introduction to various IRC and MOST specifications.

UNIT-III

Highway Maintenance: Pavement failures. Maintenance operations. Maintenance of WBM, bituminous surfaces and cement concrete pavements. Pavement evaluation. Benkelman beam. Introduction to various types of overlays.

Highway Economics and Finance: Need of economic evaluation. Highway user benefits and costs. Methods of economic evaluation: benefit cost ratio method, net present value method, internal rate of return method, comparison. Highway finance.

UNIT-IV

Highway Drainage and Hill Roads: Surface drainage: types, brief design. Types of sub-surface drainage. Special characteristics of hill roads: geometrics, hair pin bends, construction of hill roads, drainage of hill roads, maintenance problems of hill roads

Tunnels: Sections of tunnels: advantages, limitations and suitability of each section. Shaft. Pilot tunnel. Driving tunnel in rocks: sequence of construction operations, full face method, heading and bench method, drift method. Driving tunnels in soft ground: sequence of construction operations, needle beam method, shield tunneling, compressed air tunneling.

Recommended Books

1. Highway Engg *by* S. K. Khanna & C.E.G. Justo, Nem Chand Bros., Roorkee.
2. Principles and Practice of Highway Engg. *By* L. R. Kadiyali, Khanna Publishers, Delhi.
3. Principles of Pavement Design *by* Yoder, E. J & Witczak, M.W., John Wiley and Sons, USA.
4. Tunnel Engineering *by* S. C. Saxena, Dhanpat Rai Publications, N. Delhi.
5. A text book of Tunnel, Bridges and Railway Engg. By S. P. Bindra, Dhanpat Rai Delhi.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	2	2	3	1	1	1	-	-	-	-	-	-	1	3	2
CO2.	2	2	3	1	1	1	-	-	-	-	-	-	1	2	2
CO3.	2	2	3	1	3	1	1	-	-	-	-	-	2	2	2
CO4.	2	2	2	1	2	1	-	-	-	-	-	-	1	1	2
CO5.	2	2	1	1	1	1	1	-	-	-	-	-	3	1	2
3 –High 2-Medium 1-Low															

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HIGHWAY MATERIAL TESTING-II LAB

Course code	**PC/CE/81-P**			
Category	**Program Core**			
Course title	**Highway Material Testing-II Lab**			
Scheme and credits	**L**	**P**	**Credits**	
	-	**2**	**1.0**	
Course Assessment Methods	**Course Assessment Methods (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory Sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the Performa (attached herewith as Annexure II and III) to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.			

Course outcomes

S.No.	**Course outcomes** At the end of the course students will be able to:	RBT* Level
CO1	Identify the properties of aggregates to be used in Highway construction.	**L3 (Applying)**
CO2	Classify the type of aggregates based on requirement.	**L4 (Analyzing)**
CO3	Identify the properties of bitumen to be used in Highway construction.	**L3 (Applying)**
CO4	Classify the type of bitumen based on requirement.	**L4 (Analyzing)**
CO5	Assess the soil properties for suitability or necessary improvement.	**L5 (Evaluating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

List of Experiments:-

1. Aggregate Impact Test.
2. Los-Angeles Abrasion Test on Aggregates.
3. Dorry's Abrasion Test on Aggregates.
4. Deval Attrition Test on Aggregates.
5. Crushing Strength Test on Aggregates.

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6. Penetration Test on Bitumen.
7. Ductility Test on Bitumen.
8. Viscosity Test on Bituminous Material
9. Softening Point Test on Bitumen.
10. Flash and Fire Point Test on Bitumen.

REFERENCE BOOKS:

1. Khanna S.K. and C.E.G. Justo, Highway Engineering, Nemchand Bros.
2. Kadyali L. R.; Highway Engineering, Nem Chand & Brothers, Roorkee.
3. Rao G. V.; Transportation Engineering, Tata McGraw Hill Publisher, New Delhi.
4. LR. Kadiyali, Traffic Engineering and Transportation Planning, Khanna Publishers, New Delhi.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	2	3	2	2	2	1	-	-	-	-	-	-	1	1	2
CO2.	2	3	2	2	2	1	-	-	-	-	-	-	1	1	2
CO3.	2	3	2	2	2	1	-	-	-	-	-	-	1	1	2
CO4.	2	3	2	2	2	1	-	-	-	-	-	-	1	1	2
CO5.	2	3	2	2	2	1	-	-	-	-	-	-	1	1	2
3 –High 2-Medium 1-Low															

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ENVIRONMENTAL ENGG. – II Lab

Course code	**PC/CE/82-P**			
Category	**Program Core**			
Course title	**Environmental Engg.-II Lab**			
Scheme and credits	**L**	**P**	**Credits**	
	-	**2**	**1.0**	
Course Assessment Methods	**Course Assessment Methods (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory Sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the Performa (attached herewith as Annexure II and III) to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.			

Course outcomes:

S.No.	**Course outcomes** At the end of the course students will be able to:	RBT* Level
CO1	Determine the properties of a sewage sample.	**L5 (Evaluating)**
CO2	Classify the type of sewage based on its properties.	**L4 (Analyzing)**
CO3	Determine the BOD, COD of sewage sample.	**L5 (Evaluating)**
CO4	Select the type of treatment for the given sewage sample.	**L5 (Evaluating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

List of Experiments:

1. To determine the acidity of a sewage sample.
2. To determine the alkalinity of a sewage sample.
3. To determine total, suspended, dissolved and settable solids in a sewage sample.
4. To determine volatile and fixed solids in a sewage sample.
5. To determine oil and grease in a sewage sample.
6. To determine the chloride concentration in a sewage sample.
7. To determine the sulphate concentration in a sewage sample.

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8. To determine the B.O.D. of a given sewage sample.
9. To determine the C.O.D. of a given sewage sample.
10. To determine the T.O.C. of a given sewage sample.

REFERENCE BOOKS:

1. Pant M.K., Laboratory Manual for Civil Engineering, S.K. Kataria & Sons, New Delhi.
2. Moondra H.S. and Rajiv Gupta, Laboratory Manual for Civil Engineering, CBS Publishers.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1.	**1**	**2**	**1**	**3**	**1**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**1**
CO2.	**1**	**2**	**1**	**3**	**1**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**1**
CO3.	**1**	**2**	**1**	**3**	**1**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**1**
CO4.	**1**	**2**	**1**	**3**	**1**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**1**
3 –High 2-Medium 1-Low															

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PROJECT – II

Course code	**EEC/CE/81-P**			
Category	**Employability Enhancement Courses**			
Course title	**Project-II**			
Scheme and credits	**L**	**P**	**Credits**	
	-	**8**	**4.0**	
Course Assessment Methods	**Course Assessment Methods (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory Sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the Performa (attached herewith as Annexure II and III) to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.			

Course outcomes

S. No.	**Course outcomes** At the end of the course students will be able to:	**RBT* Level**
CO1	Relate the on-site problem to its category.	**L2 (Understanding)**
CO2	Analyze the problem and find its solution.	**L4 (Analyzing)**
CO3	Prepare the framework to solve the problem	**L6 (Creating)**
CO4	Create the model of prototype of the solution.	**L6 (Creating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1.	**1**	**2**	**1**	**1**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**1**
CO2.	**1**	**2**	**1**	**1**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**1**
CO3.	**1**	**2**	**3**	**1**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**1**
CO4.	**1**	**2**	**3**	**1**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**1**
3 –High 2-Medium 1-Low															

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SEMINAR

Course code	**EEC/CE/82-P**			
Category	**Employability Enhancement Courses**			
Course title	**Seminar**			
Scheme and credits	**L**	**P**	**Credits**	
	-	**2**	**1.0**	
Course Assessment Methods	**Course Assessment Methods (Internal: 100)** The assessment is based on the level of participation in laboratory Sessions, timely submission and presentation of Seminar reports, the quality of presentations, the performance in VIVA-VOCE, the quality of Report file and ethical practices followed. There will be a continuous process for laboratory course evaluation. The course coordinator will conduct the presentation and viva voce examination in the slots assigned to them as per their timetable. The marks for Presentations and viva-voce examinations must be submitted at the end of the semester. The Course Coordinator/Internal Examiners will maintain and submit the bifurcation of marks obtained by the students in internal evaluations, accordingly, in the Performa (attached herewith as Annexure II and III) to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.			

Course outcomes

S. No.	**Course outcomes** At the end of the course students will be able to:	**RBT* Level**
CO1	Outline the latest practical problems.	**L2 (Understanding)**
CO2	Analyze the problem and find its solution.	**L4 (Analyzing)**
CO3	Distinguish the latest material and machinery	**L4 (Analyzing)**
CO4	Develop the quality and technology	**L6 (Creating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1.	**1**	**2**	**1**	**1**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**1**
CO2.	**1**	**2**	**3**	**1**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**1**
CO3.	**2**	**2**	**3**	**1**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**1**
CO4.	**2**	**2**	**3**	**1**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**1**
3 –High 2-Medium 1-Low															

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GENERAL FITNESS & PROFESSIONAL APTITUDE

Course code	**EEC/CE/83-P**			
Category	**Employability Enhancement Courses**			
Course title	**General Fitness & Professional Aptitude**			
Scheme and credits	**L**	**P**	**Credits**	
	-	**-**	**1.0**	
Course Assessment Methods	**Course Assessment Methods (External: 100)** The assessment is based on the level of performance in VIVA-VOCE, the quality of Report file and ethical practices followed. The course coordinator will conduct the presentation and viva voce examination in the slots assigned to them. The marks for Presentations and viva-voce examinations must be submitted at the end of the semester. The Course Coordinator/Internal/External Examiners will maintain and submit the bifurcation of marks obtained by the students in External evaluation, accordingly, in the Performa (attached herewith as Annexure II and III) to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office.			

Course outcomes

S. No.	**Course outcomes** At the end of the course students will be able to:	**RBT* Level**
CO1	Outline the potential for job opportunities.	**L2 (Understanding)**
CO2	Identify their skills and ability in a particular field	**L3 (Applying)**
CO3	Develop overall health and well-being, deemed for a job.	**L6 (Creating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1.	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**2**	**1**	**1**	**1**
CO2.	**1**	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**3**	**-**	**-**	**1**	**2**	**1**
CO3.	-	-	-	-	-	**3**	**2**	-	-	-	-	**2**	**1**	**2**	**1**
3 –High 2-Medium 1-Low															

Scheme of Examination & Detailed Syllabus of B.Tech (CE)

Departmental Elective Courses

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Program Elective-I

Course Code	Course Name	L	T	P/D	Credits
PE/CE/51-T	Highway Engineering	3	-	-	3.0
PE/CE/52-T	Highway Construction & Management	3	-	-	3.0
PE/CE/53-T	Highway and Traffic Engineering	3	-	-	3.0
PE/CE/54-T	Pavement Materials and Design	3	-	-	3.0

Program Elective-II

Course Code	Course Name	L	T	P/D	Credits
PE/CE/55-T	Geotechnology	3	-	-	3.0
PE/CE/56-T	Foundation Engineering	3	-	-	3.0
PE/CE/57-T	Geotechnical Design	3	-	-	3.0
PE/CE/58-T	Analysis and Design of Sub-Structures	3	-	-	3.0

Program Elective-III

Course Code	Course Name	L	T	P/D	Credits
PE/CE/61-T	Water Supply & Treatment	3	-	-	3.0
PE/CE/62-T	Environment Engineering	3	-	-	3.0
PE/CE/63-T	Environmental Impact Assessment and Life Cycle Analysis	3	-	-	3.0
PE/CE/64-T	Water and Air Quality Modelling	3	-	-	3.0

Program Elective-IV

Course Code	Course Name	L	T	P/D	Credits
PE/CE/65-T	Irrigation Engineering	3	-	-	3.0
PE/CE/66-T	Design of Hydraulic Structures	3	-	-	3.0
PE/CE/67-T	Urban Hydrology and Hydraulics	3	-	-	3.0
PE/CE/68-T	Groundwater Engineering	3	-	-	3.0

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Program Elective-V

Course Code	Course Name	L	T	P/D	Credits
PE/CE/71-T	Railway & Airport Engineering	3	-	-	3.0
PE/CE/72-T	Intelligent Transport System	3	-	-	3.0
PE/CE/73-T	Transportation Engineering	3	-	-	3.0
PE/CE/74-T	Airport Planning & Design	3	-	-	3.0

Program Elective-VI

Course Code	Course Name	L	T	P/D	Credits
PE/CE/75-T	Project Planning & Management	3	-	-	3.0
PE/CE/76-T	Construction Engineering & Management	3	-	-	3.0
PE/CE/77-T	Construction Planning, Scheduling and Control	3	-	-	3.0
PE/CE/78-T	Contract Laws and Regulations	3	-	-	3.0

Program Elective-VII

Course Code	Course Name	L	T	P/D	Credits
PE/CE/81-T	Sewerage & Sewage Treatment	3	-	-	3.0
PE/CE/82-T	Industrial Waste Water Treatment	3	-	-	3.0
PE/CE/83-T	Air and Noise Pollution Control Engg	3	-	-	3.0
PE/CE/84-T	Solid and Hazardous Waste Management	3	-	-	3.0

Program Elective-VIII

Course Code	Course Name	L	T	P/D	Credits
PE/CE/85-T	Concrete Technology	3	-	-	3.0
PE/CE/86-T	Geosynthetics Engineering	3	-	-	3.0
PE/CE/87-T	Bridge Engineering	3	-	-	3.0
PE/CE/88-T	Prestressed Concrete	3	-	-	3.0

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Program

Elective-I

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HIGHWAY ENGINEERING

Course code	**PE/CE/51-T**			
Category	**Program Elective**			
Course title	**Highway Engineering**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Explain the requirement of road network.	**L2(Understanding)**
CO2.	Identify the elements in road construction.	**L3(Applying)**
CO3.	Analyze the different road surveys for road network planning.	**L4(Analyzing)**
CO4.	Utilize the traffic control devices.	**L3(Applying)**
CO5.	Determine the material properties for road construction.	**L5(Evaluating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Introduction: Road transportation. Brief review of history of road development in India and abroad: Roman, Tresaguet, Telford and Macadam constructions. Road patterns. Classification of roads, Objectives of highway planning, Planning surveys. Saturation system of planning.

Highway Plans, Highway Alignment and Surveys: Main features of 20 years road development plans in India. Requirements of an ideal highway alignment. Factors affecting alignment. Surveys for highway alignment.

UNIT-II

Cross Section Elements and Sight Distance Considerations: Cross section elements: friction, carriageway, formation width, land width, camber, IRC recommended values. Types of terrain Design speed. Sight distance, stopping sight distance, overtaking sight distance, overtaking zones, intermediate sight distance, sight distance at intersections, head light sight distance, set back distance. Critical locations for sight distance.

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Design of Horizontal and Vertical Alignment: Effects of centrifugal force. Design of super-elevation. Providing super-elevation in the field. Radius of circular curves. Extra-widening. Type and length of transition curves. Gradient, types, values. Summit curves and valley curves, their design criterion. Grade compensation on curves.

UNIT-III

Traffic Characteristics and Traffic Surveys: Road user and vehicular characteristics. Traffic studies such as volume, speed and O & D study. Parking and accident studies. Fundamental diagram of traffic flow. Level of service. PCU Capacity for non-urban roads. Causes and preventive measures for road accidents.

Traffic Control Devices: Traffic control devices: signs, signals, markings and islands. Types of signs. Types of signals. Design of an isolated fixed time signal by IRC method. Intersections at grade and grade separated intersections. Design of a rotary. Types of grade separated intersections.

UNIT-IV

Highway Materials: Soil and Aggregates: Subgrade soil evaluation: CBR test, plate bearing test. Desirable properties of aggregates. Various tests, testing procedures and IRC/IS specification for suitability of aggregates. Proportioning of aggregates for road construction by trial and error method.

Bituminous Materials and Bituminous Mixes: Types of bituminous materials: bitumen, tar, cutback and emulsions. Various tests, testing procedures and IRS/IS specifications for suitability of bituminous materials in road construction. Bituminous mix, desirable properties. Marshall' method of mix design. Basic concept of use of polymers and rubber modified bitumen in bituminous mixes.

Books:

1. Highway Engg. By S. K. Khanna & C. E. G. Justo, Nem Chand & Bros, Roorkee.
2. Principles of Transportation and Highway Engg. By G.V.Rao, Tata McGraw Hill Pub., N.Delhi.
3. Traffic Engg. And Transport Planning by L. R. Kadiyali, Khanna Pub. Delhi.
4. Traffic Engg. by Matson, T.M., Smith, W.S. and Hurd, P.W. McGraw Hill Book Co., New York.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	2	1	2	1	1	1	-	-	-	-	-	1	1	1
CO2.	1	2	2	1	2	1	-	-	-	-	-	-	1	1	1
CO3.	1	2	1	3	1	2	-	-	-	-	-	-	2	1	1
CO4.	1	2	1	2	2	1	-	-	-	-	-	-	1	1	1
CO5.	1	2	2	2	1	1	-	-	-	-	-	-	1	1	1
3 –High 2-Medium 1-Low															

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HIGHWAY CONSTRUCTION & MANAGEMENT

Course code	**PE/CE/52-T**			
Category	**Program Elective**			
Course title	**Highway Construction & Management**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1	Understand the requirements and specifications of material required for road construction as per IRC/IS standards.	**L2(Understanding)**
CO2	Able to evaluate the pavement and can suggest methods for pavement maintenance as per the pavement type.	**L5(Evaluating)**
CO3	Analyze and understand the different road construction methods	**L4(Analyzing)**
CO4	Able to utilize the pavement management system for better results in construction and to fulfill future traffic needs.	**L3(Applying)**
CO5	Understand the construction procedure and equipments required in road construction.	**L2(Understanding)**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Highway Materials: Soil and Aggregates: Subgrade soil evaluation: MDD & OMC, CBR test, plate bearing test. Road aggregates - desirable properties and various tests, IRC/IS specification for suitability of aggregates. Proportioning of aggregates for road construction by trial-and-error method.

Bituminous Materials and Bituminous Mixes: Types of bituminous materials: bitumen, tar, cutback and emulsions. Various tests and IRS/IS specifications for suitability of bituminous materials in road construction. Bituminous mixes – requirements, design - Marshall method. Basic concept of use of polymers and rubber modified bitumen in bituminous mixes.

UNIT-II

Flexible Pavement Construction: Earthwork, compaction and compacting equipments, stabilization of soil - mechanical stabilization, cementing additives and chemicals, thermal stabilization, construction of embankments, different materials for subgrade, sub-base, base course and surface/ wearing course, material specification and construction procedure for earth roads, gravel roads, GSB, WBM & WMM road constructions. Bituminous constructions – types, specifications and construction procedure.

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UNIT-III

Cement Concrete Pavement Construction: Cement Concrete Pavement Layers: Specifications and method of cement concrete pavement construction; Construction of interlocking block pavements, construction steps, Construction of various types of joints, joint filler and sealer, construction of reinforced concrete pavements, introduction to prestressed concrete pavements.

Soil Stabilized Pavement Layers: soil-cement, soil-bitumen and soil-lime stabilization – principles, applications and construction.

UNIT-IV

Pavement Evaluation & Maintenance: Pavement evaluation methods, Functional condition evaluation of pavements- Roughness, Skid Resistance, Overlay – types and design, Benkelman Beam and Falling Weight Deflectometer. Pavement Maintenance and rehabilitation techniques – pavement failures (flexible & rigid) types, maintenance of WBM, bituminous surface and CC roads.

Pavement Management: Pavement Management Systems - Pavement Management Systems- Components, structure, data requirements, Project level and Network level needs. Pavement performance prediction – concepts, introduction to modelling techniques – CRRI and HDM models, Introduction to life cycle cost analysis.

Books:

1. Highway Engg. By S. K. Khanna & C. E. G. Justo, Nem Chand & Bros, Roorkee.
2. Principles of Transportation and Highway Engg. By G.V.Rao, Tata McGraw Hill Pub., N.Delhi.
3. Traffic Engg. And Transport Planning by L. R. Kadiyali, Khanna Pub. Delhi.
4. Traffic Engg. by Matson, T.M., Smith, W.S. and Hurd, P.W. McGraw Hill Book Co., New York.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	3	1	2	3	1	1	-	-	-	-	-	1	1	1
CO2.	1	3	2	2	2	1	1	-	-	-	-	-	1	1	1
CO3.	1	2	1	1	1	1	-	-	-	-	-	-	2	1	1
CO4.	1	3	2	2	2	2	1	-	-	-	-	-	1	1	1
CO5.	1	2	1	1	1	1	-	-	-	-	-	-	1	1	1
3 –High 2-Medium 1-Low															

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HIGHWAY AND TRAFFIC ENGINEERING

Course code	**PE/CE/53-T**			
Category	**Program Elective**			
Course title	**Highway and Traffic Engineering**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No.	**Course outcomes:** At the end of the course students will be able to:	**RBT* Level**
CO 1	Understand the requirement of road network.	**L2(Understanding)**
CO 2	Analysis and design of geometric features of the highway	**L6 (Creating)**
CO 3	Able to analyze the highway survey data and can utilize in highway planning for new road construction projects.	**L4(Analyzing)**
CO4	Understand the various traffic regulations and importance traffic control devices.	**L2(Understanding)**
CO5	Understand as to how to conduct the traffic surveys and analyze the data to be used in the transportation/ traffic planning and geometric design.	**L3(Applying)**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Introduction: Importance and role of transportation systems; different modes of transportation, historical development of road construction, brief history of road development in India; overview of various roads development programmes in the country and present status thereof, classification of roads according to different criteria.

Highway Planning, Alignment and Surveys: Road development plans, Various surveys for planning of the highway, highway alignment, basic requirements of an ideal alignment, factors governing the alignment, different types of surveys for locating highway.

UNIT-II

Highway Geometric Design: Factors governing the design of geometric features, cross-sectional elements, camber, sight distance, stopping sight and passing sight distances, passing zones. Design of horizontal alignment-super elevation. Extra widening on curves, transition curves. Design of vertical alignment, gradients, types of vertical curves and their design.

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UNIT-III

Traffic Engineering: Traffic characteristics, PIEV theory, gross weight and axle weight of different types of vehicles, power performance of vehicles.

Traffic Studies: Various traffic studies (volume, speed, O & D, flow characteristics, capacity, parking, & accident studies), objectives/ uses, methods of conducting these studies with pros and cons thereof, methods of analysis of data and interpretation of results, design capacity and level of service, Passenger Car Unit, factors affecting capacity PCU. Relation between speed, travel time, volume density and capacity.

UNIT-IV

Traffic Regulations and Control: Traffic regulations, Traffic control devices, Access control, basic requirements, Traffic signs, Traffic Signals- Types and design, types of traffic markings, traffic islands, Road Intersections, Classification of intersections, factors to be considered in the design of intersection, requirements of different types of intersections, various forms of intersections, rotary intersections, design of rotary. Highway Lighting, need for street lighting, illumination level, luminaire distribution of light, types of lamps, mounting height, spacing, lateral placement, lighting layout, design of highway lighting systems.

Books:

1. Highway Engg. By S. K. Khanna & C. E. G. Justo, Nem Chand & Bros, Roorkee.
2. Principles of Transportation and Highway Engg. By G.V.Rao, Tata McGraw Hill Pub., N.Delhi.
3. Traffic Engg. And Transport Planning by L. R. Kadiyali, Khanna Pub. Delhi.
4. Traffic Engg. by Matson, T.M., Smith, W.S. and Hurd, P.W. McGraw Hill Book Co., New York.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	1	1	1	1	1	1	-	-	-	-	-	1	1	2
CO2.	1	3	3	3	3	1	-	-	-	-	-	-	1	2	2
CO3.	1	2	1	2	2	1	1	-	-	-	-	-	1	1	2
CO4.	1	2	1	1	2	2	1	-	-	-	-	1	1	1	2
CO5.	1	2	1	2	3	2	1	-	1	-	-	1	1	1	2
3 –High 2-Medium 1-Low															

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PAVEMENT MATERIALS AND DESIGN

Course code	**PE/CE/54-T**			
Category	**Program Elective**			
Course title	**Pavement Materials and Design**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No.	**Course outcomes:** At the end of the course students will be able to:	**RBT* Level**
CO1	Explain the type and requirement of material used for road construction.	**L2(Understanding)**
CO2	Able to analysis various design elements required for pavement design.	**L4(Analyzing)**
CO3	Able to design flexible and rigid pavement as per IRC methods.	**L6 (Creating)**
CO4	Understand the various paving mix design methods.	**L2(Understanding)**
CO5	Able to conduct various type of tests on material required for different layers of pavement.	**L3(Applying)**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Pavement Materials: Soil - Subgrade soil evaluation, evaluation of soil strength, MDD & OMC, CBR test, plate bearing test. Aggregates - desirable properties and various tests, IRC/IS specification for suitability of aggregates. Bituminous Materials**:** Types of bituminous materials – bitumen, tar, cutback and emulsions, properties and tests for paving bitumen, IRS/IS specifications for suitability of bituminous materials in road construction.

UNIT-II

Paving Mix Design: Granular mix design, Proportioning of aggregates for road construction by trial-and-error method. Design of Bituminous Mix, Marshall method of bituminous mix design. Basic concept of use of polymers and rubber modified bitumen in bituminous mixes.

Polymer and Rubber Modified binders: Physical and chemical properties. Fly ash and its characterization. Performance based mix design Approaches. Visco elastic properties of bitumen and bituminous mixture.

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UNIT-III

Pavement Design Elements: Definition, Highway and Airport Pavement comparison, Wheel Loads, Tyre Pressure, Contact Pressure, ESWL, Design Factors, Type of distresses: structural and functional, Serviceability. Stresses in Flexible Pavements: Layered system concept, multilayered solutions, Burmister's method, Fundamental Design concepts.
Stresses in Rigid Pavements: Relative stiffness of slabs, Modulus of subgrade reaction, Stresses due to warping, stresses due to friction, effect of warping, contraction and expansion, plain versus reinforced pavements, stresses in dowel bar, tie bar, combined stresses.

UNIT-IV

Pavement Design: Design of Flexible Pavements: Design factors, Design wheel load, Equivalent single wheel load, Difference between Airport and Highway Design concept, Different design methods, Examples of comprehensive design process as per IRC.
Design of Rigid Pavement: General design considerations, Design of joints in cement concrete pavements, spacing of expansion joint, Spacing of contraction joints, Design of dowel bars and tie bars, IRC recommendations and design steps for design of Concrete pavements.

Books:
1. Highway Engg. By S. K. Khanna & C. E. G. Justo, Nem Chand & Bros, Roorkee.
2. Principles of Transportation and Highway Engg. By G.V.Rao, Tata McGraw Hill Pub., New Delhi.
3. Traffic Engg. And Transport Planning by L. R. Kadiyali, Khanna Pub. Delhi.
4. Traffic Engg. by Matson, T.M., Smith, W.S. and Hurd, P.W. McGraw Hill Book Co., New York.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	2	1	1	1	1	1	-	-	-	-	-	1	1	2
CO2.	1	3	2	1	2	1	-	-	-	-	-	-	1	2	2
CO3.	1	3	3	2	3	2	-	-	-	-	-	-	1	1	2
CO4.	1	3	3	3	2	1	-	-	-	-	-	-	1	1	2
CO5.	1	2	2	2	2	1	-	-	-	-	-	-	1	1	2
3 –High 2-Medium 1-Low															

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Program

Elective-II

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GEOTECHNOLOGY

Course code	**PE/CE/55-T**			
Category	**Program Elective Course**			
Course title	**Geotechnology**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1	Identify and classify the soil based on standard Geotechnical Engg. practice.	**L3(Applying)**
CO2	Determine the soil properties like allowable bearing pressures and load carrying capacity.	**L5(Evaluating)**
CO3	Analyze and implement a site investigation program.	**L4(Analyzing)**
CO4	Understand and design the shallow and deep foundations.	**L6(Creating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Sub-Surface Exploration: Purpose, stages in soil exploration, depth and lateral extent of exploration, guidelines for various types of structures, ground water observations, excavation and boring methods, soil sampling and disturbance, major types of samplers, sounding methods-SCPT, DCPT, SPT and interpretation, geophysical methods, pressure-meter test, exploration logs.

Drainage & Dewatering: Introduction, ditches and sumps, well point systems, shallow well system, deep well drainage, vacuum method, Electro-osmosis, consolidation by sand piles.

UNIT-II

Shallow Foundations-I: Design criteria for structural safety of foundation (i) location of footing, (ii) shear failure criterion, (iii) settlement criterion. Ultimate bearing capacity, modes of shear failure, Rankine's analysis. Tergazi's theory. Skempton's formula. Effect of fluctuation of G.W.T. Effect of eccentricity on bearing capacity, inclined load, I.S Code recommendations. Factors affecting bearing capacity, methods of improving bearing capacity.

Shallow Foundations-II: Various causes of settlement of foundation, allowable bearing pressure based on settlement, settlement calculation, elastic and consolidation settlement, allowable settlement according to I.S.Code. Plate load test and its interpretation, bearing capacity from penetration tests, design bearing capacity.

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Shallow Foundations-III: Situation suitable for the shallow foundations, types of shallow foundations and their relative merits, depth of foundation, footing on slopes, uplift of footings, conventional procedure of proportioning of footings, combined footings, raft foundations, bearing capacity of raft in sands and clays, various methods of designing rafts, floating foundations.

UNIT-III

Pile Foundations-I : Introduction, necessity of pile foundations, classification of piles, load capacity, static analysis, analysis of pile capacity in sands and clays, dynamic analysis, pile load tests, negative skin friction, batter piles, lateral load capacity, uplift capacity of single pile, under-reamed pile.

Pile Foundations-II : Group action in piles, pile spacing, pile group capacity, stress on lower strata, settlement analysis, design of pile caps, negative skin friction of pile group, uplift resistance of pile group, lateral resistance, batter pile group.

UNIT-IV

Drilled Piers and Caisson Foundations: Drilled piers-types, uses, bearing capacity, settlement, construction procedure. Caissons-Types, bearing capacity and settlement, construction procedure. Well foundations-shapes, depth of well foundations, components, factors affecting well foundation design lateral stability, construction procedure, sinking of wells, rectification of tilts and shifts, recommended values of tilts & shifts as per I.S.3955.

Books Recommended

1 Basic and Applied Soil Mechanics by GopalRanjan& ASR Rao. New Age Int.(P)Ltd..
2 Analysis and Design of Sub-Structures by Swamisaran, IBH & Oxford.
3 Principles of Foundation EngineringByB.M.das, PWS Kent, Boston.
4 Foundation Analysis & Design by J.E.Bowles, McGraw Hills.
5 Design Aids in Soil Mechanics & Foundation Engineering by S.R.Kaniraj, McGraw Hills.
6 Foundation Design by Teng, Prentice Hall, India.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	2	1	1	1	1	-	-	-	-	-	-	1	1	2
CO2.	1	2	2	2	1	1	-	-	-	-	-	-	1	1	2
CO3.	1	3	2	3	1	2	-	-	-	-	-	-	1	1	2
CO4.	1	2	3	2	1	1	-	-	-	-	-	-	1	1	2
3 –High 2-Medium 1-Low															

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FOUNDATION ENGINEERING

Course code	**PE/CE/56-T**			
Category	**Program Elective Course**			
Course title	**Foundation Engineering**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes

S.No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1	Describe and discuss the concepts of foundation engineering	L2 (Understanding)
CO2	Employ various methods of soil exploration for foundation engineering	L3 (Applying)
CO3	Analyze and determine earth pressure behind a retaining structure- for various soil and loading conditions.	L4 (Analyzing)
CO4	Evaluate the use of soil stabilization and geo-textiles in foundation engineering	L5 (Evaluating)
CO5	Develop and design various types of foundations for civil engineering works	L6 (Creating)

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT I

Introduction to soil exploration: Scope- Methods of soil exploration- spacing- significant depth-boring and sampling techniques- types of samples- sample disturbances- penetration tests (Standard Cone Penetration Test and Standard Penetration Test)- and Geophysical methods (Seismic Refraction Method & Electrical Resistivity Method).

Earth Pressure: Earth Pressures at rest condition- states of plastic equilibrium- Rankine's theory for active and passive conditions- Influence of surcharge- water table- wall friction- Numerical Problems for the determination of Active and Passive Earth Pressure diagrams- Critical height of an Unsupported Vertical Cut.

UNIT II

Stability of Slopes: Infinite slopes- Critical Depth of a cohesive Infinite Slope- types of failure- Swedish Slip Circle Method- Taylor's stability Number and Stability Curves- Concept of factors of safety- Bishop's Method of slices- Effect of sudden draw down and submergence.

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Design of Shallow Foundation: Bearing Capacity- Definitions- depth of foundation- Terzaghi's general bearing capacity equation- JS code equation- factors affecting bearing capacity- Influence of eccentric and inclined loads. Bearing capacity by penetration tests - Plate load test. Design Criteria for Shallow Foundations- Stability- Shear- and Settlement Failures

UNIT III

Pile Foundations: Types- function- selection of piles- pile driving formulae- point- bearing and friction piles. Load carrying capacity of single pile- group action- spacing of piles- Negative skin friction- Concept of under reamed piles.

Caissons and Wells: Introduction-components- shapes- stability of well foundation- sinking of we11- tilts and shifts.

UNIT IV

Drainage and Dewatering of Soil: Methods of Ditches and Sump- Well Point System- Shallow Well System- Deep Well Drainage- Vacuum Method- Electro Osmosis Method- Seepage Analysis for various conditions of Ful1y penetrating slot and partially penetrating slot- Protective Filters.

Soil stabilization and Geo-textiles: Need and advantages of Ground Improvement techniques- Stabilization. Mechanical- Lime- Cement- bitumen- Chemical Stabilization of Soils and its advantages.

Geo-textiles: Concept- Types- Functions- Use of Geo-textiles in Earth Dam Construction- Road Works- Railway works- Erosion Control and in Bearing capacity Improvement.

REFERENCE BOOKS:-

1. Foundation Analysis and Design- by J.E. Bowles McGraw Hill Book Company- NewYork.
2. Foundation Engineering by Peck- Wiley Eastern India Limited- New Delhi.
3. Soil Dynamics and Machine Foundations by Swami Saran- Galgotia Publishers- New Delhi
4. Basic and Applied Soil Mechanics- by Gopal Ranjan Rao- ASR Rao- New Age Int. (P) Ltd. Pub.- New Delhi.
5. A Text Book of Soil Mechanics Foundation Engg. by VNS Murthy- U.B.S- New Delhi.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	2	2	1	2	2	-	-	-	-	-	-	-	1	1	1
CO2.	2	2	1	2	1	-	-	-	-	-	-	-	1	2	1
CO3.	2	2	2	2	1	-	-	-	-	-	-	-	1	1	1
CO4.	2	2	3	3	1	-	-	-	-	-	-	-	1	1	1
CO5.	2	2	3	3	1	-	-	-	-	-	-	-	1	1	1
3 –High 2-Medium 1-Low															

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GEOTECHNICAL DESIGN

Course code	**PE/CE/57-T**			
Category	**Program Elective**			
Course title	**Geotechnical Design**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course Outcomes:

S. No.	**Course outcomes:** At the end of the course students will be able to:	**RBT* Level**
CO l	Understood the various design methods required for foundation design on slopes.	**L2(Understanding)**
CO2	Design the piles subjected to lateral and uplift loads	**L6(Creating)**
CO3	Analyze and design drilled piers and well foundations	**L4(Analyzing)**
CO4	Evaluate the design methods for sheet piles and coffer dams	**L5(Evaluating)**
C05	Understanding the foundation design procedure on expansive soils	**L2(Understanding)**

***Revised Bloom's Taxonomy Action verbs/ levels**

UNIT-I

Shallow Foundations: Introduction, bearing capacity of footings, Skempton's bearing capacity factor, footings on layered soils, footings with eccentricity, allowable bearing pressure, raft foundations floating raft, uplift capacity of footing.

Pile Foundations: Introduction, bearing capacity of piles, vertical piles subjected to lateral loads, proportioning and design of pile foundations, lateral load capacity of single pile, batter piles under lateral load, uplift capacity of piles ultimate lateral load resistance of a pile group.

UNIT-II

Drilled Piers: Introduction, current construction methods, use of Drilled Piers, analysis and design of drilled piers, settlements of drilled piers, structural design of drilled piers, laterally loaded drilled pier analysis.

Bridge Sub Structures: Definitions, elements of substructures, maximum depth of scour, depth of foundation allowable bearing pressure, loads to be considered, lateral stability, design of pier cap & pier, sinking stresses in wells, design of well cap, well staining, well curb, cutting edge, bottom plug.

UNIT-III

Sheet Piles and Coffer Dams: Types of sheet piles structures, design of cantilever sheet pile wall, design of anchored bulkheads, anchorage methods design of braced sheeting in cuts, Design of cellular coffer dams, Calculation of allowable bearing pressure, Conditions for stability of a well. Terzaghi's analysis for Lateral stability of a well, embedded in sand, Forces acting on a well foundation, Computation of scour depth, Tilts & Shifts.

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UNIT-IV

Foundation in Expansive Soils: Introduction, Material structure, identification of expansive soils, Indian expansive soils, swell potential and swelling pressure, traditional Indian practice, methods of foundations in expansive soils, replacement of soils and CNS concept, under reamed pile foundations, remedial measures for cracked buildings.

Books:

1. Analysis and Design of Substructures: Limit State Design by Swami Saran, oxford &IBH Publishing Co. Pvt. Ltd.
2. Ranjan G. and Rao A.S.R., 2000, Basic and Applied Soil Mechanics, New Age International Pvt. Ltd., Publishers, New Delhi.
3. Murthy V.N.S., 2001, Principles of Soil Mechanics and Foundation Engineering, UBSPD.
4. Das, B.M. 2004, Principles of Foundation Engineering, Cengage Pulishers.
5. Couduto, D.P., 2002, Geotechnical Engineering – Principles and Practices", Prentice Hall of India.
6. Peck R. B., Hanson W. B. and Thornburn T. H., 1974, Foundation Engineering. John Wiley and Sons Inc., New York.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	3	2	2	1	1	1	-	-	-	-	-	1	1	1
CO2.	1	3	3	2	2	1	-	-	-	-	-	-	1	2	1
CO3.	1	3	3	2	2	-	-	-	-	-	-	-	1	1	1
CO4.	1	3	3	2	2	-	-	-	-	-	-	-	1	1	1
CO5.	1	2	2	1	1	-	-	-	-	-	-	-	1	1	1
3 –High 2-Medium 1-Low															

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ANALYSIS AND DESIGN OF SUB-STRUCTURES

Course code	**PE/CE/58-T**			
Category	**Program Elective**			
Course title	**Analysis and Design of Sub-structures**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course Outcomes:

S. No.	**Course outcomes:** At the end of the course students will be able to:	**RBT* Level**
COl	Knowledge of different tests for soil exploration.	**L2(Understanding)**
CO2	To get familiar general design principles of foundation design with reference to IS codes.	**L6(Creating)**
CO3	Able to analyze and understand the design elements of bridge sub-structure components.	**L4(Analyzing)**
CO4	Able to analyze and design of Marine sub-structure components.	**L6(Creating)**
CO5	Understating the behavior of foundations in expensive soils.	**L2(Understanding)**

***Revised Bloom's Taxonomy Action verbs/ levels**

Unit-I

Introduction to soil exploration: Scope- Methods of soil exploration- spacing- significant depth-boring and sampling techniques- types of samples- sample disturbances- penetration tests (Standard Cone Penetration Test and Standard Penetration Test)- and Geophysical methods (Seismic Refraction Method & Electrical Resistivity Method).

Lateral Earth pressure: introduction, Earth pressure at rest, Rankine's active & passive states of plastic equilibrium, Rankine's earth pressure theory, Coulomb's earth pressure theory, Culmann's graphical construction, Dynamic Earth pressure, Dynamic Earth pressure for c-φ Soils.

Unit-II

Shallow Foundations: Introduction, bearing capacity of footings, Skemptons bearing capacity factor, footings on layered soils, footings with eccentricity, allowable bearing pressure, raft foundations floating raft, uplift capacity of footing.

Pile Foundations: Introduction, bearing capacity of piles, vertical piles subjected to lateral loads, proportioning and design of pile foundations, lateral load capacity of single pile, batter piles under lateral load, uplift capacity of piles ultimate lateral load resistance of a pile group.

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Unit-III

Bridge Sub Structures: Definitions, elements of substructures, maximum depth of scour, depth of foundation allowable bearing pressure, loads to be considered, lateral stability, design of pier cap & pier, sinking stresses in wells, design of well cap, well staining, well curb, cutting edge, bottom plug.

Unit-IV

Marine Sub Structures : Introduction , types of marine structures; Breakwaters, Wharves, Piers, Sea walls, Docks, Quay walls, Locks, Moorings, design loads, Combined loads, wave action, wave pressure on vertical wall, Ship impact on piled wharf structure, Design of Break water, design of Rubble-Mound Breakwaters, Design of wall type Break water, Design of Gravity wall and Anchored Bulk head wharf Structures.

Foundation in Expansive Soils: Introduction, Material structure, identification of expansive soils, Indian expansive soils, swell potential and swelling pressure, traditional Indian practice, methods of foundations in expansive soils, replacement of soils and "CNS" concept. Under reamed pile foundations, Remedial measures for cracked buildings.

Books:

1. Analysis and Design of Substructures: Limit State Design by Swami Saran, oxford &IBH Publishing Co. Pvt. Ltd.
2. Ranjan, G. and Rao A.S.R., 2000, Basic and Applied Soil Mechanics. New Age International Pvt. Ltd., Publishers, New Delhi.
3. Murthy V N S., 2001, Principles of Soil Mechanics and Foundation Engineering. UBSPD.
4. Bowles J. E., 1988, Foundation Analysis and Design. McGraw Hill, New York.
5. Das, B.M. 2004, Principles of Foundation Engineering, Cengage Pulishers.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	1	1	2	2	1	1	-	-	-	-	-	1	1	2
CO2.	1	1	2	2	2	1	-	-	-	-	-	-	1	2	2
CO3.	1	1	3	3	2	-	-	-	-	-	-	-	1	1	2
CO4.	1	1	3	2	2	-	-	-	-	-	-	-	1	1	2
CO5.	1	2	2	1	1	1	-	-	-	-	-	-	1	1	2
3 –High 2-Medium 1-Low															

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Program

Elective-III

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WATER SUPPLY & TREATMENT

Course code	**PE/CE/61-T**			
Category	**Program Elective Course**			
Course title	**Water Supply & Treatment**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Estimate the quantity of water requirement.	**L5(Evaluating)**
CO2.	Select the source of water supply.	**L3(Applying)**
CO3.	Compare the water quality with the available standards.	**L4(Analyzing)**
CO4.	Select the type of treatment to be provided to water for the type of suitability.	**L3(Applying)**
CO5.	Select the type of distribution system to be adopted as per the requirement.	**L3(Applying)**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Water Quantity:

Importance and necessity of water supply scheme. Water demands and its variations. Estimation of total quantity of water requirement. Population forecasting. Quality and quantity of surface and ground water sources. Selection of a source of water supply. Types of intakes.

UNIT-II

Water Quality:

Impurities in water and their sanitary significance. Physical, chemical and bacteriological analysis of water. Water quality standards.

UNIT-III

Water Treatment:

Objectives, treatment processes and their sequence in conventional treatment plant, sedimentation – plain and aided with coagulation. Types, features and design aspects. Mixing basins and Flocculation units. Filtration – mechanism involved, types of filters, slow and rapid sand filtration units (features and design aspects). Disinfection principles and aeration.

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UNIT-IV

Water Distribution:

Distribution system – Gravity system, Pumping System, Dual system, Layout of Distribution System – Dead End System, Grid Iron System, Ring System, Radial System, their merits and demerits. Distribution Reservoir-functions & determination of storage capacity.

Books:

1. Water Supply Engineering: Subhash Verma, Varinder Kanwar, Siby John, Vikas Publishers, New Delhi.
2. Water Supply and Sanitary Engineering: S.C. Rangwala, Charotra Publishers, New Delhi.
3. Water Supply Engineering: S.K. Garg, Khanna Publishers, New Delhi.
4. Water Supply Engineering: B.C. Punmia, Laxmi Publications Pvt Limited, New Delhi.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1.	**1**	**3**	**2**	**3**	**1**	**2**	**1**	-	-	-	-	-	**1**	**1**	**2**
CO2.	**2**	**2**	**2**	**3**	**1**	**2**	**1**	-	-	-	-	-	**1**	**1**	**2**
CO3.	**2**	**3**	**2**	**2**	**1**	**2**	**1**	-	-	-	-	-	**1**	**1**	**2**
CO4.	**1**	**2**	**2**	**2**	**1**	**2**	**1**	-	-	-	-	-	**1**	**1**	**2**
CO5.	**1**	**2**	**2**	**2**	**1**	**2**	**1**	-	-	-	-	-	**1**	**1**	**2**
3 –High 2-Medium 1-Low															

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ENVIRONMENT ENGINEERING

Course code	**PE/CE/62-T**			
Category	**Program Elective Course**			
Course title	**Environment Engineering**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course Outcome

Sr. No	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Identify and describe various elements of water supply, sewerage and air & noise pollution.	**L1 (Remembering)**
CO2.	Differentiate between various types of pollutants with their sources, effects on environment and quantifications	**L2 (Understanding)**
CO3.	Analyze the effects of different kinds of pollution and outline their respective measures for treatment.	**L4(Analyzing)**
CO4.	Design and compare sewerage systems and storm water drains.	**L6(Creating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

Course Content

UNIT I

Water: Water Supply systems: Need for planned water supply schemes, Sources of Water, Water demand and Potable, industrial and agricultural water requirements, Components of water supply system; Transmission of water, Distribution system, Various valves used in W/S systems, service reservoirs and design.

UNIT II

Sewage: Domestic and Storm water, Quantity of Sewage, Sewage flow variations. Conveyance of sewage: Sewers, shapes design parameters, operation and maintenance of sewers, Sewage pumping; Sewerage, Sewer appurtenances, Design of sewerage systems.

Storm Water: Quantification and design of Storm water; Sewage and Sludge, Pollution due to improper disposal of sewage, National River cleaning plans, recycling of sewage -quality requirements for various purposes.

UNIT III

Air: Composition and properties of air, Quantification of air pollutants, Monitoring of air pollutants, Air pollution - Occupational hazards, Urban air pollution: automobile pollution, Chemistry of combustion, Automobile engines, quality of fuel, operating conditions and

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interrelationship. Air quality standards, Control measures for Air pollution, construction and limitations

UNIT IV

Noise: Basic concept, measurement, effects and various control methods.

Case studies on Pollution (Air, Water, Noise)

REFERENCE BOOKS:

1. Environmental Engineering, Vol. I, S.K Garg , Khanna Publishers, New-Delhi.
2. Environmental Pollution Control Engineering, C. S. Rao
3. Environmental Engineering by H.S.Peavy, D.R.Rowe, G.Tchobanoglous: 1991, Tata-Mcgraw Hill
4. Manual on Water Supply and Treatment, (latest Ed.), Ministry of Works & Housing,New Delhi.
5. Integrated Solid Waste Management. Tchobanoglous, Theissen & Vigil. McGraw Hill Publication

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	2	1	2	-	1	3	1	-	-	-	1	1	1	2
CO2.	1	2	1	2	-	2	3	1	-	-	-	1	1	1	2
CO3.	2	3	2	1	1	1	3	1	1	2	-	1	1	1	2
CO4.	3	2	3	1	2	-	2	1	3	2	2	1	1	1	2
3 –High 2-Medium 1-Low															

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ENVIRONMENTAL IMPACT ASSESSMENT AND LIFE CYCLE ANALYSIS

Course code	**PE/CE/63-T**			
Category	**Program Elective Course**			
Course title	**Environmental Impact Assessment and Life Cycle Analysis**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course Outcome

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1	Be aware of the environmental legislations- policies of the country and of international environmental conventions and protocols	**L1(Remembering)**
CO2	Identify the environmental attributes to be considered for the EIA study	**L2(Understanding)**
CO3	Illustrate objectives of the EIA studies	**L3(Applying)**
CO4	Evaluate the methodology to prepare rapid EIA	**L5(Evaluating)**
CO5	Formulate the methodology Environmental Auditing	**L6(Creating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

Course Content

UNIT-I

Basic Concepts of Environmental Impact Assessment: Description of the project and the environmental setting- identification of impacts- measurement and monitoring- prediction and assessment of impacts and communication ofimpacts.

UNIT – II

Environmental Impact Assessment Methodologies: Checklists- matrices- networks and overlays Prediction and Assessment of Impact on the physical environment- on the resources- and on the socio-economic- Environmental cost benefit analysis Sustainable development. Life Cycle Assessment -Environmental Risk Analysis- Definition of Risk

UNIT – III

Environmental auditing: Definition and types of audits- EMS audits- performance audits; compliance audits- registration audits ISO 14000 series of standards and environmental auditing- Methodologies for Environmental Auditing: Objectives- audit teams- planning audits- conducting

audits- reporting audit findings.

UNIT – IV

EIA related to the following sectors - Infrastructure –construction and housing Mining – Industrial - Thermal Power

- River valley and Hydroelectric Acts: Water act- Water Cess act- Air act- Environment Protection act and their amendments- Wildlife act and Forest acts. Case Studies on EIA

Reference Books:

1. Environmental Impact Analysis by R.K. Jail and L.V. Urban.
2. Environmental Impact Assessment by Canter.
3. Environmental Impact Assessment by J. Glasson

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	2	-	-	-	-	1	1	-	1	2	1	1	1	2
CO2.	-	2	-	-	-	2	1	1	-	-	2	1	1	1	2
CO3.	1	2	-	-	-	1	1	-	-	-	-	1	1	1	2
CO4.	1	2	1	2	-	-	-	-	1	--	2	1	1	1	2
CO5.	1	2	1	2	-	-	-	-	1	-	2	1	1	1	2
3 –High 2-Medium 1-Low															

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WATER AND AIR QUALITY MODELLING

Course code	**PE/CE/64-T**			
Category	**Program Elective Course**			
Course title	**Water and Air Quality Modelling**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**0**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course Outcome

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1	Define different mathematical models for air and water quality	**L1(Remembering)**
CO2	Recognize the risks of disposal of treated wastewater into the river	**L2(Understanding)**
CO3	Predict the quality of water and air through modeling	**L4(Analzing)**
CO4	Evaluate the physical- chemical and biological water quality which isessential for the abatement of water pollution	**L5(Evaluating)**
CO5	Design sound and sustainable water and air models under specified conditions	**L6(Creating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

Course Content

UNIT – I

Water and air quality management- Introduction to Mathematical Models: kinds of mathematical models – model development- Model requirements and limitations- validation effluent and stream standards; ambient air quality standards.

UNIT – II

Water quality model development- D.O. Models for Streams: Dissolved oxygen model for streams sources and sinksof dissolved oxygen estimation of system parameters Streeter Phelps model - oxygen 'sag' curve-determination of deoxygenation and re-aeration coefficients- Benthal oxygen demand mass transport mechanisms

UNIT – III

Models for Estuary and Lakes: Assumptions- Benefits- Limitations- Physical- chemical and biological

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processes in estuaries and lakes;

Mass transport of solutes- degradation of organic compounds- application of concepts to predict groundwater contaminant movement- seawater intrusion – basic concepts and modeling

UNIT – IV

Air quality models: Micrometeorological processes- wind rose- dispersion- coefficients and stability classes- Gaussian and dispersion model- Stack height computation- Regional air quality models- Source inventories and significance. Air pollution modeling and prediction – Plume rise modeling techniques- modeling for non-reactive pollutants- single source – short term impact- multiple sources and area sources- model performance and utilisation- computer models.

References Books

1. Environmental Engineering Peavy- Rowe and Tchobanglous- McGraw Hill.
2. Water Supply Engineering P.N. Modi- Standard Book House New-Delhi.
3. Environmental Engg.: by Howard S. Peavy & Others- MGH International.
4. Metacaf – EDDY – Waste-water engineering revised by George Teholonobus (TMH)
5. Manual on Water Supply and Treatment by Ministry of Urban Development- New Delhi.
6. Water Supply and Sewerage- McGhee- McGraw Hill.
7. Environmental Engineering- Vol. I- S.K. Garg- Khanna Publishers- New-Delhi.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	2	-	-	1	-	-	-	-	-	-	1	1	1	2
CO2.	1	2	-	-	-	2	2	2	-	-	-	1	1	1	2
CO3.	-	3	-	1	2	1	3	1	-	-	2	1	1	1	2
CO4.	1	3	1	2	-	1	-	-	2	1	2	2	1	1	2
CO5.	1	1	3	2	2	1	1	-	1	-	1	1	1	1	2
3 –High 2-Medium 1-Low															

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Program

Elective-IV

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IRRIGATION ENGINEERING

Course code	**PE/CE/65-T**			
Category	**Program Elective**			
Course title	**Irrigation Engineering**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Explain the necessity of irrigation.	**L2(Understanding)**
CO2.	Outline the soil properties pertaining to irrigation.	**L2(Understanding)**
CO3.	Analyze the alignment of canals.	**L4(Analyzing)**
CO4.	Propose the solution for the soil affected from water logging and requirement of lining of canals.	**L6(Creating)**
CO5.	Explain the requirement of canal outlets and river training works.	**L2(Understanding)**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Introduction: Irrigation-necessity, advantages, disadvantages, impact of irrigation on human environment , need and development of irrigation in India, crops and crop seasons, ideal cropping pattern and high yielding varieties of crops.

Soil-water relationship and irrigation methods: Soil-water relationship, root zone soil water, infiltration, consumptive use, field capacity, wilting point, available moisture in soil, GCA, CCA, intensity of irrigation, delta, base period, Kor depth, core period, frequency of irrigation, duty of water, relation between delta, duty and base period, irrigation requirement, flooding methods, border strip method, check basin and furrow method, assessment of irrigation water, sprinkler irrigation, favorable conditions, sprinkler systems, hydraulics of sprinkler irrigation, planning, design and maintenance of sprinkler systems, drip irrigation-components parts, advantages and limitations, suitability of drip irrigation.

UNIT-II

Canal irrigation: Component of canal distribution system, alignment of channels, losses in irrigation channels, design discharge, silt theories and design of alluvial channels, comparison of Kennedy's and Lacey's theories, canal section and design procedure, Garrets and Lacey's diagrams.

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UNIT-III

Water logging and land reclamation: Water logging-effects, causes and measures of prevention, lining of irrigation channels, types of lining, design of lined channel land drainage, open drains, design considerations, advantages of tile drains, depth of tile drains, layout of closed drains, discharge and spacing of closed drains, diameter of tile drain, outlets for tile drains, maintenance of tile drains, purpose of land reclamation and methods of land reclamation.

UNIT-IV

River Training: Classification of rivers, river training and its objectives, classification of river training works, methods of river training, marginal embankments, guide-banks, spurs, cutoffs, bank pitching and launching apron.

Canal outlets: Classification, requirements of a good outlet, design of pipe, APM and open flume outlet, flexibility proportionality, setting and sensitivity of outlet.

Books:

1 Irrigation, Water Resources and Water Power Engg. By P. N. Modi.
2 Fundamentals on Irrigation Engg. by Bharat Singh.
3 Irrigation Engg & Hydraulic Structures by S. K. Garg, Khanna Publihers, New Delhi
4 Irrigation Engg. By S. K. Sharma, S. Chand Publishers, New Delhi.
5 Irrigation -Theory & Practice by G.L. Asawa

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1.	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**
CO2.	**3**	**2**	**3**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**
CO3.	**3**	**3**	**3**	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**
CO4.	**3**	**3**	**3**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**
CO5.	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**
3 –High 2-Medium 1-Low															

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DESIGN OF HYDRAULIC STRUCTURES

Course code	**PE/CE/66-T**			
Category	**Program Elective**			
Course title	**Design of Hydraulic Structures**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course Outcomes:

S. No.	**Course outcomes:** At the end of the course students will be able to:	RBT* Level
CO1	Explain concepts and designs of hydraulic structures and water distribution systems for irrigation.	**L2(Understanding)**
CO2	Design of cross drainage works and diversion head works	**L6(Creating)**
CO3	Analyzing alignments for construction of water distribution system and construction of hydraulic structures for them.	**L4(Analyzing)**
CO4	Evaluate the water losses in canal & systems	**L5(Evaluating)**
CO5	To know about energy dissipation devices and their applications	**L2(Understanding)**

*Revised Bloom's Taxonomy Action verbs/ levels

UNIT-I

Regulation works: Canal falls-necessity and location, development of falls, design of cistern element, roughening devices, design of Sarda type fall, and design of straight Glacis fall. Off-take alignment, cross-regulator and distributory, head regulators, devices to control silt entry into the off-taking channel and silt ejector, canal escapes, types of escapes.

UNIT-II

Cross drainage works: Classification and their selection, hydraulic design aspects of aqueducts, syphon aqueducts, super passage, canal syphon and level crossing, design of transitions.
Diversion canal Headworks: Various components and their functions, layout plan, selection of site for diversion headworks, Bligh's creep theory, Khosla's method of independent variables, use of Khosla's curves, various corrections, silt excluders.

UNIT-III

Storage Headworks: Types of dams, selection of a site, gravity dam-two dimensional design, forces acting, stability criterion, elementary profile of a dam, cutoffs and drainage galleries, arch dams-constant angle and constant radius arch dam, simple design and sketchs, most economical angle,

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Earth dam, design principles, seepage through earth dams, seepage line, control of seepage, design of filters.

UNIT-IV

Spillways and Energy Dissipaters: Essential requirements of spillway and spillway's capacity, types of spillways and their suitability, Ogee spillways, chute, side channel, shaft and syphon spillways, energy dissipation below spillways, stilling basins, USBR and I.S. Stilling Basins.

Books:

1. Irrigation, Water Resources and Water Power Engineering by P.N.Modi.
2. Fundamentals on Irrigation Engineering by Bharat Singh.
3. Irrigation Engineering and Hydraulic Structures by S.K.Garg.
4. Theory and Design of Irrigation Structures Vol.I & II by R.S.Varshney, Gupta & Gupta.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	2	2	2	1	1	-	-	-	-	-	-	1	1	2
CO2.	1	3	3	2	1	-	-	-	-	-	-	-	1	1	2
CO3.	1	2	2	2	1	-	-	-	-	-	-	-	1	1	2
CO4.	1	3	3	2	2	-	-	-	-	-	-	-	1	1	2
CO5.	1	2	3	3	2	-	-	-	-	-	-	-	1	1	2
3 –High 2-Medium 1-Low															

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URBAN HYDROLOGY AND HYDRAULICS

Course code	**PE/CE/67-T**			
Category	**Program Elective**			
Course title	**Urban Hydrology and Hydraulics**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course Outcomes:

S. No.	**Course outcomes:** At the end of the course students will be able to:	**RBT* Level**
COl	Understand and explain the effects of urbanization on rainfall and runoff.	**L2(Understanding)**
CO2	Identify factors affecting urban hydrological cycle	**L3(Applying)**
CO3	Design various urban drainage system elements.	**L6(Creating)**
CO4	Develop integrated urban water management system.	**L3(Applying)**
CO5	Prepare master drainage plan for an urbanized area.	**L6(Creating)**

***Revised Bloom's Taxonomy Action verbs/ levels**

UNIT- I

Urbanization: Process of urbanization, Trends of urbanization and industrialization, influence on hydrologic cycle, effects and consequences for drainage.
Urban water Management: Rain water harvesting, managed aquifer recharge, effect of water management practices on urban water infrastructure, hydrology and ground water regime, mapping of water supply and sewage networks.

Unit-II

Urban water Infrastructure: Urban water supply: Estimate of demand, sources in surface and groundwater, Reservoir, capacity estimation, sanitation, sewerage and wastewater conveyance infrastructures, Water supply and sewerage network hydraulics, Structural safety and mitigating plans against natural and human caused threats.

Unit-III

Urban Storm water: Master drainage plans, Estimation of urban storm water quantity, Wastewater collection systems, Design of storm sewer network systems, Storage facilities. Interaction between urban drainage and solid waste management, Storm water Management, Operation and maintenance of urban drainage system.

Unit IV

Sustainable Design: Sustainable urban designs, Methodologies for assessing sustainability of urban water infrastructures, Emerging sustainable materials and design procedures for water supply and sewerage pipelines, determination of design flow; runoff for highways, airports, and urban areas; design of drainage gutters, channels, sewer networks, and culverts.

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Books:

1. Chow V T, Handbook of Applied Hydrology: A Compendium of Water resources technology, McGraw Hill, New York.
2. Gupta R S, Hydrology and Hydraulic Systems, Prentice Hall Publishers, New Jersey.
3. Geiger, W.F., Marsalek, J. Zudima and Rawls, G.J, "Manual on Drainage in Urban Areas", 2 Volumes, UNESCO, Paris.
4. Wanielista, M.P., and Yousef, Y.A., "Storm water Management" John Wiley and Sons, Inc., New York.
5. Hall, M.J., "Urban Hydrology", Elsevier Applied Science Publishers.
6. Mays, L.W., Hydraulic Design Handbook, McGraw-Hill.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1.	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**
CO2.	**1**	**2**	**1**	**2**	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**
CO3.	**1**	**3**	**3**	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**
CO4.	**1**	**3**	**3**	**2**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**
CO5.	**1**	**3**	**3**	**2**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**
3 –High 2-Medium 1-Low															

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GROUNDWATER ENGINEERING

Course code	**PE/CE/68-T**			
Category	**Program Elective Course**			
Course title	**Groundwater Engineering**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Understand aquifer properties and its dynamics.	**L2(Understanding)**
CO2.	Identify design and practical problems.	**L4(Analyzing)**
CO3.	Develop a model for groundwater management.	**L4(Analyzing)**
CO4.	Understand the importance of artificial recharge and groundwater quality concepts.	**L2(Understanding)**
CO5.	Examine conservation of groundwater.	**L4(Analyzing)**

***Revised Bloom's Taxonomy Action verbs/Levels**

Unit-I

Hydrogeological Parameters: Introduction – Water bearing Properties of Rock – Type of aquifers - Aquifer properties – permeability, specific yield, transmissivity and storage coefficient – Methods of Estimation – GEC norms - Steady state flow - Darcy's Law - Groundwater Velocity –- Dupuit Forchheimer assumption – Steady Radial Flow into a Well

Unit-II

Well Hydraulics: Unsteady state flow - Theis method - Jacob method – Chow's method – Law of Times – Theis Recovery – Bailer method – Slug method - tests - Image well theory – Partial penetrations of wells – Well losses – Specific Capacity and Safe yield - Collector well and Infiltration gallery

Unit-III

Groundwater Management: Need for Management Model – Database for Groundwater Management – Groundwater balance study – Introduction to Mathematical model – Model Conceptualization – Initial and Boundary Condition – Calibration – Validation – Future Prediction – Sensitivity Analysis – Uncertainty – Development of a model

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Unit-IV

Ground Water Quality: Ground water chemistry - Origin, movement and quality - Water quality standards – Drinking water – Industrial water – Irrigation water - Ground water Pollution and legislation - Environmental Regulatory requirements.

TEXT BOOKS:

1. Raghunath H.M., "Ground Water Hydrology", New Age International (P) Limited, New Delhi.
2. Todd D.K., "Ground Water Hydrology", John Wiley and Sons, New York.
3. Fitts R Charles, "Groundwater Science". Elsevier, Academic Press.
4. Ramakrishnan, S, Ground Water, K.J. Graph arts, Chennai.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	1	1	1	1	1	1	-	-	-	-	-	1	1	2
CO2.	1	2	3	3	1	1	-	-	-	-	-	-	1	1	2
CO3.	1	3	3	3	2	1	-	-	-	-	-	-	1	1	2
CO4.	1	3	3	3	1	1	-	-	-	-	-	-	1	1	2
CO5.	1	1	1	1	1	1	1	-	-	-	-	-	1	1	2
3 –High 2-Medium 1-Low															

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Program Elective-V

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RAILWAY AND AIRPORT ENGINEERING

Course code	**PE/CE/71-T**			
Category	**Program Elective Course**			
Course title	**Railway and Airport Engineering**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Explain the type of rails and its parts.	**L2(Understanding)**
CO2.	Examine the fastenings and design for joints.	**L4(Analyzing)**
CO3.	Develop the control of the movement of trains using various signals	**L3(Applying)**
CO4.	Design the components of the rail track.	**L6(Creating)**
CO5.	Classify the types of Airports	**L2(Understanding)**
CO6.	Design the pavements used in airports.	**L6(Creating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Introduction, Permanent Way and Rails : Rail transportation and its importance in India. Permanent way: requirements and components. Gauges in India and abroad. Selection of gauge. Coning of wheels. Adzing of sleepers. Rails: functions, composition of rail steel, types of rail sections, requirements of an ideal rail section, length of rails. Defects in rails. Creep of rails. Long welded rails and continuously welded rails.

Sleepers, Fastenings and Ballast: Sleepers: functions, requirements of an ideal sleeper. Types of sleepers: wooden, cast iron, steel and concrete sleepers, advantages, disadvantages and suitability of each type. Sleeper density. Fastenings for various types of sleepers: fish plates, spikes, bolts, bearing plates, keys, chairs, jaws, tie bars. Elastic fastenings. Ballast: functions, requirements, types of ballast and their suitability.

UNIT-II

Points and Crossings: Necessity, Turnout: various components, working principle. Switch: components, types. Crossing : components and types. Design elements of a turnout, design of a simple turnout. Layout plan of track junctions: crossovers, diamond crossing, single-double slips, throw switch, turn table, triangle.

Signaling, Interlocking and Train Control: Signals: objects, types and classification. Semaphore signal: components, working principle. Requirements / principles of a good interlocking system. Brief

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introduction to devices used in interlocking. Methods of control of train movements: absolute block system, automatic block system, centralized train control and automatic train control systems.

UNIT-III

Geometric Design of the Track: Gradients, grade compensation. Super elevation, cant deficiency, negative super elevation. Maximum permissible speed on curves. Tractive resistances, types. Hauling capacity of a locomotive.

Stations, Yards and Track Maintenance: Stations: functions and classification. Junction, non-junction and terminal stations. Yards: functions, types. Marshalling yard: functions, types. Maintenance of railway track: necessity, types of maintenance. Brief introduction to mechanized maintenance, M.S.P and D.T.M.

UNIT-IV

Introduction and Airport Planning: Air transportation, its importance and characteristics, status in India. Layout plan of an airport and its basic elements: terminal area, apron, taxiway, runway, hanger. Aircraft characteristics, their effect on elements of an airport. Site selection of an airport. Classification of airports.

Runway Layout and Pavement Design: Runway orientation, Wind Rose diagram. Basic runway length. Corrections to basic runway length. Runway patterns. Difference between highway and runway pavement. Types of runway pavements. Design factors for runway pavement. Brief introduction to design of thickness of a runway pavement.

Books:

1. A text book of Railway Engineering *by* S.C.Saxena and S.P.Arora, Dhanpat Rai Publicatios, N.Delhi.
2. Railway Track Engg. *by* J.S.Mundray, Tata McGraw-Hill Publishing Co. Ltd. N.Delhi.
3. Airport Planning and Design *by* S.K.Khanna, M.G.Arora, Nem Chand Bros., Roorkee.
4. The Planning and Design of Airports *by* Robort Hornjeff, McGraw Hill Book Co.
5. Air Transportation Planning and Design *by* Virender Kumar & Satish Chandra, Galgotia Publications, N.Delhi.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	1	1	1	1	1	1	-	-	-	-	-	1	1	2
CO2.	1	2	3	3	1	1	-	-	-	-	-	-	1	1	2
CO3.	1	3	3	3	2	1	-	-	-	-	-	-	1	1	2
CO4.	1	3	3	3	1	1	-	-	-	-	-	-	1	1	2
CO5.	1	1	1	1	1	1	1	-	-	-	-	-	1	1	2
CO6.	1	2	1	1	1	1	1	-	-	-	-	-	1	1	2
3 –High 2-Medium 1-Low															

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INTELLIGENT TRANSPORT SYSTEM

Course code	**PE/CE/72-T**			
Category	**Program Elective**			
Course title	**Intelligent Transport System**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No.	**Course outcomes:** At the end of the course students will be able to:	**RBT* Level**
CO 1	Understands the fundamentals of ITS and ITS functional areas	**L2(Understanding)**
CO 2	Understand the communication technologies in transportation	**L2(Understanding)**
CO 3	Able to apply the various ITS methodologies	**L3(Applying)**
CO 4	Understand the ITS implementation in developing countries	**L2(Understanding)**
CO 5	Able to understand and the advantages of ITS and apply the appropriate technologies for field conditions.	**L3(Applying)**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Introduction to Intelligent Transportation Systems (ITS) – Definition of ITS and Identification of ITS Objectives, Historical Background, Benefits of ITS - ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection.

UNIT-II

Telecommunications in ITS – Importance of telecommunications in the ITS system, Information Management, Traffic Management Centres (TMC). Vehicle – Road side communication – Vehicle Positioning System.

UNIT-III

ITS functional areas – Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS).

UNIT-IV

ITS User Needs and Services – Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, Advanced Vehicle safety systems, Information Management; Automated Highway Systems -

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Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries

Books:

1. Intelligent Transport Systems by Pradip Kumar Sarkar, Amit Kumar Jain, PHI Learning Private Limited, New Delhi
2. Intelligent Transport Systems by R Srinivasa Kumar, Orient Blackswan Pvt. Ltd.
3. Intelligent Transport Systems: New Principles and Architectures by S. Ghosh, T.S. Lee, CRC Press.
4. Fundamentals of Intelligent Transportation system planning, Mashrur A. Chowdhury and A del Sadek, Artech House.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1.	**1**	**3**	**1**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**
CO2.	**1**	**3**	**1**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**
CO3.	**1**	**2**	**1**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**
CO4.	**1**	**2**	**1**	**2**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**
CO5.	**1**	**2**	**1**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**
3 –High 2-Medium 1-Low															

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TRANSPORTATION ENGINEERING

Course code	**PE/CE/73-T**			
Category	**Program Elective**			
Course title	**Transportation Engineering**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No.	**Course outcomes:** At the end of the course students will be able to:	**RBT* Level**
CO 1	Understand the basic concepts of highways, railway, airport, tunnel and harbour engineering.	**L2(Understanding)**
CO 2	Analysis and design airport pavement thickness, super-elevation in rails.	**L6 (Creating)**
CO 3	Apply the techniques for designing the geometric features of railways and runway layout of airports.	**L3(Applying)**
CO4	Understand the various methods used for tunneling	**L2(Understanding)**
CO5	Analyze the various design requirements needed for the design of docks and harbours.	**L4(Analyze)**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Introduction: Road transportation. Brief review of history of road development in India and abroad: Roman, Tresaguet, Telford and Macadam constructions. Road patterns. Classification of roads, Objectives of highway planning, Planning surveys. Saturation system of planning.

Cross Section Elements and Sight Distance Considerations: Cross section elements: friction, carriageway, formation width, land width, camber, IRC recommended values. Types of terrain Design speed. Sight distance, stopping sight distance, overtaking sight distance, overtaking zones, intermediate sight distance, sight distance at intersections, head light sight distance, set back distance. Critical locations for sight distance.

UNIT-II

Introduction, Permanent Way and Rails: Rail transportation and its importance in India. Permanent way: requirements and components. Gauges in India and abroad. Selection of gauge. Coning of wheels. Adzing of sleepers. Rails: functions, composition of rail steel, types of rail sections, requirements of an ideal rail section, length of rails. Defects in rails. Creep of rails. Long welded rails and continuously welded rails.

Sleepers, Fastenings and Ballast: Sleepers: functions, requirements of an ideal sleeper. Types of sleepers: wooden, cast iron, steel and concrete sleepers, advantages, disadvantages and suitability of each type. Sleeper density. Fastenings for various types of sleepers: fish plates, spikes, bolts, bearing

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plates, keys, chairs, jaws, tie bars. Elastic fastenings. Ballast: functions, requirements, types of ballast and their suitability.

UNIT-III

Introduction to Airport Planning : Air transportation, its importance and characteristics, status in India. Layout plan of an airport and its basic elements: terminal area, apron, taxiway, runway, hanger. Aircraft characteristics, their effect on elements of an airport. Site selection of an airport. Classification of airports.

Runway Layout and Pavement Design: Runway orientation, Wind Rose diagram. Basic runway length. Corrections to basic runway length. Runway patterns. Difference between highway and runway pavement. Types of runway pavements. Design factors for runway pavement. Brief introduction to design of thickness of a runway pavement.

UNIT-IV

Tunnels: Sections of tunnels: advantages, limitations and suitability of each section. Shaft. Pilot tunnel. Driving tunnel in rocks: sequence of construction operations, full face method, heading and bench method, drift method. Driving tunnels in soft ground: sequence of construction operations, needle beam method, shield tunneling, compressed air tunneling.

Docks and Harbour Engineering: Definition of basic terms – Harbour, Port, Satellite Port, Docks, Waves and Tides. Planning and design of Harbours: Harbour layout and terminal facilities, Coastal structures: Piers, Break waters, wharves, Jetties, Quays, spring fenders, dolphins and floating landing stage.

Books:

1. A text book of Railway Engineering by S.C.Saxena and S.P.Arora, Dhanpat Rai Publicatios, N.Delhi.
2. Railway Track Engg. by J.S.Mundray, Tata McGraw-Hill Publishing Co. Ltd. N.Delhi.
3. Airport Planning and Design by S.K.Khanna, M.G.Arora, Nem Chand Bros., Roorkee.
4. The Planning and Design of Airports by Robort Hornjeff, McGraw Hill Book Co.
5. Air Transportation Planning and Design by Virender Kumar & Satish Chandra, Galgotia Publications, N.Delhi.
6. Tunnel Engineering by S.C.Saxena, Dhanpat Rai Publications, N.Delhi.
7. A text book of Tunnel, Bridges and Railway Engg. by S.P.Bindra, Dhanpat Rai Delhi.
8. Highways, Railways, Airport and Harbour Engineering, by K.P. Subramanian, V Scitech Publications, Chennai.
9. Railway, Airport, Docks and Harbour Engineering by R.Saravanan, R. Dinesh Kumar and L. Deepak, Suchitra Publications, (Lakshmi Publications).

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	1	1	1	1	2	1	-	-	-	-	-	1	1	2
CO2.	1	1	3	2	3	1	-	-	-	-	-	-	1	1	2
CO3.	1	1	2	3	2	1	-	-	-	-	-	-	1	1	2
CO4.	1	1	1	3	2	1	-	-	-	-	-	-	1	1	2
CO5.	1	1	3	2	2	1	-	-	-	-	-	-	1	1	2
3 –High 2-Medium 1-Low															

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AIRPORT PLANNING & DESIGN

Course code	**PE/CE/74-T**			
Category	**Program Elective**			
Course title	**Transportation Engineering**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**0**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No.	**Course outcomes:** At the end of the course students will be able to:	RBT* Level
CO 1	Understand the basic concepts of airport engineering.	**L2(Understanding)**
CO 2	Analysis and design of airport pavement thickness	**L6 (Creating)**
CO 3	Able to apply the methods for designing the geometric features of runway pavement.	**L3(Applying)**
CO4	Understand the various methods used for air traffic control and visual aids required for airports.	**L2(Understanding)**
CO5	Able to analyze the various design requirements needed for the design of drainage system for airports.	**L4(Analyze)**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Airport Engineering: Air transportation and its importance, status in India, IAAI, Civil aviation department & AAI rules and regulations, open sky policy, Component parts of aeroplane, Aircraft characteristics, Minimum circling radius, minimum turning radius, classifications of airports and aerodromes.

Airport surveys: Types of airport surveys – approach zone, traffic, topographical survey etc., airport site section survey, airport size, airport obstructions - Imaginary surfaces and objects with actual heights, clear zone, turning zone and zoning laws.

UNIT-II

Airport Planning: National airport authority & FAA recommendation for master plan, regional planning, layout plan of an airport and its basic elements: terminal area, apron, taxiway, runway, hanger, airport architecture – features of building, international airports and seating arrangement, traffic forecast, existing airport capacity improvement and planning of a new airport environmental considerations.

Airport markings and Visual aids: requirement of visual aids. Types of airport markings, alignment guidance, height information, visual parameters, airport lighting and factors affecting airport lighting, runway lighting, taxiway lighting, approach lighting, apron and hanger lighting, instrumental landing system, precision approach radar.

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UNIT III

Runway Orientation: Runway orientation, Wind Rose diagram. Basic runway length – landing and take-off, emergency stopping length requirement, corrections to basic runway length, runway patterns, Terminal area, building area, parking area, apron, hanger typical airport layouts, difference between highway and runway pavement, types of runway pavements.

Runway Pavement Design: Geometric design of runway, design factors for runway pavement, Structural design of runway pavements LCN/PCN method of rigid pavement design, Design of flexible and rigid runways as per FAA procedure, Specifications for the different layers of runway and taxiway pavements, design of overlay pavements.

UNIT-IV

Air Traffic Control: Importance and need of air traffic control, flight rules, types of control, control centres and towers, flight service stations, air traffic control aids – airway and terminal aids, GPS air traffic control system, free flight types and different approaches.

Airport Drainage System: Grading – importance and requirement, functions of airport drainage, requirements of drainage system – capacity, strength, rapid drainage and future scope, runoff estimation, design and layout of airport drainage system.

Books:

1. Airport Planning and Design by S.K.Khanna, M.G.Arora, Nem Chand Bros., Roorkee.
2. Airport Engineering, by Ranwala, Charotar Publishing House, PVT., LTD.
3. Air Transportation Planning and Design by Virender Kumar & Satish Chandra, Galgotia Publications, N.Delhi.
4. Highways, Railways, Airport and Harbour Engineering, by K.P. Subramanian, V Scitech Publications, Chennai.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	2	1	1	1	2	1	-	-	-	-	-	1	1	2
CO2.	1	3	3	3	3	1	-	-	-	-	-	-	1	1	2
CO3.	1	3	2	3	2	1	-	-	-	-	-	-	1	1	2
CO4.	1	2	2	3	2	1	-	-	-	-	-	-	1	1	2
CO5.	1	3	3	2	2	1	-	-	-	-	-	-	1	1	2
3 –High 2-Medium 1-Low															

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Program Elective-VI

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PROJECT PLANNING & MANAGEMENT

Course code	**PE/CE/75-T**			
Category	**Program Elective Course**			
Course title	**Project Planning & Management**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Identify the type of types of contract	**L3 (Applying)**
CO2.	Analyze a project life cycle, and can map each stage in the cycle.	**L4(Analyzing)**
CO3.	Estimate the time needed to successfully complete a project.	**L6 (Creating)**
CO4.	Develop a project scope while considering factors such as customer requirements and internal/external goals.	**L6 (Creating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Construction Management: Significance, objectives and functions of construction management, types of constructions, resources for construction industry, stages for construction, construction team, engineering drawings.

Construction Contracts & Specifications: Introduction, types of contracts, contract document, specifications, important conditions of contract, arbitration.

UNIT-II

Construction Planning: Introduction, work breakdown structure, stages in planning-pre-tender stages, contract stage, scheduling, scheduling by bar charts, preparation of material, equipment, labour and finance schedule, limitation of bar charts, milestone charts.

Construction Organization: Principles of Organization, communication, leadership and human relations, types of Organizations, Organization for construction firm, site organization, temporary services, job layout.

UNIT-III

Network Techniques in Construction Management-I: CPM- Introduction, network techniques, work break down, classification of activities, rules for developing networks, network development-logic of network, allocation of time to various activities, Fulkerson's rule for numbering events, network analysis , determination of project schedules, critical path, ladder construction, float in activities, shared float, updating, resources allocation, resources smoothing and resources leveling.

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Network Techniques in Construction Management-II-PERT- Probability concept in network, optimistic time, pessimistic time, most likely time, lapsed time, deviation, variance, standard deviation, slack critical path, probability of achieving completion time, central limit theorem.

UNIT-IV

Cost-Time Analysis: Cost versus time, direct cost, indirect cost, total project cost and optimum duration, contracting the network for cost optimization, steps in time cost optimization, illustrative examples.

Inspection & Quality Control: Introduction, principles of inspection, enforcement of specifications, stages in inspection and quality control, testing of structures, statistical analysis.

Books Recommended

1 Construction Planning & Management by P.S. Gehlot & B.M. Dhir, Wiley Eastern Ltd.
2 PERT & CPM -Principles & Applications by L.S. Srinath. Affiliated East-West Press (P)Ltd.
3 Project Planning & Control with PERT & CPM by B.C. Punmia & K. K. Khandelwal, Lakshmi Pub. Delhi
4 Construction Management & Planning by B. Sengupta & H. Guha, Tata McGraw -Hills.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	1	1	1	1	1	1	-	-	-	-	-	1	1	2
CO2.	1	2	3	3	1	1	-	-	-	-	-	-	1	1	2
CO3.	1	3	3	3	2	1	-	-	-	-	-	-	1	1	2
CO4.	1	3	3	3	1	1	-	-	-	-	-	-	1	1	2
3 –High 2-Medium 1-Low															

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CONSTRUCTION ENGINEERNG & MANAGEMENT

Course code	**PE/CE/76-T**			
Category	**Program Elective Course**			
Course title	**Construction Engineering & Management**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Identify the types of construction projects.	**L3 (Applying)**
CO2.	Analyze a project planning using network techniques.	**L4(Analyzing)**
CO3.	Estimate the time needed to successfully complete a project.	**L6 (Creating)**
CO4.	Develop a project scope while considering factors such as customer requirements and internal/external goals.	**L6 (Creating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

Unit-I

Basics of Construction: Unique features of construction, construction projects types and features, phases of a project, agencies involved and their methods of execution.

Construction project planning: Stages of project planning: pre-tender planning, preconstruction planning, detailed construction planning, role of client and contractor, level of detail.

Process of development of plans and schedules, work break-down structure, activity lists, assessment of work content, concept of productivities, estimating durations, sequence of activities, activity utility data; Techniques of planning- Bar charts, Gantt Charts.

Unit-II

Networks: basic terminology, types of precedence relationships, preparation of CPM networks: activity on link and activity on node representation, computation of float values, critical and semi critical paths, calendaring networks.

PERT: Assumptions underlying PERT analysis, determining three time estimates, analysis, slack computations, calculation of probability of completion.

Construction Methods basics: Types of foundations and construction methods, Basics of Formwork and Staging; Common building construction methods (conventional walls and slabs; conventional framed structure with block work walls; Modular construction methods for repetitive works; Precast concrete construction methods; Basics of Slip forming for tall structures; Basic construction methods for steel structures; Basics of construction methods for Bridges.

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Unit-III

Construction Equipment basics: Conventional construction methods Vs Mechanized methods, Equipment for Earthmoving, Dewatering, Concrete mixing, transporting & placing; Cranes, Hoists and other equipment for lifting, Equipment for transportation of materials.

Planning and organizing construction site and resources: Site - site layout including enabling structures, developing site organization, Documentation at site; Manpower: planning, organizing, staffing, motivation; Materials- concepts of planning, procurement and inventory control; Equipment- basic concepts of planning and organizing. Funds- cash flow, sources of funds; Earned Value; Resource Scheduling- Bar chart, line of balance technique, resource constraints and conflicts; resource aggregation, allocation, smoothening and leveling.

Unit-IV

Project Monitoring & Control: Supervision, record keeping, periodic progress reports, periodical progress meetings. Updating of plans: purpose, frequency and methods of updating. Common causes of time and cost overruns and corrective measures. Basics of Modern Project management systems such as Lean Construction; Use of Building Information Modelling (BIM) in project management; Quality control: concept of quality, quality of constructed structure, use of manuals and checklists for quality control, role of inspection, basics of statistical quality control. Safety, Health and Environment on project sites: accidents; their causes, effects and preventive measures, costs of accidents, occupational health problems in construction, organizing for safety and health.

Contracts and Construction Costs: Importance of contracts; Types of Contracts, parties to a contract; Common contract.

Make-up of construction costs; Classification of costs, time cost trade-off in construction projects, compression and decompression.

Reference Books:

1. Varghese, P.C., "Building Construction", Prentice Hall India, 2007.
2. National Building Code, Bureau of Indian Standards, New Delhi, 2017.
3. Peurifoy, R.L. Construction Planning, Methods and Equipment, McGraw Hill, 2011.
4. Nunnally, S.W. Construction Methods and Management, Prentice Hall, 2006.
5. Jha, Kumar Neeraj., Construction Project management, Theory & Practice, Pearson Education India.
6. Punmia, B.C., Khandelwal, K.K., Project Planning with PERT and CPM, Laxmi Publications.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	1	1	1	1	1	1	-	-	-	-	-	1	1	2
CO2.	1	2	3	3	1	1	-	-	-	-	-	-	1	1	2
CO3.	1	3	3	3	2	1	-	-	-	-	-	-	1	1	2
CO4.	1	3	3	3	1	1	-	-	-	-	-	-	1	1	2
3 –High 2-Medium 1-Low															

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CONSTRUCTION PLANNING, SCHEDULING AND CONTROL

Course code	**PE/CE/77-T**			
Category	**Program Elective Course**			
Course title	**Construction Planning, Scheduling and Control**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Identify the types of technology and construction methods.	**L3 (Applying)**
CO2.	Analyze a project schedule and its planning.	**L4(Analyzing)**
CO3.	Analyze the cost and its control throughout the project.	**L4(Analyzing)**
CO4.	Develop a project with quality control and safety provisions.	**L6 (Creating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

Course Content

Unit-I

Construction Planning : Basic Concepts in the Development of Construction Plans – Choice of Technology and Construction Method – Defining Work Tasks – Defining Precedence Relationships among Activities – Estimating Activity Durations – Estimating Resource Requirements for Work Activities – Coding Systems.

Unit-II

Scheduling Procedures and Techniques: Construction Schedules – Critical Path Method – Scheduling Calculations – Float – Presenting Project Schedules – Scheduling for Activity-on-Node and with Leads, Lags, and Windows – Scheduling with Resource Constraints and Precedence – Use of Advanced Scheduling Techniques – Scheduling with Uncertain Durations – Calculations for Monte Carlo Schedule Simulation – Crashing and Time/Cost Tradeoffs – Improving the Scheduling Process.

Unit-III

Cost Control, Monitoring and Accounting: The Cost Control Problem – The Project Budget – Forecasting for Activity Cost Control – Financial Accounting Systems and Cost Accounts – Control of Project Cash Flows –Schedule Control – Schedule and Budget Updates – Relating Cost and Schedule Information.

Unit-IV

Quality Control and Safety During Construction: Quality and Safety Concerns in Construction – Organizing for Quality and Safety – Work and Material Specifications – Total Quality Control – Quality Control by Statistical Methods – Statistical Quality Control with Sampling by Attributes – Statistical Quality Control with Sampling by Variables – Safety.

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Reference Books:

1. Calin M. Popescu, Chotchai Charoenngam, "Project Planning, Scheduling and Control in Construction: An Encyclopedia of terms and Applications", Wiley, New York, 1995.
2. Chitkara, K.K. "Construction Project Management: Planning, Scheduling and Control", McGraw-Hill Publishing Company, New Delhi, 1998.
3. Chris Hendrickson and Tung Au, "Project Management for Construction – Fundamental Concepts for Owners, Engineers", Architects and Builders, Prentice Hall, Pittsburgh, 2000.
4. Halpin, D. W., "Financial and Cost Concepts for Construction Management", John Wiley & Sons, New York, 1985.
5. Jha, Kumar Neeraj., Construction Project management, Theory & Practice, Pearson Education India.
6. Punmia, B.C., Khandelwal, K.K., Project Planning with PERT and CPM, Laxmi Publications.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1.	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**
CO2.	**1**	**2**	**3**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**
CO3.	**1**	**3**	**3**	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**
CO4.	**1**	**3**	**3**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**
3 –High 2-Medium 1-Low															

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CONTRACT LAWS AND REGULATIONS

Course code	**PE/CE/78-T**			
Category	**Program Elective Course**			
Course title	**Contract Laws and Regulations**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**0**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Identify the types of Contracts and develop the content.	**L3 (Applying)**
CO2.	Identify and Analyze the types of Tenders.	**L4(Analyzing)**
CO3.	Examine the causes of arbitration for removal.	**L4(Analyzing)**
CO4.	Decide the legal requirements of a project.	**L5 (Evaluating)**
CO5.	Adapt the labour regulations to avoid litigations in a project	**L6 (Creating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

Course Content

Unit-I

Construction Contracts: Indian Contracts Act – Elements of Contracts – Types of Contracts – Features – Suitability – Design of Contract Documents – International Contract Document – Standard Contract Document – Law of Torts.

Unit-II

Tenders: Prequalification – Bidding – Accepting – Evaluation of Tender from Technical, Contractual and Commercial Points of View – Contract Formation and Interpretation – Potential Contractual Problems – World Bank Procedures and Guidelines.

Unit-III

Arbitration: Comparison of Actions and Laws – Agreements – Subject Matter – Violations – Appointment of Arbitrators – Conditions of Arbitration – Powers and Duties of Arbitrator – Rules of Evidence – Enforcement of Award – Costs.

Unit-IV

Legal Requirements: Insurance and Bonding – Laws Governing Sale, Purchase and Use of Urban and Rural Land – Land Revenue Codes – Tax Laws – Income Tax, Sales Tax, Excise and Custom Duties and their Influence on Construction Costs – Legal Requirements for Planning – Property Law – Agency Law – Local Government Laws for Approval – Statutory Regulations.

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Labour Regulations: Social Security – Welfare Legislation – Laws relating to Wages, Bonus and Industrial Disputes, Labour Administration – Insurance and Safety Regulations – Workmen's Compensation Act – Indian Factory Act – Child Labour Act - Other Labour Laws.

Reference Books:

1. Gajaria G.T., "Laws Relating to Building and Engineering" Contracts in India.
2. Patil. B.S, "Civil Engineering Contracts and Estimates", Universities Press (India) Private Limited, 2006.
3. Joseph T. Bockrath, "Contracts and the Legal Environment for Engineers and Architects", McGraw Hill, 2000.
4. Jimmie Hinze, "Construction Contracts", McGraw Hill, 2001.
5. Punmia, B.C., Khandelwal, K.K., Project Planning with PERT and CPM, Laxmi Publications.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1.	**1**	**1**	**1**	**1**	**3**	**1**	-	-	-	-	-	-	**1**	**1**	**2**
CO2.	**1**	**1**	**1**	**1**	**3**	**1**	-	-	-	-	-	-	**1**	**1**	**2**
CO3.	**1**	**1**	**1**	**1**	**3**	**1**	-	-	-	-	-	-	**1**	**1**	**2**
CO4.	**1**	**1**	**1**	**1**	**3**	**1**	-	-	-	-	-	-	**1**	**1**	**2**
CO5.	**1**	**1**	**1**	**1**	**3**	**1**	-	-	-	-	-	-	**1**	**1**	**2**
3 –High 2-Medium 1-Low															

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Program

Elective-VII

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SEWERAGE AND SEWAGE TREATMENT

Course code	**PE/CE/81-T**			
Category	**Program Elective Course**			
Course title	Sewerage and Sewage Treatment			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Identify the types of sewerage system.	**L3 (Applying)**
CO2.	Identify and Analyze the characteristics of sewage.	**L4(Analyzing)**
CO3.	Examine the causes and decide the treatment required for sewage.	**L5 (Evaluating)**
CO4.	Propose the disposal of sewage.	**L6 (Creating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Collection of sewage: Importance of sanitation, Systems of sewerage – separate, combined and partially separate. Quantity of sanitary sewage and variations. Shapes of sewer – circular and egg shaped. Design of sewers, self-cleansing velocity and slopes, Construction and testing of sewer lines. Sewer materials. joints and appurtenances.

UNIT-II

Sewage Characterization: Quality parameters- BOD, COD, Solids, D.O., Oil & Grease. Indian Standards for disposal of effluents into inland surface sources and on land.

UNIT-III

Sewage Treatment: Objectives, sequence and efficiencies of conventional treatment units. Preliminary treatment, screening and grit removal units. Theory and design aspects of primary treatment, secondary treatment- activated sludge process & its modifications, Tricking filter, sludge digestion and drying beds. Stabilization pond, aerated lagoon, UASB process , septic tank and Imhoff tank.

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UNIT-IV

Disposal of Sewage: Disposal of sewage by dilution – self-purification of streams. Sewage disposal by irrigation (Sewage treatment).

Recommended Books:

1. Waste Water Engineering: Metcalf and Eddy.
2. Sewage and Sewage Treatment: S.K. Garg.
3. Sewage and Sewage Treatment: S.R. Krishansagar.
4. Waste Water Engineering: B.C. Punmia.
5. Manual on Sewerage and Sewage Treatment: Ministry of Urban Dev., New Delhi.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1.	**1**	**1**	**1**	**1**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**2**	**1**	**1**	**2**
CO2.	**1**	**1**	**1**	**1**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**2**	**1**	**1**	**2**
CO3.	**1**	**1**	**1**	**1**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**2**	**1**	**1**	**2**
CO4.	**1**	**1**	**1**	**1**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**2**	**1**	**1**	**2**
3 –High 2-Medium 1-Low															

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INDUSTRIAL WASTE WATER TREATMENT

Course code	**PE/CE/82-T**			
Category	**Program Elective Course**			
Course title	**Industrial Waste Water Treatment**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Identify the effect of industrial waste.	**L3 (Applying)**
CO2.	Analyze the characteristics of industrial waste.	**L4(Analyzing)**
CO3.	Propose the kind of disposal of industrial waste.	**L6 (Creating)**
CO4.	Identify the type and treatment of industrial waste.	**L3 (Applying)**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Effects of industrial wastes on streams, sewerage systems and wastewater treatment plants.

UNIT-II

Minimizing the effects of industrial effluents on waste water treatment plants and receiving streams-conservation of water, process change, reuse of waste water, volume reduction, strength reduction, neutralization, equalization and proportioning.

UNIT-III

Population equivalent. Industrial effluent standards for disposal into inland surface water sources and on land for irrigation.

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UNIT-IV

Study of the following Industries from waste generation, quality and its treatment including brief overview of manufacturing process:

Textile, tannery, sugar mill, distillery, dairy, pulp & paper, metal plating, oil refinery, nitrogenous fertilizers, thermal power plants and radio-active wastes.

Books:

1. Industrial and Hazardous Waste Treatment by N.L.Nemerow & A.Dasgupta.
2. Industrial Effluents by N.Manivasakam.
3. Waste Water Treatment by M.N.Rao & A.K.Dutta.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	1	1	1	3	2	2	-	-	-	-	2	1	1	2
CO2.	1	1	1	1	3	2	2	-	-	-	-	2	1	1	2
CO3.	1	1	1	1	3	2	2	-	-	-	-	2	1	1	2
CO4.	1	1	1	1	3	2	2	-	-	-	-	2	1	1	2
3 –High 2-Medium 1-Low															

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AIR AND NOISE POLLUTION CONTROLENGG.

Course code	**PE/CE/83-T**			
Category	**Program Elective Course**			
Course title	**Air and Noise Pollution Control Engg.**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1	Understand sources of air pollution , air pollution problems	**L1(Remembering)**
CO2	Demonstrate a detailed knowledge of study the effect of meteorological parameters in the dispersion of air pollutants	**L3(Applying))**
CO3	Analyze Environment legislation and regulations for air and noise pollution	**L4(Analyzing)**
CO4	Evaluate efficiency of various air pollution control devices used for particulate removal	**L5(Evaluating)**
CO5	Design, operate and control the devices used for gaseous emission control and noise emission control	**L6(Creating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT I

Air pollutants, Sources, classification, Combustion Processes and pollutant emission, Effects on Health, vegetation, materials and atmosphere, Reactions of pollutants in the atmosphere and their effects, Smoke, smog and ozone layerdisturbance, Greenhouse effect.

UNIT II

Air sampling and pollution measurement methods, principles and instruments, ambient air quality and emissionstandards, Air pollution indices, Air Act, legislation and regulations

UNIT III

Control principles, Removal of gaseous pollutants by adsorption, absorption, reaction and other methods. Particulate emission control, settling chambers, cyclone separation, Wet collectors, fabric filters, electrostatic precipitators and other removal methods like absorption, adsorption, precipitation

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etc. Biological air pollution control technologies, Indoor air quality.

UNIT IV

Noise pollution: Basics of acoustics and specification of sound; sound power, sound intensity and sound pressure levels; plane, point and line sources, multiple sources; outdoor and indoor noise propagation; psychoacoustics and noise criteria, effects of noise on health, annoyance rating schemes; special noise environments: Infrasound, ultrasound, impulsive sound and sonic boom; noise standards and limit values; noise instrumentation and monitoring procedure. Noise indices. Noise control methods

REFERENCE BOOKS:

1. C. S. Rao, "Environmental Pollution Control Engineering", Wiley Eastern Limited, 2000.
2. M. N. Rao, H. V. N. Rao, Air pollution, Tata McGraw Hill Pvt. Ltd, New Delhi, 1993.
3. G.K. Nagi, M.K. Dhillon, G.S. Dhaliwal, Commonwealth Publishers, Noise Pollution.
4. S.K. Garg, Khanna publishers, Sewage Disposal and Air Pollution Engineering.
5. S.M. Khopkar, Environmental pollution analysis, New Age International Publications

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	2	-	-	-	1	2	1	-	-	-	1	1	1	2
CO2.	1	2	3	-	-	1	2	1	-	-	1	1	1	1	2
CO3.	1	3	-	-	-	1	2	1		1	1	2	1	1	2
CO4.	1	2	3	2	-	1	2	-	-	-	2	2	1	1	2
CO5.	1	2	3	1	-	1	2	-	2	-	2	3	1	1	2
3 –High 2-Medium 1-Low															

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SOLID AND HAZARDOUS WASTE MANAGEMENT

Course code	**PE/CE/84-T**			
Category	**Program Elective Course**			
Course title	**Solid and Hazardous Waste Management**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Sr. No.	**Course outcomes** At the end of the course students will be able to:	**RBT* Level**
CO1	Describe the principles of solid & hazardous waste management.	**L1(Remembering)**
CO2	Acquire knowledge on specialized solid & hazardous waste treatment	**L2(Understanding)**
CO3	Illustrate various techniques for treatment of solid waste and hazardous waste	**L3(Applying)**
CO4	Analyze policies regarding solid and hazardous wastes including legal implications.	**L4(Analyzing)**
CO5	Design & optimize techniques in solid & hazardous waste management	**L6(Creating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Solid Wastes: Origin- Analysis- Composition and Characteristics. Integrated Solid Waste Management System: Collection- Storage- Segregation- Reuse and Recycling possibilities- Transportation- Treatment / Processing and Transformation Techniques- Final Disposal.

UNIT-II

Management of: Municipal- Biomedical- Nuclear- Electronic and Industrial Solid Wastes and the rules and regulations.

UNIT-III

Introduction to Hazardous wastes- Definition of Hazardous waste- The magnitude of the problem; Hazardous waste: Risk assessment- Environmental legislation- Characterization and site assessment- Waste minimization and resourcerecovery- Transportation of hazardous waste- Physical- chemical and biological treatment- Ground water contamination- Landfill disposal

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UNIT-IV

Current Management Practices- Environmental audit- Pollution Prevention- Facility Development and operation- Site Remediation: Quantitative risk assessment- site and subsurface characterization- Containment- remedial alternatives.

Reference Books:

1. Solid and Hazardous Waste Management , M.N. Rao and Razia Sultana
2. Environmental Hazards-Smith- Keith
3. Environmental Hazards-Iqbal- M-Srivastava- A.S. and Siddiqu- T.Q.
4. Basic Environmental Technology-Nathanson- J.A.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	2	-	-	-	1	2	1	-	-	-	2	1	1	2
CO2.	2	1	-	1	-	1	1	2	-	1	1	2	1	1	2
CO3.	1	3	3	2	1	1	2	1	1	-	2	2	1	1	2
CO4.	1	2	2	1	-	1	1	2	-	1	2	2	1	1	2
CO5.	1	1	3	3	3	1	1	1	1	-	2	2	1	1	2
3 –High 2-Medium 1-Low															

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Program

Elective-VIII

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CONCRETE TECHNOLOGY

Course code	**PE/CE/85-T**			
Category	**Program Elective Course**			
Course title	**Concrete Technology**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Identify the concrete making materials.	**L3 (Applying)**
CO2.	Classify the concrete on basis of its quality.	**L4(Analyzing)**
CO3.	Design the concrete on basis of its requirement.	**L6 (Creating)**
CO4.	Examine the concrete using non-destructive technique.	**L4(Analyzing)**
CO5.	Outline special types of concrete.	**L2 (Understanding)**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Concrete as Structural Material: Introduction, preparation of concrete, grades of concrete, advantages of concrete, concept of quality control.

Concrete Making Materials: Cement- tests on cement (physical tests), types of Portland cement, various types of cement-ordinary Portland cement, rapid hardening cement, low heat cement, sulphate resistant cement, Portland-pozzolona cement, high strength Portland cement, high alumina cement, waterproof cement, white Portland cement, hydrophobic cement, colored Portland cement.

Aggregates- classification of aggregates based on petrography, size, shape and textures, deleterious substances in aggregates, bulking of fine aggregates, grading of aggregates as per IS-383-1970, fineness modulus.

UNIT-II

Properties of Concrete: Introduction, workability, factors influencing workability, measurement of workability, requirements of workability, properties of hardened concrete, stress and strain characteristics of concrete, Young's modulus of concrete, creep and shrinkage of concrete, permeability of concrete, durability of concrete sulphate attack, fire-resistance, thermal properties of concrete, construction joints, expansion and contraction joints.

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Production of Concrete: Introduction, batching of materials, mixing of concrete materials, transportation of concrete, compaction of concrete, ready mixed concrete, vibrators, Internal vibrators, external vibrators, concrete curing and formwork removal.

UNIT-III

Non-Destructive Testing of Concrete: Significance of Non-Destructive Testing, Rebound Hammer, Ultrasonic pulse velocity techniques, Penetration techniques, pullout tests, vibration methods, Radio-active techniques, Cover meter, core-tests.

Deterioration of Concrete & its Prevention: Causes of concrete deterioration, deterioration by water, surface weir, frost action, deterioration by chemical reactions, sulphate attack, alkali-aggregate reaction, corrosion of embedded steel in concrete, Prevention of deterioration of concrete

UNIT-IV

Repair Technology for Concrete Structures: Symptoms and diagnosis of distress, evaluation of cracks, repair of cracks, common types of repairs, distress in fire damaged structures, underwater repairs.

Special Concrete: Light weight concrete, definition and its properties, applications, high strength concrete, definitions, its properties and applications, Mass Concrete, waste material based concrete, shotcrete, fiber reinforced concrete: Materials Fibre types and properties, ferrro-cement, polymer concrete composites, heavy weight concrete for radiation shielding.

Prestressed Concrete: Introduction, basic concepts, classifications and types of prestressing, prestressing systems, properties of materials, pre tensioned and post tensioned concrete elements.

Books Recommended:

1. Gambhir, M.L. 'Concrete Technology'. TMH Pub. N. Delhi
2. Shetty, M.S. 'Concrete Technology', S. Chand & Co. N. Delhi
3. Nevelli, A.M., 'Concrete Technology', Pearson Education

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	1	1	1	3	1	-	-	-	-	-	-	1	1	2
CO2.	1	1	1	1	3	1	-	-	-	-	-	-	1	1	2
CO3.	1	1	1	1	3	1	-	-	-	-	-	-	1	1	2
CO4.	1	1	1	1	3	1	-	-	-	-	-	-	1	1	2
CO5.	1	1	1	1	3	1	-	-	-	-	-	-	1	1	2
3 –High 2-Medium 1-Low															

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GEO-SYNTHETICS ENGINEERING

Course code	**PE/CE/86-T**			
Category	**Program Elective Course**			
Course title	**Geo-synthetics Engineering**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Identify types of Geosynthetics.	**L3 (Applying)**
CO2.	Illustrate the manufacturing methods.	**L2 (Understanding)**
CO3.	Explain the usefulness of Geogrids.	**L5 (Evaluating)**
CO4.	Identify the use of Geosynthetics in Water resources projects.	**L3 (Applying)**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT I

Basic Description of Geosynthetics: Historical Development, the Nomenclature, Function, Use around the World, Applications, Development in India.
Raw Materials – Their Durability and Ageing: Raw Materials, Durability, Degrading Agencies, Polymers, Biological Resistance, Chemical Resistance, Weathering Resistance

UNIT II

Manufacturing Methods: Fibres, Yarn, Nonwoven Geotextiles, Woven Geotextiles, D.S.F. Fabrics.
Geogrids- Testing and Evaluation: Factors influencing Testing, Sampling, Physical Properties, and Mechanical Properties under Uniaxial loading, Creep Testing

UNIT III

Erosion Control with Geogrids: Wind Erosion, Rain Water Erosion, Erosion Control Measures, Placement of Geogrids
Bearing Capacity Improvement with Geogrids: Advantages, Mechanism, Modes of Failure, Friction Coefficient, Experimental Studies.

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UNIT IV

Application of Geosynthetics in Water Resource Projects: Case Study: Dharoidam, Hiran II Dam, Meda Creek Irrigation Scheme, Lining of Kakarpar Canal

Reference Books:

1. Robert M. Koerner, Designing with Geosynthetics, Prentice Hall.
2. **G.V. Rao & G.V.S. Raju, Engineering with Geosynthetics, Tata MacGraw Hill.**

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	1	1	1	3	1	-	-	-	-	-	-	1	1	2
CO2.	1	1	1	1	3	1	-	-	-	-	-	-	1	1	2
CO3.	1	1	1	1	3	1	-	-	-	-	-	-	1	1	2
CO4.	1	1	1	1	3	1	-	-	-	-	-	-	1	1	2
3 –High 2-Medium 1-Low															

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BRIDGE ENGINEERING

Course code	**PE/CE/87-T**			
Category	**Program Elective Course**			
Course title	**Bridge Engineering**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Identify types of Bridge and its components.	**L3 (Applying)**
CO2.	Explain the load specifications for roads and railways.	**L2 (Understanding)**
CO3.	Design the bridge structures for roads and railways.	**L6 (Creating)**
CO4.	Design the joinery for bridges.	**L6 (Creating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Introduction: Definition, components of bridge, classification of bridges, selection of site, economical span, aesthetics consideration, necessary investigations and essential design data.

Standard Specifications for Roads and Railways Bridges: General, Indian Road Congress Bridge Code, width of carriage way, clearance, various loads to be considered for the design of roads and railway bridges, detailed explanation of IRC standard live loads.

UNIT-II

Design Consideration for R. C. C. Bridges: Various types of R.C.C. bridges(brief description of each type), design of R.C.C. culvert and T-beam bridges.

UNIT-III

Design Consideration for Steel Bridges: Various types of steel bridges (brief description of each), design of truss and plate girder bridges.

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UNIT-IV

Hydraulic & Structural Design: Piers, abutments, wing-wall and approaches.

Brief Description: Bearings, joints, articulation and other details.

Bridge Foundation: Various types, necessary investigations and design criteria of well foundation.

Books:

1 Essentials of Bridge Engineering, D. J. Victor, Oxford & IBH Pub. New Delhi.
2 Design of Bridges, N. Krishna Raju, Oxford & IBH, New Delhi.
3 Bridge Deck Analysis, R. P. Pama & A. R. Cusens, John Wiley & Sons.
4 Design of Bridge Structures, T. R. Jagadish & M. A. Jairam, Prentice Hall of India, New Delhi.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	1	1	1	3	1	-	-	-	-	-	-	1	1	2
CO2.	1	1	1	1	3	1	-	-	-	-	-	-	1	1	2
CO3.	1	1	1	1	3	1	-	-	-	-	-	-	1	1	2
CO4.	1	1	1	1	3	1	-	-	-	-	-	-	1	1	2
3 –High 2-Medium 1-Low															

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PRESTRESSED CONCRETE

Course code	**PE/CE/88-T**			
Category	**Program Elective Course**			
Course title	**Prestressed Concrete**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Understand the requirement of PSC members for present scenario.	**L3 (Applying)**
CO2.	Analyse the stresses encountered in PSC element during transfer and at working.	**L4(Analyzing)**
CO3.	Understand the effectiveness of the design of PSC after studying losses	**L4(Analyzing)**
CO4.	Capable of analyzing the PSC element and finding its efficiency.	**L5 (Evaluating)**
CO5.	Design PSC beam for different requirements.	

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Introduction and Analysis of Members: Concept of Pre stressing - Types of Pre stressing - Advantages - Limitations –Pre stressing systems - Anchoring devices - Materials - Mechanical Properties of high strength concrete - high strength steel - Stress-Strain curve for High strength concrete.

Analysis of members at transfer - Stress concept - Comparison of behaviour of reinforced concrete – pre stressed concrete - Force concept - Load balancing concept - Kern point -Pressure line.

UNIT-II

Losses in Pre stress: Loss of Pre stress due to Elastic shortening, Friction, Anchorage slip, Creep of concrete, Shrinkage of concrete and Relaxation of steel - Total Loss.

Deflection and Crack Width Calculations of Deflection due to gravity loads - Deflection due to prestressing force-Total deflection - Limits of deflection - Limits of span-to-effective depth ratio -Calculation of Crack Width - Limits of crack width.

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UNIT-III

Design of Sections for Flexure: Analysis of members at ultimate strength - Preliminary Design - Final Design for Type 1 members.

UNIT-IV

Design for Shear: Analysis for shear - Components of shear resistance - Modes of Failure - Limit State of collapse for shear - Design of transverse reinforcement.

Different anchorage system and design of end block by latest IS codes.

Reference Books:

1. Krishna Raju, N. "Pre-stressed Concrete", Tata McGraw Hill Publishing Company, New Delhi 2006
2. Krishna Raju. N., "Pre-stressed Concrete - Problems and Solutions", CBS Publishers and Distributors, Pvt. Ltd., New Delhi.
3. Rajagopalan N, "Pre-stressed Concrete", Narosa Publishing House, New Delhi.
4. Pundit G S and Gupta S P, "Pre-stressed Concrete", C B S Publishers, New Delhi
5. IS: 1343: Indian Standard code of practice for Pre-stressed concrete, BIS, New Delhi.
6. IS: 3370-Indian Standard code of practice for concrete structures for storage of liquids, BIS, New Delhi.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	1	2	2	1	1	-	-	-	-	-	-	1	1	2
CO2.	1	2	2	2	1	1	-	-	-	-	-	-	1	1	2
CO3.	1	2	2	1	1	1	-	-	-	-	-	-	1	1	2
CO4.	1	1	2	1	1	1	-	-	-	-	-	-	1	1	2
CO5.	1	1	2	1	1	1	-	-	-	-	-	-	1	1	2
3 –High 2-Medium 1-Low															

Scheme of Examination & Detailed Syllabus of B.Tech (CE)

Open Elective

Courses for other Branches

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OPEN ELECTIVE COURSES OFFERED FOR VARIOUS B.TECH PROGRAMMES (2023 onwards scheme)

Open Elective Course –I for B.Tech 5th Semester

S.No	Course code	Course Name	Offered by	Credits
01	OE/CE/51-T	Introduction to Civil Engineering	Civil Engineering	3.0
02	OE/CE/52-T	Introduction to Fluid Mechanics	Civil Engineering	3.0
03	OE/CE/53-T	Disaster Preparedness and Planning Management	Civil Engineering	3.0
04	OE/CE/54-T	Civil Engg-Societal & Global Impact	Civil Engineering	3.0

Open Elective Course –II for B.Tech 6th Semester

S.No	Course code	Course Name	Offered by	Credits
01	OE/CE/61-T	Project Planning & Management	Civil Engineering	3.0
02	OE/CE/62-T	Introduction to Irrigation Engineering	Civil Engineering	3.0
03	OE/CE/63-T	Introduction to Intelligent Transport System	Civil Engineering	3.0
04	OE/CE/64-T	Remote Sensing and GIS	Civil Engineering	3.0

Open Elective Course –III for B.Tech 7th Semester

S.No	Course code	Course Name	Offered by	Credits
01	OE/CE/71-T	Environmental Engineering	Civil Engineering	3.0
02	OE/CE/72-T	Environmental Impact Assessment	Civil Engineering	3.0
03	OE/CE/73-T	Introduction to Industrial Waste Water Treatment	Civil Engineering	3.0
04	OE/CE/74-T	Introduction to Geosynthetics Engineering	Civil Engineering	3.0

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Open Elective Course –I

For

B.Tech 5th Semester

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INTRODUCTION TO CIVIL ENGINEERING

Course code	**OE/CE/51-T**			
Category	**Open Elective Course**			
Course title	**Introduction to Civil Engineering**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1	Understand the properties of different types of building materials	**L2(Understanding)**
CO2	Realize the type of forces acting on any object.	**L3(Applying)**
CO3	Explain the methods to survey any field	**L2(Understanding)**
CO4	Explain the type of highway.	**L2(Understanding)**
CO5	Identify the kind of Irrigation and Water works	**L3(Applying)**
CO6	Identify the type of soil and foundation	**L3(Applying)**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT — I

Construction materials: Stones - Characteristics of good building stones-common building stones and their uses, **Bricks** - Characteristics of good bricks-classification of bricks and their uses, **Timber -** Classification of Timber and their uses. **Cement** -Types of cement and their uses.

UNIT — II

Components of building: Components of sub structure and their functions-Components of super structure and their functions. **Type of forces** - compression, tension, shear, Stress & Strain. **Concrete** - Ingredients of concrete and its importance in construction. **Steel** - types of steel and its importance in construction

UNIT – III

Survey Engineering: Definition and classification of surveying, linear and angular measurements, levelling,

Highway Engineering: Modes of transportation, Classification of highways, Classification of pavements, Super elevation.

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UNIT — IV

Irrigation and Water supply: Definition and c1assification of irrigation, Irrigation structures dams, weirs, cross drainage works, canal drops, Quality of water-Treatment methods.

Geotechnical Engineering: Origin of soil, types of soil, bearing capacity of soil, Types of foundation - shallow and deep.

Recommended Books

1. B C Punmia, Ashok K Jain, Arun K Jain, (1st Edition, 2003), "Basic Civil Engineering", Laxmi Publications (P) Ltd.
2. G K Hiraskar, (1st Edition, 2004), "Basic Civil Engineering", Dhanpat Rai Publication

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	**2**	**2**	-	-	1	1	1	-	-	-	-	1	1	1	2
CO2.	**2**	**2**	-	-	1	1	1	-	-	-	-	1	1	1	2
CO3.	**2**	**2**	-	-	1	1	1	-	-	-	-	1	1	1	2
CO4.	**2**	**2**	-	-	1	1	1	-	-	-	-	1	1	1	2
CO5.	**2**	**2**	-	-	1	1	1	-	-	-	-	1	1	1	2
CO6.	**2**	**2**	-	-	1	1	1	-	-	-	-	1	1	1	2
3 –High 2-Medium 1-Low															

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INTRODUCTION TO FLUID MECHANICS

Course code	**OE/CE/52-T**			
Category	**Open Elective Course**			
Course title	**Introduction to Fluid Mechanics**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes

S.No	Course Outcome At the end of the course, students will be able to:	RBT* Level
CO1	Outline principles of hydrostatics and explain the concept of buoyancy and state of equilibrium	**L1(Remembering)**
CO2	Understand the properties of fluids and their behavior under static and dynamic conditions and measure fluid pressure in a manometer	**L2 (Understanding)**
CO3	Use fluid measuring devices like venture meter, orifice meter, notches and mouthpiece	**L3 (Applying)**
CO4	Distinguish various types of flows and solve the problem on continuity equation, stream function and velocity potential function	**L4(Analysing)**
CO5	Evaluate Bernoulli's equation and use it to solve the problems of fluids	**L5(Evaluating)**
CO6	Formulate one-, two- and three-dimensional continuity equations in Cartesian coordinates	**L6(Creating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

Course Content

Unit I

Basic Concepts and Definitions – Distinction between a fluid and a solid; Density, Specific weight, Specific gravity, Kinematic and dynamic viscosity; variation of viscosity with temperature, Newton law of viscosity; vapour pressure, boiling point, cavitation; surface tension, capillarity, Bulk modulus of elasticity, compressibility.

Unit II

Fluid Statics - Fluid Pressure: Pressure at a point, Pascals law, pressure variation with temperature, density and altitude. Piezometer, U-Tube Manometer, Single Column Manometer, U-Tube Differential

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Manometer, Micro-manometers. Pressure gauges, Hydrostatic pressure and force: horizontal, vertical and inclined surfaces. Buoyancy and stability of floating bodies.

Unit III

Fluid Kinematics-Classification of fluid flow: steady and unsteady flow; uniform and non-uniform flow; laminar and turbulent flow; rotational and irrotational flow; compressible and incompressible flow; ideal and real fluid flow one, two and three dimensional flows; Stream line, path line, streak line and stream tube; stream function, velocity potential function. One-, two- and three -dimensional continuity equations in Cartesian coordinates.

Unit IV

Fluid Dynamics- Surface and body forces; Equations of motion - Euler's equation; Bernoulli's equation – derivation; Energy Principle; Practical applications of Bernoulli's equation: Venturimeter, orifice meter and pitot tube; Momentum principle; Forces exerted by fluid flow on pipe bend; Vortex Flow – Free and Forced; Dimensional Analysis and Dynamic Similitude – Definitions of Reynolds Number, Froude Number, Mach Number, Weber Number and Euler Number; Buckingham's π-Theorem.

REFERENCE BOOKS

1. Fluid Mechanics and Hydraulic Machine by R. K. Bansal, Laxmi Publications.
2. Fluid mechanics and Fluid Power Engg. by D.S. Kumar, S. K. Kataria & Sons, New Delhi.
3. Hydraulics and Fluid Mechanics, P N Modi and S M Seth, Standard Book House, New Delhi.
4. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	3	2	1	2	-	1	-	-	-	-	-	-	1	1	2
CO2.	2	1	1	2	2	1	-	-	-	-	-	-	1	1	2
CO3.	2	2	1	1	-	1	-	-	-	-	-	-	1	1	2
CO4.	1	1	2	2	3	1	-	-	-	-	-	-	1	1	2
CO5.	2	3	2	2	1	1	-	-	-	-	-	-	1	1	2
CO6.	2	2	1	2	1	1	-	-	-	-	-	-	1	1	2
3 –High 2-Medium 1-Low															

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DISASTER PREPAREDNESS & PLANNING

Course code	**OE/CE/53-T**			
Category	**Open Elective Course**			
Course title	**Disaster Preparedness & Planning**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1	Understand Categories of Disasters	L2(Understanding)
CO2	Realize the responsibilities to society	L3(Applying)
CO3	Analyze relationship between Development and Disasters	L4(Analyzing)
CO4	Apply Disaster Concepts to Management	L5(Creating)

***Revised Bloom's Taxonomy Action verbs/Levels**

Course Contents

Unit I

Introduction - Concepts and definitions: disaster, hazard, vulnerability, risks- severity, frequency and details, capacity, impact, prevention, mitigation).

Disasters - Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); man-made disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills, transportation accidents, terrorist strikes, etc.); hazard and vulnerability profile of lndia, mountain and coastal areas, ecological fragility.

Unit II

Disaster Impacts - Disaster impacts (environmental, physical, social, ecological, economic, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters.

Unit III

Disaster Risk Reduction (DRR) - Disaster management cycle - its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post-disaster environmental response(water, sanitation, food safety, waste management, disease control, security, communications); Roles and responsibilities of government, community, local

institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

Unit IV

Disasters, Environment and Development - Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land-use changes, urbanization etc.), sustainable and environmental friendly recovery; reconstruction and development methods.

Reference :

1. http://ndma.gov.in/ (Home page of National Disaster Management Authority)
2. Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.
3. Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication.
4. Ghosh G.K., 2006, Disaster Management, APH Publishing Corporation
5. Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June 2003.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	2	3	-	-	-	-	-	1	-	-	-	1	1	1	2
CO2.	-	-	-	-	-	-	3	-	2	-	-	1	1	1	2
CO3.	-	-	-	1	-	3	3	2	2	-	-	1	1	1	2
CO4.	-	-	-	-	-	-	-	-	-	1	3	2	1	1	2
3 –High 2-Medium 1-Low															

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CIVIL ENGG-SOCIETAL & GLOBAL IMPACT

Course code	**OE/CE/54-T**			
Category	**Open Elective Course**			
Course title	**Civil Engg-Societal & Global Impact**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes

S.No	Course Outcome At the end of the course, students will be able to:	RBT* Level
CO1	Recall aspects of the built environment and factors impacting the quality of life	L1(Remembering)
CO2	Understand the impact that Civil Engineering projects have on the society at large and on the global arena; and use resources efficiently and effectively.	L2 (Understanding)
CO3	Apply professional and responsible judgement and take a leadership role	L3(Applying)
CO4	Examine the potential of Civil Engineering for employment creation and its contribution to the GDP	L4(Analysis)
CO5	Value the sustainability of the environment, including its aesthetics	L5(Evaluating)
CO6	Formulate energy requirement with the extent of infrastructure and analyze how they are met, comparing the past present and future.	L6(Creating)

***Revised Bloom's Taxonomy Action verbs/Levels**

Unit I

Introduction to Course and Overview; Understanding the past to look into the future: Preindustrial revolution days, Agricultural revolution, first and second industrial revolutions, IT revolution; Recent major Civil Engineering breakthroughs and innovations; Present day world and future projections, Ecosystems in Society and in Nature; the steady erosion in Sustainability; Global warming, its impact and possible causes; Evaluating future requirements for various resources; GIS and applications for monitoring systems; Human Development Index and Ecological Footprint of lndia Vs other countries and analysis; Understanding the importance of Civil Engineering in shaping and impacting the world; The ancient and modem Marvels and Wonders in the field of Civil Engineering; Future Vision for Civil Engineering

Unit II

Infrastructure - Habitats, Megacities, Smart Cities, futuristic visions; Transportation (Roads, Railways & Metros, Airports, Seaports, River ways, Sea canals, Tunnels (below ground, under

water); Futuristic systems (ex, Hyper Loop)); Energy generation (Hydro, Solar (Photovoltaic, Solar Chimney), Wind, Wave, Tidal, Geothermal, Thermal energy); Water provisioning; Telecommunication needs (towers, above-ground and underground cabling); Awareness of various Codes & Standards governing Infrastructure development; Innovations and methodologies for ensuring Sustainability.

Unit Ill

Environment-Traditional & futuristic methods; Solid waste management, Water purification, Wastewater treatment & Recycling, Hazardous waste treatment; Flood control (Dams, Canals, River interlinking), Multi-purpose water projects, Atmospheric pollution; Global warming phenomena and Pollution Mitigation measures, Stationarity and non-stationarity; Environmental Metrics & Monitoring; Other Sustainability measures: Innovations and methodologies for ensuring Sustainability.

Built environment-Facilities management, Climate control; Energy efficient built environments and LEED ratings, Recycling, Temperature/ Sound control in built environment, Security systems; Intelligent/ Smart Buildings; Aesthetics of built environment, Role of Urban Arts Commissions; Conservation, Repairs & Rehabilitation of Structures & Heritage structures; Innovations and methodologies for ensuring Sustainability.

Unit IV

Civil Engineering Projects - Environmental Impact Analysis procedures; Waste (materials, manpower, equipment) avoidance/ Efficiency increase; Advanced construction techniques for better sustainability; Techniques for reduction of Green House Gas emissions in various aspects of Civil Engineering Projects; New Project Management paradigms & Systems (Ex. Lean Construction), contribution of Civil Engineering to GDP, Contribution to employment(projects, facilities management), Quality of products, Health & Safety aspects for stakeholders; Innovations and methodologies for ensuring Sustainability during Project development.

REFERENCE BOOKS

1. NAE Grand Challenges for Engineering (2006), Engineering for the Developing World, The Bridge, Vol 34, No.2, Summer 2004.
2. Allen M. (2008) Cleansing the city. Ohio University Press. Athens Ohio.
3. Ashley R., Stovin V., Moore S., Hurley L., Lewis L., Saul A. (2010). London Tideway Tunnels Programme - Thames Tunnel Project Needs Report - Potential source control and SUDS applications: Land use and retrofit options
4. http://www.thamestunnelconsultation.co.uk/consultation-documents.aspx
5. Ashley **RM.,** Nowell **R.,** Gersonius B., Walker L. (2011). Surface Water Management and Urban Green Infrastructure. Review of Current Knowledge. Foundation for Water Research FR/R0014
6. Barry M. (2003) Corporate social responsibility- unworkable paradox or sustainable Paradigm Proc ICE Engineering Sustainability 156. Sept Issue ES3 paper 13550. p 129-130
7. Blackmore J M., Plant RAJ. (2008). Risk and resilience to enhance sustainability with application to urban water systems. J. Water Resources Planning and Management. ASCE. Vol. 134, No. 3, May

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	-	1	2	1	1	3	2	2	2	2	1	1	1	1	2
CO2.	3	1	2	1	-	3	1	1	-	-	-	-	1	1	2
CO3.	-	-	1	1	-	1	1	2	3	2	3	2	1	1	2
CO4.	-	1	1	2	-	3	1	1	-	1	1	1	1	1	2
CO5.	-	1	1	-	-	1	3	2	-	1	-	1	1	1	2
CO6.	2	2	1	2	1	1	1	-	-	1	1	1	1	1	2
3 –High 2-Medium 1-Low															

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Open Elective Course –II

For

B.Tech 6th Semester

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PROJECT PLANNING & MANAGEMENT

Course code	**OE/CE/61-T**			
Category	**Open Elective Courses**			
Course title	**Project Planning & Management**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	**Explain the construction management**	**L2(Understanding)**
CO2.	**Choose the type of contract as per the need.**	**L5(Evaluating)**
CO3.	**Explain the construction organization and planning.**	**L2(Understanding)**
CO4.	**Improve the time and cost efficiency of a project**	**L6(Creating)**
CO5.	**Extend the quality control in a project**	**L2(Understanding)**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Construction Management: Significance, objectives and functions of construction management, types of constructions, resources for construction industry, stages for construction, construction team, engineering drawings.

Construction Contracts & Specifications: Introduction, types of contracts, contract document, specifications, important conditions of contract, arbitration.

UNIT-II

Construction Planning: Introduction, work breakdown structure, stages in planning-pre-tender stages, contract stage, scheduling, scheduling by bar charts, preparation of material, equipment, labour and finance schedule, limitation of bar charts, milestone charts.

Construction Organization: Principles of Organization, communication, leadership and human relations, types of Organizations, Organization for construction firm, site organization, temporary services, job layout.

UNIT-III

Network Techniques in Construction Management-I: CPM- Introduction, network techniques, work break down, classification of activities, rules for developing networks, network development-

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logic of network, allocation of time to various activities, Fulkerson's rule for numbering events, network analysis , determination of project schedules, critical path, ladder construction, float in activities, shared float, updating, resources allocation, resources smoothing and resources leveling.

Network Techniques in Construction Management-II-PERT- Probability concept in network, optimistic time, pessimistic time, most likely time, lapsed time, deviation, variance, standard deviation, slack critical path, probability of achieving completion time, central limit theorem.

UNIT-IV

Cost-Time Analysis: Cost versus time, direct cost, indirect cost, total project cost and optimum duration, contracting the network for cost optimization, steps in time cost optimization, illustrative examples.

Inspection & Quality Control: Introduction, principles of inspection, enforcement of specifications, stages in inspection and quality control, testing of structures, statistical analysis.

Books Recommended

1. Construction Planning & Management by P. S. Gehlot & B. M. Dhir, Wiley Eastern Ltd.
2. PERT & CPM -Principles & Applications by L. S. Srinath. Affiliated East-west Press (P) Ltd.
3. Project Planning & Control with PERT & CPM by B. C. Punmia & K. K. Khandelwal, Lakshmi Pub. Delhi
4. Construction Management & Planning by B. Sengupta & H. Guha, Tata McGraw -Hills.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	3	2	3	1	1	1	-	-	-	-	-	-	2	1	2
CO2.	1	2	3	1	1	1	-	-	-	-	-	-	2	1	2
CO3.	1	3	2	1	1	1	-	-	-	-	-	-	2	1	2
CO4.	1	3	2	2	1	1	-	-	-	-	-	-	2	1	2
CO5.	3	2	2	1	1	1	-	-	-	-	-	-	2	1	2
3 –High 2-Medium 1-Low															

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INTRODUCTION TO IRRIGATION ENGINEERING

Course code	**OE/CE/62-T**			
Category	**Open Elective Courses**			
Course title	**Introduction to Irrigation Engineering**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Explain the necessity of irrigation.	**L2(Understanding)**
CO2.	Outline the soil properties pertaining to irrigation.	**L2(Understanding)**
CO3.	Analyze the alignment of canals.	**L4(Analyzing)**
CO4.	Propose the solution for the soil affected from water logging and requirement of lining of canals.	**L6(Creating)**
CO5.	Explain the requirement of river training works.	**L2(Understanding)**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Introduction: Irrigation-necessity, advantages, disadvantages, impact of irrigation on human environment , need and development of irrigation in India, crops and crop seasons, ideal cropping pattern and high yielding varieties of crops.

Soil-water relationship: Soil-water relationship, root zone soil water, infiltration, consumptive use, field capacity, wilting point, available moisture in soil, GCA, CCA, intensity of irrigation, delta, base period, Kor depth, core period, frequency of irrigation, duty of water, relation between delta, duty and base period.

UNIT-II

Irrigation methods: Irrigation requirement, flooding methods, border strip method, check basin and furrow method, assessment of irrigation water, sprinkler irrigation, favorable conditions, sprinkler systems, hydraulics of sprinkler irrigation, planning, design and maintenance of sprinkler systems, drip irrigation-components parts, advantages and limitations, suitability of drip irrigation.

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Canal irrigation: Component of canal distribution system, alignment of channels, losses in irrigation channels, design discharge.

UNIT-III

Water logging and land reclamation: Water logging-effects, causes and measures of prevention, lining of irrigation channels, types of lining, design of lined channel land drainage, open drains, design considerations, advantages of tile drains, depth of tile drains, layout of closed drains, discharge and spacing of closed drains, diameter of tile drain, outlets for tile drains, maintenance of tile drains, purpose of land reclamation and methods of land reclamation.

UNIT-IV

River Training: Classification of rivers, river training and its objectives, classification of river training works, methods of river training, marginal embankments, guide-banks, spurs, cutoffs, bank pitching and launching apron.

Books:

1. Irrigation, Water Resources and Water Power Engg. By P. N. Modi.
2. Fundamentals on Irrigation Engg. by Bharat Singh.
3. Irrigation Engg & Hydraulic Structures by S. K. Garg, Khanna Publihers, New Delhi
4. Irrigation Engg. By S. K. Sharma, S. Chand Publishers, New Delhi.
5. Irrigation -Theory & Practice by G.L. Asawa

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	1	1	1	1	1	1	-	-	-	-	-	1	1	2
CO2.	1	2	3	3	1	1	-	-	-	-	-	-	1	1	2
CO3.	1	3	3	3	2	1	-	-	-	-	-	-	1	1	2
CO4.	1	3	3	3	1	1	-	-	-	-	-	-	1	1	2
CO5.	1	1	1	1	1	1	1	-	-	-	-	-	1	1	2
3 –High 2-Medium 1-Low															

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INTRODUCTION TO INTELLIGENT TRANSPORT SYSTEM

Course code	**OE/CE/63-T**			
Category	**Open Elective Courses**			
Course title	**Introduction to Intelligent Transport System**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No.	**Course outcomes:** At the end of the course students will be able to:	**RBT* Level**
CO1	Understands the fundamentals of ITS and ITS functional areas	**L2(Understanding)**
CO2	Understand the communication technologies in transportation	**L2(Understanding)**
CO3	Able to apply the various ITS methodologies	**L3(Applying)**
CO4	Understand the ITS implementation in developing countries	**L2(Understanding)**
CO5	Able to understand and the advantages of ITS and apply the appropriate technologies for field conditions.	**L3(Applying)**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Introduction to Intelligent Transportation Systems (ITS) – Definition of ITS and Identification of ITS Objectives, Historical Background, Benefits of ITS - ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection.

UNIT-II

Telecommunications in ITS – Importance of telecommunications in the ITS system, Information Management, Traffic Management Centres (TMC). Vehicle – Road side communication – Vehicle Positioning System.

UNIT-III

ITS functional areas – Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS).

UNIT-IV

ITS User Needs and Services – Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management,

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Advanced Vehicle safety systems, Information Management; Automated Highway Systems - Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries

Books:

1. Intelligent Transport Systems by Pradip Kumar Sarkar, Amit Kumar Jain, PHI Learning Private Limited, New Delhi
2. Intelligent Transport Systems by R Srinivasa Kumar, Orient Blackswan Pvt. Ltd.
3. Intelligent Transport Systems: New Principles and Architectures by S. Ghosh, T.S. Lee, CRC Press.
4. Fundamentals of Intelligent Transportation system planning, Mashrur A. Chowdhury and A del Sadek, Artech House.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1.	**1**	**3**	**1**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**
CO2.	**1**	**3**	**1**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**
CO3.	**1**	**2**	**1**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**
CO4.	**1**	**2**	**1**	**2**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**
CO5.	**1**	**2**	**1**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**
3 –High 2-Medium 1-Low															

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REMOTE SENSING & GIS

Course code	**OE/CE/64-T**			
Category	**Open Elective Courses**			
Course title	**Remote Sensing & GIS**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Explain the different concepts and terms used in Remote Sensing.	**L2(Understanding)**
CO2.	Outline the data conversion and Process in different coordinate systems of GIS interface.	**L2(Understanding)**
CO3.	Evaluate the accuracy of Data and implementing a GIS.	**L5(Evaluating)**
CO4.	Explain the applicability of RS and GIS for various applications	**L2(Understanding)**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Concepts of Remote Sensing Basics of remote sensing- elements involved in remote sensing, electromagnetic spectrum, remote sensing terminology & units, energy resources, energy interactions with earth surface features & atmosphere, atmospheric effects, satellite orbits, Sensor Resolution, types of sensors. Remote Sensing Platforms and Sensors, IRS satellites.

Remote Sensing Data Interpretation: Visual interpretation techniques, basic elements, converging evidence, interpretation for terrain evaluation, spectral properties of soil, water and vegetation. Concepts of Digital image processing, image enhancements, qualitative & quantitative analysis and pattern recognition, classification techniques and accuracy estimation.

UNIT- II

Introduction to GIS: Introduction, History of GIS, GIS Components, GIS Applications in Real life, The Nature of geographic data, Maps, Types of maps, Map scale, Types of scale, Map and Globe, Coordinate systems, Map projections, Map transformation, Geo-referencing.

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UNIT- III

Spatial Database Management System: Introduction: Spatial DBMS, Data storage, Database structure models, database management system, entity-relationship model, normalization.
Data models and data structures: Introduction, GIS Data model, vector data structure, raster data structure, attribute data, geo-database and metadata.

UNIT- IV

Implementing a GIS: Awareness, developing system requirements, evaluation of alternative systems, decision making using GIS.

Applications of GIS: GIS based road network planning, Mineral mapping using GIS, Shortest path detection using GIS, Hazard Zonation using remote sensing and GIS, GIS for solving multi criteria problems, GIS for business applications.

BOOKS:

1. Remote Sensing and GIS by Basudeb Bhatta, Oxford University Press, 2nd Edition, 2011.
2. Introduction to Geographic Information systems by Kang-tsung Chang, McGraw Hill Education (Indian Edition), 7th Edition, 2015.
3. Fundamentals of Geographic Information systems by Michael N. Demers, 4th Edition, Wiley Publishers, 2012.
4. Textbook of Remote Sensing and Geographical Information systems by M. Anji Reddy.
5. Advanced Surveying: Total Station, GIS and Remote Sensing by Satheesh Gopi, R. Sathi Kumar, N. Madhu, Pearson Education, 1st Edition, 2007.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	2	2	1	3	1	-	-	-	-	-	-	1	1	2
CO2.	1	2	2	1	3	1	-	-	-	-	-	-	1	1	2
CO3.	1	2	2	1	3	2	-	-	-	-	-	-	1	1	2
CO4.	1	2	2	1	3	1	-	-	-	-	-	-	1	1	2
3 –High 2-Medium 1-Low															

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Open Elective Course –III

For

B.Tech 7th Semester

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ENVIRONMENTAL ENGINEERING

Course code	**OE/CE/71-T**			
Category	**Open Elective Course**			
Course title	**Environmental Engineering**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course Outcome

Sr. No	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Identify and describe various elements of water supply, sewerage and air & noise pollution.	**Ll (Remembering)**
CO2.	Differentiate between various types of pollutants with their sources, effects on environment and quantifications	**L2(Understanding)**
CO3.	Analyze the effects of different kinds of pollution and outline their respective measures for treatment.	**L4(Analyzing)**
CO4.	Design and compare sewerage systems and storm water drains.	**L6(Creating)**

Course Content

UNIT I

Water: Water Supply systems: Need for planned water supply schemes, Sources of Water, Water demand and Potable, industrial and agricultural water requirements, Components of water supply system; Transmission of water, Distribution system, Various valves used in W/S systems, service reservoirs and design.

UNIT II

Sewage: Domestic and Storm water, Quantity of Sewage, Sewage flow variations. Conveyance of sewage: Sewers, shapes design parameters, operation and maintenance of sewers, Sewage pumping; Sewerage, Sewer appurtenances, Design of sewerage systems.

Storm Water: Quantification and design of Storm water; Sewage and Sludge, Pollution due to improper disposal of sewage, National River cleaning plans, recycling of sewage -quality requirements for various purposes.

UNIT III

Air: Composition and properties of air, Quantification of air pollutants, Monitoring of air

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pollutants, Air pollution - Occupational hazards, Urban air pollution: automobile pollution, Chemistry of combustion, Automobile engines, quality of fuel, operating conditions and interrelationship. Air quality standards, Control measures for Air pollution, construction and limitations

UNIT IV

Noise: Basic concept, measurement, effects and various control methods.

Case studies on Pollution (Air, Water, Noise)

REFERENCE BOOKS:

1. Environmental Engineering, Vol. I, S.K Garg, Khanna Publishers, New-Delhi.
2. Environmental Pollution Control Engineering, C. S. Rao.
3. Environmental Engineering by H.S.Peavy, D.R.Rowe, G.Tchobanoglous: 1991, Tata-Mcgraw Hill
4. Manual on Water Supply and Treatment, (latest Ed.), Ministry of Works & Housing, New Delhi.
5. Integrated Solid Waste Management. Tchobanoglous, Theissen & Vigil. McGraw Hill Publication

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	2	1	2	-	1	3	1	-	-	-	1	1	1	2
CO2.	1	2	1	2	-	2	3	1	-	-	-	1	1	1	2
CO3.	2	3	2	1	1	1	3	1	1	2	-	1	1	1	2
CO4.	3	2	3	1	2	-	2	1	3	2	2	1	1	1	2
3 –High 2-Medium 1-Low															

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ENVIRONMENTAL IMPACT ASSESSMENT

Course code	**OE/CE/72-T**			
Category	**Open Elective Course**			
Course title	**Environmental Impact Assessment**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course Outcome

Sr. No	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Identify the environmental attributes to be considered for the EIA study	**L 3(Applying)**
CO2.	Formulate objectives of the EIA studies	**L6(Creating)**
CO3.	Identify the methodology to prepare rapid EIA	**L 3(Applying)**
CO4.	Prepare EIA reports and environmental management plans	**L6(Creating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT- I

Introduction: The Need for EIA, Indian Policies Requiring EIA, The EIA Cycle and Procedures, Screening, Scoping, Baseline Data, Impact Prediction, Assessment of Alternatives, Delineation of Mitigation Measure and EIA Report, Public Hearing, Decision Making, Monitoring the Clearance Conditions, Components of EIA, Roles in the EIA Process. Government of India Ministry of Environment and Forest Notification (2000), List of projects requiring Environmental clearance, Application form, Composition of Expert Committee, Ecological sensitive places, International agreements.

UNIT- II

EIA Methodologies: Environmental attributes -Criteria for the selection of EIA methodology, impact identification, impact measurement, impact interpretation & Evaluation, impact communication, Methods-Adhoc methods, Checklists methods, Matrices methods, Networks methods, Overlays methods. EIA review- Baseline Conditions -Construction Stage Impacts, post project impacts.

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UNIT- III

Environmental Management Plan: EMP preparation, Monitoring Environmental Management Plan, Identification of Significant or Unacceptable Impacts Requiring Mitigation, Mitigation Plans and Relief & Rehabilitation, Stipulating the Conditions, Monitoring Methods, Pre- Appraisal and Appraisal.

UNIT- IV

Environmental Legislation and Life cycle Assessment: Environmental laws and protection acts, Constitutional provisions-powers and functions of Central and State government, The Environment (Protection) Act 1986, The Water Act 1974, The Air act 1981, Wild Life act 1972, Guidelines for control of noise, loss of biodiversity, solid and Hazardous waste management rules.

Life cycle assessment: Life cycle analysis, Methodology, Management, Flow of materials-cost criteria case studies.

Case Studies: Preparation of EIA for developmental projects- Factors to be considered in making assessment decisions, Water Resources Project, Pharmaceutical industry, thermal plant, Nuclear fuel complex, Highway project, Sewage treatment plant, Municipal Solid waste processing plant, Air ports.

TEXT BOOKS:

1. Anjaneyulu. Y and Manickam. V., Environmental Impact Assessment Methodologies, B.S. Publications, Hyderabad, 2007
2. Barthwal, R. R., Environmental Impact Assessment, New Age International Publishers, 2002.
3. Jain, R.K., Urban, L.V., Stracy, G.S., Environmental Impact Analysis, Van Nostrand Reinhold Co., New York, 1991.
4. Rau, J.G. and Wooten, D.C., Environmental Impact Assessment, McGraw Hill Pub. Co., New York, 1996.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	2	1	2	1	2	3	-	-	-	2	3	1	1	1
CO2.	1	2	1	2	1	2	3	-	-	-	2	3	1	1	1
CO3.	2	3	2	1	1	2	3	-	-	-	2	3	1	1	1
CO4.	3	2	3	1	2	2	3	-	-	-	2	3	1	1	1
3 –High 2-Medium 1-Low															

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INTRODUCTION TO INDUSTRIAL WASTE WATER TREATMENT

Course code	**OE/CE/73-T**			
Category	**Open Elective Course**			
Course title	**Introduction to Industrial Waste Water Treatment**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Identify the effect of industrial waste.	**L3 (Applying)**
CO2.	Analyze the characteristics of industrial waste.	**L4(Analyzing)**
CO3.	Propose the kind of disposal of industrial waste.	**L6 (Creating)**
CO4.	Identify the type and treatment of industrial waste.	**L3 (Applying)**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Effects of industrial wastes on streams, sewerage systems and wastewater treatment plants.

UNIT-II

Minimizing the effects of industrial effluents on waste water treatment plants and receiving streams-conservation of water, process change, reuse of waste water, volume reduction, strength reduction, neutralization, equalization and proportioning.

UNIT-III

Population equivalent. Industrial effluent standards for disposal into inland surface water sources and on land for irrigation.

UNIT-IV

Study of the following Industries from waste generation, quality and its treatment including brief overview of manufacturing process:
Textile, tannery, sugar mill, distillery, dairy, pulp & paper, metal plating, oil refinery, nitrogenous fertilizers, thermal power plants and radio active wastes.

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Books:

1. Industrial and Hazardous Waste Treatment by N.L.Nemerow & A.Dasgupta.
2. Industrial Effluents by N.Manivasakam.
3. Waste Water Treatment by M.N.Rao & A.K.Dutta.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	1	1	1	3	2	2	-	-	-	-	2	1	1	1
CO2.	1	1	1	1	3	2	2	-	-	-	-	2	1	1	1
CO3.	1	1	1	1	3	2	2	-	-	-	-	2	1	1	1
CO4.	1	1	1	1	3	2	2	-	-	-	-	2	1	1	1
3 –High 2-Medium 1-Low															

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INTRODUCTION TO GEO-SYNTHETICS ENGINEERING

Course code	**OE/CE/74-T**			
Category	**Open Elective Course**			
Course title	**Introduction to Geo-synthetics Engineering**			
Scheme and credits	**L**	**T**	**Credits**	
	3	**-**	**3.0**	
Course Assessment Methods	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks			
	End semester examination (70 marks): • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.			

Course outcomes:

Sr. No	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Identify types of Geosynthetics.	**L3 (Applying)**
CO2.	Illustrate the manufacturing methods.	**L2 (Understanding)**
CO3.	Explain the usefulness of Geogrids.	**L5 (Evaluating)**
CO4.	Identify the use of Geosynthetics in Water resources projects.	**L3 (Applying)**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT I

Basic Description of Geosynthetics: Historical Development, the Nomenclature, Function, Use around the World, Applications, Development in India.
Raw Materials – Their Durability and Ageing: Raw Materials, Durability, Degrading Agencies, Polymers, Biological Resistance, Chemical Resistance, Weathering Resistance

UNIT II

Manufacturing Methods: Fibres, Yarn, Nonwoven Geotextiles, Woven Geotextiles, D.S.F. Fabrics.
Geogrids- Testing and Evaluation: Factors influencing Testing, Sampling, Physical Properties, and Mechanical Properties under Uniaxial loading, Creep Testing

UNIT III

Erosion Control with Geogrids: Wind Erosion, Rain Water Erosion, Erosion Control Measures, Placement of Geogrids
Bearing Capacity Improvement with Geogrids: Advantages, Mechanism, Modes of Failure, Friction Coefficient, Experimental Studies.

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UNIT IV

Application of Geosynthetics in Water Resource Projects: Case Study: Dharoidam, Hiran II Dam, Meda Creek Irrigation Scheme, Lining of Kakarpar Canal

Reference Books:

1. **Robert M. Koerner, Designing with Geosynthetics, Prentice Hall.**
2. **G.V. Rao & G.V.S. Raju, Engineering with Geosynthetics, Tata MacGraw Hill.**

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	1	1	1	3	1	-	-	-	-	-	-	1	1	1
CO2.	1	1	1	1	3	1	-	-	-	-	-	-	1	1	1
CO3.	1	1	1	1	3	1	-	-	-	-	-	-	1	1	1
CO4.	1	1	1	1	3	1	-	-	-	-	-	-	1	1	1
3 –High 2-Medium 1-Low															

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List of Common Courses: 2023-24

Course Code	Definition / Category
BSC	Basics Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences Including Management Courses
MC	Mandatory Courses
PC	Program Courses
PE	Program Core
OE	Open Elective Courses
EEC	Employability Enhancement Courses (Project Work/ Summer Training/ Industrial Training/ Practical Training/ Internship/ Seminar, etc.)

BSC

#	Course Title	Course Code (T)	Course Code(P)
1.	Physics	BSC/1-T(i-vii)	BSC/1-P
2.	Chemistry	BSC/2-T	BSC/2-P
3.	Mathematics-I	BSC/3-T	
4.	Mathematics-II	BSC/4-T	
5.	Mathematics-I (CSE/IT)	BSC/5-T	
6.	Mathematics-II (CSE/IT)	BSC/6-T	
7.	Mathematics-III	BSC/7-T	
8.	Introduction to Food Biotechnology	BSC/8-T	BSC/8-P

ESC

#	Course Title	Course Code (T)	Course Code(P)
1.	Basics Electrical Engineering	ESC/1-T	ESC/1-P
2.	Engineering Graphics and Design Lab	-	ESC/2-P
3.	Programming for Problem Solving	ESC/3-T	ESC/3-P
4.	Workshop/ Manufacturing Practices	ESC/4-T	ESC/4-P
5.	Analog Electronics Circuit	ESC/5-T	
6.	Engineering Properties of Food	ESC/6-T	
7.	Civil Engineering Mats Testing Evaluation-I Lab	-	ESC/7-P
8.	Civil Engineering Mats Testing Evaluation-II Lab	-	ESC/8-P
9.	Engineering Mechanics	ESC/9-T	
10.	Workshop Technology-II Lab		ESC/10-P
11.	Basics of Machine Drawing		ESC/11-P

HSMC

#	Course Title	Course Code (T)	Course Code(P)
1.	English	HSMC/1-T	HSMC/1-P
2.	Human Values & Personality Development	HSMC/2-T	
3.	Fundamentals of Management for Engineers	HSMC/3-T	
4.	Economics for Engineers	HSMC/4-T	
5.	Industrial Physiology	HSMC/5-T	

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MC

#	Course Title	Course Code (T)	Course Code(P)
1.	Induction Training	MC/1	
2.	Environmental Sciences	MC/2-T	
3.	Indian Constitution	MC/3-T	
4.	Essence of Indian Traditional Knowledge	MC/4-T	
5.	Technical Presentation		MC/5-P
6.	Entrepreneurship	MC/6-T	
7.	Disaster Preparedness & Planning Management	MC/7-T	
8.	General Proficiency		MC/8-P