Academic Programme Guide

Bachelor in Engineering (Civil Engineering)

Based on
Choice Based Credit System (CBCS)/ Elective Course System (ECS)

CHITKARA UNIVERSITY
HIMACHAL PRADESH
NAAC ACCREDITED

w.e.f.
Academic Year: 2020-21

Approved in 25th Academic Council dated 03-07-2020 vide agenda item No. 25.7

Index

1. General Information

The academic program guide is a comprehensive document detailing course scheme, associated credits per course and the distribution of each course in lecture, tutorial and practical hours. It also details the eligibility criteria for admission, for award of degree, the assessment and evaluation procedures along-with a glimpse of the pedagogical aspects of the programs. This guide is to be used in association with the academic regulations of the university to make a complete rule set. The course schemes given in this document are approved by respective Board of Studies and the Academic Council of Chitkara University. The courses of Bachelor of Engineering in Civil Program are listed in the Section 12 of this guide.

This undergraduate program in Civil Engineering prepares the students for the ever-expanding Civil Engineering fields. The graduates will have required knowledge to work in industries and will also be able take up research in related and interdisciplinary areas. The program also prepares the students in basic and applied sciences. The program of Civil Engineering at Chitkara University forms professionals who are highly proficient in the theoretical elements in order to design, develop and improve automated equipments in industry. Also, the program develops a solid knowledge to implement alternative technologies in production processes, services and in the use of computational tools for the design and improvement of civil engineering systems. The program is committed to the formation of effective communicators, team members and independent thinkers as well as with the formation of individuals who recognize universal values and the importance of life-long learning. Also, the students get an overview of basic as well as advanced engineering concepts and also learn them to apply in real life applications. Training the students with help of a 100 % application oriented and project-based learning approach remains the key strength of the program.

1.1 Program Educational Outcomes (PEOs)

The outcomes of the B.E. Civil Engineering program focus mainly on preparing engineers capable of entering and developing successfully in the workplace or on pursuing graduate studies not only in India but also in foreign companies and institutions

in areas related to discipline. During the initial years of their careers, Civil Engineering graduates will:

PEO-01: Have a successful career in Civil Engineering by demonstrating technical proficiency in the theoretical and practical knowledge of the discipline.

PEO-02: Become an effective communicator, team members, decision makers and leaders.

PEO-03: Understand the global impact of the profession and recognize the social responsibility of Civil Engineers.

PEO-04: Recognize the relevance of life-long learning and commit to professional development.

1.2 Programme Outcomes (PO)

The Programme is designed to provide the knowledge and skills needed to become an effective Engineer in a variety of organizational settings. It is a broad based, career advancement degree, rather than technical training for a particular job within an organization. The broad goal of the Programme is to provide students with a foundation in content and supporting skills/competencies that will support their development as effective Engineer. The Programme Outcomes of BE Civil Engineering are summarized as below:

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.

PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.

PO4: 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: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: 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: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: 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.

PO9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: 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: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: 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.

University Vision

To be a globally recognized organization promoting academic excellence through interdisciplinary applied research and to expand realms of knowledge through innovation.

University Mission

M1: To carry out the academic process for achieving excellence through active teacher-student-industry participation.

M2: To promote research, innovation and entrepreneurship in collaboration with industries and laboratories.

M3: To inculcate high moral, ethical and professional standards amongst our students.

M4: To contribute to building a skillful society.

1.3.1 Extra-curricular Activities based Programme Outcomes

In B.E. Civil Engineering Program, the students will be facilitated to enrich their intrapersonal skills by inculcating a diverse variety of extracurricular activities in the course curriculum. These activities are observed at two levels, one at university level and other at department level to assist in attaining the Programme Outcome based on personality of the graduate. The main objective of practicing these activities evolves around teaching the students to draw upon knowledge and experience gained from the past while adapting to the changing needs of the modern world as well as introduces them to the challenging world of construction and development through which they can develop socially valuable projects that prove eminently worthwhile in providing solutions for the local and global technical problems.

To be precise, a few of them can be co-related to a variety of activities that have been planned in accordance with the **PO3, PO4, PO7, PO8, PO9, PO10**. To promote the same, the university as a whole has taken up initiatives into organizing a variety of university-level and national level events such as Algorythm (cultural fest) and Techlone respectively on a yearly basis. The department also plays an active role in aiding students to achieve the above-stated POs by organizing several extracurricular and co-curricular activities. These activities include students offering active participation in managing the events organized by the club. The events such as Painting Contest and Quiz contests etc. could be considered for instance. Participation in such inter/intra college activities shall be considered while grading the performance of the student for each semester respectively.

1.3.2 Integration of Programme Outcomes at Global/National/SDG level

The curriculum designed will aim at achieving sustainable development goals set up by the United Nations. As we begin to take on the new Sustainable Development Goals (SDGs) architecture figures prominently in the propagation and implementation of the goals on the global, national and local stage. Inline to this, the curriculum also synchronizes outcomes of various courses of the B.E. Civil programme for designing viable structures keeping under due consideration the contemporary Sustainable Development Goals (SDGs) to ensure that the budding engineers are trained to create

safer and environment friendly buildings and, therefore contribute to healthier people, communities, and sustainable societies in the long term. The PO9 directly aims at achieving the global goal of achieving a blueprint of sustainable development across the industry, promoting a culture of widespread innovation and eminent infrastructure. The curriculum also aims to lay its prime focus upon serving its role in the achievement of the UN 2030 agenda. Through a variety of courses/activities such as EPICS, NSS, NOVATE etc., the overall purpose of service-learning is achieved with an emphasis on good health and well-being, sustainable cities and communities, quality education, responsible consumption, and effective utilization of resources. 1.4 Salient Features of the Programme

Some of the innovative initiatives for building better professionals are –

- Mentoring Program
- Engineering Exploration
- Survey camp
- Value added courses
- IOHE (Industry Oriented Hands-on Experience)

2.Eligibility for Admission

The student seeking admission in BE program should have minimum 60%marks in 12th grade or equivalent exam as declared by JEE / CBSE, with Mathematics and Physics as compulsory subjects. She/he should have appeared in JEE. The admission is based purely on merit. During admission process, the University follows reservation policy as decided by the State including the written test.

3.Programme Duration

The duration of the BE program is four years – divided into 8 semesters. There is University end term examination at the end of each semester, except in the case of Industry Oriented Hands-on Experience (IOHE) or Internship at Industry, which is evaluated by a jury appointed by the University.

Normal duration of the degree program	Maximum time allowed for completion of program
4 years	6 years

4. Pedagogical Aspects

The structural layout of the program and its courses requires that each course be divided in lecture, tutorial and practical sessions. Duration of each session as given in the column against the course in the course scheme is 55 minutes for theory and 2-4 hours for practical.

Lecture sessions: Lectures are delivered by traditional – chalk board method, supplemented by modern Information Communication technology (ICT) methods. The students are encouraged to ask questions and involve in group discussion to the extent allowed by the teacher. In some subjects where case study-based methodology is adopted, the lectures are supplemented by discussions on case studies.

Tutorial Sessions: The tutorial sessions are small groups of students interacting with the teacher, solving application oriented analytical problems. The tutorial sessions are very interactive and inculcate problem solving skills in the students.

Lab / Practical Sessions: During lab / practical sessions, the students work on prescribed list of experiments and do what they have learnt in the Lecture / Tutorial sessions.

5. Programme Structure

The various courses of BE Civil Engineering are categorized in terms of their academic affinity or their functional objectives as Basic Science, Professional Core, Engineering Science, Professional Electives, and Humanities as per AICTE model.

Professional Core/ Engineering Science/ Basic Science/ Humanities: Core courses are compulsory set of papers.

5.1 Electives courses: There will be a specified number of elective courses classified as Professional Electives or Open Electives. The students are offered a pool of different elective courses out of which they will choose the course/courses as per their interest and credit requirements. A faculty advisor may be appointed to guide the students to opt for the elective courses those are relevant to the subject in which student is registered for the degree.

5.2 Special Courses: (Engineering Exploration) During Exploration course, the students identify their team members (team size 4 to 5) and the teams would be working on Problem description EPICS (Engineering Projects in Community Service) or campus-

based problems, Solution scope (Full problem/ Module), Overview of the proposed solution. The teams should complete the following phases with the deadlines. The process for competing in this course is divided into three phases.

5.3 Industry Oriented skills are imparted to students in two types of courses:

a. Summer Course: Summer Course is designed to impart very basic industry skills in their branch of study.

b. IOHE (Industry Oriented Hands-on Experience): During Industry Oriented Hands-on Experience (IOHE), the students go to the industry and obtain extensive experience to work there.

All summer courses and IOHE together supplement the course scheme, thereby, make students Industry Ready and prepare them to be Day-one, Hour-one professionals.

5.4 Projects

In the course, the students identify their team mates (at the most 4 in each team) and work on a unique project allotted to them by faculty / group of faculty members. The projects are allotted to them either at the start of each semester or at a later stage (but not later than sessional test I) in the semester. Projects are designed by the faculty keeping in mind the courses, which the students have studied so far and are currently studying. Thus, the project statements are made in such a way that the students while working on these projects apply the concepts learned so far and the deliverables are multi-faceted. The students work on the integrated project during their lab hours.

Course Code Scheme

Sample Course Code				
C	**E**	**1**	**0**	**1**

- First two letters would indicate the academic unit offering the course
- First number would indicate the year of Course
- Second and third number would indicate the sequence number of the course in that particular semester.

The above-mentioned course code scheme may vary according to semesters and courses.

Programme Structure of BE Civil Engineering
Year I

1st Semester					
Courses					
S. No.	**Course Code**	**Name of the Course**	**Category**	**Hours (L-T-P)**	**Credits**
1	AM121	Calculus and Statistical Analysis	Basic Science	4-1-0=5	5
2	CE101	Engineering Mechanics	Basic Science	4-1-0=5	5
3	ME102	Engineering Graphics	Engineering Science	2-0-4=6	4
4	ES102	Environmental Sciences	Engineering Science	3-0-0=3	3
5	CL101	English-I	Humanities	0-0-4=4	2
6	AS101	Engineering Exploration (One-year duration)	Project Work/Special Course	3-1-0=4	Credits Offered Next semester
Total Credits (1st Semester)				**27 Hours**	**19**

2nd Semester					
Courses					
S. No.	**Course Code**	**Name of the Course**	**Category**	**Hours (L-T-P)**	**Credits**
1	AM122	Differential equation & Transformation	Basic Science	4-1-0=5	5
2	PH121	Modern and Computational Physics	Basic Science	3-1-0=4	4
3	CE202	Mechanics of solids	Professional Core	3-0-0=3	3
4	EE103	Basics of Electrical & Electronics Engineering	Engineering Science	3-1-0=4	4
5	EE104	Basic of Electronics and Electrical Engineering Lab	Engineering Science	0-0-2=2	1
6	CE102	Surveying	Professional Core	3-0-0=3	3
7	CE206	Mechanics of solids lab	Professional Core	0-0-2=2	1
8	CE103	Surveying Lab	Professional Core	0-0-2=2	1
9	PH111	Modern and Computational Physics Lab	Basic Science	0-0-2=2	1
10	AS101	Engineering Exploration	Project	0-0-2=2	3

			Work/Specia l Course		
Summer Course					
9	ME152	Manufacturing Practice	Engineering Science	0-0-4=4	2
10	CE210	Survey Camp	Professional Core/Special Course	Summer Camp	5
Total Credits (2nd Semester)				**29 Hours**	**33**

Year II

3rd Semester					
Courses					
S. No.	**Course Code**	**Name of the Course**	**Category**	**Hours (L-T-P)**	**Credits**
1	CE201	Fluid Mechanics	Professional Core	3-1-0=4	4
2	CE203	Building Material and Construction	Professional Core	3-0-0=3	3
3	CE204	Structural Analysis I	Professional Core	4-0-0=4	4
4	HR101	Human values & Professional Ethics	Engineering Science	2-0-0=2	2
5	CE402	Programming for Problem Solving	Engineering Science	2-0-4=6	4
6	CE205	Fluid Mechanics lab	Professional Core	0-0-2=2	1
7	CE207	Building Material and Construction Lab	Professional Core	0-0-2=2	1
8	CE208	Structure analysis-I Lab	Professional Core	0-0-2=2	1
9	CE209	Computer Aided Design I	Professional Core	One-week course	2
10	CL201	English-II	Humanities	0-0-4=4	2
11	AS102	Engineering Exploration II (One-year duration)	Project Work	0-0-2=2	Credits offered Next semester
Total Credits (3rd Semester)				**31 Hours**	**24**

4th Semester					
Courses					
S. No.	**Course Code**	**Name of the Course**	**Category**	**Hours (L-T-P)**	**Credits**
1	CE301	Transportation Engineering	Professional Core	3-0-0=3	3
2	CE302	Geotechnical Engineering	Professional Core	3-1-0=4	4
3	CE212	Structural Analysis II	Professional Core	3-1-0=4	4
4	CE214	Environmental Engineering	Professional Core	4-0-0=4	4
5	CE215	Hydraulic Engineering	Professional Core	3-0-0=3	3
6	CE306	Transportation Engineering lab	Professional Core	0-0-2=2	1
7	CE307	Geotechnical Engineering lab	Professional Core	0-0-2=2	1
8	CE217	Environmental Engineering Lab	Professional Core	0-0-2=2	1
9	AS102	Engineering Exploration II	Project Work/Special Course	0-0-2=2	2
Total Credits (4th Semester)				**26 Hours**	**23**

Year III

5th Semester					
Courses					
S. No.	**Course Code**	**Name of the Course**	**Category**	**Hours (L-T-P)**	**Credits**
1	CE211	Design of Concrete Structures I	Professional Core	3-1-0=4	4
2	CE213	Hydrology and Water Resources Engineering	Professional Core	3-0-0=3	3
3	CE303	Design of Steel Structures	Professional Core	3-1-0=4	4
4	CE304	Engineering Economics, Estimation & Costing	Professional Core	3-1-0=4	4
5	CE305	Computer Aided Design II	Professional Core	0-0-2=2	1
6	HU211	Cyber Security	Engineering Science	0-0-2=2	1
7	CE216	Design of Concrete structures lab	Professional Core	0-0-2=2	1

8	AS103	Engineering Exploration III (One-year duration)	Project Work/Special Course	0-0-2=2	Credits offered next semester
9	Track 1	Structural Engineering	Professional Electives, Student need to select any one track	3-0-0=3	3
	Track 2	Environmental Engineering			
	Track 3	Geotechnical Engineering			
	Track 4	Transportation Engineering			
Total Credits (5th Semester)				**25 Hours**	**21**

6thSemester					
Courses					
S. No.	**Course Code**	**Name of the Course**	**Category**	**Hours (L-T-P)**	**Credits**
1	CE308	Design of Concrete Structures- II	Professional Core	3-1-0=4	4
2	CE309	Construction Planning and Management	Professional Core	3-0-0=3	3
3	GTI301	Numerical Ability and Logical Reasoning	Professional Elective	3-0-0=3	3
4	CE310	Geo-informatics	Professional Core	3-0-0=3	3
5	CL401	Language Skills- I	Humanities	0-0-4=4	2
6	CE311	Geo-informatics Lab	Professional Core	0-0-2=2	1
7	AS103	Engineering Exploration III	Project Work	0-0-2=2	2
8	Track 1	Structural Engineering	Profession al Electives, Student need to follow the selected track in previous Semester	3-0-0=3	3
	Track 2	Environmental Engineering			
	Track 3	Geotechnical Engineering			
	Track 4	Transportation Engineering			
Total Credits (6th Semester)				**24 Hours**	**21**

Year IV

7th Semester					
Courses					
S. No.	**Course Code**	**Name of the Course**	**Category**	**Hours (L-T-P)**	**Credits**
1	CE401	Environmental Impact Assessment and Lifecycle	Professional Core	3-0-0=3	3

		Analysis			
2	CE403	Disaster Preparedness & Planning Management	Professional Core	2-0-0=2	2
3	CE404	Professional Practices (Entrepreneurship/Gate)	Professional Elective	0-0-4=4	2
4	CE409	Computer Aided Design III	Professional Core	0-0-4=4	2
5	AS104	Engineering Exploration IV	Project Work/Special Course	0-0-4=4	2
6	CL402	Language Skills- II	Humanities	0-0-4=4	2
7	Track 1	Structural Engineering	Professional Electives, Student need to follow the selected track in previous	3-0-0=3	3
	Track 2	Environmental Engineering			
	Track 3	Geotechnical Engineering			
	Track 4	Transportation Engineering			
Total Credits (7th Semester)				**24 Hours**	**16**

8th Semester				
Courses				
S. No.	**Course Code**	**Name of the Course**	**Category**	**Credits**
1	CET 9403	Industry Oriented Hands- on Experience	Training	25
2	CET 9410	Co-opt Training Module	Training	-
Total Credits (8th Semester)				**25**

Professional Electives Courses

Track 1: Structural Engineering				
S. No	**Course Code**	**Title of the Course**	**L-T-P**	**Credits**
1	CE350	Engineering Materials for Sustainability	2+1+0=3	3
2	CE351	Wood Structures	3-1-0	3
3	CE352	Masonry Structures	3-1-0	3
4	CE353	Prestressed Concrete	3-1-0	3
5	CE354	Earthquake Engineering	3-1-0	3
Track: 2 Environmental Engineering				
6	CE322	Environmental Laws and Policy	3-1-0	3
7	CE320	Municipal Solid Waste Management	3-1-0	3
8	CE323	Sustainable Design Engineering & Technology	3-1-0	3
9	CE321	Industrial wastewater Management	3-1-0	3
Track 3: Geotechnical Engineering				
11	CE331	Geotechnical Design	3-1-0	3
12	CE332	Offshore Engineering	3-1-0	3
13	CE333	Rock Mechanics	3-1-0	3
Track 4: Transportation Engineering				
15	CE340	Airport Planning and Design	3-1-0	3
16	CE341	Railway Engineering	3-1-0	3
17	CE342	Intelligent Transportation Systems	3-1-0	3
18	CE343	Port and Harbour Engineering	3-1-0	3

6. Assessment and Evaluation

The evaluation system for the BE Civil Engineering Programme has been designed to achieve the following:

- Help teaching faculty to evaluate the progress of learning of each student.
- Prescribe and promote certain acceptable and uniform standards of comprehension.
- Encourage a healthy and constructive competition among the students.

Keeping this in view, CSOET follows a system of continuous evaluation. Throughout the term, the student will be tested on his / her ability to understand concepts, learn techniques and apply them to problems in the real world. At each stage of the course, the student would be in a position to assess his / her performance and take measures to make improvements.

There are three Sessional Tests (STs) for all theory papers, the average of best two are considered. The policy on the evaluation component = Quizzes / Tutorials / Assignments is decided by the course coordinator and HOD and is announced separately for each course. The End Term examination for practical courses includes conduct of experiment and an oral examination (viva-voce).

The weightage of various components is as given in Table 1 (For Theory courses) and in Table 2, 3 (for Practical Courses).

Table 1: Evaluation components for Theory Courses

Courses can be evaluated in one of these three ways depending upon the course					
Quizzes/Assignments/ Class Tests/Case Studies	10	Formative Assessments (FAs)	20	Sessional Tests (STs)	40
Sessional Tests (STs)	30	Sessional Tests (STs)	30		
End Term Examination	60	End Term Examination	50	End Term Examination	60
Total	**100**	**Total**	**100**	**Total**	**100**

Table 2: Evaluation Components for Practical Courses

Lab Courses		
S. No.	**Evaluation Component**	**Weightage**
1	Lab Performance / File	30%

	work	
2	Lab File	10%
3	Internal Viva – Voce	20%
4	End Term	40%
	Total	**100%**

Table 3: Evaluation Components for Engineering Exploration/Integrated Projects

Lab Courses		
S. No.	**Evaluation Component**	**Weightage**
1	Identification of the Problem	10%
2	Review the literature / Model	10%
3	Weekly Performance	20%
4	Working / Presentation / Project report	20%
5	End Term Project / Working Model Display/External Viva-Voice	40%
	Total	**100%**

7. Rules for Attendance

The Programme being highly rigorous, all the students are expected to show utmost regularity in attendance. Even a day's absence is detrimental to the student's interest. Therefore, University's requirement in this regard is very stringent. The university expects its students to be regular in attending the classes. Although, we expect full 100% attendance, but the mandatory requirement of attendance is 75%. However, 10% relaxation is possible only in case of extreme circumstances and at the sole discretion of the Vice Chancellor on the recommendation of Dean/Head of the department.

Students are encouraged for participating in co-curricular activities conducted by prestigious institutions at national/international level. Such students would be eligible for grant of special Duty Leaves (limited by a cap decided by the Vice Chancellor) to make up for the attendance, in case any class work is missed during this period. This privilege extended to students will not be termed as right and is limited to just the attendance benefit.

There is no weightage for attendance in evaluation criteria.

8. Grading System

The list of letter and non-letter grades, their applicability and connotation are given below:

(a) Letter Grades

% Marks Range of Total	Grade	Qualitative Meaning	Grade Point
80 – 100	O	Outstanding	10
70 – 79	A+	Excellent	9
60 – 69	A	Very Good	8
55 – 59	B+	Good	7
50 – 54	B	Above Average	6
45 – 49	C	Average	5
40 – 44	P	Pass	4
0 – 39	F	Fail	0
	I	Incomplete	0

(b) Non-letter Grades

Audit Courses will be graded as Excellent, Good, Fair or Poor.

The grade I (Incomplete) may be awarded in the following conditions:

(i) Where a case of unfair means is pending, a 'Grade I' is awarded till the case is finalized.

(ii) Where a case of indiscipline is pending, a 'Grade I' is awarded till the case is finalized.

(iii) In cases of unfair means and indiscipline where the results for a particular examination are declared null and void.

(iv) In cases, where the student does not complete his course work because of some reason viz, shortage of attendance / is absent in the end term examination.

In case the grades are not received by the University as per the time schedule the, the HOD may make a specific authorization for the Course coordinator to report GA (Grade Awaited). The concerned HOD will also simultaneously advise Dean Examination about the estimated time by which the grades will be received. Whenever the report GA appears in the grade sheet, permission for further registration of such a student will be decided by HOD.

The Cumulative Grade Point Average (CGPA) denotes the overall performance of a student in all courses in which he is awarded letter grades. It is the weighted average of

the grade points of all the letter grades received by the student from the time of his entry into the University.

Calculation of CGPA:

The CGPA (calculated on a 10-point scale) would be used to describe the overall performance of a student (from the trimester of admission till the point of reckoning) in all courses for which LETTER GRADES will be awarded. SGPA will indicate the performance of student for any particular semester/trimester. Formulas for calculation of SGPA and CGPA have been provided as below:

$$SGPA_i = \frac{\sum_{j=i}^{n} C_{ij} G_j}{\sum_{j=1}^{n} C_{ij}}; \qquad CGPA = \frac{\sum_{i=I}^{N} SGPA_i * \sum_{j=i}^{n} C_{ij}}{\sum_{i=I}^{N} \left(\sum_{j=I}^{n} C_{ij}\right)}$$

Where n = number of subjects in the trimester; N = number of trimesters; $SGPA_i$ = SGPA for the i^{th} trimester; C_{ij} = number of credits for the j^{th} course in i^{th} trimester; and G_j = Grade point corresponding to the grade obtained in the j^{th} course.

Example to Understand the Calculation of SGPA

Suppose a student is registered in four courses 'W', 'X', 'Y' and 'Z' in a particular trimester as mentioned below in the Column - I of the table. Column - II in the table below depicts the number of credits, which those courses carried. At the end of the trimester, student was awarded with the grades as mentioned in Column – III in the table given below. Column – IV indicates the corresponding grade weight. Column – V indicate essentially the Total Grade Points for every course completed by a student in that particular semester.

Courses (Col. I)	**Credits (Col. II)**	**Grade (Col. III)**	**Grade Point (Col. IV)**	**Total Grade Points (Col. V)**
Course W	3	B	6	3 x 6 = 18
Course X	3	A	8	3 x 8 = 24
Course Y	3	O	10	3 x 10 = 30
Course Z	2	O	10	2 x 10 = 20
Total	11			92

Thus, the total GPA of the student would be =

$$SGPA = \frac{Total\ grade\ pts.}{Total\ no.of\ credits} = \frac{92}{11} = 8.36$$

Suppose the GPA of the student in two successive terms is 7.0 and 8.0 with respective course credits being 12 and 11, then the

$$CGPA = \frac{7\times12+8\times11}{12+11} = \frac{84+88}{23} = 7.48$$

9. Promotion and Registration

Any bonafide student, who appears for the examination conducted by the University, shall be promoted to the next higher semester and shall carry forward all course(s) / subject(s) in which he/she is declared fail. The student shall have to pass all papers within stipulated maximum duration as prescribed by the University to qualify for the award of degree. Further, any specific condition stipulated for a particular course, by the concerned regulatory body shall be enforced.

All students are eligible to register for next semester irrespective of number of backlogs unless a criterion is specified for any particular course.

A student is not permitted to register in a term if

(i) He/she has dues outstanding to the University, hostel, or any recognized authority or body of the University, or

(ii) His/her grade sheet in his/her immediately preceding term is withheld, or

(iii) He/she has been specifically debarred or asked to stay away from that term

Late registration may be granted in case a student fails to register on the stipulated date. Students failing to register on the specified day of registration will be allowed to register only after permission from HOD and after paying the stipulated late fee. Any student who has not registered will not be allowed to attend classes.

The registration of the student may be cancelled, if at the later stage, it is found that the student is not eligible for registration due to following reasons:

(a) If the registration of a student in a Course is not found to be in accordance with the regulations, his/her registration in that Course will be cancelled and the grade obtained, if any, will be rejected.

(b) The registration of a student in a Course or complete set of Courses in a term can be cancelled by the concerned authority when he is found guilty in cases of unfair means, breach of discipline, etc. or when he/she persistently and deliberately does not pay his dues.

(c) Absence for a period of four or more weeks at a stretch during a term shall result in automatic cancellation of the registration of a student from all the Courses in that term.

A student who is duly registered in a term is considered to be on the rolls of the university. After registration, if he withdraws from the term, or has been given prior permission to temporarily withdraw from the University for the term, or has been asked to stay away by an appropriate authority of the University will be considered to be on the rolls of the University for that term. While such a student retains the nominal advantage of being on the rolls of the University the loss of time from studies and its consequences cannot be helped by the University.

If for any valid reason a student is unable to register in a term, he must seek prior permission of HOD to drop the term. If such permission has not been requested or after a request the permission has been denied, his name would be struck off the rolls of the University and he would no longer be a student of the University. His case will be automatically processed and the file will be closed. However, if such a student, after his name has been struck off the rolls of the University, is permitted to come back, his case can be considered at the sole discretion of the competent authority of the University with the provision that all his previous records as a former student are revived under the current academic and administrative structure, regulations and schedule of fees.

10. Migration/Credit Transfer Policy

The following procedures will be followed for credit transfer for student under migration, studied in other Universities in India and Abroad:

"The credits earned by the student from the other universities in India or abroad shall be transferred as such. The Degree shall only be awarded to candidate subject to the condition that student earned the minimum no. of credit defined by Academic Regulation/APG of the Programme run by the Chitkara University."

11. Eligibility to Award the Degree

A student is deemed to have fulfilled the requirement of graduation for a degree or a higher-level degree when he has:

i. Cleared all Courses prescribed for the Programme.

ii. Earned the minimum credits required for the BE Civil Engineering Programme i.e., 182 Credits.

iii. Obtained the minimum CGPA 4.5 for the award of degree (CGPA will be calculated for minimum no. of Credits required for the BE Civil Engineering).

iv. Satisfied all requirements of these regulations.

A student is deemed to have become eligible for the degree if, in addition to satisfying the above requirements he has:

(a). Satisfied all rules of evaluation

(b). No case of indiscipline or unfair means is pending against him.

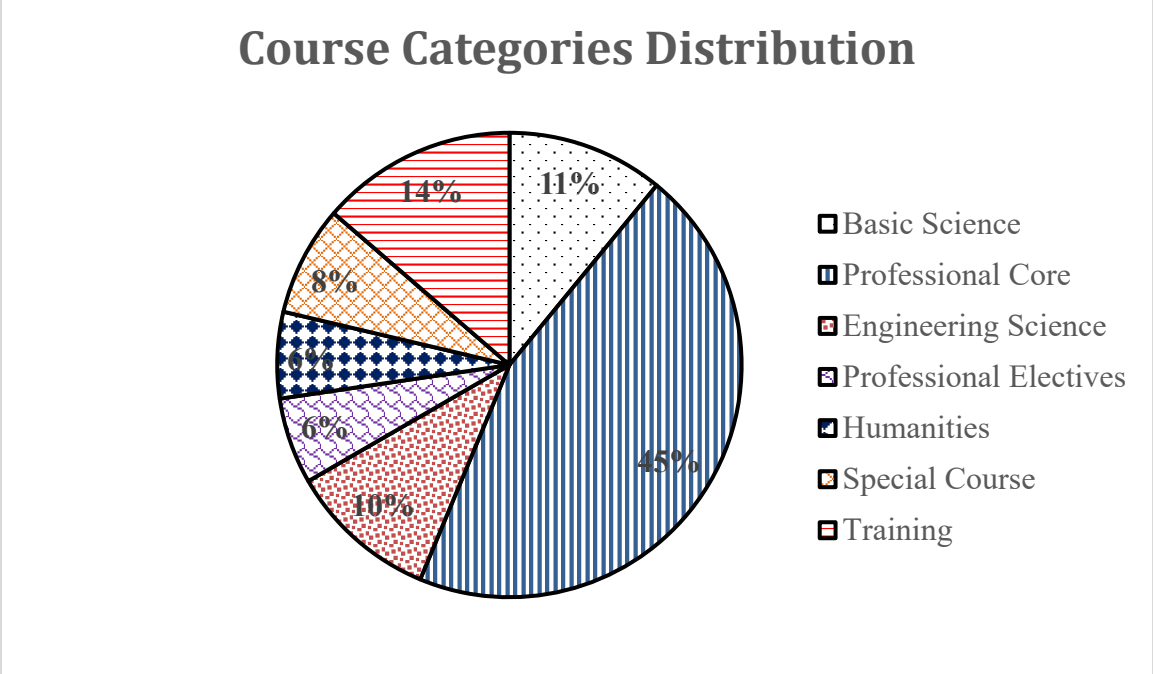
However, in case of a student having outstanding dues against him to be paid to the University, Hostel or any other recognized organ of the University, his degree will be withheld until the said dues are cleared.

Under extreme exceptional circumstances where gross violation of graduation is detected at a later stage the Academic Council may recommend to the Governing Body the recall of a degree already awarded.

12. Programme Overview

Table: Course categories wise Credits

Semester	Basic Science	Professional Core	Engineering Science	Professional Electives	Humanities	Special Course	Training	**Total Credits**
1st	10	0	8	0	2	0	0	**19**
2nd	10	8	7	0	0	8	0	**33**
3rd	0	16	4	0	4	0	0	**24**
4th	0	21	0	0	0	2	0	**23**
5th	0	17	0	3	1	0	0	**21**
6th	0	14	0	3	2	2	0	**21**
7th	0	7	0	5	2	2	0	**16**
8th	0	0	0	0	0	0	25	**25**
Total Credits	**19**	**83**	**19**	**11**	**11**	**14**	**25**	**182**



Semester I

Courses in 1st Semester of BE (Civil Engineering) Programme

Semester I				
Course Code	**Title of the Course**	**Category**	**Hours (L+T+P)**	**Credits**
AM121	Calculus and Statistical Analysis	BS	4-1-0=5	5
CE101	Engineering Mechanics	BS	4-1-0=6	5
ME102	Engineering Graphics	ESC	2-0-4=6	4
ES102	Environmental Sciences	ESC	3-0-0=3	3
CL101	English-I	HU	0-0-4=4	2
AS101	Engineering Exploration (One-year	PW	3-1-0=4	Credits Offered Next
Total			**27**	**19**

AM121	Calculus and Statistical Analysis (4-1-0)	5 Credits

Course Learning Outcomes:

CLO1: Introduce and form matrices to present mathematical solutions in a concise and informative manner. Use matrices to solve the problems of system of linear equations and solve various live problems using matrices.

CLO2: Find local extreme values of functions of several variables, test for saddle points, examine the conditions for the existence of absolute extreme values. Solve constraint problems using Lagrange multipliers and solve related application problems.

CLO3: Apply the principles of Integral Calculus to solve a variety of practical problems in Engineering and applied Sciences.

CLO4: To interpret statistical inference tasks with the help of probability & distributions and hypothesis testing for means, variances and proportions of large as well as small data and employ appropriate regression models in determining statistical relationships.

CLO5: To equip with the techniques to understand advanced level mathematics and its applications that would enhance analytical thinking to solve engineering problems.

Course Contents

Matrices:
Matrices: Review of matrices and determinants, Elementary operations, rank, Inverse of matrix (using rank), Normal form, Solution of a system of linear equations by using rank, Characteristics equations, Cayley Hamilton theorem (without proof), Eigen values and vectors , Diagonalization, Quadratic form & Canonical form, nature of quadratic form, Curve tracing (Cartesian and polar curves)- Cissoid, cardioid, Leminscate, Folium of Descartes, Three/Four Leaved Rose, Limacon.

Partial Differentiation & its Applications: Introduction to Partial Derivatives: Function of several variables, Limit and continuity Partial Differentiation, Euler's Theorem, Total derivatives, Error & Approximation, Geometrical Interpretation Tangent and Normal. Partial Derivative of Composite Functions, Implicit Functions, Jacobians, Taylor's Series Expansion, Maclaurin's Series (one and two variables). Application: Maxima and Minima of functions of two and three variables, Lagrange's method of Undetermined Multipliers.

Multiple Integration and its Applications: Introduction to Double Integration using Cartesian & polar coordinate, Change of order in double integration, Introduction to Triple Integration ,Change of variables in Polar, Cylindrical and Spherical Coordinates , Applications of multiple integral to find Area enclosed by Plane curves ,Applications of multiple integral to find Volume, Mass, Moment of Inertia, Centroid, Center of Gravity, Centre of Pressure, Improper integrals of first and second kind , Special Functions: Beta and Gamma functions.

Probability and Statistics : Random variable (discrete and continuous), discrete and continuous distribution, Binomial, Poisson distribution, Normal, Exponential distribution, Hypothesis Testing: General concepts (Testing a Statistical hypothesis, one and two tailed tests, Critical region, Confidence interval estimation), Single and two sample tests on proportion, mean and standard deviation, Sampling distribution of means and variance, t-distribution(significance test of a sample mean, significance test of difference between sample means) and F-distribution, Correlation, coefficient of co relation (direct method and step deviation method), Lines of Regression (two variable only).

Recommended Books:

1. "Advanced Engineering Mathematics", Erwin Kreyszig, Wiley India Pvt. Ltd.
2. "Engineering Mathematics", Srimanta Pal & Subodh C. Bhunia, Edition 2015, Oxford University Press.
3. "The Engineering Mathematics", 2nd Edition, Chitkara University Publication, Vol. I.
4. "Higher Engineering Mathematics", B.V. Ramana, Tata McGraw-Hill Education.
5. "Advanced Engineering Mathematics", R.K. Jain and S.R.K. Iyengar, Alpha Science International Ltd.
6. "Higher Engineering Mathematics", B.S. Grewal, Khanna Publications.
7. "A text book of Engineering Mathematics", N. P. Bali and Manish Goyal, Laxmi Publications.
8. "Vector Analysis with applications", by MD. Ali Ashraf, MD. Abdul Khaleq Hazra, Published by New Age International (New Delhi).
9. "Calculus", by Howard Anton, Irl Bivens Stephens Davis.
10. "Advanced Engineering Mathematics", H.C. Taneja, I.K. International, Vol I.

CE101	Engineering Mechanics (4-1-0)	5 Credits

Course Learning Outcomes:

CLO1: Determine resultants and apply conditions of static equilibrium to plane force systems.

CLO2: Identify and quantify all forces associated with a static framework.

CLO3: Solve problems in kinematic and dynamic systems to develop analytical skills.

CLO4: Understand basic kinematics concepts – displacement, velocity and acceleration.

CLO5: Understand basic dynamics concepts – force, momentum, work and energy with a focus on employability.

Course Contents

Introduction to Engineering Mechanics: Force Systems, Basic concepts, System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams.
Friction: Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction, screw jack & differential screw jack.
Basic Structural Analysis: Method of sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Beams & types of beams.
Centroid and Centre of Gravity: Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia-Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of Circular plate, Cylinder, Cone, Sphere.

Virtual Work and Energy Method: Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, applications of virtual work to (Beams carrying Point Load. Beams carrying U.D.L.) Energy equation for equilibrium, applications of energy method for equilibrium and Stability of equilibrium.
Review of particle dynamics- rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion.

Recommended Books:

1. "A Text Book of Engineering Mechanics", R S Khurmi, S Chand Publications.
2. "Engineering Mechanics", Dr. DS Kumar, Katson Books.
3. "Engineering Mechanics", Timoshenko and Young.
4. "Engineering Mechanics", Beer and Johnson.

ME102	Engineering Graphics (2-0-4)	4 Credits

Course Learning Outcomes:
CLO1: Understand the fundamentals of engineering drawing and geometrical objects.
CLO2: Construct the technical letters and different types of scales.
CLO3: Develop the ability of drawing a wide range of geometrical figures.
CLO4: High accuracy in constructing complex engineering curves.
CLO5: Improves the basic sketching and drawing.
CLO6: Drafting skills beneficial for civil drafting and intensifying employability.

Course Contents

Introduction of Engineering Drawing & Drawing Instruments: Classifications of Drawing, Drawing Instruments and Drawing Materials, Use of Scale and Set Square, Compass and divider and its applications, Drawing Sheet and its sizes, Grading of Pencils, Title Block.

Conventions & Dimensioning: Detailed description of various lines, uses and its conventions, Comparative thickness of various types of line groups, Conventions for various materials, Conventional Breaks. Notation of Dimensioning, Placement of Dimensioning: Aligned System, Unidirectional System, Arrangement of Dimensioning: Chain Dimensioning, Parallel Dimensioning, Combined dimensioning, Symbols & Notations for Dimensioning: Dimensioning of Arcs and Circles, Spheres, Square.

Scales: Representation of scales, Representative fraction, Data required for construction of scales, Units of measurements, Types of scales, Plain scale, Construction of a plain scale, Diagonal scale, Principle of diagonal scale, Construction of diagonal scale.

Projection of Lines: Introduction, Projection of lines, true lengths of lines and their horizontal and vertical traces (inclination to one reference plan).

Projections of Planes: Projection of planes and their traces.

Projection of solids: Projection of right solids; solids of rotation and polyhedrons etc. (inclination to one reference plane).

Sectioning of Solids: Principles of sectioning, types of sectioning, and their practice on projection of solids, sectioning by auxiliary planes.

Development of surfaces: Development of surfaces of cylinders, cones, pyramids and prisms.

Projection Techniques: Theory of Projection, Aspects of Technical Drawing, Orthographic Projection, Isometric Drawing, Auxiliary Projection.

Auto CAD: GUI Setting, Drawing Area, Starting, Saving and Opening Drawing. Coordinate (Cartesian, Polar, relative), World coordinate system (WCS) & user coordinate System (UCS), Co-ordinate Position. How to give printing command? Draw Command, Line, construction line, Polyline, Polygon, Rectangle. Arc, Circle, Spline, Parabola & Ellipse Modify Commands: Erase, copy, mirror, offset, Array, Move, Rotate Scale, Trim, Extend, Break, Chamfer, fillet, Explode. Snap command (End point, Midpoint, Intersection, Center. Drawing uses OSNAPS commands.

Recommended Books:

1. "A Text Book of Engineering Drawing", R.K. Dhawan; S. Chand & Company Ltd.
2. "Engineering Drawing", Basant Aggarwal & C.M. Aggarwal; Mc Graw Hill Education (Ind) Pvt. Ltd.
3. "Engineering Drawing", P.S. Gill, S.K. Kataria & Sons.
4. "Engineering Drawing", Harwinder Singh, Dhanpat Rai Publishing Co.
5. "Mastering AutoCAD 2018 and AutoCAD LT 2018", George Omura, Wiley Pub, India, 2018.

ES102	Environmental Sciences (3-0-0)	3 Credits

Course Learning Outcomes:

CLO1: Describe about all the natural resources, various ecosystems and energy resources, environmental pollution, waste management, biodiversity and human population.

CLO2: Design, identify and analyze both natural (disasters such as floods and earthquakes) and man-made (industrial pollution and global warming) environmental problems.

CLO3: Analyze the societal and environmental impacts of energy with respect to meet the growing energy needs for sustainable growth.

CLO4: Apply the above knowledge, as an activity to do various Case studies, required to understand the interrelationships of the natural world and also to students to real-world issues.

CLO5: Gain knowledge for employability in the field of environmental conservation, water sciences, waste management etc.

Course Contents

Introduction to environmental studies: Multidisciplinary nature of environmental studies; Scope and importance; Concept of sustainability and sustainable development.

Ecosystems: Structure and function of an ecosystem. Producers, consumers and decomposers, energy flow in the ecosystem, food chains, food webs and ecological succession. Introduction, types, characteristic features, and case study of the following ecosystems: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

Natural Resources: Renewable and non-renewable resources, Land resources and Land use change; land degradation, soil erosion and desertification, Deforestation: Causes and Impacts due to mining, dams building on environment, on forest, biodiversity and tribal populations. Water resources: Use and over exploitation of surface and ground water, floods, drought, conflicts over water (international and inter-state). Energy resources: renewable and non-renewable energy sources use of alternate energy sources, Growing energy needs, Case studies.

Biodiversity and Conservation: Definition, Levels of biological diversity: genetic, species and ecosystem diversity. Bio-geographical classification of India; biodiversity patterns and global biodiversity Hot-sports. India as a mega-biodiversity nation; Endangered and endemic species of India. Threats to biodiversity: Habitat loss, poaching of wildlife, man wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and informational values.

Environmental Pollution: Definition: types, Causes, effects and control measures of Air, Water, Soil, and Noise pollution. Nuclear hazards and human health risks. Solid waste Management: control measures of urban and industrial wastes. Pollution case studies.

Environmental Policies & Practices: Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture. Environment Laws; Environment Protection Act; Air (Prevention and control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements; Montreal and Kyoto protocols and Conservation on Biological Diversity (CBD). Nature reserves, Tribal Populations and rights, and human wildlife conflicts in Indian context.

Human Communities and the Environment: Human Population growth: Impacts on environment, human health and welfare. Resettlement and rehabilitation of project affected persons; case studies. Disaster management; floods, earthquake, cyclones and landslides. Environmental movements; Chipko, silent valley, Bishnois of Rajasthan. Environmental ethics: Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (CNG vehicles in Delhi).

Recommended Books:

1. "Environmental Studies", by Erach Bharucha, UGC, New Delhi.
2. "A Text Book of Environmental Studies", by Shashi Chawla, McGraw Hill Publication.
3. "Environmental Studies", Chitkara University Publication.
4. "Environmental Science And Engineering", N. Arumugam, V. Kumaresan , Saras Publication.
5. "Advances in Environmental Science and Engineering", Reza Iranpour, Ji Zhao, Aijie Wang, Fenglin Yang and Xinyong Li., Trans Tech Publications

CL101	English-I (0-0-4)	2 Credits

Course Learning Outcomes:

CLO1: Student will be able to apply grammatical structures in presenting contextual ideas clearly to aid communication skills.

CLO2: Student will be able to elucidate vocabulary progressively and effectively use as per the social condition.

CLO3: Student will be able to exhibit the language functionally in real life situations and social settings.

CLO4: Student will be able to determine and demonstrate the usage of the language effectively in both academic and professional setup.

CLO5: Students will be effectively able to appear in group discussions for employability enhancement.

Course Contents

The basic course on English language, mainly focusing on the student ability to develop the skills mentioned below. The Course will cover basic and advanced grammar as well as focus on speaking skills of students in day-to-day life. The student will be trained to comfortably converse with people who speak the language well and conduct a simple conversation on the telephone and face to face. The student will be trained to start short conversations on familiar subjects. The student will be encouraged to talk about his/ her life experiences, discuss progress and describe future plans and use correct intonation. The student will practice question tags, relative clauses, present perfect, present perfect continuous, regular and irregular verbs, passive voice and future passive.

AS101	Engineering Exploration (One-year duration) (0-0-1)	2 Credits

Course Learning Outcomes:

CLO1: Students will able to apply material from their discipline to the design of community-based projects.

CLO2: Students will get an appreciation of the role that their discipline can play in social contexts.

CLO3: To get awareness of professional ethics and responsibility.

CLO4: To enhance team working and leadership skills to facilitate employability.

CLO5: Demonstrate the ability to work in a team based small projects and effectively use.

Course Contents

This course is based on the concept of problem-based learning. It is crafted to address the design requirements of the degree and prepare engineering students with all the necessary skills to face the challenges of today's world economy. Students work in teams of 3 to 5 on their projects. Project supervision focuses on the process as well as the product. There is a continuous assessment of the team including an Interim report and a final report.

Semester II

Courses in 2nd Semester of BE (Civil Engineering) Programme

Semester II				
Course Code	**Title of the Course**	**Category**	**Hours (L+T+P)**	**Credits**
AM122	Differential equation & Transformation	BS	4-1-0=5	5
PH121	Modern and Computational Physics	BS	3-1-0=4	4
CE202	Mechanics of solids	PCC	3-0-0=3	3
EE103	Basics of Electrical & Electronics Engineering	ESC	3-1-0=4	4
CE102	Surveying	PCC	3-0-0=3	3
EE104	Basics of Electrical & Electronics Engineering Lab	ESC	0-0-2=2	1
CE103	Surveying Lab	PCC	0-0-2=2	1
CE206	Mechanics of solids lab	PCC	0-0-2=2	1
PH111	Modern and Computational Physics Lab	BS	0-0-2=2	1
AS101	Engineering Exploration I	PW	0-0-2=1	3
Total			**29**	**26**

Summer Courses

ME152	Manufacturing Practices Lab	ESC	0+0+4=4	2
CE210	Survey Camp	PCC	Summer Camp	5

AM122	Differential equation & Transformation (4-1-0)	5 Credits

Course Learning Outcomes:

CLO1: To analyze and correlate many real-life problems mathematically and thus find the appropriate solutions for them using Fourier series and Transforms (Fourier and Laplace transform).

CLO2: Using ordinary differential equations student will be able to solve various practical problems in Science and Engineering.

CLO3: Possess an ability to recognize and find families of solutions for most real physical processes such as heat transfer, elasticity, quantum mechanics, water flow and other practical problems in Science and Engineering, which are governed by ordinary and partial differential equations.

CLO4: Student will be able to analyze functions of complex variables, techniques of complex integrals and compute integrals over complex surfaces.

CLO5: To develop skills required to find the appropriate differential equations that can be used as mathematical models.

Course Contents

Fourier series: Introduction, Fourier Series on Arbitrary Intervals, Half-range cosine and sine series, Fourier Transform with properties, Parseval's Identity.

Ordinary Differential Equations: Differential equations of first order and first degree – exact, linear and Bernoulli, Clairauts, Application to orthogonal trajectories. Second and higher order ordinary linear differential equations with constant coefficients - Complementary function - Particular integrals (standard types), Differential Operator Method, Variation of parameters, Method of Undetermined Coefficients. Cauchy-Euler differential equation. Simultaneous linear differential equations (two variables) with constant coefficients, Application to RLC circuit, etc.

Partial Differential Equation: Formation of partial differential equations - Equations of first Order - Lagrange's linear equation - Charpit's method - Standard types of first order non-linear partial differential equations. Solution of second order linear partial differential equations in two variables with constant coefficients by finding complementary function and particular integral. Classification of PDE of second order - parabolic, elliptic and hyperbolic equations - Solution by separation of variables. Solutions of one-dimensional heat and wave equations and two-dimensional Laplace equation using Fourier series.

Functions of Complex Variables: Limits, Continuity, Derivative of Complex Functions, Analytic Function, Cauchy Riemann Equation, Harmonic Functions, Conformal Mapping, Complex Integration, Cauchy's Theorem, Cauchy Integral formula, Taylors and Laurent's Expansion.

Laplace Transform: Laplace Transforms (with proof) (periodic functions, functions with discontinuity, multiplication with tn, division by t), Inverse transforms properties, transforms of derivatives and integrals, Unit step function, Dirac's delta function, impulse function, Applications to solve homogeneous and non-homogeneous differential equations.

Recommended Books:

1. "Advanced Engineering Mathematics", Erwin Kreyszig, Wiley India Pvt. Ltd.

2. "Engineering Mathematics", Srimanta Pal &Subodh C. Bhunia, Edition 2015, Oxford University Press.
3. "The Engineering Mathematics", 2nd Edition, Chitkara University Publication, Vol. II.
4. "Higher Engineering Mathematics", B.V. Ramana, Tata McGraw-Hill Education.
5. "Advanced Engineering Mathematics", R.K. Jain and S.R.K. Iyengar, Alpha Science International Ltd.
6. "Higher Engineering Mathematics", B.S. Grewal, Khanna Publications.

PH121	Modern and Computational Physics (3-1-0)	4 Credits

Course Learning Outcomes:

CLO1: Possess an ability to apply knowledge of fundamental physical concepts and appropriate mathematics involved in the course.

CLO2: Possess an ability to analyze a physical problem, and suggest the possible solution of that problem.

CLO3: Apply fundamental principles of physics together with analytic tools to evaluate and describe physical situations appropriate to address a scientific problem.

CLO4: Apply the fundamental principles involved in Physics to solve a variety of practical problems in engineering domain.

CLO5: Develop skills for critical thinking and problem solving involving the various concepts of physics.

Course Contents

Electrodynamics: Vector and scalar fields, Gradient, divergence, curl and their physical interpretation, Gauss's theorem and Stoke's theorem & Green's theorem (Statement only) (Statement only), Equation of continuity, Maxwell's equations (Integral & differential form), Maxwell's equations in free space, Propagation of electromagnetic waves in free space and its applications in daily life.

Laser: Introduction, Laser characteristics such as coherence, monochromaticity, collimated and angular divergence, laser action, stimulated absorption, spontaneous emission, stimulated emission, Population inversion and pumping. Derivation of Einstein's coefficient relation, Various level lasers, two level, three level, four level, Ruby laser, Helium-Neon laser, Semiconductor laser, concepts of Holography, LASER Applications in engineering.

Fiber Optics: Basic principle of optical fibre, step index and graded index fibers, Parameters of optical fibers, acceptance angle, acceptance cone, numerical aperture, normalized frequency, No. of modes, Attenuation in optical fibers, intermodal and intramodal dispersion (no derivation), optical fibers in communication, Applications of optical fibres in engineering.

Magnetic Materials: Terminology and classification, Derivation of Magnetic moments of an atom, Ferromagnetism and related phenomena, Ferrites, The domain structure, The hysteresis loop, Types of magnetic materials, soft magnetic materials, hard magnetic materials, comparison between ferromagnetic and super paramagnetic materials, applications of magnetic materials in engineering.

Superconductivity: Introduction, Meissner effect, critical field, critical current, Isotope effect, Types of superconductors: type I superconductors, type II superconductors, London equations, Penetration depth, Cooper pair and BCS theory (Qualitative only), high temperature superconductors. Applications of superconductivity e.g. Lavitation Effect, SQUID etc.

Quantum Mechanics: Introduction to Quantum Mechanics, Group velocity and phase velocity (No relation), de-Broglie waves, Uncertainty principle (statement only), Postulates of Quantum Mechanics, Wave function and its significance, Normalized wave function, Time Independent Schrodinger wave equations, Time dependent Schrodinger wave equations, Orthonormal wave functions, Particle in a one-dimensional box.

Gaming Sciences: Basic Physics behind flight of Drone and Navigation (GPS).

Recommended Books:

1. "Engineering Physics", by H. K. Malik and A. K. Singh, Mc Graw Hill Education.
2. "Engineering Physics", by Chitkara Publication 2nd Edition.
3. "Engineering Physics" by Dr. M. N. Avadhanulu and Dr P.G. Kshirsagar, S. Chand & Company PVT. LTD.
4. "Engineering Physics", by Dr S Mani Naidu, Pearson.
5. "Engineering Physics", by Dattu R Joshi, Mc Graw Hill Education.
6. "Concepts of Modern Physics", by Arthur Beiser.
7. "Engineering Physics", by R.K Guar, & S. L. Gupta.
8. "Engineering Physics", by Vanchna Singh and Sheetal Kumar.
9. "Interactive Engineering Physics", by Randhir Singh.

CE202	Mechanics of solids (3-0-0)	3 Credits

Course Learning Outcomes:
CLO1: Determine resultants and apply conditions of static equilibrium to plane force systems to develop analytical skills.
CLO2: Identify and quantify all forces associated with a static framework.
CLO3: Analyze different load cases with different loading conditions.
CLO4: Understand the basic concept of simple stress and strain, theory of flexure and torsion, springs and strain energy.
CLO5: Have understanding about failure modes of materials and response to fatigue enhancing employability skills.

Course Contents
Simple Stresses and Strains: Simple Stresses and Strains- Concept of stress and strain, St. Venant's principle, stress and strain diagram, Elasticity and plasticity – Types of stresses and strains, Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio and volumetric strain – Elastic moduli and the relationship between them– Bars of varying section – composite bars – Temperature stresses. Strain Energy – Resilience – Gradual, sudden, impact and shock loadings – simple applications.
Internal Loading in Beams: Bending moment and Shear Force Diagrams- Bending moment (BM) and shear force (SF) diagrams.BM and SF diagrams for cantilevers simply supported and fixed beams with or without overhangs. Calculation of maximum BM and SF and the point of contra flexure under concentrated loads, uniformly distributed loads over the whole span or part of span, combination of concentrated loads (two or three) and uniformly distributed loads, uniformly varying loads, application of moments.
Deflections of Beams: Slope and deflection- Relationship between moment, slope and deflection, Moment area method, Double Integration Method, Macaulay's method. Use of these methods to calculate slope and deflection for determinant beams.
Principal Stress and Strain: Compound Stresses and Strains- Two-dimensional system, stress at a point on a plane, principal stresses and principal planes, Mohr circle of stress, ellipse of stress and their applications. Two-dimensional stress-strain system, principal strains and principal axis of strain, circle of strain and ellipse of strain. Thin Cylinders and Spheres- Derivation of formulae and calculations of hoop stress, longitudinal stress in a cylinder, and sphere subjected to internal pressures.
Bending and Shear Stresses: Flexural Stresses-Theory of simple bending – Assumptions – Derivation of bending equation: $M/I = f/y = E/R$ - Neutral axis – Determination of bending stresses – Section modulus of rectangular and circular sections (Solid and Hollow), I, T, Angle and Channel sections – Design of simple beam sections. Shear Stresses- Derivation of formula – Shear stress distribution across various beam sections like rectangular, circular, triangular, I, T angle sections.
Torsion: Torsion- Derivation of torsion equation and its assumptions. Applications of the equation of the hollow and solid circular shafts, torsional rigidity, Combined torsion and bending of circular shafts, principal stress and maximum shear stresses under combined loading of bending and torsion. Analysis of close-coiled-helical springs.

Recommended Books:

7. “Mechanics of Materials", R.C. Hibbeler, Pearson Higher Education.
8. "Strength of Materials", S. Ramamrutham and R. Narayanan, Dhanpat Rai Publishing Company.
9. “Mechanics of Material”, Barry J. Goodno/James M. Gere, Cengage Learning India Pvt. Ltd.
10. “Mechanics of Materials", Egor P. Popov, Mechanics of Material, Pearson.

EE103	Basics of Electrical & Electronics Engineering (3-1-0)	4 Credits

Course Learning Outcomes:

CLO1: Students would have the basics skills pertaining to electronics elements, their functionality and applications. They would be able to perceive the concept of logic gates and integrated circuits in electronics.

CLO2: Skills to interpret the characteristics of various types of diodes and transistors to describe the operation of related circuits for evolving engineering solutions.

CLO3: Students would be able to apply fundamental principles of electronics together with analytic tools to evaluate and describe physical situations appropriate to address a scientific problem.

CLO4: Function on multidisciplinary teams to strengthen leadership and team working skills.

CLO5: Students would possess a skill to explore physical systems by setting up experiments, collecting and analyzing data, identifying sources of uncertainty, and interpreting their results in terms of the fundamental principles and concepts of electronics.

Course Contents

ANALYSIS OF DC CIRCUITS: Ohm's law, Kirchhoff's law – KCL and KVL, Analysis of DC circuits using Mesh and Nodal analysis.

ANALYSIS OF AC CIRCUITS: Introduction to Alternating Voltage and Current—Waveform terms and Definitions. Root mean square, peak value, average value of A.C, phasor representation, and rectangular and polar forms of alternating quantities. Analysis of pure resistive, inductive and capacitive circuits. Analysis of series R-L, R-C and R-L-C circuits. Introduction to three phase systems-types of connections.

ELECTROMECHANICS: Definition of emf, mmf, flux and reluctance, Faraday's laws, self and mutual inductance. Transformer – principle, construction & working, DC Motor: Principle, Construction, Working, Three Phase, Induction Motors: Principle, Construction, Working.

ELECTRICAL PROTECTION: Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing, Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

ELECTRONIC COMPONENTS AND DEVICES: Introduction to semiconductor theory & PN junction. Working principle of Light Emitting Diode, Photodiode.

DIGITAL ELECTRONICS AND LINEAR ICs: Number Systems: binary, octal and hexadecimal. Logic gates (74XX series), Implementation of Boolean expression using Universal gates.

Recommended Books:

1. "Basic Electrical and Electronics Engineering", by M.S. Sukhija, T.K. Nagsarkar, Oxford University, 2012.

2. "Basic Electrical and Electronics", by R Muthusubramanian, S Salivahanan, K, Tata McGraw Hill, 2013.
3. "Basic Electrical Engineering", by DC Kulshrestha, Tata McGraw-Hill Education, 2012.
4. "Basics of Electrical & Electronics Engineering", S. K. Bhattacharya, Pearson Publications

CE102	Surveying (3-0-0)	3 Credits

Course Learning Outcomes:

CLO1: Skills enhanced to carry out preliminary surveying in the field of civil engineering, applications such as structural, highway engineering and geotechnical engineering.

CLO2: Plan a survey, taking accurate measurements, field booking, plotting and adjustment of traverse.

CLO3: Use various conventional instruments involved in surveying with respect to utility and precision.

CLO4: Plan a survey for applications such as road alignment and height of the building.

CLO5: Undertake measurement and plotting as field surveyor with focus on employability.

Course Contents

Introduction to Surveying: Principles, Linear, angular and graphical methods, Survey stations, Survey lines- ranging, bearing of survey lines: Plane table surveying, Principles of levelling- booking and reducing levels; differential, reciprocal leveling, profile levelling and cross sectioning. Digital and Auto Level, Errors in levelling; contouring: Characteristics, methods, uses.

Triangulation and Trilateration: Theodolite survey: Instruments, Measurement of horizontal and vertical angle; Horizontal and vertical control - methods -triangulation - network- Signals. Baseline - choices - instruments and accessories - extension of base lines - corrections - Satellite station - reduction to centre - Intervisibility of height and distances - Trigonometric leveling.

Curves: Elements of simple and compound curves – Method of setting out– Elements of Reverse curve - Transition curve – length of curve – Elements of transition curve - Vertical curves.

Modern Field Survey Systems: EDM: Principle of Electronic Distance Measurement, Modulation, Types of EDM instruments, Distomat.

Total Station – Parts of a Total Station – Accessories –Advantages and Applications, Field Procedure for total station survey, Errors in Total Station Survey.

Global Positioning Systems: Basics of Global Positioning Systems, Segments, GPS measurements and applications.

Recommended Books:

1. "Surveying and leveling", by N.N Basak.
2. "Surveying and leveling Vol – II", by B.C. Punmia.
3. "Higher Surveying", by A M Chandra.
4. "Surveying Vol, I & II", by S K Duggal.

EE104	Basics of Electrical & Electronics Engineering Lab (0-0-2)	1 Credit

Course Learning Outcomes:

CLO1: After completing the course, students would have skills to know the basics of electronics elements, their functionality and applications and would be able to design basic electronics projects.
CLO2: They would be able to analyze and characterize the electronic circuits and have basic understanding for their implementation.
CLO3: They would possess a skill to perceive the concept of logic gates like XOR and X-NOR and integrated circuits in electronics.
CLO4: Simulate laboratory experiments in the software.
CLO5: Perform tests on motor-generator set.

Course Contents

1. Introduction to various basic electronic components and use of Multimeter.
2. Verification of Kirchhoff's laws in D.C circuits.
3. Analysis of AC Circuits.
4. To start and reverse the direction of rotation of three phase induction motors.
5. Measurement of self-inductance, mutual inductance and coupling coefficient of windings.
6. Analyze the truth tables of various basic digital gates.
7. Plot and analyze the forward and reverse characteristics of PN junction Si and Ge diodes and determine their knee and breakdown voltages.
8. To plot the temperature versus resistance characteristics for RTD.
9. To study the concept of electrical protection devices such as Fuse and MCB.
10. To perform open- circuit and short circuit test on a transformer and determine (i) efficiency, (ii) voltage regulation.
11. To analyze Zener diode as voltage regulator.

Recommended Books:

1. "Chitkara University Lab Manuals" by Chitkara University Himachal Pradesh.
2. 'Basic Electrical Engineering', by D. C. Kulshreshtha, Tata McGraw Hill, 2009.
3. "Electronics Engineering Lab Manual", NAVAS, K. A, Abhishek publications.

CE103	Surveying Lab (0-0-2)	1 Credit

Course Learning Outcomes:

1. Measurement of distance and determination of area of polygon by chaining.
2. Traversing with prismatic compass (Open & Closed traverse).
3. Plane table surveying by radiation method and Intersection method Profile Leveling.
4. Carry out the Fly Leveling.
5. Carry out the Contouring in the field.
6. Measurement of horizontal and vertical angles using theodolite.
7. Setting out the simple curve in different methods (Chord & Rankine's method).
8. Measurement of Horizontal, Vertical Angles and area using Total Station.
9. Observations using GPS.

Recommended Books:

1. "Lab manual Geodesy- I" (surveying- I) by Chitkara University.
2. "Lab Manual Geodesy- II" (Surveying- II) by Chitkara University.

PH111	Modern and Computational Physics Lab (0-0-2)	1 Credit

Course Learning Outcomes:

CLO1: Possess an ability to apply knowledge of fundamental physical concepts and appropriate mathematics involved in the course.
CLO2: Possess an ability to analyze a physical problem, and suggest the possible solution of that problem.
CLO3: Apply fundamental principles of physics together with analytic tools to evaluate and describe physical situations appropriate to address a research problem.
CLO4: Develop the skill to explore physical systems by setting up experiments, collecting and analyzing data, identifying sources of uncertainty, and interpreting their results in terms of the fundamental principles and concepts of physics.
CLO5: Possess an ability to evaluate and analyze scientific measurement and error analysis.

Course Contents

1. To determine attenuation & propagation losses in optical fibre.
2. To determine numerical aperture of an optical fibre.
3. To study the Hall effect in a semiconductor.
4. To determine Planck's constant by using light emitting diodes.
5. To find out the Mass Susceptibility of FeCl3 by Quinke's Method.
6. To draw the B-H curve of a given magnetic material.
7. To determine the wavelength of light using Michelson's Interferometer.
8. To measure the specific rotation of cane sugar solution using Laurent's half shade polarimeter.
9. Study of Diffraction using Laser beam and thus to determine the wavelength/grating element.
10. To study the laser beam characteristics like wave length, aperture & divergence etc.
11. To determine the ionization potential of mercury using a gas filled diode.
12. To determine e/m ratio of electron by using Thomson method.
13. To study the variation of magnetic field with distance along the axis of a current carrying coil using Stewart and Gee's apparatus.

Recommended Books:

1. "Practical physics by Squires", Cambridge University press.
2. "Practical Physics" C.L Arora.

CE206		**Mechanics of solids lab (0-0-2)**	**1 Credit**

Course Learning Outcomes:

CLO1: Calculate deformation of statically determinate structures using geometric and energy methods.
CLO2: Conduct compression tests on spring, wood and concrete.
CLO3: Conduct flexural and torsion test to determine elastic constants.
CLO4: Determine hardness of metals.
CLO5: Analyze the behavior of the solid bodies subjected to various types of loading.

Course Contents

1. Study of Universal Testing Machine (U.T.M.).
2. Determine tensile strength of mild steel specimen in the U.T.M.
3. Determine tensile strength of cast iron specimen in the U.T.M.
4. Determine the hardness of a mild steel specimen using Rockwell hardness tester
5. Determine torsional strength of mild steel & calculate modulus of rigidity in the torsion testing machine.
6. Determine the compressive strength of cast iron specimen in the U.T.M.
7. Determine the impact strength of mild steel by Izod impact test.
8. Determine the impact strength of mild steel by Charpy impact test.
9. Determine the fatigue strength of a given mild steel specimen in a fatigue testing machine.
10. Calculate the flexural rigidity of simply supported wooden beam.

Recommended Books:

1. A text book of "Strength of materials" by Dr. Sadhu Singh.
2. "Chitkara Lab Manual" by Chitkara University.

AS101	**Engineering Exploration (One-year duration) (0-0-1)**	**2 Credits**

Course Contents

This course is based on the concept of problem-based learning. It is crafted to address the design requirements of the degree and prepare engineering students with all the necessary skills to face the challenges of today's world economy. Students work in teams of 3 to 5 on their projects. Projects are done in cooperation with various departments and various laboratories/ workshops are available to the students. Project supervision focuses on the process as well as the product. There is a continuous assessment of the team including an Interim report and a final report.

ME152	Manufacturing Practices Lab (0-0-4)	2 Credits

Course Learning Outcomes:
CLO1: To acquire skills in basic mechanical/civil engineering practice.
CLO2: To identify the hand tools and instruments.
CLO3: To acquire measuring skills.
CLO4: To provides the knowledge of job materials in various shops.
CLO5: To provides the knowledge of core technical subjects for making and working of any type of project.
CLO6: Understand modern manufacturing operations, including their capabilities, limitations, and how to design economically.
CLO7: Assess the working conditions of any machining process and thus calculating the actual forces involved so as to enhance employability**.**

Course Contents

Carpentry and Pattern making: Various types of timber and practice boards, defects in timber, seasoning of wood; tools, wood operation and various joints; exercises involving use of important carpentry tools to practice various operations and making joints.

Fitting Shop: Introduction of fitting practice and tools used in fitting shop; exercise involving marking, cutting, fitting practice (Right Angles), male-Female mating parts practice, trapping practice.

Sheet Metal: Development of surfaces of various objects; sheet metal forming and joining operations, joints, soldering and brazing; exercises involving use of sheet metal forming operations for small joints.

Machine Shop: Introduction to various machine tools, grinders etc; cutting tools and operations; exercises involving lathe, various tools used on lathe, drilling m/c, grinder etc.

Welding Shop: Introduction to different welding methods; welding equipment; electrodes; welding joints; welding defects; exercises involving use of gas/ electric arc welding.

Electrical Shop: Introduction to electrical wiring; Testing tools and apparatus, Computer Work Bench: Introduction to computer Hardware & peripherals Parts: Motherboard, Processor, Socket types, Input/output ports, Memory (primary, secondary), hard disc, CD/DVD drive, key board, mouse, SMPS.

Recommended Books:

1. "Chitkara Lab Manual" by Chitkara University.
2. "Production Technology", By Jain R.K.; Khanna Publishers, New Delhi.

CE210	Survey Camp	5 Credits

Course Learning Outcomes:

CLO1: An ability to function in multidisciplinary teams.
CLO2: To develop a skill to communicate (both oral and written) effectively
CLO3: Ability to concepts of surveying and plotting topographical maps of various terrains as well as to analyze and interpret data from these maps.
CLO4: Recognition of the need for, and ability to engage in life-long learning.
CLO5: To make student ready for industry in field of surveying and thus enhances employability.

Course Contents

1. Profile or Longitudinal Levelling.
2. Cross section Levelling of the given river / road.
3. Calculate the height of landform / Building using the theodolite.
4. Locate the Building / land using plane tabling.
5. Prepare the contours map for given area using any levelling instruments.
6. Prepare the contours map for given area using any levelling instruments.
7. Total station surveying.
8. Prepare the map with coordinates (X, Y and Z) using the GPS and calculate the area for given site.

Recommended Books:

1. "Lab manual Geodesy- I" (surveying- I), Chitkara University.
2. "Lab Manual Geodesy- II" (Surveying- II), Chitkara University.

Semester III

Courses in 3rd Semester of BE (Civil Engineering) Programme

SEMESTER III				
Course Code	**Title of the Course**	**Category**	**Hours (L+T+P)**	**Credits**
CE201	Fluid Mechanics	PCC	3-1-0=4	4
CE203	Building Material and Construction	PCC	3-0-0=3	3
CE204	Structural Analysis I	PCC	4-0-0=4	4
HR101	Human values & professional Ethics	ESC	2-0-0=2	2
CE402	Programming for Problem Solving	ESC	2-0-4=6	4
CE205	Fluid Mechanics lab	PCC	0-0-2=2	1
CE207	Building Material and Construction Lab	PCC	0-0-2=2	1
CE208	Structure analysis-I Lab	PCC	0-0-2=2	1
CE209	Computer Aided Design I	PCC	One-week course	2
CL201	English-II	HU	0-0-4=4	2
AS102	Engineering Exploration II (One-year duration)	PW	0-0-2=2	credits offered next semeste
	Total		**31**	**24**

CE201	Fluid Mechanics (3-1-0)	4 Credits

Course Learning Outcomes:

CLO1: Solve hydrostatic problems to enhance analytical skills.
CLO2: Describe the physical properties of a fluid.
CLO3: Calculate the pressure distribution for incompressible fluids.
CLO4: Calculate the hydrostatic pressure and force on plane and curved surfaces.
CLO5: Demonstrate the application point of hydrostatic forces on plane and curved surfaces to focus on employability.

Course Contents

Concept of fluid: Difference between solids, liquids and gases, ideal and real fluids, units and dimensions. Physical properties of fluids: continuum concept of fluid – mass density, specific weight and specific gravity; viscosity and its dependence on temperature, Surface tension and capillarity, evaporability and vapor pressure; Newtonian and Non –Newtonian fluids.
Fluid statics: Pressure and its relationship with height, pressure, Pascal's law, hydrostatic law, action of fluid pressure on plane (horizontal, vertical and inclined) submerged surface, force on curved submerged surface. Buoyancy and flotation: Archimedes's principle, stability of immersed and floating bodies, determination of Metacentric height.
Fluid kinematics: classification of fluid flows, streamlines path lines and streak line, Flow Rate and Continuity equation, Differential equation of Continuity, Continuity Equation in Polar Co-ordinates, Velocity and acceleration of fluid particles, Rotational velocity and Circulation, Vortex motion, Free Vortex flow, Forced Vortex flow stream & velocity potential functions.
Fluid Dynamics: Control Volume and control surface, energy and its forms, Euler Equation along a Streamline, Euler's Equation in Cartesian Co-ordinates, Bernoulli's Theorem: Principle of Energy Conservation, Steady Flow Energy Equation, Momentum of Fluids in Motion (Impulse –Momentum Relationship).
Flow Losses in pipes: Darcy – Weisbach equation, Chezy Equation for Head loss due to friction, Minor Head losses, Flow through pipes in series and parallel, Equivalent pipe, Flow through branched pipes, Hydraulic Transmission of power Hydraulic Gradient and total energy lines.
Dimensional Analysis and Model Similitude: System of Dimensions, Dimensional Homogeneity, Dimensional Analysis, Rayleigh's Method, Buckingham's Pi-Theorem, Dimensionless numbers and their significance, Undistorted and Distorted Models.

Recommended Books:

1. "A Textbook of' Fluid Mechanics & Hydraulics Machines", by R K Bansal, Laxmi Publications New Delhi.
2. "Fluid Mechanics and Fluid Power Engineering", by D.S. Kumar, S.K. Kataria & Sons, Publishers New Delhi.
3. "Hydraulics and Fluid Mechanics including Hydraulics Machines", by P N Modi and S M Seth Standard Book House New Delhi.
4. "Fluid Mechanics and Hydraulic machines", by R.K. Rajput, S. Chand Publishers, New Delhi.

CE203	Building Material and Construction (3-0-0)	3 Credits

Course Learning Outcomes:

CLO1: Evaluate various properties of concrete to gain the construction skills.
CLO2: Evaluate various properties of the basic construction materials such as brick, stone timber, metals.
CLO3: Develop skills to work in the field of building materials quality control to produce the employability.
CLO4: Evaluate the properties of miscellaneous materials such as bitumen, paints, distempering, and materials for structural repairs.
CLO5: Perform various quality control tests for the various civil engineering materials by performing different lab tests on materials.

Course Contents

Introduction: Specifications, details and sequence of activities- Functional planning of a building, and site clearance, principles of site selection, Important building components like sub structure, super structure, basements, temporary sheds, sills, lintels etc. and loads on structures, Site investigations and ground techniques Masonry : Introduction of stones, bricks, stone masonry, brick masonry Mortar classification, testing of cement, Classifications of stone masonry, Brick masonry, Bonds in brick masonry, concrete hollow block masonry.

Flooring: Definition of flooring, types of flooring and factors affecting the choice of flooring materials and materials used for flooring. Damp proof courses: Damp proofing, causes of dampness, effects of dampness, requirements of an ideal material for damp proofing, materials used for damp proofing, general principles of damp proofing. Cement Concrete Construction: Introduction to cement concrete, properties of cement concrete, materials used in RCC work proportioning of concrete. Joints in concrete structures. Placing concrete under water. Prestressed concrete and High tensile steel. Quality control of construction materials. Centering and Shuttering: Introduction to shuttering or formworks, requirements of formwork, Cost of formwork, materials used for preparing formwork, formwork for different components of buildings, Slip forms, removal of formwork or de shuttering forms. Centering for big arches, types of centering, formwork for domes, failure of formwork and maintenance of formwork.

Scaffoldings and Shoring: Introduction to scaffolding, components of a scaffolding, types of scaffolding. Shoring: definition of shoring, types of shoring for deep cutting Foundations (Sub Structure Construction) Introduction to foundations, pilling techniques-wells and cassions, uses of cassions, materials used for the construction of cassions. Cofferdams and cassions, classifications of cassions.

Wells: Introduction to wells and types of wells. Uses of wells. Dewatering: Dewatering of the foundation trenches, well point systems, chemical grouting Water Proofing: Water proofing of flat roofs. Roofs and roof finishes: Requirements of a good roof,

classifications of roofs, roof coverings for pitched roofs, advantages of steel trusses over timber trusses. Super Structure.

Construction: Launching girders, bridge decks, pre stressing in high rise structures, materials handling, light weight components on tall structures. Support structure for heavy equipment and conveyors, design production, application, specification and quality control of construction materials unique to civil engineering.

Plastics: Plastics in construction, 3D printing, recycling of construction and demolition wastes.

Fire protection: Fire-resisting characteristics and properties of materials, fire protection systems, fire resistant construction. Acoustics: Introduction to acoustics, velocity of sound, frequency of sound, intensity of sound, types of absorbent materials, conditions for good acoustics of an auditorium or a hall. Factors to be considered in the acoustic design of an auditorium, noise and its effects.

Recommended Books:

1. "Building Materials and Construction", Book with Reference to Rangawala, Sushil Kumar, Bindra, Kamala.
2. "Building Construction", Laxmi Publications, B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain (2016).
3. "Concrete Technology theory and practice", by M.L Gambhir.
4. 'Building Construction and Material', Standard Book House Gurcharan Singh, (2017).
5. "Engineering Materials", By S.C. Rangwala, Engineering Materials, Charotor Publishing House, Anand (1993).

CE204	Structural Analysis I (4-0-0)	4 Credits

Course Learning Outcomes:

CLO1: Calculate deformation of statically determinate structures using geometric and energy methods.
CLO2: Analyze statically indeterminate beams using classical and conventional methods.
CLO3: Develop qualitative diagrams showing the displaced shape, bending moments and support reactions for an indeterminate plane frame.
CLO4: Develop effective structural analysis skills for building design activities.

Course Contents

Degree of static and kinematic indeterminacies for plane frames: Analysis of indeterminate pin-jointed frames - rigid frames. Virtual work and energy principles – Moving loads for determinate beams – Different load cases.

Influence lines for reactions in statically determinate structures: Influence lines for member forces in pin jointed frames.

Influence lines for shear force and bending moment in beam sections: Calculation of critical stress resultants due to concentrated and distributed moving loads. Influence lines of indeterminate beams using Muller Breslau principle.

Arches as structural forms: Examples of arch structures – Types of arches – Analysis of three hinged, two hinged.

Slope and Deflection method: Continuous beams and rigid frames (with and without sway) – Symmetry and ant symmetric –Simplification for hinged end –Support displacements.

Moment distribution method: Distribution and carryover of moments –Stiffness and carry over factors – Application of simple problems of beams and frames.

HR101	Human values and professional Ethics (2-0-0)	2 Credits

Course Learning Outcomes:

CLO1: The students will be able to get awareness on human values and professional ethics.

CLO2: The students will enhance the skills on human values and professional ethics that shape their ethical behavior.

CLO3: The Students will be able to take active part in social, political, economic and cultural activities with responsibility.

CLO4: The students will gain thorough knowledge in the field of human rights and this will add to the academic qualification to achieve the employability.

CLO5: To identify issues and problems relating to the realization of human rights, and strengthens the ability to contribute to the resolution of human rights issues and problems.

Course Contents

General Concepts: Introduction about human rights and value education, aim of education, concept of human values and its types.

Personal development: Self-analysis, gender equality, respect to age, experience, maturity, family member, co-worker. Personality development and its importance in professional world.

Character formation through human values: Truthfulness, sacrifice, sincerity, self-control, tolerance, positive attitude, dignity, ethics.

National values: Democracy, socialism, secularism, equality, justice, liberty, freedom.

Social values: Sympathy, universal brother-hood, duty towards our society.

Professional Values: Knowledge thirst, sincerity towards responsibility, ethics, regularity, punctuality, and faith.

Religious values: Accept and respect others believes, tolerance, understanding, faith.

Fundamental rights: Introduction and importance of fundamental rights of Indian constitution.

Right to Equality: Introduction and its importance, types of right of equality, equality before law, abolition of untouchability, abolition of titles.

Right to freedom: Introduction and its importance, types of right, freedom of speech, freedom to reside and settle, freedom to practice any profession.

Rights against exploitation and right to freedom of religion: Introduction and its importance and its effect on human life.

Cultural and educational rights and rights to constitutional remedies, Right to property and right to education: Introduction and its importance, importance of education on our life.

Human rights-general: concepts of human rights and its Indian and international perspective, evolution of human rights, UDHR, significance and purpose of UDHR.

Therapeutic Measures: Control of mind through physical exercise, meditation.

Meditation and yoga: Introduction and its effects on human mind, types of yoga, how to control our thought through yoga and meditation.

Human rights of women and children: Social practice and constitutional safeguards, gender discrimination in workplace.

Female feticide, physical assault and harassment, domestic violence, condition of working of women, child labour, violation by individuals, nuclear weapons and terrorism safeguard.

Recommended Books (s):

1. "A text book of value education", Dominant Publishers and Distributors, New Delhi. Austrian Development Agency (2010). Human Rights Manual, Vienna.
2. "Human Values and Professional Ethics", 3rd Edition, B S Raghavan, S. Chand Limited
3. "A Textbook on Professional Ethics and Human Values"

CE402	Programming for Problem Solving (2-0-4)	4 Credits

Course Learning Outcomes:

CLO1: Describe the basics of computer and understand the problem-solving aspect.
CLO2: Demonstrate the algorithm and flow chart for the given problem.
CLO3: Design and develop C program to evaluate simple expressions and logical operations.
CLO4: Develop & Implement C programming skills with suitable modules to solve the given problem.
CLO5: Demonstrate the concept of pointer and perform I/O operations in files.

Course Contents

Introduction to Programming: Introduction to Programming (Flow chart/pseudo code, compilation etc.), Variables (including data types).

Arithmetic expressions and precedence: Conditional Branching and Loops (8 hrs), Writing and evaluation of conditionals and consequent branching, Iteration and loops.

Arrays: Arrays (1-D, 2-D), Character arrays and Strings.

Basic Algorithms: Searching, Basic Sorting Algorithms, Finding roots of equations, idea of time complexity.

Function and Recursion: Functions (including using built in libraries), Recursion with example programs such as Quick sort, Ackerman function etc.

Structure and Pointers: Pointers, Structures (including self-referential structures e.g., linked list, notional introduction) Unit 7: File handling (2 hrs).

CE205	Fluid Mechanics lab (0-0-2)	1 Credit

Course Learning Outcomes:

CLO1: Identify, name, and characterize flow patterns and regimes.
CLO2: Understand basic units of measurement, convert units, and appreciate their magnitudes.
CLLO3: Utilize basic measurement techniques of fluid mechanics.
CLO4: Enhancing skills to differentiate among measurement techniques, their relevance and applications.
CLO5: Prove good understanding of concepts and their applications in the laboratory.
CLO6: Compare the results of analytical models introduced in lecture to the actual behavior of real fluid flows and draw correct and sustainable conclusions.
CLO7: Understand ethical issues associated with decision making and professional conduct to get employability.

Course Contents

1. Compare actual and theoretical discharges in a pipe using a Venturimeter and calculate its coefficient of discharge, Cd.
2. Compare actual and theoretical discharges in a pipe using a Orifice meter and calculate its coefficient of discharge, Cd.
3. Calculate the coefficient of friction (f) and major energy loss in pipes of different diameters.
4. Measure the discharge in an open channel using a flow measuring device V-notch.
5. Determine the viscosity of a given fluid by using Stoke's law.
6. Verify conservation of energy (Bernoulli's principle) by taking measurements at eleven points along the duct of varying cross-section.
7. Determine the stability of a floating body by calculating the metacentric height of a ship model.
8. Determine the discharge through an orifice using coefficient of contraction (Cc), coefficient of velocity (Cv) and coefficient of discharge (Cd).
9. Verify that in a naturally occurring circular flow, called a free vortex, there is no difference in total head between two streamlines.
10. A forced vortex is a circular flow generated by the action of a mechanical rotor on the fluid. Calculate the head distribution along its profile.

Recommended Books:

1. "Chitkara Lab Manual" by Chitkara University
2. "Experiments in Fluid Mechanics", by Sarbjit Singh.

CE207	Building Material and Construction Lab (0-0-2)	1 Credit

Course Learning Outcomes:

CLO1: Able to check the quality of building materials.
CLO2: Able to impart the knowledge about the characteristics, sources and defects in various materials used for construction purposes.
CLO3: Able to design and test the materials either in the laboratory or in the field before their actual use at the site.
CLO4: Able to attain the knowledge of different building materials, their classification.
CLO5: Enhances skills in quality control and thus helps in employability.

Course Contents

1. Determine the normal consistency of standard cement Paste (IS: 4031 – Part 4-1998) using Vicat's Apparatus (IS:5513).
2. Determine the Initial and final setting times of cement (IS4031-Part-5-1988) using Vicat's apparatus (IS:5513).
3. Determine the Soundness of cement by Le-Chatlier's Method (IS: 4031-Part-3-1988) using Le-Chatlier's Apparatus (IS:5514).
4. Determine the Compressive strength of cement using cement mortar cubes and Compression Testing Machine (CTM). Use standard sand (IS:650) and cube mould (IS:10080).
5. Determine the fineness of cement by dry sieving (IS: 40314- PartI- 1996) through 90-micron sieve.
6. Determine the specific Gravity of cement (IS: 2720- Part-3) using Le-Chatlier's flask or Specific Gravity Bottle.
7. Determine the specific Gravity of soil using pycnometer.
8. To determine the Compressive strength of concrete using CTM test on aggregates
9. Assess the particle size distribution and fineness modulus of Coarse aggregates through dry sieve analysis.
10. Assess the particle size distribution and fineness modulus of Fine aggregates through dry sieve analysis.
11. To determine the Hardness test of any material using Rockwell hardness test.

Recommended Books:

1. Gambhir, M. L., "Reinforced Concrete Design", Prentice Hall of India (2013).
2. "Concrete Lab Manual" by Hemant Sood.
3. Sinha, S. N. and Roy, "Fundamentals of Reinforced Concrete", S Chand Publishers (2014).

CE208	Structure analysis-I Lab (0-0-2)	1 Credit

Course Learning Outcomes:

CLO1: Distinguish between statically determinate and indeterminate structures.
CLO2: Apply equations of equilibrium to structures and compute the reactions.
CLO3: Draw the shearing force and bending moment diagrams.
CLO4: Calculate the internal forces in cable and arch type structures to extent employability skills.
CLO5: Evaluate and draw the influence lines for reactions, shears, and bending moments in beams and girders due to moving loads.
CLO6: Calculate the deflections of truss structures, beams, and portal frames.

Course Contents

1. Determine the horizontal thrust in a three hinged arch for a given system of loads experimentally and verify the same with calculated values and obtain influence line diagram for horizontal thrust in a three hinged arch experimentally and compare it with the calculated values.
2. Verify Clarke's Maxwell Reciprocal theorem by direct measurements of the deflections of various points with the help of a dial gauge due to a load placed at the reciprocal points.
3. Determine the value of flexural rigidity (EI) for a given beam and compare it with theoretical value.
4. To study two hinged arch for the horizontal displacement of the roller end for a given system of loading and to compare the same with those obtained analytically.
5. Determine the deflection of a pin connected truss analytically & graphically and verify the same experimentally.
6. To study the behavior of a cantilever beam under symmetrical and unsymmetrical bending.
7. Determine deflections in curved bars using Castigliano's first theorem.
8. Determine the behavior of column and struts with different end conditions. Assess the deflections and the buckling loads.
9. To calculate experimentally and theoretically the loads in the three suspension rods supporting an elastic beam with a concentrated load hung midway between two of the suspension rods under two different conditions.
10. Determine the fixed end moment of a fixed end beam.

Recommended Books:

1. "Fundamentals of building construction: materials and methods", John Wiley & Sons, New Jersey Allen, E., & Iano, J. (2013).
2. "Fundamental Structural Analysis", Springer-Verlag, New York. W. SPENCER, (1988).
3. "Strength of Materials and theory of structures Vol I & II", Laxmi Publication New Delhi, Punmia B.C, Jain R.K., (2005).

CE209	Computer Aided Design I (0-0-4)	2 Credits

Course Learning Outcomes:
CLO1: Demonstrate basic concepts of the AutoCAD software to gain employability.
CLO2: Apply basic skills to develop construction (drawing) techniques.
CLO3: Ability to manipulate drawings through editing and plotting techniques.
CLO4: Understand geometric construction.
CLO5: Produce template drawings.

Course Contents

Introduction to Revit Architecture: Understanding the basic Concepts and Principles, Understanding the Interface, Understanding the Shortcut Keys, starting a Project, Setting Units, Setting Other Global Settings, Model Display Tools, saving a Project, Closing a Project. Working with Datums and Building Envelopes: Understanding Walls and its Types, Adding Wall Sweep and Wall Reveal, Adding Door & Window, Understanding Door & Window Properties, Openings in Wall.

Modify Tools: Creating a Selection Set, Moving and Copying Elements, Trimming and Extending Elements, Cutting and Pasting Elements, Rotating, Mirroring, Matching, Aligning, Deleting, and Splitting Elements, Pinning and Unpinning Elements, Creating Group of Elements.

Developing the Building Model: Introducing to Architectural Floors, Creating Roof using roof tool, sketching a Ceiling, Adding Rooms, Calculating Room Values, Adding Component, Creating Stairs and Ramps, Using Curtain System in a Project.

Massing & Site: Working with Site Features, Setting Site Properties, Adding Property Lines, Understanding Massing Concepts, Creating Building Elements from massing geometry, Creating Families.

Documentation: Working with tags and keynotes, Adding Symbols, Adding Dimensions and its types. Creating Details Using Building Model, Creating Drafted Details, Adding Text Notes, and Using Schedules in a Project, Creating Drawing Sheets, creating 3D Views, Rendering Views and Creating Walkthroughs.

Advanced Features: Creating Structural Components, Generating Multiple Design Options, Using Area Analysis tools, Understanding Color Schemes, Masking Region, Linking Building Models, Work sharing Concepts, Purging Unused Elements, Understanding Point Cloud.

CL201	English-II (0-0-4)	2 Credits

Course Learning Outcomes:

CLO1: Demonstrate Body Language (including facial expressions) and voice modulation/ intonation via role plays.

CLO 2: Team Dynamics via text-based group presentations.

CLO 3: Leadership Skills via flipped classrooms.

CLO4: Research Aptitude via projects to value the employability.

CLO 5: Effective communication with emphasis on capturing the attention of the audience.

Course Contents

The advanced course on English language, mainly focusing on further development of student ability to develop the English language skills. The Course will involve various live sessions and focus on speaking skills of students in their professional as well as social life, as mentioned below:

- The student will be trained to discuss aspects of his/ her life such as dreams, ambitions and plans and express opinions.
- The student will be taught to initiate and sustain extended conversations as well as discuss topics of interest such as politics, culture, technology, lifestyle, art and leisure.
- Student will be trained exhaustively to speak confidently in familiar situations.
- The language of the students should get enriched by using various expressions and conditionals (1^{st}&2^{nd}).

AS102	Engineering Exploration II (One-year duration) (0-0-2)	2 Credits

Course Learning Outcomes:

CLO1: Students will able to apply material from their discipline to the design projects.
CLO2: Students will get an appreciation of the role that their discipline can play in social contexts.
CLO3: To get awareness of professional ethics and responsibility.
CLO 4: Demonstrate the ability to work in a team based small projects and effectively use.
CLO 5: To enhance team working and leadership skills to facilitate employability.

Course Contents

This course is based on the concept of problem-based learning. It is crafted to address the design requirements of the degree and prepare engineering students with all the necessary skills to face the challenges of today's world economy. Students work in teams of 3 to 5 on their projects. Projects are done in cooperation with various departments and various laboratories/ workshops are available to the students. Project supervision focuses on the process as well as the product. There is a continuous assessment of the team including an Interim report and a final report.

Semester IV

Courses in 4th Semester of BE (Civil Engineering) Programme

SEMESTER IV				
Course Code	**Title of the Course**	**Category**	**Hours**	**Credits**
CE301	Transportation Engineering	PCC	3-0-0=3	3
CE302	Geotechnical Engineering	PCC	3-1-0=4	4
CE212	Structural Analysis II	PCC	3-1-0=5	4
CE214	Environmental Engineering	PCC	4-0-0=4	4
CE215	Hydraulic Engineering	PCC	3-0-0=4	3
CE306	Transportation Engineering lab	PCC	0-0-2=2	1
CE307	Geotechnical Engineering lab	PCC	0-0-2=2	1
CE217	Environmental Engineering Lab	PCC	0-0-2=2	1
AS102	Engineering Exploration II	PW	0-0-1=1	2
	Total		**26**	**23**

CE301	Transportation Engineering (3-0-0)	3 Credits

Course Learning Outcomes:

CLO1: Given basic information, prepare a horizontal and vertical alignment, including super elevation, which complies with AASHTO standards.

CLO2: Understand the importance & characteristics of road transport for geometric design of various roads with proper alignment based on planning principles, survey data, economics & finance data

CLO3: Determine the characteristics of pavement material

CLO4: Implement Traffic studies, traffic regulations and control and intersection design.

CLO5: Design flexible and rigid pavements as per IRC.

CLO6: To develop the skills of applying probability and statistics in solving the Transportation Engg. Related problem.

Course Contents

Road Development and Planning: Transportation and its importance. Different modes of transportation. History development of road construction. Scope of highway engineering, Objectives of highway planning. Classification of roads, Road patterns, Planning surveys. Saturation system of planning. Highway Geometric Design. Introduction, Highway Cross Section Elements, Sight Distance Considerations. Design of Horizontal Alignment. Design of Vertical Alignment.

Traffic Engineering: Traffic characteristics, Traffic Engineering studies. Traffic flow and Roadway Capacity characteristics. Traffic Regulation and control, Traffic Signs, Traffic Signal design as per IRC Guidelines, Road markings and parking facilities, Highway Lighting.

Pavement materials: Materials used in Highway Construction- Soils, Stone aggregates, bituminous binders, applications, bituminous paving mixes; Portland cement and cement concrete: desirable properties, tests.

Design of Highway pavements: Introduction; component parts of pavements, flexible pavements, factors affecting design and performance; stresses in flexible pavements; design of flexible pavements as per IRC; rigid pavements- components and functions; factors affecting design and performance of CC pavements; stresses in rigid pavements; design of concrete pavements as per IRC; problems.

Recommended Books

1. "Highway Engineering" by Khanna, S.K. & Justo, C.E.G., , Nem Chand and Bros.
2. "Traffic Engineering & Transport Planning" by L.R. Kadiyali, (2013), Khanna Publishers, India.

3. "Principles of transportation engineering" by Chakroborty, P., & Das, A. (2017)., PHI Learning Pvt. Ltd.
4. "Principles of highway engineering and traffic analysis" by Mannering, F., Kilareski, W., & Washburn, S. (2007)., John Wiley & Sons.
5. "Traffic Engineering and Transport Planning" by Kadiyali, L.R, , Khanna Publishers, New Delhi.
6. "Principles of Highway Engineering" by Kadiyali, , Khanna Publishers.
7. "Traffic Engineering", By Matson, T.M., Smith, W.S. and Hurd, P.W. McGraw Hill Book Co., New York.
8. "A Course on Highway Engineering" by Bindra, SP;, New Delhi, Dhanpat Rai and Sons.

CE302	Geotechnical Engineering (3-1-0)	4 Credits

Course Learning Outcomes:

CLO1: To enhance skills to identify the origin of soil and to identify different types of soil.
CLO2: To understand the various physical and engineering characteristics of different types of soil.
CLO3: To understand the concept of slope stability.
CLO4: To appreciate the use of modern technology in the field of geotechnical engineering.
CLO5: Understand and apply the Principle of Effective Stress to a range of typical geotechnical problems in order to predict the ground response under different conditions of loading, soil type and groundwater states.

Course Contents

Introduction: Soil and Soil Engineering; Soil Formation and Soil Types, Soil as a Three Phase System; Definitions of Water Content, Unit Weights and Specific Gravity; Void Ratio, Porosity and Degree of Saturation; Phase Relationships.

Index Properties of soil: Particle Size Analysis- Sieve analysis and hydrometer method, Behaviour of with change in water content- Atterberg limits; Activity, Sensitivity and thixotropy of clays.

Soil classification: Particle Size Classification; Indian Standard Classification System.

Soil Compaction: Introduction, Laboratory tests and factors affecting compaction of soil, Compaction of soil in Field.

Permeability of soil: Darcy's Law; Co-efficient of permeability and its determination; Constant head and falling head test; Permeability of stratified deposits, Seepage of soils, Seepage pressure; Critical hydraulic gradient; Quick sand condition.

Effective stress principle: Stresses due to applied loads; Boussinesq and Westergaard's equations. Comparison of both Boussinesq and Westergaard's equations.

Compressibility and Consolidation of soils: Compressibility and consolidation characteristics; Rate of consolidation, Terzaghi's one dimensional theory of consolidation and its applications, Determination of coefficient of consolidation and settlement due to loads from structure.

Shear strength: Shear Strength of soil and its Importance; Mohr-Coulomb's Strength theory; Laboratory and field tests; Factors affecting shear strength.

Earth Pressure: Effect of wall movement on earth pressure, Rankine's and Coulomb's theory for Lateral earth pressure.

Bearing capacity of foundations: Terzaghi's bearing capacity theory of shallow foundation, bearing capacity of pile foundation.

Stability of slope: Infinite slope and translational slide, definition of factor safety, forms of slip surface.

Recommended Books:

1. "Soil Mechanics and Foundation Engineering", K R Arora, Standard Publishers.
2. "Basic and Applied Soil Mechanics", by Ranjan, G. and Rao, A.S.R. New Age International Publishers.
3. "Soil mechanics and foundation engineering", by Dr B.C Punmia, Ashok kumar.
4. "Soil Mechanics", by Lambe, T.W. and Whitman, R.V John Wiley and Sons, New York, USA, (1979).
5. "Soils and Foundations", by Cheng Liu and Jack Evett.

CE212	Structural Analysis II (3-1-0)	4 Credits

Course Learning Outcomes:

CLO1: Distinguish statically determinate and redundant structural systems

CLO2: Choose a suitable method for the analysis of structural system (pin-jointed as well as rigid jointed) while designing

CLO3: To use the techniques, skills and modern engineering methods involved in the analysis of structures.

CLO4: Utilize the concept of influence lines for deciding the critical forces and sections while designing

CLO5: To impart knowledge about various methods involved in the analysis of indeterminate structures

Course Contents

Slope Deflection Method: Introduction to displacement approach, fixed end moments, Development of equations, Analysis of continuous beams, Analysis of frames with No lateral translation of joints, Analysis of frames with lateral translation of joints.

Moment distribution method: Introduction, Development of method, Distribution theorem, Analysis of frames with No lateral translation of joints, Analysis of frames with lateral translation of joints, Symmetrical frames, Multi-storey frames.

Arches: Introduction to different types of Arches, Introduction on differences between Arches and Beams. Introduction to Two hinge Arches, Analysis of Two hinge Circular Arches, Analysis of Two Hinge Parabolic Arches, Shortening of Rib, Effect of Temperature Changes, Introduction to Tied Arches.

Pin jointed Frames: Introduction, Analysis of indeterminate pin-jointed plane frames (with redundancy restricted to one), and analysis by tension coefficient method. Deflection in trusses by energy method, Effect of Temperature Changes.

Cables and Suspension Bridges: Introduction, Assumptions in cable, General Cable theorem, shape of a loaded cable, cable carrying point loads and UDL, cables with ends at different level, cable subjected to temperature stresses, suspension bridge with two hinged and three hinged stiffening girders.

Matrix Method of Structural Analysis: Introduction, Stiffness and flexibility coefficients, Member stiffness and flexibility matrices, Applications of flexibility matrix and stiffness matrix to solve indeterminate structures by force and displacement method respectively.

Recommended Books

1. "Theory of Structures" by Rammamurtham, , Dhanpat Rai.
2. "Analysis of Structures (I&II)" by Bhavikatti S.S., Vikas Publication
3. "Basic Structural Analysis" by C.S. Reddy C. S.;, Tata McGraw Hill.
4. "Analysis of Structures", Khanna Publications.

5. "Indeterminate Structural Analysis" by Wang, C.K;, McGraw Hill Book Company.
6. "Structural Analysis" by Hibbeler; R.C.;, Pearson Education Asia publication.
7. "Structural Analysis" by Devdas Menon, Narosa Publishing House.
8. "Structural Analysis" by Pandit and Gupta;, Tata McGraw Hill, Pub. Co. Ltd.

CE214	Environmental Engineering (4-0-0)	4 Credits

Course Learning Outcomes:

CLO1: Identify various water demands and select suitable source of water.
CLO2: Demonstrate a firm understanding of various water quality parameters
CLO3: Enhancing skills to develop relevant design criteria, procedures and methods for various water treatment processes
CLO4: Describe structure of drinking water supply system, water transport and its distribution.
CLO5: Able to determine the population forecast for a city to meet its water requirement enhancing skills for employability in town planning projects.

Course Contents

Water quality and treatment: Sources of Water and quality issues, water quality requirement for different beneficial uses, Water quality standards, water quality indices, water safety plans, Water Supply systems, need for planned water supply schemes, Water demand industrial and agricultural water requirements, Components of water supply system; Distribution system, Various valves used in W/S systems. Water Treatment: aeration, sedimentation, coagulation flocculation, filtration, disinfection, advanced treatments like adsorption, ion exchange, membrane processes.
Wastewater: 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, Storm Water-Quantification and design of Storm water; Sewage and Sullage, Pollution due to improper disposal of sewage, National River cleaning plans, Wastewater treatment, aerobic and anaerobic treatment systems, suspended and attached growth systems, recycling of sewage – quality requirements for various purposes.
Air: Composition and properties of air, Quantification of air pollutants, monitoring of air pollutants, Air pollution- Occupational hazards, Urban air pollution automobile pollution, Air quality standards, Control measures for Air pollution, construction and limitations. Noise- Basic concept, measurement and various control methods.
Solid Waste management: Solid waste Management-Municipal solid waste, Composition and various chemical and physical parameters of MSW, MSW management: Collection, transport, treatment and disposal of MSW. Special MSW: waste from commercial establishments and other urban areas, solid waste from construction activities, biomedical wastes, Effects of solid waste on environment: effects on air, soil, water surface and ground health hazards. Disposal of solid waste-segregation, reduction at source, recovery and recycle. Disposal methods - Integrated solid waste management. Hazardous waste: Types and nature of hazardous waste as per the HW Schedules of regulating authorities.
Building Plumbing: Introduction to various types of home plumbing systems for water supply and waste water disposal, various kinds of fixtures and fittings used.

Recommended Books:

1. "Water supply engineering (vol. I)", by S.K. Garg, Khanna Publishers
2. "Sewage disposal and air pollution engineering (vol. II)", by S.K. Garg, Khanna Publishers
3. "Environmental Engineering", by Howard S. Peavy, Donald R. Rowe and George
4. "Textbook On Environment Engineering", N. N. Basak · 2003, McGraw Hill

CE215	Hydraulic Engineering (3-0-0)	3 Credits

Course Learning Outcomes:

CLO1: Ability to develop the open channel flow equations from the basic conservation equations.

CLO2: Analyse and manage irrigation and water resource system for sustainable development by applying managerial skills.

CLO3: Become familiar with different water resources terminology like hydrology, ground water, hydraulics of pipelines and open channel

CLO4: Understand and be able to use the energy and momentum equations

CLO5: Design and select pumps (single or multiple) for different hydraulic applications.

Course Contents

Laminar Flow: Navier- Stokes equation of motion (no derivation), Laminar flow through a pipe, parallel plates. Plates having relative motion, annulus, laminar flow past a sphere.

Turbulent Flow: Transition from laminar to turbulent, shear stress in turbulent flow, eddy viscosity, Prandtl mixing length concept, smooth and rough surfaces, velocity distribution in turbulent flow resistance of smooth and artificially roughened pipes, commercial pipes.

Boundary Layer Analysis: Boundary layer thickness and its characteristics, laminar and turbulent layers, von- karman integral momentum equation and its application for different velocity profiles, separation of boundary and methods for its preventions.

Steady state open channel flow: Uniform flow, critical flow, analysis of rapidly varied flow, Chezy's formula, most economical sections (rectangular, trapezoidal and circular sections). **Non-Uniform Flow:** Specific energy, Specific energy curve, critical flow, Specific depth, and Critical depth. Channel Transitions.

Gradually Varied Flow: Classification of channel bottom slopes, Classification of surface profile, Characteristics of surface profile. Computation of water surface profile by graphical, numerical and analytical approaches. Direct Step method, Graphical Integration method and Direct integration method. Hydraulic Jump- Theory of hydraulic jump, Elements and characteristics of hydraulic jump in a rectangular Channel, length and height of jump, location of jump.

Computational Fluid Dynamics: Basic equations of fluid dynamics, Grid generation, Introduction to in viscid incompressible flow, Boundary layer flow as applicable to C.F.D. Hydro informatics: Concept of hydro informatics –scope of internet and web-based modelling in water resources engineering.

Recommended Books:

1. "A Textbook of' Fluid Mechanics & Hydraulics Machines" 'by R K Bansal, Laxmi Publications New Delhi
2. 'Fluid Mechanics and Fluid Power Engineering" 'by D.S. Kumar, S.K. Kataria & Sons, Publishers New Delhi
3. "Hydraulics and Fluid Mechanics including Hydraulics Machines" by P N Modi and S M Seth Standard Book House New Delhi
4. "Fluid Mechanics and Hydraulic machines" by R.K. Rajput, S. Chand Publishers, New Delhi
5. "Fluid Mechanics" by Yunus A Cengel & John M. Cimbala Tata McGraw Hill New Delhi

CE306	Transportation Engineering lab (0-0-1)	1 Credit

Course Learning Outcomes:

CLO1: Student shall be able to apply the scientific method to Transportation Problems Tests on Bituminous Materials.

CLO2: Students shall connect theory with field observations and ability to identify limitations in theory/models Tests on Pavement Layers.

CLO3: Outline the various properties of bitumen material and mixes by performing various tests on it

CLO4: Recognise the knowledge about different physical properties of aggregates by performing different test on road aggregates

CLO5: To enhance skills for testing pavement materials

CLO6: Evaluate the strength of sub grade soil by CBR test

Course Contents

List of Experiments

1. Crushing Value of Aggregate
2. Los Angeles Abrasion Test on Aggregate
3. Attrition value of aggregate
4. Specific gravity of bitumen
5. Penetration test on bitumen
6. Ductility test on bitumen
7. Softening point test on bitumen
8. Viscosity test on bitumen
9. Flash & Fire point test on bitumen
10. Traffic data analysis

Recommended Books:

1. "Highway Materials and Pavement testing", By S.K khanna, C.E.G. Justo, Nem Chand & Bros.

CE307	Geotechnical Engineering Lab (0-0-2)	1 Credit

Course Learning Outcomes:

CLO1: Have thorough knowledge about the procedures of laboratory tests used for determination of physical, index and engineering properties of soils.

CLO2: Have the capability to classify soils based on test results and interpret engineering behaviour based on test results.

CLO3: To enhance the skills to evaluate the permeability and shear strength of soils.

CLO4: Be able to evaluate settlement characteristics of soils

CLO5: Be able to evaluate compaction characteristics required for field application.

1. Determine the moisture content of given soil sample.
2. Determinations of specific gravity of soil fraction passing 4.75mm I.S sieve using a Density bottle.
3. Determination of specific gravity by Pycnometer method.
4. Field density test – Core Cutter method.
5. Determination of in situ density of natural or compacted soils using sand pouring cylinders by Sand replacement method.
6. Determination of percentage of different grain sizes contained within a coarse soil sample using sieve analysis.
7. Particle size analysis of fine-grained soil sample using a hydrometer.
8. Determination of Index properties of soil – Atterberg liquid and plastic limit.
9. Determination of Index property of soil – Shrinkage limit.
10. Density index/relative density test of a soil sample.

Recommended Books:

1. "Lab manual of Geotechnical Engineering", (Chitkara University).
2. "Soil Mechanics and Foundation Engineering", by Dr B.C Punmia, A.K Jain.
3. "Engineering Soil Testing", by Shamsher Prakash and P.K. Jain.

CE217	Environmental Engineering Lab (0-0-2)	1 Credit

Course Learning Outcomes:

CLO1: Statistically analyse and interpret laboratorial results.

CLO2: Apply the laboratorial results to problem identification, quantification, and basic environmental design and technical solutions.

CLO3: Students will achieve perfectness in experimental skills

CLO4: Understand and use the water and wastewater sampling procedures and sample preservations.

CLO5: Able to determine the population forecast for a city to meet its water requirement enhancing skills for employability in town planning projects.

CLO6: Understand the impact of water and wastewater treatment on people and the environment.

Course Contents

List of Experiments

1. Determination of pH of water sample.
2. Determination of Total Solids in water sample.
3. Determination of Dissolved Oxygen in water sample.
4. Measurement of Total Suspended Solids (TSS) in wastewater sample.
5. Jar Test for determining optimum coagulant dose.
6. Determination of electrical conductivity of water sample.
7. Determination of turbidity of water sample.
8. Determination of Biochemical Oxygen Demand (B.O.D) of wastewater sample.
9. Determination of Chemical Oxygen Demand (C.O.D) of wastewater sample.
10. Determination of alkalinity of water sample.
11. Determination of acidity of water sample.
12. Determination of total hardness of water sample.
13. Determination of chloride ion of water sample.

Recommended Books:

1. "Laboratory manual Environmental Engineering Lab-II" by Chitkara University.
2. "Water supply Engineering, Vol-II" by S.K. Garg.

ASE102	**Engineering Exploration II (One-year duration) (0-0-1)**	**2 Credits**

Course Contents

This course is based on the concept of problem-based learning. It is crafted to address the design requirements of the degree and prepare engineering students with all the necessary skills to face the challenges of today's world economy. Students work in teams of 3 to 5 on their projects. Projects are done in cooperation with various departments and various laboratories/ workshops are available to the students. Project supervision focuses on the process as well as the product. There is a continuous assessment of the team including an Interim report and a final report.

Semester V

Courses in 5th Semester of BE (Civil Engineering) Programme

SEMESTER V				
Course Code	**Title of the Course**	**Category**	**Hours (L+T+P)**	**Credits**
CE211	Design of Concrete Structures I	PCC	3-1-0=4	4
CE213	Hydrology and Water Resources Engineering	PCC	3-0-0=3	3
CE303	Design of Steel Structures	PCC	3-1-0=4	4
CE304	Engineering Economics, Estimation & Costing	PCC	3-1-0=4	3
CE305	Computer Aided Design II	PCC	0-0-2=2	1
HU211	Cyber Security	ESC	2-0-0=2	2
CE216	Design of Concrete structures lab	PCC	0-0-2=2	1
AS103	Engineering Exploration III (One-year duration)	PW	0-0-2=2	Credits offered next
Track1	Structural Engineering	Professional Electives (Students need to select anyone track)	3-0-0=3	3
Track2	Environmental Engineering			
Track3	Geotechnical Engineering			
Track4	Transportation Engineering			
	Total		**25**	**21**

CE211	Design of Concrete Structures I (3-1-0)	4 Credits

Course Learning Outcomes:
CLO1: Learn the basic elements of a steel structure
CLO2: Learn the fundamentals of structural steel fasteners.
CLO3: Able to design basic elements of steel structure like tension members, compression members, beams and beam-columns.
CLO4: Able to design column splices and bases.
CLO5: To enhance the skills to analyse and design of simple bolted and welded connections.
Course Contents

Introduction: Concrete, proportioning of concrete, water cement ratio, workability of concrete, Plain cement concrete, reinforced cement concrete, advantages and disadvantages of RCC, materials used in RCC, grades of concrete, and characteristic strength of concrete. Grades of cement, reinforcing material, types of steel reinforcement, characteristic strength of steel, types of loads on RCC structures.

Design philosophies or Methods of RCC design: Introduction, Working stress method, ultimate load method or load factor method, limit state method, safety and serviceability requirements. Calculation of design strength and design load, partial safety factors and factor of safety.

Introduction to Limit State Design Method: Limit State Concept, Limit state of collapse and limit state of serviceability, Comparison of working stress method and limit state method.

Singly Reinforced Sections: Limit state of collapse in flexure, assumptions of limit state of collapse in flexure, stress strain relationship for concrete and steel. Analysis of singly reinforced beam, Stress distribution, Stress block parameters, neutral axis, limiting depth of neutral axis.
Moment of resistance for singly reinforced beam, limiting value of moment of resistance, balanced section, under reinforced section and over reinforced section. Numerical based on M.O.R, Design of singly reinforced beams, basic rules for designing of beams, Design of singly reinforced rectangular sections for flexure, Types of problems in designing of singly reinforced beams.

Limit State of Collapse in Shear and Bond: Shear stresses in RCC beams, effects of shear: Diagonal Tension, Types of shear reinforcement. Shear strength of RCC beam, IS Code recommendations for shear design, steps for design of shear reinforcement. Bond and development length, numerical.

Serviceability Limit State: Introduction, Control of Deflection, Control of Cracking.

Doubly reinforced section: Stresses block diagram and N.A, determination of moment of resistance, Design of Doubly Reinforced Sections according to Limit state design

method.

Flanged beams: Introduction of flanged beams, Stress block and moment of resistance effective width of flange, Designs.

Torsion: Introduction IS Code Approach, introduction to torsion. Design Procedure – Equivalent Shear Force, Equivalent Nominal Shear Stress, Torsional Reinforcement.

Slabs: Introduction of slabs, Design of one-way slabs, Design of two-way slabs.

Columns: Introduction, effective length of columns, Slenderness limits, minimum eccentricity, short column under axial compression, assumptions, Designs of short columns under axial loading.

Foundations: Introduction, bearing capacity of soil, analysis of foundation, design of isolated footings square and rectangle.

Recommended Books

1. "R.C.C Design and Drawing", by Neelam Sharma.
2. "Design of Reinforced Concrete Structures", By B.C Punmia.
3. "Design of Reinforced Concrete Structures", By M.L Gmabhil.
4. "Reinforced Concrete Structures", by Ramamrutham.
5. "Reinforced-Concrete-Design", PILLAI-and-MENON.

CE213	Hydrology and Water Resources Engineering (3-0-0)	3 Credits

Course Learning Outcomes:

CLO1: Design rain gauge network and calculate depth of precipitation, runoff, infiltration, peak flow over the basin using different methods

CLO2: Estimate peak flows and fix design flood by different methods to enhance analytical skills.

CLO3: Select a suitable type of dam to be constructed according to the site requirements

CLO4: Demonstrate the concepts, techniques and modernization of Irrigation

CLO5: Plan, design and execute by applying various concepts in the irrigation structures

Course Contents

Introduction: Hydrologic cycle, water-budget equation, history of hydrology, world water balance.

Precipitation: Forms of precipitation, characteristics of precipitation in India, measurement of precipitation (Types of Gauges), rain gauge network, mean precipitation over an area, Presentation of rainfall data, Probable Maximum Precipitation (PMP).

Evaporation: Abstractions from precipitation - evaporation process, types of evaporimeters, analytical methods of evaporation estimation, methods to reduce evaporation losses, evapo-transpiration, measurement of evapo-transpiration, potential evapo-transpiration over India, Interception, depression storage, infiltration, infiltration capacity, measurement of infiltration.

Runoff: Direct runoff, base flow, natural flow, runoff volume, flow duration curve, Hydrograph, Factors affecting runoff hydrograph, components of hydrograph, effective rainfall, unit hydrograph, uses and limitations of unit hydrograph, surface water resources of India.

Ground water: Forms of subsurface water, water table, confined and unconfined aquifers, Aquifer properties, Ground water monitoring network in India.

Well Hydrology: Steady state flow in wells, confined flow and unconfined flow, open wells, well loss, recharge, natural and artificial recharge.

Crops and Irrigation system: Water requirement of crops, Crop seasons in India, crop period and base period, duty of water and delta, factors affecting duty of water, methods of improving duty of water, consumptive use of water, factors affecting consumptive use, Irrigation efficiencies irrigation requirements of crops.

Distribution systems: Classification of canals, alignment of canals, canal losses, Canals on alluvial and non-alluvial soils, Canal outlets: types of outlets, Water logging: causes, effects and remedial measures, Lining of canals, types of lining.

Dams: Classification of dams, factors governing selection of dam and site, preliminary and final investigation of dam sites, Gravity dams: forces on gravity dams, causes of failure.

Spillways: Components of spillways, types of spillways.

Reservoirs: Types and capacity of reservoirs yield of reservoir, selection of suitable site.

Recommended Books

1. "Engineering Hydrology" by Subramanya, K., Tata McGraw-Hill Education, India
2. "Irrigation Water Resources and Water Power Engineering by Modi, P.N.,", Standard Book House, New Delhi.
3. "Water Resources Engineering through Objective Questions" by K Subramanya, 1990, , Tata Mc-Graw Hill.
4. "Irrigation engineering" by Asawa, G.L. (1993), , Wiley Eastern Limited.

CE303	Design of Steel Structures (3-1-0)	4 Credits

Course Learning Outcomes:

CLO1: Understand and appreciate various aspects of steel construction like different types of steel sections, their specifications, advantages of steel construction etc

CLO2: Analyze and design various types of steel connections using rivets, bolts and weld to enhance the analytical skills.

CLO3: Design basic elements of a steel building like beam, column, and column bases etc. for given conditions and loading.

CLO4: Estimate 'design loads' for a roof truss and then be able to design its various components like top chord members, bottom chord members, web members, purlins etc with focus on employability skills.

CLO5: Ability to design steel framing system and connections of a building in a team setting.

Course Contents

Steel as structural material: Design philosophies and general comparison between Limit state and Work stress Methods of design.

Steel Connections: Bolted Connections - Design Overview, Strength of Bolted connections, Design of Bolted connections.

Welded Connections: Fillet Welds and Butt welds, Design strength of Welded connections, Design of Welded Connections Design of Plug and Slot welds, Eccentric Connections Load in plane and perpendicular to plane of Welded and Bolted joint.

Tension Members: Strength calculations and Design of Tension Members.

Compression Members: Strength of Angle strut and Double Angles, Design of Lacing and Batten Systems. Strength calculations and Design of laterally supported and laterally unsupported Beams, Purlins and Introduction to Gantry Girders.

Design of Column Base: Slab Base and Introduction to gusset base and salient design features.

Recommended Books

1. "Limit State Design of Steel Structures" by Duggal, S.K., TATA McRaw Hill Publishing Co. Ltd, India.
2. "Design of Steel Structures by Limit State Method as Per IS:800-2007" by Bhavikatti, S.S., I K International Pvt. Ltd. New Delhi, India.
3. "Steel Structures Design and Practice" by N Subramanian, OXFORD University Press.
4. "IS Publications: IS 800:2007" and IS 875 (Part I -V) and Standard Steel Tables.
5. "Design of Steel Structures" by Abu-Saba, Elias G, (1995), Springer US.

CE304	Engineering Economics, Estimation &Costing (3-1-0)	4 Credits

Course Learning Outcomes:

CLO1: Understand the method of preparation of estimates for civil engineering works of various Buildings, Masonry tanks and stair case to incorporate mandatory employability skills.
CLO2: Understand method of preparation of specifications and their implications.
CLO3: Calculate the analysis of rates for different materials.
CLO4: Understand about various aspects of civil engineering Tenders and contracts.
CLO5: Ability to evaluate and analyze present worth, future worth and annual worth analyses on one of more economic alternatives.

Course Contents

Procedure for Estimating: Principle of estimation, Abstract form, Measurement Form, Contingencies and Work charged establishment, Types of Estimates, Centage charges, Electrification and Sanitary works, complete set of estimate, Lum Sum items, Methods of taking out quantities, Centre Line Method, Long wall – short wall method, Estimate of single & two roomed building, estimate of stairs, Estimate of masonry tank, estimation of R.C.C structures, Estimate of quantity of earthwork in roads in plain areas.
Specification of works: Necessity of specification types of specification, general specification of 1st class, 2nd class & 3rd class buildings, Detailed specification for earthwork in excavation in foundation, centering and shuttering, Cement plastering, R.C.C, Cement concrete, specification of bricks, brickwork in mud mortar, reinforced brick, Mosaic Floor.
Rate analysis: Purpose, importance and requirements of rate analysis, units of measurement, Preparation & procedure of rate analysis for items, Earth work, concrete works, R.C.C works, Plastering, brickwork.
Valuation: Purpose & principles of valuation, Gross income, net income, outgoings, annuity, Depreciation, Year's Purchase, Capitalized value, Sinking fund, Salvage & scrap value, Methods of valuation. Mortgage Lease, Easement, Fixation of Rent.
Public Works Account: Acquaintance Roll, Book of Forms, Manual of orders, Budget, Work classification, Types of Repair works; Tender. Type, preparation, Process of issue, receipt and processing of tenders, Global Tender, Informal Tender, Administrative sanction, Expenditure sanction, Technical sanction.
Basic Principles and Methodology of Economics: Flow in an economy - Demand/Supply –types of efficiency – elements of cost – types of costs. Basic Macro-economic Concepts (including GDP/GNP/NI/Disposable Income). Price Indices (WPI/CPI), Interest rates, Direct and Indirect Taxes. Investment Analysis – NPV, ROI, IRR, Payback Period, Depreciation, Time value of money - present and future worth of cash flows.

Recommended Books

1. "Estimating and Costing in Civil Engineering" Theory and Practical including Specifications and Valuation, UBS Publishers Pvt Ltd., 26th Revised Edition. B.N. Dutta.
2. "Estimating Costing and Valuation" by Gurcharan Singh, Standard Publishers, 20th Revised Edition.
3. "Civil Estimating & Costing" by A. K. Upadhyay, S. K. Kataria & Sons Publishers, 19th Revised Edition.
4. "Any standard book on Building Construction to refresh construction method", 25th Revised Edition.
5. "Engineering Economics" by R. Panneerselvam, Eastern Economy Edition.
6. "Principles of Economics" by Mankiw Gregory N. (2002), Thompson Asia.

CE305	Computer Aided Design II (0-0-2)	1 Credit

Course Learning Outcomes:

CLO1: Produce structural drawing of Reinforced Concrete Elements such as Beams, Slabs
CLO2: Develop Structural Drawings of steel elements such as Connections, Tension Members, Compression Members, Beams, Column Base, and Roof Trusses.
CLO3: To enhance team working and leadership skills to facilitate employability.
CLO4: Design and draw working structural drawings of staircase, foundation, domes and water retaining structures
CLO5: Use of relevant Indian Standard specifications applicable to Reinforced concrete structures.

Course Contents

INTRODUCTION: Introduction to concept of drawings, Interpretation of typical drawings, Planning drawings to show information concisely and comprehensively; optimal layout of drawings and Scales, Introduction to computer aided drawing, coordinate systems, and reference planes. Commands: Initial settings, drawing aids, drawing basic entities, Modify commands, Layers, Text and Dimensioning, Blocks. Drawing presentation norms and standards.

SYMBOLS AND SIGN CONVENTIONS: Materials, Architectural, Structural, Electrical and Plumbing symbols. Rebar drawings and structural steel fabrication and connections drawing symbols, welding symbols; dimensioning standards.

MASONRY BONDS: English Bond and Flemish Bond, Corner wall and Cross walls, One brick wall and one and half brick wall.

BUILDING DRAWING: Introduction to building drawing terms, Elements of planning building drawing, principles of site selection. Methods of making line drawing, detailed drawing. Site plan, floor plan, elevation and section. Drawing of small residential buildings. Foundation plan. Roof drainage plans. Depicting joinery, standard fittings & fixtures, finishes.

PICTORIAL VIEW: Principles of isometrics, Principles of perspective drawing, perspective view of building, fundamentals of building, Information Modelling (BIM).

HU211	Cyber Security (2-0-0)	2 Credits

Course Learning Outcomes:

CLO1: Ability to analyse a problem, and to identify and define the computing requirements appropriate to its solution.

CLO2: Skills to design, implement and evaluate a computer-based solution to meet a given set of computing requirements in the context of the discipline.

CLO3: Skills to communicate effectively with a range of audiences about technical information.

CLO4: An ability to make informed judgments in computing practice based on legal and ethical principles.

CLO5: An ability to analyze and evaluate systems with respect to maintaining operations in the presence of risks and threats**.**

Course Contents

Introduction to Cyber Crime: Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Classifications of Cybercrimes, Legal Perspectives, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes, Survival Mantra for the Netizens.

Cyber offenses: Introduction, How Criminals Plan the Attacks? Social Engineering, Cyber stalking, Cybercafé and Cybercrimes, Botnets- the Fuel for Cybercrime; Cloud Computing Cybercrime: Proliferation of Mobile and Wireless devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era.

Security Challenges Posed by Mobile Devices: Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Security Implications for Organizations, Organizational Security Polices and Measures in Mobile Computing Era.

Laptops Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and D DoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks.

Cost of Cybercrimes and IPR Issues: Lessons for Organizations, Web Threats for Organizations, Security and Privacy Implications from Cloud Computing, Social Media Marketing: Security Risks and Perils for Organizations, Social Computing and the Associated Challenges for Organizations, Protecting People's Privacy in the Organization, Organizational Guidelines for Internet Usage, Safe Computing Guidelines and Computer Usage Policy, Incident Handling: An Essential Component of Cyber Security.

Forensics: Best Practices for Organizations, Media and Asset Protection, Importance of Endpoint Security in Organizations, Cybercrime and Cyber terrorism: Social, Political, Ethical and Psychological Dimensions, Introduction, Intellectual Property in the Cyberspace, The Ethical Dimension of Cybercrimes, and The Psychology, Mindset and Skills of Hackers and Other Cyber criminals. Cybercrime: Illustrations, Examples and Mini-Cases.

Recommended Books

1. "Introduction to cyber security: stay safe online", The Open University, Asia Pacific Holdings Private Limited (India).
2. "Online Safety: Scams, SPAM, Viruses and Clouds", Perry A.M., Asia Pacific Holdings Private Limited (India).
3. "The Quick Guide to Cloud Computing and Cyber Security " Pistorious, Marcia, R.T., Asia Pacific Holdings Private Limited (India).
4. "Finance: Cloud Computing, Cyber Security and Cyber Heis", Uwajeh, Alex Nkenchor, Asia Pacific Holdings Private Limited (India).

CE216	Design of Concrete Structures Lab (0-0-2)	1 Credit

Course Learning Outcomes:

CLO1: Able to check quality of constituent material of concrete.

CLO2: Able to design a concrete mix.

CLO3: Able to perform laboratory tests for properties of fresh and hardened concrete.

CLO4: Students will achieve perfectness in experimental skills.

CLO5: Carry out test procedures for major laboratory properties of fresh and hardened concrete

Course Contents

1. Determine the percentage of aggregates having undesirable shapes like Flakiness and Elongation.
2. Determine the impact strength of aggregates using an Impact testing machine.
3. Check the workability of concrete using Slump Cone.
4. Check the workability of concrete using Compaction factor test apparatus.
5. Check the consistency of freshly made concrete or its workability using a Vee Bee Consistometer.
6. Determine the compressive strength of concrete of given proportions in a Compression testing machine.
7. To determine the flexure strength of concrete.
8. Calculate the Split Tensile Strength of Concrete of given proportions in a Compression testing machine.
9. Create a concrete mix design.

Recommended Books:

1. "Reinforced Concrete Design" by M.L., Prentice Hall of India (2013).
2. "Lab Manual on Concrete Technology" by Hemant Sood, Mittal L.N., CBS Pvt. Ltd. Sinha, S.N. and Roy, Fundamentals of Reinforced Concrete, S Chand Publishers (2014).

AS103	Engineering Exploration III (0-0-2)	2 Credits

Course Learning Outcomes:

CLO1: Students will able to apply material from their discipline to the design projects.
CLO2: Students will get an appreciation of the role that their discipline can play in social contexts.
CLO3: To get awareness of professional ethics and responsibility.
CLO4: Demonstrate the ability to work in a team based small projects and effectively use.
CLO5: To enhance team working and leadership skills to facilitate employability.

Course Contents

This course is based on the concept of problem-based learning. It is crafted to address the design requirements of the degree and prepare engineering students with all the necessary skills to face the challenges of today's world economy. Students work in teams of 3 to 5 on their projects. Projects are done in cooperation with various departments and various laboratories/ workshops are available to the students. Project supervision focuses on the process as well as the product. There is a continuous assessment of the team including an Interim report and a final report.

Semester VI

Courses in 6th Semester of BE (Civil Engineering) Programme

SEMESTER VI				
Course Code	**Title of the Course**	**Category**	**Hours (L+T+P)**	**Credits**
CE308	Design of Concrete Structures- II	PCC	3-1-0=4	4
CE309	Construction Planning and Management	PCC	3-0-0=3	3
GTI301	Numerical Ability and Logical Reasoning	PE	3-0-0=3	3
CE310	Geo-informatics	PCC	3-0-0=3	3
CL401	Language Skills- I	HU	0-0-4=4	2
CE311	Geo-informatics Lab	PCC	0-0-2=2	1
AS103	Engineering Exploration III	PW	0-0-2=2	2
Track1	Structural Engineering	**Professional Electives,** Student need to follow the selected track in previous semester.	3-0-0=3	3
Track2	Environmental Engineering			
Track3	Geotechnical Engineering			
Track4	Transportation Engineering			
	Total		**24**	**21**

CE308	Design of Concrete Structures –II (3-1-0)	4 Credits

Course Learning Outcomes:

CLO1: Apply principles of engineering mechanics and use appropriate tools to solve problems in structural engineering.

CLO2: Design and evaluate structural components and systems to meet the desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, constructability, and sustainability.

CLO3: Plan, compose, and integrate verbal, written, and graphical communication to technical and non-technical audiences.

CLO4: Function effectively as a skilled member of an engineering team and enhance employability development.

CLO5: Discuss professional responsibility in light of social context of engineering problems.

Course Contents

Design of continuous beams and building frames: Moment redistribution, Estimation of wind and seismic loads, Desirable features of earth quake resistant construction, detailing for earth quake resistant construction–ductility criteria.

Water tank and staging: Introduction, Design criteria, Design of rectangular and circular water tank, Design of Intzetank, Staging for overhead tank.

Introduction to bridge engineering: Investigation for bridges, IRC loadings, Design of slab culvert.

Design of Masonry walls and columns: Prestressed concrete, Introduction, pre-stressing system, losses in pre-stress, Design of simple span girders, Design of end block; Design of stair cases; Design of cantilever and counter for t type retaining wall; All design steps/process to as per the most recent BIS code of practices.

Recommended Books:

1. "Design of RCC Structural Elements (Vol.1)" by Bhavikatti, S.S. (2007). New Age International, India.
2. 1992). "Reinforced concrete structures (Vol.1)" Punmia B.C., Jain A, K., &Jain, A K. (, Firewall Media, India.
3. "Advanced reinforced concrete design" by Varghese, P.C. (2009). PHI Learning Pvt. Ltd, India.
4. "Basic Principles of Concrete Structures" by Gu, Xianglin, Jin, Xianyu, Zhou, Yong (2016), , Springer-Verlag Berlin Heidelberg, China.
5. "Concrete Structures" by Setareh, Mehdi, Darvas, Robert, (2017), Springer International Publishing, Switzerland.

CE309	Construction Planning and Management (3-0-0)	3 Credits

Course Learning Outcomes:

CLO1: Apply theoretical and practical aspects of project management techniques to achieve project goals.
CLO2: Possess organizational and leadership capabilities for effective management of construction projects.
CLO3: Be able to apply knowledge and skills of modern construction practices and techniques.
CLO4: Have necessary knowledge and skills in accounting, financing, risk analysis and contracting to enhance skill and employability development.
CLO5: Be capable of using relevant software packages for planning, scheduling, executing and controlling of construction projects.

Course Contents

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, pre-construction planning, detailed construction planning, role of client and contractor, level of detail. Process of development of plans and schedules, work breakdown 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. 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.

Construction Equipment basics: Conventional construction methods Vs Mechanized methods and advantages of latter; Equipment for Earthmoving, Dewatering; Concrete

mixing, transporting &placing; Cranes, Hoists and other equipment for lifting; Equipment for transportation of materials. Equipment Productivities 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; Histograms and S-Curves. Earned Value; Resource Scheduling- Bar chart, line of balance technique, resource constraints and conflicts; resource aggregation, allocation, smoothening and leveling. Common Good Practices in Construction.

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 over runs 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 check lists 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 Management basics: Importance of contracts; Types of Contracts, parties to a contract; Common contract clauses (Notice to proceed, rights and duties of various parties, notices to be given, Contract Duration and Price. Performance parameters; Delays, penalties and liquidated damages; Force Majeure, Suspension and Termination. Changes & variations, Dispute Resolution methods.

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

Recommended Books:

1. "Building Construction" by Varghese P.C., 2007, Prentice Hall India.
2. "National Building Code", 2017—Bureau of Indian Standards, New Delhi.
3. "Construction Technology" by Chudley R., 2007, ELBS Publishers.
4. "Construction Planning', Methods and Equipment" by Peurifoy R.L. 2011, McGraw Hill.
5. "Construction Methods and Management" by Nunnally S.W. 2006, Prentice Hall.

GTI301	Numerical Ability and Logical Reasoning (3-0-0)	3 Credits

Course Contents

Quantitative Aptitude: Calculation , Number System, Simplification, Surds & Indices, Square & Square roots, Formula Based Problems, HCF & LCM, Percentages, Averages, Ratio & Proportion, Allegation, Profit & Loss & Discount, Simple & Compound Interest & Installment, Partnership, Set Theory, Venn Diagrams, Time & Distances, Trains, Boats & Streams, Races & Game Skills, Time & Work, Pipes & Cisterns, Chain Rule, Geometry, Mensuration-Area, Perimeter, Surface Area & Volume, Permutation & Combination**, Probability**, Sequence & Series**, Equation Linear**, Quadratic Equation**, Trigonometry**, Logarithm*.

Data Interpretation: Data Tabulation -1 & 2, Pie Charts -1 & 2, Bar Graph – 1 & 2, Line Graph – 1 & 2, Data Sufficiency.

Reasoning Aptitude: Number Series, Alphabet Series, Inserting of Missing Character, Number Sequence, Alpha Numeric Sequence, Time Sequence, Ranking Sequence, Arithmetical Reasoning, Quantitative Analysis, Problem on Ages, Clocks, Calendars, Cube Cutting, Cubes & Dices, Coding –Decoding - 1& 2, Sense of Direction, Blood Relations, Puzzles 1: Classification, Puzzles 2: Sitting Arrangement –Linear , Circular, Puzzles 3: Comparison, Puzzles 4: Sequential Order of Things, Puzzles 5: Condition & Grouping, Puzzles 6: Family Relations, Mathematical Operations & Symbol Notations, Logical Venn Diagrams, Syllogisms, Alphabet Test, Analogy, Classification, Counting of Figures, Mirror Image -1& 2, Water Image – 1 & 2, Paper Folding, Paper Cutting.

Verbal Aptitude: Subject Verb Agreement, Nouns, Pronouns, Tenses, Adjectives, Adverbs, Conjunctions, Prepositions, Articles, Reading Comprehensions, Cloze Test, fill in the Blanks, Vocabulary, Mix Sentence Errors.

CE310	Geoinformatics (3-0-0)	3 Credits

Course Learning Outcomes:

CLO1: Explain basic physical principles of remote sensing
CLO2: Understand the basic difference between various kinds of satellites and sensors.
CLO3: Know the appropriate use of satellite data for different applications.
CLO4: Explain the principles of thermal and microwave satellites, sensors and their nature of the data.

Course Contents

Remote Sensing: Introduction- Electromagnetic Spectrum, interaction of electromagnetic radiation with the atmosphere and earth surface, remote sensing data acquisition: platforms and sensors; visual image interpretation; digital image processing.

Photogrammetry Surveying: Introduction, Basic concepts, perspective geometry of aerial photograph, relief and tilt displacements, terrestrial photogrammetry, flight planning; Stereoscopy, ground control extension for photographic mapping-aerial triangulation, radial triangulation, methods; photographic mapping-mapping using paper prints, mapping using stereo plotting instruments, mosaics, map substitutes.

Investigation of geographic information systems (GIS) and science (GI Science) including theory and applications areas. A major portion of the course will be based on use of a current widely-used GIS computer software system. Aspects of geographic data entry and editing, spatial analysis, and map development and display will be considered. Relationship of GIS to the Global Positioning System (GPS) and satellite generated data will be addressed.

Recommended Books

1. "Advanced Surveying', Total Station, GIS and Remote Sensing" by Gopi Satheesh, Sathikumar R and Madhu N (2007), Dorling Kindersly, India.
2. "Geomatics Engineering" by Manoj K, Aroraand Badjatia, 2011, Nem Chand &Bros.
3. "Surveying and levelling (Vol.1)" by Bhavikatti S.S. (2010), IK International Pvt Ltd.
4. "Higher Surveying" by Chandra A.M. (2005), New Age International.
5. "Remote sensing and Geographical information system" by Anji Reddy M., 2001, B.S. Publications.
6. "Surveying Vol-I, II and III" by Arora K.R., 2015, Standard Book House.

CL401	Language Skills-I (0-0-4)	2 Credits

Course Learning Outcomes:

CLO1 Demonstrate Body Language (including facial expressions) and voice modulation/ intonation via role plays

CLO2 Develop skills of team Dynamics via text based group presentations

CLO3 Leadership Skills via flipped classrooms

CLO4 Research Aptitude via projects

CLO5 Effective communication with emphasis on capturing the attention of the audience for employability development**.**

Course Contents

The course provides a wide scope of learning & understanding of the subject. The course will make the students ready for campus placements using various mediums such as:

- Through G.D., the students should be able to demonstrate life skills namely group dynamics, leadership skills, conflict resolution skills, thinking out of the box etc.
- The students are made adept at handling the pressure surrounding interviews. The students are given real life scenarios and situations and through intensive training are rigorously prepared for their interviews.
- Analyze various problems occurring in the society and provide an opinion on the same during discussions.
- Formulate new solutions for team work management or improve existing conditions to ensure smooth functioning in professional sphere effectively.

CE311	Geoinformatics Lab (0-0-2)	1 Credit

Course Learning Outcomes:

CLO1: Interpret hard copy satellite FCC images.
CLO2: Understand the effect of different resolutions of satellite image on identifying different terrestrial features.
CLO3: Generate field spectra for various land cover features and draw inferences.
CLO4: Extract different features from satellite image.
CLO5: Provides effective leaning of industry orientated techniques related to the subject, personality development, communication and skills for employability development.

Course Contents

Tutorial on Spatial data generation, management, modeling, analysis and applications; on satellite image georeferencing, enhancement and filtering, transformations, classification and accuracy assessment and applications Laboratory sessions involving use of state-of-the-art GIS and image processing software to get familiarized with handling and analyzing spatial datasets including satellite images Reading and discussing papers/reports on image processing/GIS/applications.

Recommended Books

1. "ArcGIS documentation" by ESRI Press (2009).
2. "Manual of Remote Sensing" by Rencz A.N. (ed.), , American Society for ERDAS Field Guide, ERDAS (2009).
3. "Photogrammetry and Remote Sensing", Bethesda, Maryland, (2004).

AS 103	**Engineering Exploration III (0-0-1)**	**2 Credits**

Course Learning Outcomes:

CLO1: Students will able to apply material from their discipline to the design projects.
CLO2: Students will get an appreciation of the role that their discipline can play in social contexts.
CLO3: To get awareness of professional ethics and responsibility.
CLO4: Demonstrate the ability to work in a team based small projects and effectively use.
CLO5: To enhance team working and leadership skills to facilitate employability.

Course Contents

This course is based on the concept of problem-based learning. It is crafted to address the design requirements of the degree and prepare engineering students with all the necessary skills to face the challenges of today's world economy. Students work in teams of 3 to 5 on their projects. Projects are done in cooperation with various departments and various laboratories/ workshops are available to the students. Project supervision focuses on the process as well as the product. There is a continuous assessment of the team including an Interim report and a final report.

Semester VII

Courses in 7th Semester of BE (Civil Engineering) Programme

SEMESTERVII				
Course Code	**Title of the Course**	**Category**	**Hours (L+T+P)**	**Credits**
CE401	Environmental Impact Assessment and Lifecycle Analysis	PCC	3-0-0=3	3
CE403	Disaster Preparedness & Planning Management	PCC	2-0-0=2	2
CE404	Professional Practices (Entrepreneurship/Gate)	PE	0-0-4=4	2
CE409	Computer Aided Design III	PCC	0-0-4=4	2
AS104	Engineering Exploration IV	PW	0-0-4=1	2
CL402	Language Skills- II	HU	0-0-4=4	2
Track1	Structural Engineering	Professional Electives, Student need to follow the selected track in previous	3-0-0=4	3
Track2	Environmental Engineering			
Track3	Geotechnical Engineering			
Track4	Transportation Engineering			
Total			**22**	**16**

CE401	Environmental Impact Assessment and Life Cycle Analysis (3-0-0)	3 Credits

Course Learning Outcomes:

CLO1: Be able to find the necessary information/legislation/procedures for an assessment of environmental impact of a "Project".
CLO2: Be able to conduct an EIA on a proposed project.
CLO3: Be able to conduct an environmental audit on a selected company/industry.
CLO4: Be able to develop a waste reduction and minimization plan for a selected company/industry.
CLO5: Be able to have skills to develop an EMS for a "Project".
CLO6: Be able to conduct a LCA on a selected process.

Course Contents

Evolution of EIA: Concepts of EIA methodologies, Screening and scoping; Rapid EIA and Comprehensive EIA; impact indicators, Evaluation of EIA: Evaluation of EIA works wide, Evaluation of EIA in India. General Framework for Environmental Impact Assessment, Characterization and site assessment. Environmental Risk Analysis, Definition of Risk, Matrix Method. Checklist method, Fault tree analysis, Consequence Analysis; Socioeconomic aspects, measures of effectiveness of pollution control activities; Environmental Legislation; Introduction to Environmental Management Systems; Environmental Statement - procedures; Environmental Audit: Cost Benefit Analysis; Life Cycle Assessment; Resource Balance, Energy Balance & Management Review; Operational Control; Case Studies on EIA.

Recommended Books:

1. "Environmental Impact Assessment" by R.L., (1996), McGraw Hill Inc., New Delhi.
2. "Concepts in Environmental Impact Analysis" by Canter Shukla, S.K. and Srivastava, P.R., Common Wealth Publishers, New Delhi (1992).
3. "Environmental Risk Assessment" by Lerche, Ian, Glaesser, Walte, Springer-Verlag Berlin Heidelberg (2006).

CE403	Disaster Preparedness & Planning Management (2-0-0)	2 Credits

Course Learning Outcomes:
CLO1: Acquire the knowledge disaster management.
CLO2: Understand the vulnerability of ecosystem and infrastructure due to a disaster.
CLO3: Acquire the knowledge of disaster management Phases.
CLO4: Understand the hazard and vulnerability profile of India.
CLO5: Knowledge about existing global frameworks and existing agreements for employability and skill development.
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.); manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills, transportation accidents, terrorist strikes, etc.); hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility.

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.

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.

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 environment friendly recovery; reconstruction and development methods.

Recommended Books

1. http://ndma.gov.in/ "(Home page of National Disaster Management Authority)".
2. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs).
3. "Disaster Risk Reduction in South Asia" by Pradeep Sahni, 2004, , Prentice Hall.
4. "Handbook of Disaster Management: Techniques & Guidelines" by Singh B.K., , Rajat Publication (2008).
5. "Disaster Management" by Ghosh G.K, APH Publishing Corporation (2006).

CE409	Computer Aided Design III (0-0-2)	1 Credit

Course Learning Outcomes:

CLO1: Demonstrate basic concepts of the Staad Pro and AutoCAD software.
CLO2: Apply basic concepts to develop design and analysis techniques.
CLO3: Ability to manipulate drawings through editing and plotting techniques.
CLO4: Understand geometric construction.
CLO5: Produce 3D drawings.
CLO6: To acquire skills in design-analysis and thus make student industry ready for employability development.

Course Contents

1. Concept of computer aided design and introduction of software packages used for analysis and design of structures including STAAD Pro.
2. Model generation for a building, assigning material properties, loads, creating load combination, analysis and design of a double storied building frame using STAAD Pro and check by any of analytical methods. Introduction to MATLAB, MATLAB tool box and MATLAB functions.
3. Hands on Civil Engineering problems using MATLAB.

AS104	Engineering Exploration IV (0-0-4)	2 Credits

Course Learning Outcomes:

CLO1: Students will able to apply material from their discipline to the design projects.
CLO2: Students will get an appreciation of the role that their discipline can play in social contexts.
CLO3: To get awareness of professional ethics and responsibility & develop the skills for employability.
CLO4: Demonstrate the ability to work in a team based small projects and effectively use.
CLO5: Develop skills to communicate with engineers and the community at large in written an oral form.

Course Contents

This course is based on the concept of problem-based learning. It is crafted to address the design requirements of the degree and prepare engineering students with all the necessary skills to face the challenges of today's world economy. Students work in teams of 3 to 5 on their projects. Projects are done in cooperation with various departments and various laboratories/ workshops are available to the students. Project supervision focuses on the process as well as the product. There is a continuous assessment of the team including an Interim report and a final report.

CL402	Language Skills II (0-0-4)	2 Credits

Course Learning Outcomes:

CLO1: Demonstrate Body Language (including facial expressions) and voice modulation/ intonation via role plays

CLO2: Team Dynamics via text-based group presentations to develop employability skills

CLO3: Leadership Skills via flipped classrooms

CLO4: Research Aptitude via projects

CLO5: Effective communication with emphasis on capturing the attention of the audience to develop employability skills.

Course Contents

Demonstrate Body Language (including facial expressions) and voice modulation / intonation via role plays. Team Dynamics via text-based group presentations. Leadership Skills via flipped classrooms. Research Aptitude via projects. Effective communication with emphasis on capturing the attention of the audience. Analyse various problems occurring in the society and provide an opinion on the same during discussions.

Semester VIII

Courses in 8th Semester of BE (Civil Engineering) Programme

Semester VIII				
Courses				
S. No.	**Course Code**	**Name of the Course**	**Category**	**Credits**
1	CET 9403	Industry Oriented Hands- on Experience	Training	25
2	CET 9410	Co-opt Training Module	Training	-
Total Credits (8th Semester)				**25**

Professional Electives Courses

Specialization Tracks (Professional Electives)

Track 1 Structural Engineering

Course Code	Course Name	L-T-P	Credits
CE350	Engineering Materials for Sustainability	3-0-0	3

Course Learning Outcomes (CLO):

CLO1: Compare the advantages and disadvantages of current and potential energy conversion

CLO2: Identify critical materials challenges associated with current and potential energy conversion and storage processes.

CLO3: Compare the environmental impact of products.

CLO4:

acquire skills in sustainable practice.

CLO5:

a PCC mixture and an HMA mixture using sustainability concepts for skill and employability development.

The mapping of CLO/ PO attainment/ Graduate Attributes are at Appendix -01

Course Contents:

Environmental impact of materials; life-cycle assessment; material selection to optimize performance; design, evaluation, and production of green construction materials.

Recommended Book(s):

1. "Materials and Sustainable Development", by Michael F. Ashby, Butterworth-Heinemann
2. "Sustainable Materials", by Julian Allwood, Jonathan Cullen, UIT Cambridge, 2011.

Course Code	Course Name	L-T-P	Credits
CE351	Wood Structures	3-0-0	3

Course Learning Outcomes (CLO):

CLO1: Ability to perform detail modeling of vertical and lateral loads on structures.

CLO2: Understanding of properties of sawn lumber, glued laminated timber, and structural panels.

CLO3: Ability to raise the skills to analyze and design beams.

CLO4: Ability to analyze and design columns and members under combined bending and axial force.

CLO5: Ability to analyze and design simple nailed and bolted connections.

CLO6: Ability to design the wood framing system and connections of a building for building up of employability.

The mapping of CLO/ PO attainment/ Graduate Attributes are at Appendix -01

Course Contents:

Mechanical properties of wood, stress grades and working stresses; effects of strength- reducing characteristics, moisture content, and duration of loading and causes of wood deterioration; glued- laminated timber and plywood; behaviour and design of connections, beams, and beam-columns; design of buildings and bridges; other structural applications: trusses,rigid frames, arches, and pole-type buildings; and prismatic plates and hyperbolic parabolise.

Recommended Book(s):

1. "Design of wood structure" by Donald E Breyer, Mcgraw-Hill (1993).
2. "Structural design and wood", Judith J, Stalnaker, Springer (2012).
3. "Principles of Structural Design": Wood, Steel, and Concrete Ram S. Gupta, (2014), CRC Press.

Course Code	Course Name	L-T-P	Credits
CE352	Masonry Structures	3-0-0	3

Course Learning Outcomes (CLO):

CLO1: Able to design masonry structures to achieve employability.

CLO2: Able to analyze masonry structures.

CLO3: Design skills enhanced.

CLO4: Explain engineering properties, uses of masonry units, defects, crack in masonry.

CLO5: To enhance the skills in remedial measures and factors affecting compressive strength of masonry units.

The mapping of CLO/ PO attainment/ Graduate Attributes are at Appendix -01

Course Contents:

Introduction to analysis, design and construction of masonry structures. Mechanical properties of clay and concrete masonry units, mortar, and grout. Compressive, tensile, flexural, and shear behaviour of masonry structural components. Strength and behaviour of unreinforced bearing walls. Detailed design of reinforced masonry beams, columns, structural walls with and without penings, and complete lateral-force resisting building systems.

Recommended Book(s):

1. Dayaratnam, P. (1987).” Brick and reinforced brick structures”. South Asia Books.
2. Jagadish K. S., 2015, —” Structural Masonry”, I K International Publishing House Pvt. Ltd,
3. Hendry, A. W., Sinha, B. P., & Davies, S. R. (2003). “Design of masonry structures”. CRC Press

Course Code	Course Name	L-T-P	Credits
CE353	Prestressed Concrete	3-0-0	3

Course Learning Outcomes (CLO):

CLO1:	Understanding of the behavior of prestressed concrete structures which is an advanced topic of civil engineering.
CLO2:	Knowledge of calculation of effect of prestressing on statically determinate structures and statically indeterminate structures.
CLO3:	Design, analysis, detailing and construction of prestressed concrete structural.
CLO4:	Develop knowledge of contemporary issues for skill and employability development.
CLO5:	Use the techniques, skill, and modern engineering tools necessary for pre-tensioning technology and post-tensioning technology.

The mapping of CLO/ PO attainment/ Graduate Attributes are at Appendix -01

Course Contents:

Study of strength, behaviour, and design of prestressed reinforced concrete members and structures, with primary emphasis on pretension, precast construction; emphasis on the necessary coordination between design and construction techniques in prestressing.

Recommended Book(s):

1. "Prestressed Concrete" by N. Krishna Raju McGraw Hill Education (2018).
2. 'Prestressed Concrete" by G.S. Pandit, S.P. Gupta, CBS Publishers and Distributors Pvt Ltd (2008).
3. "Fundamentals of Pre-Stressed Concrete" by NC Sinha, Sujit Kumar Roy, S., (2011).

Course Code	Course Name	L-T-P	Credits
CE354	Earthquake Engineering	3-0-0	3

Course Learning Outcomes (CLO):

CLO1: The students will gain an experience in the implementation of Earthquake Engineering on engineering concepts which are applied in field Structural Engineering.

CLO2: The students will get a diverse knowledge of earthquake engineering practices for skill and employability development.

CLO3: The students will learn to understand the theoretical and practical aspects of earthquake engineering along with the planning and design aspects.

CLO4: The students will get a diverse knowledge of earthquake engineering practices applied to real life problems

CLO5: The students will learn to understand the theoretical and practical aspects of earthquake engineering along with the planning and design aspects

The mapping of CLO/ PO attainment/ Graduate Attributes are at Appendix -01

Course Contents:

Theory of Vibrations; Concept of inertia and damping - Types of Damping - Difference between static forces and dynamic excitation - Degrees of freedom - SDOF idealization - Equations of motion of SDOF system for mass as well as base excitation - Free vibration of SDOF system - Response to harmonic excitation - Impulse and response to unit impulse - Duhamel integral; Multiple Degree of Freedom System; Two degree of freedom system - Normal modes of vibration - Natural frequencies - Mode shapes - Introduction to MDOF systems - Decoupling of equations of motion - Concept of mode superposition (No derivations); Elements of Seismology; Causes of Earthquake – Geological faults - Tectonic plate theory - Elastic rebound – Epicentre; Hypocentre - Primary, shear and Raleigh waves - Seismogram - Magnitude and intensity of earthquakes - Magnitude and Intensity scales - Spectral Acceleration - Information on some disastrous earthquakes; Response of Structures to Earthquake; Response and design spectra - Design earthquake - concept of peak acceleration - Site specific response spectrum - Effect of soil properties and damping - Liquefaction of soils - Importance of ductility - Methods of introducing ductility into RC structures Design Methodology IS 1893, IS 13920 and IS 4326 - Codal provisions - Design as per the codes - Base isolation techniques - Vibration control measures – Important points in mitigating effects of earthquake on structures

Recommended Book(s):

1. "Fundamental Concepts of Earthquake Engineering" Roberto Villaverde, , CRC Press (2009).
2. "Earthquake Resistant Design of Structures", Shashikant K, Duggal Oxford (2013).
3. "Structural Dynamics and Earthquake Engineering" SrinivasVasam & Dr. K. Jagannadha Rao, S.K. KATARIA &SONS (2018).

Track 2: Environmental Engineering

Course Code	Course Name	L-T-P	Credits
CE322	Environmental Laws and Policy	3-0-0	3

Course Learning Outcomes (CLO):

CLO1: Be familiar with the laws, policies and institutions in the field of environment.

CLO2: Acquire the skills needed for interpreting laws, policies and judicial decisions in a holistic perspective.

CLO3: Acquire the ability to evaluate the role of law and policy in conservation and management of natural resources and prevention of pollution.

CLO4: To sensitize the students towards human activities that adversely affect the environment and the need for regulation of such activities

CL05: Students will develop practical skills for procedure followed by various environmental law enforcing agencies/bodies.

The mapping of CLO/ PO attainment/ Graduate Attributes are at Appendix -01

Course Contents:

Overview of environment, nature and eco system, Concept of laws and policies, Origin of environmental law, Introduction to environmental laws and policies, Environment and Governance, sustainable development and environment, understanding climate change, carbon crediting, carbon foot print etc., Introduction to trade and environment. International environmental laws, Right to Environment as Human Right, International Humanitarian Law and Environment, environment and conflicts management, Famous international protocols like Kyoto.

Recommended Book(s):

1. "Environmental Law and Policy in India: Cases, Material & Statutes" by Divan Shyam, Rosencranz Armin, 2002, Oxford.
2. "Environmental Protection, Law and Policy" by Jane Holder and Maria Lee, 2012, , Cambridge University Press.

Course Code	Course Name	L-T-P	Credits
CE320	Municipal Solid Waste Management	3-0-0	3

Course Learning Outcomes (CLO):

CLO1: Gain a solid understanding of core concepts of SWM, with a focus on municipal solid waste (MSW), and the importance of the sector on economic development and environmental protection.

CLO2: Evaluate various technology options based on the financial, technical, and operational capacities of each technology and treatment/disposal options.

CLO3: Familiarize and apply solutions for improvement in the sector, while learning from practical examples and case studies.

CLO4: Make physical and chemical analysis of municipal solid wastes

CLO5: Develop skills to collect required data for a Solid Waste Management Plan

The mapping of CLO/ PO attainment/ Graduate Attributes are at Appendix -01

Course Contents:

Classification of Solid Wastes, Source-based classification, Type-based classification, Solid Waste Management (SWM), SWM system, ESSWM and EST. Factors affecting SWM system, SWM: The Indian Scenario, Progress of MSW Management in India. Waste Stream Assessment (WSA) Rationale for analysis, Field investigation, Waste Generation and Composition, Waste generation, Waste composition, Factors causing variation, Waste Characteristics, Physical characteristics, Chemical characteristics, Health and Environmental Effects, Public health effect, Environmental effect. Collection Components, Storage: Containers/Collection Vehicles, Containers/storage bins, Collection vehicles, Collection Operation, Movement of collection crew, Collection vehicle routing, Transfer Station, Types, Capacity, Viability, Waste Collection System Design, Record Keeping, Control, Inventory and Monitoring, Implementing Collection and Transfer System. Key Issues in Waste Disposal, Disposal Options and Selection Criteria, Disposal options, Selection criteria, Sanitary Landfill, Principle, Landfill processes, Landfill Gas Emission, Composition and properties, Hazards, Migration, Control, Leachate Formation, Composition and properties, Leachate migration, Control, Treatment, Environmental Effects of Landfill, Landfill Operation Issues, Design and construction, Operation, Monitoring. Composting, Benefits, Processes, Stages & Technologies. Incineration: An Introduction, Combustion of waste material, Incineration objectives, Planning an Incineration Facility, Incineration Technologies, Mass-burning system, Refuse derived fuel (RDF) system, Modular incineration, Fluidised-bed incineration. Hazardous Waste: Identification and Classification, Identification, Classification, Hazardous Waste Management, Generation, Storage and collection, Transfer and transport, Processing, Disposal. Basics of Integrated Waste Management, Characteristics, Planning, Implementation, Benefits of IWM for developing economies, Waste management modelling.

Recommended Book(s):

1. "Municipal Solid Waste Management in Developing Countries", Su Kumar, Taylor & Francis
2. "Solid Waste Management Principles and Practice", Ramesha Chandrappa, Diganta Bhusan Das, Springer

Course Code	Course Name	L-T-P	Credits
CE323	Sustainable Design Engineering & Technology	3-0-0	3

Course Learning Outcomes (CLO)

CLO1:	Compare the advantages and disadvantages of current and potential energy conversion and storage processes.
CLO2:	Identify critical materials challenges associated with current and potential energy conversion and storage processes.
CLO3:	Compare the environmental impact of products.
CLO4:	To acquire skills in basic sustainable practice.
CLO5:	Effectively communicate the principles of sustainability to various stakeholders including the community and senior management.

The mapping of CLO/ PO attainment/ Graduate Attributes are at Appendix -01

Course Contents:

Quantitative sustainable design (QSD) and how to navigate engineering decision- making. Economic (life cycle costing, techno economic assessment) and environmental (life cycle assessment: LCA) sustainability assessments, and how to link these tools to design decisions under uncertainty. Design of engineered technologies individually and in teams, with special attention to water infrastructure and bio energy production. Semester-long design project that includes components from two of the following three CEE sub-disciplines: environmental, hydraulic, geotechnical.

Recommended Book(s):

1. "A Handbook of Sustainable Building Design and Engineering" by Dejan Mumovic, Mat Santamouris, 2004, Routledge.
2. "Sustainability in Engineering Design" by Anthony Johnson Andy Gibson, 2014, Academic Press.

Course Code	Course Name	L-T-P	Credits
CE321	Industrial wastewater Management	3-0-0	3

Course Learning Outcomes (CLO):

CLO1: Define and reason about fundamental concepts of industrial wastewater treatment

CLO2: Design a component, system or process to meet desired needs and imposed constraints.

CLO3: To be able to understand Environmental Management System (EMS) approach and knowing the essential elements of an EMS and develop employability skills.

CLO4: Develop skills for selection process for high organic load of waste water treatment needed.

CLO5: Have information about treatment methods, pharmaceutical industry and the chemical (phenol) facilities which produces of wastewater properties of, operational problems for employability skills development.

The mapping of CLO/ PO attainment/ Graduate Attributes are at Appendix -01

Course Contents:

Introduction to industrial wastewater treatment (IWWT) & Sources of pollution. Define different terms of IWWT and understanding the different sources of pollution.

Characteristics of industrial effluents and their possible impacts on quality of underground water. Effects of industrial waste on streams. Prevention vs Control of Industrial Pollution Strategy for wastewater management. Key issues in industrial wastewater treatment, recycling, and reuse, hierarchical approach.

Separation processes and conventional: Methods of wastewater treatment: Physical unit operations. Screens, Coarse solid reduction, Flow equalization, Mixing and flocculation. Gravity separation theory: Particle settling theory, Discrete particle settling, Flocculent particle settling, hindered settling compression settling, Grit removal and sedimentation.

Chemical Unit Processes: Chemical coagulation, Chemical precipitation for improved plant performance, chemical storage & feeding.

Fundamentals of Biological treatment: Role of micro-organism in wastewater treatment, types of biological processes for wastewater treatment. Suspended Growth Biological Treatment Processes: Activated sludge processes, design considerations, Processes for BOD removal and nitrification. Attached growth Treatment Process: Trickling filters, classification and applications, design considerations, Rotating biological contactors

Anaerobic Suspended and Attached Growth Biological Treatment Processes: The rationale for anaerobic treatment, general design considerations, Anaerobic suspended growth process: Anaerobic contact process, Anaerobic sequence batch reactor, Anaerobic sludge blanket process

Individual and Common Effluent Treatment Plants- Zero effluent discharge systems- wastewater reuse. Disposal of effluent on land- Quantification, Characteristics and disposal of sludge.

Waste treatment flow sheet & pollution characteristics for Pharmaceuticals- Sugar and Distilleries- food processing- fertilizers- Thermal Power Plants. Waste treatment flow sheet & pollution characteristics for Pharmaceuticals- Sugar and Distilleries- food processing- fertilizers- Thermal Power Plants. Wastewater Discharge standards. Environmental Management System (EMS) Approach: Basic concepts of EMS approach; Essential elements of an EMS and ISO 14001; ISO 14000 series of standards and their relevance to EMS and to the environmental performance improvement.

Recommended Book(s):

1. "Wastewater engineering Treatment disposal reuse" by Metcalf & Eddy, Tata McGraw Hill.
2. "Industrial Water Pollution Control" by Eckenfelder, W.W., McGraw-Hill
3. "Industrial Waste treatment Handbook", Frank W., Butterworth Heinemann

Track 3: Geotechnical Engineering

Course Code	Course Name	L-T-P	Credits
CE331	Geotechnical Design	3-1-0	3

Course Learning Outcomes (CLO):

CLO1: The students will gain an experience in the implementation of Geotechnical Engineering on engineering concepts which are applied in field Geotechnical Engineering.

CLO2: The students will get a diverse knowledge of geotechnical engineering practices applied to real life problems of designing of structures.

CLO3: The students will learn to understand the theoretical and practical aspects of geotechnical engineering along with the design and management applications.

CLO4: Develop Skills to determine aims of the ground Investigation.

CLO5: Can explain the methods of soil improvement.

The mapping of CLO/ PO attainment/ Graduate Attributes are at Appendix -01

Course Contents:

"Subsurface site evaluation; integrated design of retaining walls, foundations, pavements, and materials for airports, highways, dams, or other facilities".

Recommended Book(s):

1. "Analysis and Design of Substructures" Limit State Design by Swami Saran (2006)

Course Code	Course Name	L-T-P	Credits
CE332	Offshore Engineering	3-1-0	3

Course Learning Outcomes (CLO)):

CLO1: Flotation and stability of floating offshore platforms

CLO2: Deep and shallow water wave kinematics

CLO3: Wave, wind, current and motion induced loading on floating offshore renewable energy structures

CLO4: Skill development to analyse wind and current force formulations

CLO5: Derivation and solution of dynamic motion equations

The mapping of CLO/ PO attainment/ Graduate Attributes are at Appendix -01

Course Contents:

Introduction to offshore structures, codes of practice, offshore project management, deep water, offshore site investigations, geophysical methods; offshore sediment sampling, in-situ testing, geological aspects; development of design stratigraphies.

Recommended Book(s):

1. "Marine and Offshore Engineering" by T.V. Ramakrishnan, 2007, Gene-Tech Books.
2. "Handbook of Off shore Engineering" Subrata K. Chakrabarti, 2005, , Elsevier.

Course Code	Course Name	L-T-P	Credits
CE333	Rock Mechanics	3-1-0	3

Course Learning Outcomes (CLO)

CLO1: Student will become conversant with various rock mechanics and apply appropriate repair strategy for a distressed structure.

CLO2: The students will get a diverse knowledge of geotechnical engineering practices applied to real life problems of designing of structures.

CLO3: Enhance skill to use rock mass classification systems (RMR, Q, GSI).

CLO4: Analyse the stress distribution (isotropic, anisotropic) in situ and around an opening in rock (competent rock, jointed rock mass, blocky rock)

CLO5: Propose designs of excavation supports.

The mapping of CLO/ PO attainment/ Graduate Attributes is at Appendix -01

Course Contents:

Determination of physical properties of rocks, failure criterion, rock mass classification, stress around mine openings, strain and displacement of the rock mass, rock reinforcement and support, subsidence.

Recommended Book(s):

1. "Engineering Rock Mechanics: An Introduction to the Principles" by J. A. Hudson and J. P. Harrison, 2000, Elsevier.
2. "Rock Mechanics: For Underground Mining" by Barry H.G. Brady, Elsevier
3. "Fundamentals of Rock Mechanics" byJohn ConradJaeger, NevilleG. W. Cook, Robert Zimmerman, 2007, , 4th Edition‖ Wiley-Blackwell.

Track 4: Transportation Engineering

Course Code	Course Name	L-T-P	Credits
CE340	Airport Planning and Design	3-1-0	3

Course Learning Outcomes (CLO)):

CLO1: Design & evaluate the various airport pavements.
CLO2: Develop the Pavement Management System for airport pavements.
CLO3: Estimate airport demand using simple regression models.
CLO4: Develop skills to estimate airport delays using queueing models
CLO5: To analyse windrows diagram.

The mapping of CLO/ PO attainment/ Graduate Attributes are at Appendix -01

Course Contents:

Aircraft characteristics; Aircraft performance characteristics: Airport planning and air travel demand forecasting: Airport Site Selection; Geometric Design of the Airfield: Determination of Runway Capacity and Delay - Taxiway and Gate Capacity- Holding Aprons - Terminal Aprons – Airport drainage - Function of Airport Passenger and Cargo Terminal - Design of Air Freight Terminals - Airport access - Airport Landside planning - Capacity; Air Traffic Management: Navigational aids: ground based systems, satellite based systems – Air traffic control and surveillance facilities – Airfield lighting – air traffic management.

Recommended Book(s):

1. "Airport Planning and Design" by Khanna Sk Nem Chand, Nem Chand Brothers (1999).
2. "Planning and Design of Airport" Asheesh Kumar, Vayu Education of India (2016).

Course Code	Course Name	L-T-P	Credits
CE341	Railway Engineering	3-1-0	3

Course Learning Outcomes (CLO):

CLO1: Design the permanent way sections for the railways.

CLO2: Apply the knowledge of railway track components, materials and fixtures and fastenings

CLO3: Solve problems of railway track geometrics, train resistance, points and crossings, Signaling and control system to value the skills.

CLO4: Carry out feasibility study of rail tracks to purpose the employability.

CLO5: Compute economical spans, hydraulic design of bridge and carry out erection and maintenance of bridge.

The mapping of CLO/ PO attainment/ Graduate Attributes are at Appendix -01

Course Contents:

Railway track gauge, alignment of railway lines, engineering surveys and construction of new lines, tracks and track stresses; rails, sleepers; ballast; subgrade and formation, rack fittings and fastenings, creep of rails, geometric design of track, curves and super-elevation, points and crossings, track junctions and simple track layouts; rail joints and welding of rails; track maintenance, track drainage; modern methods of track maintenance, rehabilitation and renewal of track; tractive resistance and power, railway stations and yards; railway tunneling; signaling and interlocking; maintenance of railways and high speed trains.

Recommended Book(s):

1. "A Text Book of Railway Engineering" by S.C. Saxena., S.P. Arora, DhanpatRai, 2010, , Publications (p) Ltd.-new Delhi.
2. "Railway Track Engineering" by JS Mundrey, 2017, , McGraw Hill Education.

Course Code	Course Name	L-T-P	Credits
CE342	Intelligent Transportation Systems	3-1-0	3

Course Learning Outcomes (CLO):

CLO1: Implement the ITS in public transportation systems.
CLO2: Use ITS for the travel demand management.
CLO3: Use ITS for evaluation of bridge performance.
CLO4: Select appropriate ITS technology depending upon site specific conditions.
CLO5: Design and implement ITS components skills.

The mapping of CO/ PO attainment/ Graduate Attributes are at Appendix -01

Course Contents:

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. Telecommunications in ITS – Importance of telecommunications in the ITS system, Information Management, Traffic Management Centres (TMC). Vehicle – Road side communication – Vehicle Positioning System; ITS functional areas – Advanced Traffic Management Systems (ATMS), Advanced Traveller Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS); 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 - Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries.

Recommended Book(s):

1. "Jain Intelligent Transport Systems" by Pradip Kumar Sarkar, Amit Kumar, , PHI Learning Private Limited (2017).
2. "Intelligent Transportation Systems: From Good Practices to Standards" by Paolo Pagano, , CRC Press (2016).

Course Code	Course Name	L-T-P	Credits
CE343	Port and Harbour Engineering	3-1-0	3

Course Learning Outcomes (CLO)

CLO1: Design, plan and integrate port and harbour infrastructure.

CLO2: Explain the construction, maintenance and renovation aspects of ports and inland waterways.

CLO3: Use ITS for evaluation of bridge performance.

CLO4: Demonstrate highly developed analytical and problem-solving skills.

CLO5: Demonstrate a knowledge of the fundamental topics of port and harbour engineering;

The mapping of CLO/ PO attainment/ Graduate Attributes are at Appendix -01

Course Contents:

Harbour Planning: Types of water transportation, water transportation in India, requirements of ports and harbours, classification of harbours, selection of site and planning of harbours, location of harbour, traffic estimation, master plan, ship characteristics, harbour design, turning basin, harbour entrances, type of docks, its location and number, Site investigations – hydrographic survey, topographic survey, soil investigations, current observations, tidal observations; Docks and Repair Facilities: Design and construction of breakwaters, berthing structures - jetties, fenders, piers, wharves, dolphins, trestle, moles, Harbour docks, use of wet docks, design of wet docks, repair docks, lift docks, dry docks, keel and bilge blocking, construction of dry docks, gates for dry docks, pumping plant, floating docks, slipways, locks, size of lock, lock gates, types of gates; Navigational Aids: Requirements of signals, fixed navigation structures, necessity of navigational aids, lighthouses,beaconlights,floatingnavigationalaids,lightships,buoys,radar; Dredging and Coastal Protection: Classification, types of dredgers, choice of dredger, uses of dredged materials, coastal erosion and protection, sea wall, revetment, bulkhead, coastal zone and beach profile; Port facilities: Port development, port planning, port building facilities, transit sheds, warehouses, cargo handling facilities, container handling terminal facilities, shipping terminals, inland port facilities. Inland waterways, Inland water transportation in India, classification of waterways, economics of inland waterways transportation, national waterways.

Recommended Book(s):

1. “Port and Harbour Engineering” by Adrian Jarvis, Routledge, CRC Press (1998).
2. “Harbour Airport Engineering” by R. P. Rathaliya, Atul Prakashan (2019)

Semester VIII

Courses in 8th Semester of BE (Civil Engineering) Programme

8th Semester				
Courses				
S. No.	**Course Code**	**Name of the Course**	**Category**	**Credits**
1	CET 9403	Industry Oriented Hands- on Experience	Training	25
2	CET 9410	Co-opt Training Module (Optional)	Training	25
Total Credits (8th Semester)				**25**

Course Code	Course Name	L-T-P	Credits
CET9403	**Industry Oriented Hands-on Experience**	**-**	**25**

Course Learning Outcomes (CLO):

CLO1: Capability to acquire and apply fundamental principles of engineering.

CLO2: To get awareness of professional ethics and responsibility. Become master in one's specialized technology.

CLO3: To get awareness of professional ethics and responsibility. Become updated with all the latest changes in technological world.

CLO4: To get awareness of professional ethics and responsibility. Ability to communicate efficiently.

CLO5: To get awareness of professional ethics and responsibility. Knack to be a multi-skilled engineer with good technical knowledge, management, leadership and entrepreneurship skills.

CLO6: To get awareness of professional ethics and responsibility. Ability to identify, formulate and model problems and find engineering solution based on a systems approach.

CLO7: To get awareness of professional ethics and responsibility. Capability and enthusiasm for self-improvement through continuous professional skills development and life-long learning.

CLO8: To get awareness of professional ethics and responsibility. Awareness of the social, cultural, global and environmental responsibility as an engineer.

The mapping of CO/ PO attainment/ Graduate Attributes are at Appendix -01

Course Contents:

Six Months industrial training.

Students shall be nominated to various industries/ Work fields working on a live construction project (Building construction, Multi-storeyed buildings, Bridges, Factory Sheds, Silos, Water tanks, Hydel Projects, Pavement construction Highway Projects etc.). A student will go intensive training under the co supervision of the construction Engineer /Project manager and will submit a comprehensive report on the work learnings at the end of the training period. Daily monitoring of the student shall be carried out and progress shall be monitored 3 times during the period of the training.

Appendix 01: Mapping of Programme Outcomes (POs) and Course Outcomes (COs)

Course Code	Title of the Course	Course Outcomes (COs)	Programme Outcome (PO)											
			1	2	3	4	5	6	7	8	9	10	11	12
AM121	Calculus and Statistical Analysis	CLO1: Introduce and form matrices to present mathematical solutions in a concise and informative manner. Use matrices to solve the problems of system of linear equations and solve various live problems using matrices.		H		M	H							H
		CLO2: Find local extreme values of functions of several variables, test for saddle points, examine the conditions for the existence of absolute extreme values. Solve constraint problems using Lagrange multipliers and solve related application problems.	M				M							M
		CLO3: Apply the principles of Integral Calculus to solve a variety of practical problems in Engineering and applied Sciences.	L			H	H					L		H
		CLO4: To interpret statistical inference tasks with the help of probability & distributions and hypothesis testing for means, variances and proportions of large as well as small data and employ appropriate regression models in determining statistical relationships.					M			L	L			M
		CLO5: To equip with the techniques to understand advanced level mathematics and its applications that would enhance analytical thinking to solve engineering problems.	M				M							M
CL101	English-I	CLO1: Student will be able to apply grammatical structures in presenting contextual ideas clearly to aid communication skills.				M			H					
		CLO2: Student will be able to elucidate vocabulary progressively and effectively use as per the social condition.	H						H					
		CLO3: Student will be able to exhibit the language functionally in real life situations and social settings.							M					
		CLO4: Student will be able to determine and demonstrate the usage of the language effectively in both academic and professional setup.							L					M
		CLO5: Students will be effectively able to appear in group discussions for employability enhancement.												
CE101	Engineering Mechanics	CO1: Determine resultants and apply conditions of static equilibrium to plane force systems.	M	M		L								H
		CLO2: Identify and quantify all forces associated with a static framework.	L			H								
		CO3: Solve problems in kinematic and dynamic systems to develop analytical skills.	H	H						L	L			M
		CLO4: Understand basic kinematics concepts – displacement, velocity and acceleration.				M								
		CLO5: Understand basic dynamics concepts – force, momentum, work and energy with a focus on employability.	H			M							L	

ME152	Manufacturing Practice	CLO1: To acquire skills in basic mechanical/civil engineering practice.	H	H		H								H
		CLO2: To identify the hand tools and instruments.					L							
		CLO3: To acquire measuring skills.	M	L										
		CLO4: To provides the knowledge of job materials in various shops.	M			M								H
		CLO5: To provides the knowledge of core technical subjects for making and working of any type of project.	M	H		H								H
		CLO6: Understand modern manufacturing operations, including their capabilities, limitations, and how to design economically.	M	M					L					H
		CLO7: Assess the working conditions of any machining process and thus calculating the actual forces involved so as to enhance employability.	M	M			L							H
EE103	Basics of Electronics and Electrical Engineering	CLO1: Students would have the basics skills pertaining to electronics elements, their functionality and applications. They would be able to perceive the concept of logic gates and integrated circuits in electronics.	L	L										
		CLO2: Skills to interpret the characteristics of various types of diodes and transistors to describe the operation of related circuits for evolving engineering solutions.	H	H			M							H
		CLO3: Students would be able to apply fundamental principles of electronics together with analytic tools to evaluate and describe physical situations appropriate to address a scientific problem.		H										H
		CLO4: Function on multidisciplinary teams to strengthen leadership and team working skills.				H								
		CLO5: Students would possess a skill to explore physical systems by setting up experiments, collecting and analyzing data, identifying sources of uncertainty, and interpreting their results in terms of the fundamental principles and concepts of electronics.												
ME102	Engineering Graphics	CLO1: Understand the fundamentals of engineering drawing and geometrical objects.	H	H										
		CLO2: Construct the technical letters and different types of scales.												
		CLO3: Develop the ability of drawing a wide range of geometrical figures.	H						M					
		CLO4: High accuracy in constructing complex engineering curves.										M		H
		CLO5: Improves the basic sketching and drawing.												
		CLO6: Drafting skills beneficial for civil drafting and intensifying employability.				L								M
EE104	Basics of Electronics and Electrical Engineering	CLO1: After completing the course, students would have skills to know the basics of electronics elements, their functionality and applications and would be able to design basic electronics projects.	L											M

	Lab	CLO2: They would be able to analyze and characterize the electronic circuits and have basic understanding for their implementation.							L					
		CLO3: They would possess a skill to perceive the concept of logic gates like XOR and X-NOR and integrated circuits in electronics.	H	H										
		CLO4: Simulate laboratory experiments in the software.												M
		CLO5: Perform tests on motor-generator set.	M											
AM122	Differential Equations and transformations	CLO1: To analyze and correlate many real-life problems mathematically and thus find the appropriate solutions for them using Fourier series and Transforms (Fourier and Laplace transform).	H				M							
		CLO2: Using ordinary differential equations student will be able to solve various practical problems in Science and Engineering.								M	M			L
		CLO3: Possess an ability to recognize and find families of solutions for most real physical processes such as heat transfer, elasticity, quantum mechanics, water flow and other practical problems in Science and Engineering, which are governed by ordinary and partial differential equations.		M					L					
		CLO4: Student will be able to analyze functions of complex variables, techniques of complex integrals and compute integrals over complex surfaces.	M											H
		CLO5: To develop skills required to find the appropriate differential equations that can be used as mathematical models.	H						L					M
PH121	Modern and Computational Physics	CLO1: Possess an ability to apply knowledge of fundamental physical concepts and appropriate mathematics involved in the course.		H				L						
		CLO2: Possess an ability to analyze a physical problem, and suggest the possible solution of that problem.	M											M
		CLO3: Apply fundamental principles of physics together with analytic tools to evaluate and describe physical situations appropriate to address a scientific problem.		M										
		CLO4: Apply the fundamental principles involved in Physics to solve a variety of practical problems in engineering domain.		L										
		CLO5: Develop skills for critical thinking and problem solving involving the various concepts of physics.												
ES102	Environmental Sciences (EVS)	CLO1: Describe about all the natural resources, various ecosystems and energy resources, environmental pollution, waste management, biodiversity and human population.		M										H
		CLO2: Design, identify and analyze both natural (disasters such as floods and earthquakes) and man-made (industrial pollution and global warming) environmental problems.		H		M								
		CLO3: Analyse the societal and environmental impacts of energy with respect to meet the growing energy needs for sustainable growth.								M	M			

		CLO4: Apply the above knowledge, as an activity to do various Case studies, required to understand the interrelationships of the natural world and also to students to real-world issues.	M											H
		CLO5: Gain knowledge for employability in the field of environmental conservation, water sciences, waste management etc.	M							L				H
CE102	Surveying	CLO1: Skills enhanced to carry out preliminary surveying in the field of civil engineering, applications such as structural, highway engineering and geotechnical engineering.			H									H
		CLO2: Plan a survey, taking accurate measurements, field booking, plotting and adjustment of traverse.	M			L								
		CLO3: Use various conventional instruments involved in surveying with respect to utility and precision.		M			H							
		CO4: Plan a survey for applications such as road alignment and height of the building.												
		CLO5: Undertake measurement and plotting as field surveyor with focus on employability.	M			L								
PH111	Modern and Computational Physics Lab	CLO1: Possess an ability to apply knowledge of fundamental physical concepts and appropriate mathematics involved in the course.	H	L										
		CLO2: Possess an ability to analyze a physical problem, and suggest the possible solution of that problem.		M		L								
		CLO3: Apply fundamental principles of physics together with analytic tools to evaluate and describe physical situations appropriate to address a research problem.						L						M
		CLO4: Develop the skill to explore physical systems by setting up experiments, collecting and analyzing data, identifying sources of uncertainty, and interpreting their results in terms of the fundamental principles and concepts of physics.	H	L										
		CLO5: Possess an ability to evaluate and analyze scientific measurement and error analysis.		M		L								
		CLO6: Apply the fundamental concepts of physics to related engineering problems.						L						M
CE103	Surveying Lab	CLO1: Survey an area under various topographical feature and obstructions.	H				M							
		CLO2: Skill development to prepare the plan or map of the area surveyed.		H					M					
		CLO3: Analyze, report and where appropriate distribute the survey errors.	H				M							
		CLO4: Perform instruments checks to ensure they meet the specifications.												H
		CLO5: Surveying practice skills enhanced.	M	H										
		CLO6: To make student ready for industry in field of surveying and thus enhances employability.				H								H
AS101	Engineering Exploration	CLO1: Students will able to apply material from their discipline to the design of community-based projects.	H	H		H								H
		CLO2: Students will get an appreciation of the role that their												H

		discipline can play in social contexts.												
		CLO3: To get awareness of professional ethics and responsibility.			M							M		
		CLO4: To enhance team working and leadership skills to facilitate employability.		H			M							
		CLO5: Demonstrate the ability to work in a team based small projects and effectively use.												
CE202	Mechanics of Solids	CLO1: Determine resultants and apply conditions of static equilibrium to plane force systems to develop analytical skills.	H							M	M			M
		CLO2: Identify and quantify all forces associated with a static framework.				M								M
		CLO3: Analyze different load cases with different loading conditions.	M											
		CLO4: Understand the basic concept of simple stress and strain, theory of flexure and torsion, springs and strain energy.					M						M	
		CLO5: Have understanding about failure modes of materials and response to fatigue enhancing employability skills.											M	
CE206	Mechanics of Solids Lab	CLO1: Calculate deformation of statically determinate structures using geometric and energy methods.	H										L	M
		CLO2: Conduct compression tests on spring, wood and concrete.		M		M								
		CLO3: Conduct flexural and torsion test to determine elastic constants.				M								M
		CLO4: Determine hardness of metals.	H											
		CLO5: Analyze the behavior of the solid bodies subjected to various types of loading.	M											M
CE210	Survey Camp	CLO1: An ability to function in multidisciplinary teams.	H			M								H
		CLO2: To develop a skill to communicate (both oral and written) effectively	M											M
		CLO3: Ability to concepts of surveying and plotting topographical maps of various terrains as well as to analyze and interpret data from these maps.				M								
		CLO4: Recognition of the need for, and ability to engage in life-long learning.	M											
		CLO5: To make student ready for industry in field of surveying and thus enhances employability.	H			L								M
CE201	Fluid Mechanics	CLO1: Solve hydrostatic problems to enhance analytical skills.	H							M	M			M
		CLO2: Describe the physical properties of a fluid.				M								M
		CLO3: Calculate the pressure distribution for incompressible fluids.	M											
		CLO4: Calculate the hydrostatic pressure and force on plane and curved surfaces.					M						M	
		CLO5: Demonstrate the application point of hydrostatic forces on plane and curved surfaces to focus on employability.											M	

CE203	Building Material and Construction	CLO1: Evaluate various properties of concrete to gain the construction skills.	H										L	M
		CLO2: Evaluate various properties of the basic construction materials such as brick, stone timber, metals.		M		M								
		CLO3: Develop skills to work in the field of building materials quality control to produce the employability.				M								M
		CLO4: Evaluate the properties of miscellaneous materials such as bitumen, paints, distempering, materials for structural repairs.	H											
		CLO5: Perform various quality control tests for the various civil engineering materials by performing different lab tests on materials.	M											M
CE204	Structural Analysis I	CLO1: Calculate deformation of statically determinate structures using geometric and energy methods.	H			M								H
		CLO2: Analyze statically indeterminate beams using classical and conventional methods.	M											M
		CLO3: Develop qualitative diagrams showing the displaced shape, bending moments and support reactions for an indeterminate plane frame.				M								
		CLO4: Develop effective structural analysis skills for building design activities.	M											
		CLO5: To impart the principles of elastic structural analysis and behaviour of indeterminate structures focusing on employability.	M			L								M
HR101	Human values & professional Ethics	CLO1: The students will be able to get awareness on human values and professional ethics.	M						L					
		CLO2: The students will enhance the skills on human values and professional ethics that shape their ethical behavior.												
		CLO3: The Students will be able to take active part in social, political, economic and cultural activities with responsibility.							M					
		CLO4: The students will gain thorough knowledge in the field of human rights and this will add to the academic qualification to achieve the employability.	L						M					
		CLO5: To identify issues and problems relating to the realization of human rights, and strengthens the ability to contribute to the resolution of human rights issues and problems.	M						M					
CE402	Programming for Problem Solving	CLO1: Describe the basics of computer and understand the problem-solving aspect.	H	L			M							
		CLO2: Demonstrate the algorithm and flow chart for the given problem.	M	H					M					
		CLO3: Design and develop C program to evaluate simple expressions and logical operations.	H										M	
		CLO4: Develop & Implement C programming skills with suitable modules to solve the given problem.	M							L	L			H
		CLO5: Demonstrate the concept of pointer and perform I/O operations in files.	M	H										M
CE205	Fluid	CLO1: Identify, name, and characterize flow patterns and	H				M							

	Mechanics Lab	regimes.												
		CLO2: Understand basic units of measurement, convert units, and appreciate their magnitudes.	M				L							
		CLO3: Utilize basic measurement techniques of fluid mechanics.										L		M
		CLO4: Enhancing skills to differentiate among measurement techniques, their relevance and applications.				M								
		CLO5: Prove good understanding of concepts and their applications in the laboratory.				M								
		CLO6: Compare the results of analytical models introduced in lecture to the actual behavior of real fluid flows and draw correct and sustainable conclusions.	M											M
		CLO7: Understand ethical issues associated with decision making and professional conduct to get an employability.			M									H
CE207	Building Material and Construction Lab	CLO1: Able to check the quality of building materials.	M			H								
		CLO2: Able to impart the knowledge about the characteristics, sources and defects in various materials used for construction purposes.												L
		CLO3: Able to design and test the materials either in the laboratory or in the field before their actual use at the site.		H					L					M
		CLO4: Able to attain the knowledge of different building materials, their classification.		M										M
		CLO5: Enhances skills in quality control and thus helps in employability.							M					M
CE208	Structure Analysis-I Lab	CLO1: Distinguish between statically determinate and indeterminate structures.	M											L
		CLO2: Apply equations of equilibrium to structures and compute the reactions.	L	M										L
		CLO3: Draw the shearing force and bending moment diagrams.		M		M								
		CLO4: Calculate the internal forces in cable and arch type structures to extent employability skills.	H	M										
		CLO5: Evaluate and draw the influence lines for reactions, shears, and bending moments in beams and girders due to moving loads.	H											M
		CLO6: Calculate the deflections of truss structures, beams, and portal frames.		M										
CE209	Computer Aided Design I	CLO1: Demonstrate basic concepts of the AutoCAD software to gain employability.				L								M
		CLO2: Apply basic skills to develop construction (drawing) techniques.		M										
		CLO3: Ability to manipulate drawings through editing and plotting techniques.				H			M					
		CLO4: Understand geometric construction.	L						H					
		CLO5: Produce template drawings.	M			H								M
CL201	English-II	CLO1: Demonstrate Body Language (including facial expressions) and voice modulation/ intonation via role plays.	M						L					
		CLO 2: Team Dynamics via text-based group presentations.												

		CLO 3: Leadership Skills via flipped classrooms.							M					
		CLO4: Research Aptitude via projects to value the employability.	L						M					
		CLO 5: Effective communication with emphasis on capturing the attention of the audience.	M						M					
AS102	Engineering Exploration II	CLO1: Students will able to apply material from their discipline to the design projects.	M	M										M
		CLO2: Students will get an appreciation of the role that their discipline can play in social contexts.	L		M									
		CLO3: To get awareness of professional ethics and responsibility.			H									
		CLO 4: Demonstrate the ability to work in a team based small projects and effectively use.							H					M
		CLO 5: To enhance team working and leadership skills to facilitate employability.	M						L					
CE301	Transportation Engineering	CLO1: Given basic information, prepare a horizontal and vertical alignment, including super elevation, which complies with AASHTO standards.	H		L				M					
		CLO2: Understand the importance & characteristics of road transport for geometric design of various roads with proper alignment based on planning principles, survey data, economics & finance data	L				L							L
		CLO3: Determine the characteristics of pavement material	M							H	M			
		CLO4: Implement Traffic studies, traffic regulations and control and intersection design.	L			M							H	
		CLO5: Design flexible and rigid pavements as per IRC.	H						M				L	
		CLO6: To develop the skills of applying probability and statistics in solving the Transportation Engg. related problem.					H					H		
CE302	Geotechnical Engineering	CLO1: To enhance skills to identify the origin of soil and to identify different types of soil.	L			H							H	
		CLO2: To understand the various physical and engineering characteristics of different types of soil.	H							M	M			L
		CLO3: To understand the concept of slope stability.						H				M		
		CLO4: To appreciate the use of modern technology in the field of geotechnical engineering.		H		L								
		CLO5: Understand and apply the Principle of Effective Stress to a range of typical geotechnical problems in order to predict the ground response under different conditions of loading, soil type and groundwater states.		M										L
CE212	Structural Analysis II	CLO1: Distinguish statically determinate and redundant structural systems	H							M	M			L
		CLO2: Choose a suitable method for the analysis of structural system (pin-jointed as well as rigid jointed) while designing						H				M		
		CLO3: To use the techniques, skills and modern engineering methods involved in the analysis of structures.		H		L								
		CLO4: Utilize the concept of influence lines for deciding the critical forces and sections while designing	H		L				M					
		CLO5: To impart knowledge about various methods involved in the analysis of indeterminate structures	L				L							L
CE214	Environmental Engineering	CLO1: Identify various water demands and select suitable source of water.	M	M										M
		CLO2: Demonstrate a firm understanding of various water quality parameters	L		M									

		CLO3: Enhancing skills to develop relevant design criteria, procedures and methods for various water treatment processes			H						H			
		CLO4: Describe structure of drinking water supply system, water transport and its distribution.						L						M
		CLO5: Able to determine the population forecast for a city to meet its water requirement enhancing skills for employability in town planning projects.				H					M			
CE215	Hydraulic Engineering	CLO1: Ability to develop the open channel flow equations from the basic conservation equations.	M				H							
		CLO2: Analyse and manage irrigation and water resource system for sustainable development by applying managerial skills. CLO3: Become familiar with different water resources terminology like hydrology, ground water, hydraulics of pipelines and open channel	H							L				M
		CLO4: Understand and be able to use the energy and momentum equations	M				H							
		CLO5: Design and select pumps (single or multiple) for different hydraulic applications.				L			H					M
CE306	Transportation Engineering lab	CLO1: Student shall be able to apply the scientific method to Transportation Problems Tests on Bituminous Materials.	M				H							
		CLO2: Students shall connect theory with field observations and ability to identify limitations in theory/models Tests on Pavement Layers.	L	L										
		CLO3: Outline the various properties of bitumen material and mixes by performing various tests on it	H	H			M							M
		CLO4: Recognise the knowledge about different physical properties of aggregates by performing different test on road aggregates	H	H										
		CLO5: To enhance skills for testing pavement materials	M					L						
		CLO6: Evaluate the strength of subgrade soil by CBR test	H											M
CE307	Geotechnical Engineering lab	CLO1: Have thorough knowledge about the procedures of laboratory tests used for determination of physical, index and engineering properties of soils.	H	H										M
		CLO2: Have the capability to classify soils based on test results and interpret engineering behaviour based on test results.	M				M							
		CLO3: To enhance the skills to evaluate the permeability and shear strength of soils.		M					L					
		CLO4: Be able to evaluate settlement characteristics of soils	M	M										H
		CLO5: Be able to evaluate compaction characteristics required for field application.	H							M	M			
CE217	Environmental Engineering Lab	CLO1: Statistically analyse and interpret laboratorial results.		L						L				M
		CLO2: Apply the laboratorial results to problem identification, quantification, and basic environmental design and technical solutions.	M		L	M								L
		CLO3: Students will achieve perfectness in experimental skills	M		M					M	M			
		CLO4: Understand and use the water and wastewater sampling procedures and sample preservations.	L							H	M			M
		CLO5: Able to determine the population forecast for a city to meet its water requirement enhancing skills for employability in town planning projects.	M							M	M			H
		CLO6: Understand the impact of water and wastewater treatment on people and the environment.								L	L			

CE211	Design of Concrete Structures I	CLO1: Learn the basic elements of a steel structure	M	M									
		CLO2: Learn the fundamentals of structural steel fasteners.		M									L
		CLO3: Able to design basic elements of steel structure like tension members, compression members, beams and beam-columns.						L				M	
		CLO4: Able to design column splices and bases.	H										
		CLO5: To enhance the skills to analyse and design of simple bolted and welded connections.	M	M									
CE213	Hydrology and Water Resources Engineering	CLO1: Design rain gauge network and calculate depth of precipitation, runoff, infiltration, peak flow over the basin using different methods											L
		CLO2: Estimate peak flows and fix design flood by different methods to enhance analytical skills.	M				H						
		CLO3: Select a suitable type of dam to be constructed according to the site requirements	H										M
		CLO4: Demonstrate the concepts, techniques and modernization of Irrigation	M										
		CO5: Plan, design and execute by applying various concepts in the irrigation structures				L							M
CE303	Design of Steel Structures	CLO1: Understand and appreciate various aspects of steel construction like different types of steel sections, their specifications, advantages of steel construction etc		M									L
		CLO2: Analyse and design various types of steel connections using rivets, bolts and weld to enhance the analytical skills.		H					M				
		CLO3: Design basic elements of a steel building like beam, column, and column bases etc. for given conditions and loading.	H							H	H		
		CLO4: Estimate 'design loads' for a roof truss and then be able to design its various components like top chord members, bottom chord members, web members, purlins etc with focus on employability skills.		L									
		CLO5: Ability to design steel framing system and connections of a building in a team setting.					H					H		L
CE304	Engineering Economics, Estimation & Costing	CLO1: Understand the method of preparation of estimates for civil engineering works of various Buildings, Masonry tanks and stair case to incorporate mandatory employability skills.	H										M
		CLO2: Understand method of preparation of specifications and their implications.	H			L							M
		CLO3: Calculate the analysis of rates for different materials.	L	M									L
		CO4: Understand about various aspects of civil engineering Tenders and contracts.				M						L	
		CO5: Ability to evaluate and analyse present worth, future worth and annual worth analyses on one of more economic alternatives.	H							M	M		
CE305	Computer Aided Design II	CO1: Produce structural drawing of Reinforced Concrete Elements such as Beams, Slabs	M	M		L							H
		CLO2: Develop Structural Drawings of steel elements such as Connections, Tension Members, Compression Members, Beams, Column Base, and Roof Trusses.				M							L
		CO3: To enhance team working and leadership skills to facilitate employability.	H	H									M
		CLO4: Design and draw working structural drawings of staircase, foundation, domes and water retaining structures				M							
		CO5: Use of relevant Indian Standard specifications applicable to Reinforced concrete structures.	L			H							

HU211	Cyber Security	CLO1: Ability to analyse a problem, and to identify and define the computing requirements appropriate to its solution.	M											M
		CLO2: Skills to design, implement and evaluate a computer-based solution to meet a given set of computing requirements in the context of the discipline.			H									
		CLO3: Skills to communicate effectively with a range of audiences about technical information.							H					
		CLO4: An ability to make informed judgments in computing practice based on legal and ethical principles.		M		M								
		CLO5: An ability to analyse and evaluate systems with respect to maintaining operations in the presence of risks and threats.	M											M
CE216	Design of Concrete structures lab	CLO1: Able to check quality of constituent material of concrete.								H	H			M
		CLO2: Able to design a concrete mix.			H					H	H			H
		CLO3: Able to perform laboratory tests for properties of fresh and hardened concrete.	M		M									
		CLO4: Students will achieve perfectness in experimental skills.				L						M		
		CLO5: Carry out test procedures for major laboratory properties of fresh and hardened concrete	M		L	M								L
AS103	Engineering Exploration III (One-year duration)	CLO1: Students will able to apply material from their discipline to the design projects.	M	M										M
		CLO2: Students will get an appreciation of the role that their discipline can play in social contexts.	L		M									
		CLO3: To get awareness of professional ethics and responsibility.			H									
		CLO4: Demonstrate the ability to work in a team based small projects and effectively use.							H					M
		CLO5: To enhance team working and leadership skills to facilitate employability.	M	M										
CE308	Design of Concrete Structures – II	CLO1: Apply principles of engineering mechanics and use appropriate tools to solve problems in structural engineering.	H				M							
		CLO2: Design and evaluate structural components and systems to meet the desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, constructability, and sustainability.	H		M					L	L			
		CLO3: Plan, compose, and integrate verbal, written, and graphical communication to technical and non-technical audiences.	L									L		M
		CLO4: Function effectively as a skilled member of an engineering team and enhance employability development.	M			M								L
		CLO5: Discuss professional responsibility in light of social context of engineering problems.	H			M							M	
CE309	Construction Planning and Management	CLO1: Apply theoretical and practical aspects of project management techniques to achieve project goals.	M			M								L
		CLO2: Possess organizational and leadership capabilities for effective management of construction projects.	M						L					H
		CLO3: Be able to apply knowledge and skills of modern construction practices and techniques.		L								M		H
		CLO4: Have necessary knowledge and skills in accounting, financing, risk analysis and contracting to enhance skill and	M	L		M								L

		employability development.												
		CLO5: Be capable of using relevant software packages for planning, scheduling, executing and controlling of construction projects.	M											H
CE310	Geoinformatics	CLO1: Explain basic physical principles of remote sensing	H		H									H
		CLO2: Understand the basic difference between various kinds of satellites and sensors.	M	H		L								M
		CLO3: Know the appropriate use of satellite data for different applications.		M			H							
		CLO4: Explain the principles of thermal and microwave satellites, sensors and their nature of the data.		H		L			M					M
		CLO5: Apply remote sensing in different thematic studies and enhance skill and employability development	M											
CE311	Geoinformatics Lab	CLO1: Interpret hard copy satellite FCC images.				H			M					
		CLO2: Understand the effect of different resolutions of satellite image on identifying different terrestrial features.	L						H					
		CLO3: Generate field spectra for various land cover features and draw inferences.	M			H			L					M
		CLO4: Extract different features from satellite image.				M						L		
		CLO5: Provides effective leaning of industry orientated techniques related to the subject, personality development, communication and skills for employability development.												
CL401	Language Skills I	Demonstrate Body Language (including facial expressions) and voice modulation/ intonation via role plays								M		H		
		Develop skills of team Dynamics via text based group presentations								M		H		
		Leadership Skills via flipped classrooms										M		
		Research Aptitude via projects	M											
		Effective communication with emphasis on capturing the attention of the audience for employability development.					M				L	H		
CE401	Environmental Impact Assessment and Life Cycle Analysis	CLO1: Be able to find the necessary information/legislation/procedures for an assessment of environmental impact of a "Project".	H	L			M						H	
		CLO2: Be able to conduct an EIA on a proposed project.	L									M		H
		CLO3: Be able to conduct an environmental audit on a selected company/industry.	L			L							L	
		CO4: Be able to develop a waste reduction and minimization plan for a selected company/industry.			L							H		H
		CLO5: Be able to have skills to develop an EMS for a "Project".	H			M								
		CLO6: Be able to conduct a LCA on a selected process.		M										H
CE403	Disaster Preparedness & Planning Management	CLO1: Acquire the knowledge disaster management.	M	M										M
		CLO2: Understand the vulnerability of ecosystem and infrastructure due to a disaster.	L		M					M	M			
		CLO3: Acquire the knowledge of disaster management Phases.			H							L		
		CLO4: Understand the hazard and vulnerability profile of India.							H					M

		CO5: Knowledge about existing global frameworks and existing agreements for employability and skill development.			M				H					
CE409	Computer Aided Design III	CLO1: Demonstrate basic concepts of the Staad Pro and AutoCAD software.	H				M							
		CLO2: Apply basic concepts to develop design and analysis techniques.				L				H	H			
		CLO3: Ability to manipulate drawings through editing and plotting techniques.	M		H					H	H			
		CLO4: Understand geometric construction.	M		M									
		CLO5: Produce 3D drawings.				L						M		
		CLO6: To acquire skills in design-analysis and thus make student industry ready for employability development.	L	M				M						
CE404	Professional Practices	CLO1: To know the pattern of Various Examinations.	L					M						
		CLO2: To get the information about the exams conducted for the entry into jobs.	H	M		H								M
		CLO3: To become aware about the various soft skills and entrepreneurship skills								M				
		CLO4: To use the time effectively.	H			H				L	M			
		CLO5: To become aware about the goals of life and employability development.	M	L		L								M
AS104	Engineering Exploration IV	CLO1: Students will able to apply material from their discipline to the design projects.	H			M								H
		CLO2: Students will get an appreciation of the role that their discipline can play in social contexts.	M							L	M			M
		CLO3: To get awareness of professional ethics and responsibility & develop the skills for employability.				M								
		CLO4: Demonstrate the ability to work in a team based small projects and effectively use.	M											L
		CLO5: Develop skills to communicate with engineers and the community at large in written an oral form.									L			
CL402	Language Skills II	CLO1: Demonstrate Body Language (including facial expressions) and voice modulation/ intonation via role plays	M		M									
		CLO2: Team Dynamics via text-based group presentations to develop employability skills				L						M		
		CLO3: Leadership Skills via flipped classrooms	L	M				M						
		CLO4: Research Aptitude via projects	L					M						
		CLO5: Effective communication with emphasis on capturing the attention of the audience to develop employability skills.	H	M		H								M
CET9403	Industry Oriented Hands- on Experience	CLO1: Capability to acquire and apply fundamental principles of engineering.	M		L									
		CLO2: To get awareness of professional ethics and responsibility. Become master in one's specialized technology.	M		M									
		CLO3: To get awareness of professional ethics and responsibility. Become updated with all the latest changes in technological world.	L						M					
		CLO4: To get awareness of professional ethics and responsibility. Ability to communicate efficiently.	M	L										
		CLO5: To get awareness of professional ethics and					H					L		

		responsibility. Knack to be a multi-skilled engineer with good technical knowledge, management, leadership and entrepreneurship skills.													
		CLO6: To get awareness of professional ethics and responsibility. Ability to identify, formulate and model problems and find engineering solution based on a systems approach.			L								L		
		CLO7: To get awareness of professional ethics and responsibility. Capability and enthusiasm for self-improvement through continuous professional skills development and life-long learning.													L
		CLO8: To get awareness of professional ethics and responsibility. Awareness of the social, cultural, global and environmental responsibility as an engineer.	L		M					H	H				
		CLO2: Identify critical materials challenges associated with current and potential energy conversion and storage processes.	M		M										
		CLO3: Compare the environmental impact of products.				L		M				M			
		CLO4: To acquire skills in sustainable practice.	M							H	H				
		CO5: Design a PCC mixture and an HMA mixture using sustainability concepts for skill and employability development.				L				H					
		CLO2: Understanding of properties of sawn lumber, glued laminated timber, and structural panels.				H			M						L
		CLO3: Ability to raise the skills to analyze and design beams.							H	M	M				
		CLO4: Ability to analyze and design columns and members under combined bending and axial force.	M			H									M
		CLO5: Ability to analyze and design simple nailed and bolted connections.	H					M				L			
CE352	Masonry Structures	CLO1: Able to design masonry structures to achieve employability.	H				H								L
		CLO2: Able to analyze masonry structures.	M			H						L			
		CLO3: Design skills enhanced.	H			L			H						
		CLO4: Explain engineering properties, uses of masonry units, defects, crack in masonry.				L			H						L
		CLO5: To enhance the skills in remedial measures and factors affecting compressive strength of masonry units.				M									H
CE354	Earthquake Engineering	CLO1: The students will gain an experience in the implementation of Earthquake Engineering on engineering concepts which are applied in field Structural Engineering.	H				H								L
		CLO2: The students will get a diverse knowledge of earthquake engineering practices for skill and employability development.	M			H						L			
		CLO3: The students will learn to understand the theoretical and practical aspects of earthquake engineering along with the planning and design aspects.	H			L			H						
		CLO4: The students will get a diverse knowledge of earthquake engineering practices applied to				L			H						L

		real life problems												
		CLO5: The students will learn to understand the theoretical and practical aspects of earthquake engineering along with the planning and design aspects				M								H
CE353	Prestressed Concrete	CLO1: Understanding of the behavior of prestressed concrete structures which is an advanced topic of civil engineering.		M								H		
		CLO2: Knowledge of calculation of effect of prestressing on statically determinate structures and statically indeterminate structures.				H			M					L
		CO3: Design, analysis, detailing and construction of prestressed concrete structural.							H	M	M			
		CLO4: Develop knowledge of contemporary issues for skill and employability development.	M			H								M
		CLO5: Use the techniques, skill, and modern engineering tools necessary for pre-tensioning technology and post-tensioning technology.	H					M				L		
CE322	Environmental Laws and Policy	CLO1: Be familiar with the laws, policies and institutions in the field of environment.	H			L			M			L		M
		CLO2: Acquire the skills needed for interpreting laws, policies and judicial decisions in a holistic perspective.	L		M		L			L		M		H
		CLO3: Acquire the ability to evaluate the role of law and policy in conservation and management of natural resources and prevention of pollution.	H					M				L		
		CLO4: To sensitize the students towards human activities that adversely affect the environment and the need for regulation of such activities	H			L			M			L		M
		CLO5: Students will develop practical skills for procedure followed by various environmental law enforcing agencies/bodies.	L		M		L			L		M		H
CE320	Municipal Solid Waste Management	CLO1: Gain a solid understanding of core concepts of SWM, with a focus on municipal solid waste (MSW), and the importance of the sector on economic development and environmental protection.	M		H		M		L			L		M
		CLO2: Evaluate various technology options based on the financial, technical, and operational capacities of each technology and treatment/disposal options.	M		L			H			M			L
		CLO3: Familiarize and apply solutions for improvement in the sector, while learning from practical examples and case studies.	H					M				L		
		CLO4: Make physical and chemical analysis of municipal solid wastes	H			L			M			L		M
		CLO5: Develop skills to collect required data for a Solid Waste Management Plan	L		M		L			L		M		H
CE323	Sustainable Design Engineering & Technology	CLO1: Compare the advantages and disadvantages of current and potential energy conversion and storage processes.	H				M					L		M
		CLO2: Identify critical materials challenges associated with current and potential energy conversion and storage processes.	M			H			L			L		

		CLO3: Compare the environmental impact of products.	H		M			L		M			L	
		CLO4: To acquire skills in basic sustainable practice.	L			H			M			L		
		CLO5: Effectively communicate the principles of sustainability to various stakeholders including the community and senior management.			L			M			H			L
CE321	Industrial wastewater Management	CLO1: Define and reason about fundamental concepts of industrial wastewater treatment	H		M			L		M			L	
		CLO2: Design a component, system or process to meet desired needs and imposed constraints.	L			H			M			L		
		CLO3: To be able to understand Environmental Management System (EMS) approach and knowing the essential elements of an EMS and develop employability skills.			L			M			H			L
		CLO4: Develop skills for selection process for high organic load of waste water treatment needed.	L		M				L			H		
		CLO5: Have information about treatment methods, pharmaceutical industry and the chemical (phenol) facilities which produces of wastewater properties of, operational problems for employability skills development.	M			L			L		M			
CE331	Geotechnical Design	CLO1: The students will gain an experience in the implementation of Geotechnical Engineering on engineering concepts which are applied in field Geotechnical Engineering.	H			H								M
		CLO2: The students will get a diverse knowledge of geotechnical engineering practices applied to real life problems of designing of structures.			H	M								
		CLO3: The students will learn to understand the theoretical and practical aspects of geotechnical engineering along with the design and management applications.			M									M
		CLO4: Develop Skills to determine aims of the ground Investigation.	M				H							
		CLO5: Can explain the methods of soil improvement.	H			H								M
CE333	Rock Mechanics	CLO1: Student will become conversant with various rock mechanics and apply appropriate repair strategy for a distressed structure.	M		H	H				H	M			H
		CLO2: The students will get a diverse knowledge of geotechnical engineering practices applied to real life problems of designing of structures.		M				M		L	M			
		CO3: Enhance skill to use rock mass classification systems (RMR, Q, GSI).	H			H								M
		CLO4: Analyse the stress distribution (isotropic, anisotropic) in situ and around an opening in rock (competent rock, jointed rock mass, blocky rock)			H	M								
		CLO5: Propose designs of excavation supports.			M									M
CE340	Airport Planning and Design	CLO1: Design & evaluate the various airport pavements.	L							H	H			M
		CLO2: Develop the Pavement Management System for airport pavements.	M	L						M	M			H
		CLO3: Estimate airport demand using simple regression models.	M	L						M	M			H
		CLO4: Develop skills to estimate airport delays using	H			M								H

		queueing models												
		CLO5: To analyse windrows diagram.	M		M					M	M			
CE341	Railway Engineering	CLO1: Design the permanent way sections for the railways.	H			M								H
		CLO2: Apply the knowledge of railway track components, materials and fixtures and fastenings	M		H	H				H	M			H
		CLO3: Solve problems of railway track geometrics, train resistance, points and crossings, Signaling and control system to value the skills.	L							H	H			M
		CLO4: Carry out feasibility study of rail tracks to purpose the employability.	M	L						M	M			H
		CLO5: Compute economical spans, hydraulic design of bridge and carry out erection and maintenance of bridge.	H			M								H
CE342	Intelligent Transportation Systems	CLO1: Implement the ITS in public transportation systems.	M		M					M	M			
		CLO2: Use ITS for the travel demand management.	L							H	M			M
		CLO3: Use ITS for evaluation of bridge performance.	M					M		M	L			H
		CLO4: Select appropriate ITS technology depending upon site specific conditions.	L		M									M
		CLO5: Design and implement ITS components skills.			H	M								
CE343	Port and Harbour Engineering	CLO1: Design, plan and integrate port and harbour infrastructure.	H						M				L	
		CLO2: Explain the construction, maintenance and renovation aspects of ports and inland waterways.		L			M							H
		CLO3: Use ITS for evaluation of bridge performance.	M				H							
		CLO4: Demonstrate highly developed analytical and problem-solving skills.	H			H								M
		CLO5: Demonstrate a knowledge of the fundamental topics of port and harbour engineering.	M					M						