Academic Programme Guide

Bachelor of Engineering
(Civil Engineering)

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

w.e.f.
Academic Year: 2018-19

Approved by the 21st Academic Council dated 30-06-2018, vide agenda item 21.6

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 to design, develop and improve automated equipment 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 member, decision maker and leader.

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 towards building a skillful society.

1.3.1 Extra-curricular activities-based Programme Outcomes

In B.E. Civil Engineering Program, the students are 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 develop students' personality through community services, NSS activities are offered with the idea of social welfare and to provide service to the society. Varieties of extra- curricular activities such as "TECHELONE", "ALGORYTHM" are organized every year to enrich student's interpersonal skills. Apart from these, the department, in association with various technical societies like CIVENGS, ICI, organizes industrial visits, technology-focused workshops, technical quizzes, hackathons and coding competitions for overall grooming of the students. Students also participate in sports activities which emphasize good health and their well-being. These activities have been designed taking into account various Programme Objectives like **PO3, PO6, PO7, PO8, PO9 and PO10**, and are in accordance with the Programme Educational Objectives (PEO). Participation in such inter/intra college activities is considered while grading the performance of the students for each semester respectively.

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

The curriculum design 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); the programme 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

the outcomes of various courses of the B.E. Civil programme for designing viable structures considering 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.

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 CBSE and other state recognized Education Boards; with Mathematics and Physics as compulsory subjects. He/She 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 practicals.

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 the AICTE model.

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

5.2 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.

5.3 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.

5.4 Value Added Courses: Value-added courses are the types of courses which help a particular individual to develop their own skills in their chosen field of the study. The courses, not limited to the following list, are offered to students in different semesters and the students are certified by the department on the completion of these courses after evaluation. Usually, these courses will be offered on optional basis during the programme during the semester or in summers falling between two semesters: purely as per the flexibility and feasibility.

VALUE ADDED COURSES	
Title of Course	**Duration**
Geotechnical Lab Practices	20 hrs
Integrated Certificate Program on BIM	60-90 hrs
Certificate Course on HERE Maps	30 hrs

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.

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 semester 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

Semester-1					
S. No.	**Course Code**	**Title of the Course**	**Category**	**L-T-P**	**Credits**
1	AM101	Engineering Mathematics I	Basic Science	4+1+0	5
2	PH101	Engineering Physics	Basic Science	3+1+0	4
3	ME102	Engineering Graphics	Engineering Science	2+0+4	4
4	GEL4101	Environmental Sciences	Engineering Science	3+0+0	3
5	CL101	English-I	Humanities	0+0+4	2
6	PH103	Engineering Physics Lab	Basic Science	0+0+2	1
7	ME153	Engineering Graphics Lab	Engineering Science	0+0+2	1
8	AS101	Engineering Exploration (One year duration)	Project Work/ Special Course	0+0+4	Credits Offered Next semester
Total Credits (1st Semester)				**30**	**20**

Semester-2					
S. No	**Course Code**	**Title of the Course**	**Category**	**L-T-P**	**Credits**
1	AM102	Engineering Mathematics II	Basic Science	4+1+0	5
2	CE101	Engineering Mechanics	Professional Core	3+1+0	4
3	EE103	Basics of Electrical & Electronics Engineering	Engineering Science	3+0+0	3
4	CE102	Surveying	Professional Core	3+0+0	3
5	CE104	Introduction to Civil Engineering	Professional Core	2+0+0	2
6	EE104	Basics of Electrical & Electronics Engineering Lab	Engineering Science	0+0+2	1
7	CE103	Surveying Lab	Professional Core	0+0+2	1
8	AS101	Engineering Exploration	Project Work/ Special Course	0+0+2	3
Total Credits (2nd Semester)				**23**	**22**

Year II

Semester-3					
S. No	**Course code**	**Title of the Course**	**Category**	**L-T-P**	**Credits**
1	CE201	Fluid Mechanics	Professional Core	3+0+0	3
2	CE202	Mechanics of solids	Professional Core	3+0+0	3
3	CE203	Building Material and Construction	Professional Core	3+0+0	3
4	CE204	Structural Analysis I	Professional Core	3+1+0	4
5	HU201	Human Rights and values	Humanities	2+0+0	2
6	CE205	Fluid Mechanics lab	Professional Core	0+0+2	1
7	CE206	Mechanics of solids lab	Professional Core	0+0+2	1
8	CE207	Building Material and Construction Lab	Professional Core	0+0+2	1
9	CE208	Structure analysis-I Lab	Professional Core	0+0+2	1
10	CE209	Computer Aided Design I	Professional Core	One week course	2
11	CL201	English-II	Humanities	0+0+4	2
12	AS102	Engineering Exploration II (One year duration)	Project Work/ Special Course	0+0+2	Credits Offered Next
Summer Course					
13	ME152	Manufacturing Practices	Engineering Science	0+0+4	2
14	CE210	Survey Camp	Professional Core	Summer Camp	5
		Total Credits (3rd Semester)		**33**	**30**

Semester-4					
S. No	**Course Code**	**Title of the Course**	**Category**	**L-T-P**	**Credits**
1	CE211	Design of Concrete Structures I	Professional Core	3+1+0	4
2	CE212	Structural Analysis II	Professional Core	3+1+0	4
3	CE213	Hydrology and Water Resources	Professional Core	3+0+0	3
4	CE214	Environmental Engineering	Professional Core	3+1+0	4
5	CS501	Cyber Security	Engineering Science	2+0+0	2
6	CE216	Design of Concrete structures lab	Professional Core	0+0+2	1
7	CE217	Environmental Engineering Lab	Professional Core	0+0+2	1
8	AS102	Engineering Exploration II	Project Work /Special	0+0+2	2
Total Credits (4th Semester)				**23**	**21**

Year III

Semester-5					
S. No	**Course Code**	**Title of the Course**	**Category**	**L-T-P**	**Credits**
1	CE301	Transportation Engineering	Professional Core	3+0+0	3
2	CE302	Geotechnical Engineering	Professional Core	3+1+0	4
3	CE303	Design of Steel Structures	Professional Core	3+1+0	4
4	CE304	Estimation & Costing	Professional Core	3+0+0	3
5	CE305	Computer Aided Design II	Professional Core	0+0+2	1
6	CE306	Transportation Engineering lab	Professional Core	0+0+2	1
7	CE307	Geotechnical Engineering lab	Professional Core	0+0+2	1
8	AS103	Engineering Exploration III (One year duration)	Project Work/ Special Course	0+0+2	Credits Offered Next semester

9	Track 1	Structural Engineering	Professional Electives, Student need to select any one track	2+1+0	**3**
10	Track 2	Environmental Engineering			
11	Track 3	Geotechnical Engineering			
12	Track 4	Transportation Engineering			
Total Credits (5th Semester)				**25**	**20**

Semester-6					
S. No	**Course Code**	**Title of the Course**	**Category**	**L-T-P**	**Credits**
1	CE308	Design of Concrete Structures- II	Professional Core	3+1+0	4
2	CE309	Construction Planning And Management	Professional Core	3+0+0	3
3	CE310	Geo-informatics	Professional Core	3+0+0	3
4	CE311	Geo-informatics Lab	Professional Core	0+0+2	1
5	AS103	Engineering Exploration III (One year duration)	Project Work /Special	0+0+2	2
6	GTI4301	Numerical Ability and Logical Reasoning	Professional Electives	3+0+0	3
7	Track 1	Structural Engineering	Professional Electives, Student need to follow the selected track in previous	3+0+0	3
8	Track 2	Environmental Engineering			
9	Track 3	Geotechnical Engineering			
10	Track 4	Transportation Engineering			
Total Credits (6th Semester)				**20**	**19**

Year IV

Semester-7					
S. No	**Course Code**	**Title of the Course**	**Category**	**L-T-P**	**Credits**
1	CE401	Environmental Impact Assessment and Life cycle Analysis	Professional Core	3+0+0	3
2	CE402	Programming for Problem Solving	Engineering Science	2+0+4	4
3	DM101	Disaster Management	Professional Core	2+0+0	2
4	CE404	Computer Aided Design III	Professional Core	0+0+4	2
5	AS104	Engineering Exploration IV (One year duration)	Project Work /Special Course	0+0+4	2
6	CE405	Professional Practices (Entrepreneurship / Gate)	Professional Elective	2+0+0	2
7	Track 1	Structural Engineering	Professional Electives, Student need to select any one track	3+0+0	3
8	Track 2	Environmental Engineering			
9	Track 3	Geotechnical Engineering			
10	Track 4	Transportation Engineering			
		Total		**24**	**18**

Semester-8					
S. No	**Course Code**	**Title of the Course**	**Category**	**L-T-P**	**Credits**
1	CET 9403	Industry Oriented Hands- on Experience	Training	- - -	25
2	CET 9410	Coopt Training Module (optional)	Training	-	**25**
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 evaluation will be continuous, and the weightage of various components are as given in Table 1 (For Theory courses) and in Table 23 (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 work	30%
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-Voce	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. GPA will indicate the performance of student for any particular semester/trimester. Formulas for calculation of GPA and CGPA have been provided as below:

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

Where n = number of subjects in the trimester; N = number of trimesters; GPA_i = GPA 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 CGPA of the student would be =

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

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

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

9. Promotion and Registration

Any bona fide 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. 175 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.

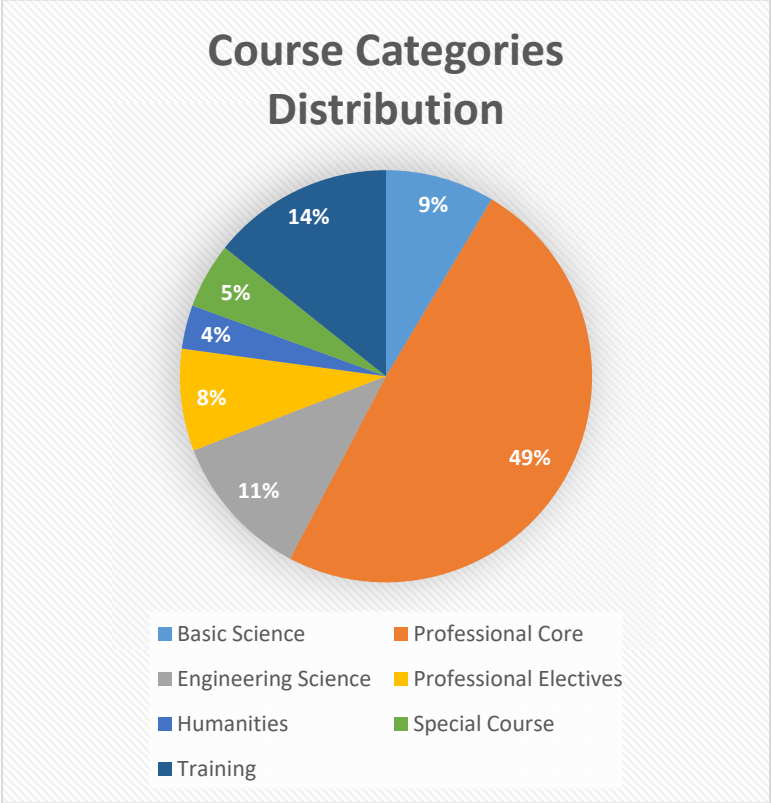
However, in case of a student having outstanding dues against him to be paid to the University, Hostel or any other recognized organ of the University, his degree will be withheld until the said dues are cleared.

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

Sem.	Basic Science	Professional Core	Engineering Science	Professional Electives	Humanities	Special Course	Training	**Total Credits**
1st	10	0	8	0	2	0	0	20
2nd	5	10	4	0	0	3	0	22
3rd	0	24	2	0	4	0	0	30
4th	0	17	2	0	0	2	0	21
5th	0	17	0	3	0	0	0	20
6th	0	11	0	6	0	2	0	19
7th	0	7	4	5	0	2	0	18
8th	0	0	0	0	0	0	25	25
Total Credits	**15**	**86**	**20**	**14**	**6**	**9**	**25**	**175**

Table: Course categories wise Credits



Semester I

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

Semester-1					
S. No.	**Course Code**	**Title of the Course**	**Category**	**L-T-P**	**Credits**
1	AM101	Engineering Mathematics I	Basic Science	4+1+0	5
2	PH101	Engineering Physics	Basic Science	3+1+0	4

3	ME102	Engineering Graphics	Engineering Science	2+0+4	4
4	GEL4101	Environmental Sciences	Engineering Science	3+0+0	3
5	CL101	English-I	Humanities	0+0+4	2
6	PH103	Engineering Physics Lab	Basic Science	0+0+2	1
7	ME153	Engineering Graphics Lab	Engineering Science	0+0+2	1
8	AS101	Engineering Exploration (One year duration)	Project Work/ Special Course	3+1+0	Credits Offered Next semester
Total Credits (1st Semester)				**30**	**20**

Course Code	Course Name	L-T-P	Credits
AM101	Engineering Mathematics-1	4+1+0	5

Course Learning Outcomes (CO):

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 Outlines:

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. 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, Homogeneous function, Euler's Theorem, Total derivatives, Error & Approximation, 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. Introduction to Scalars and Vector: Vector Function (Derivative and integral), velocity and acceleration tangent to the curve, Unit tangent, Scalar and Vector Field, Gradient and its Physical Interpretations, Directional Derivatives. Divergence and its Physical Interpretations, Curl and its Physical Interpretations, Properties of Gradient, Divergence and Curl, Integration of vectors, Line Integrals, Surface & Volume Integral, Green's Theorem in

the Plane (without proof) and applications, Stoke's Theorem (without proof) and applications, Gauss Divergence Theorem (without proof) and applications.

Recommended Books:

1. The Engineering Mathematics', Vol.-1, Chitkara University Publication Ramana, B. V. (2006).
2. Higher Engineering Mathematics. Tata McGraw-Hill Education.
3. Introduction to Linear Algebra, 3rd Edition Gilbert Strang
4. Linear Algebra Jump Start And Catch Up; Jonathan D Tullis 2017

Course Code	Course Name	L-T-P	Credits
PH101	Engineering Physics	3+1+0	4

Course Learning Outcomes (CO):

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 Outlines:

Vector and scalar fields, Gradient, divergence, curl and their physical interpretation, Gauss's theorem and Stoke's theorem (Statement only), Equation of continuity, Maxwell's equations (Integral & differential form), Maxwell's equations in free space, Propagation of electromagnetic waves in free space. 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, 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. Quantum Mechanics: Introduction to Quantum Mechanics, Group velocity and phase velocity (No relation), de-Broglie waves, Uncertainty principle (statement only), Wave function and its significance, Normalised wave function, Time Independent Schrodinger wave equations, Time dependent Schrodinger wave equations, Particle in a one dimensional box. Electronic Properties of Solids: Free electron theory (quantum theory in 1-D), Fermi energy, Band theory of solids (introduction): metals, semiconductors, insulator, doping, Intrinsic and extrinsic semiconductors, Carrier concentration of semiconductors (no derivation), Hall effect (Quantitative idea).

Recommended Books:

1. Malik, H. K., & Singh, A. K. (2010). Engineering physics. McGraw-Hill Education.
2. Dr. M. N. Avadhanulu and Dr P.G. Kshirsagar "Engineering Physics" S. Chand & Company PVT. LTD.
3. Dr S Mani Naidu, "Engineering Physics", Pearson.
4. Dattu R Joshi, "Engineering Physics", Mc Graw Hill Education

Course Code	Course Name	L-T-P	Credits
ME102	Engineering Graphics	2+0+4	4

Course Learning Outcomes (CO):

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 Outlines:

Drawing of Various types of lines, principles of dimensioning, symbols, conventions, scales (plane and diagonal) Vertical and inclined lettering as per IS code of practice (SP-46) for general Engineering, Projection of points, lines, planes and solids. Sectioning of solids, Isometric Projection, Orthographic projections and development of surfaces.

Recommended Books:

1. Chitkara University Lab Manual
2. Dhananjay, A. J. (2010). 'Engineering Drawing: With An Introduction To Auto Cad'. Tata McGraw Hill Education Private Limited, New Delhi.

3. Giesecke, F. E., Hill, I. L., Spencer, H. C., Mitchell, A. E., Dygdon, J. T., Novak, J. E., & Goodman, M. (2016). Technical drawing with engineering graphics. Peachpit Press, USA.
4. Madsen, D. A., & Madsen, D. P. (2016). 'Engineering drawing and design', Nelson Education, Canada.

Course Code	Course Name	L-T-P	Credits
GEL4101	Environmental Sciences	3+0+0	3

Course Learning Outcomes (CO):

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:

Definition, Scope and Importance of environmental studies, natural resources, its types, conservation and associated problems, Equitable use of resources for sustainable lifestyles, Concept, Structure, functions and Energy flow in an ecosystem, Ecological succession, Introduction, types, characteristic features, structure and functions of Forest, Grassland , Desert and Aquatic ecosystem, Biodiversity, its types, values, threats and its conservation, study at global, National and local levels, India as a mega diversity nation ,Hot-spots of biodiversity, Bio-geographical classification and Endangered and endemic species of India, Pollution definition, Causes, effects and control measures of Air, Water, Soil, Marine ,Noise, Thermal, and Radioactive pollution, Solid waste Management–Causes, effects and control measures, Disaster management ,Water conservation, rain water harvesting, and watershed management, Urban problems related to energy ,concern of Resettlement and rehabilitation of people, Environmental Issues and its possible solutions, Environment Protection Act, Air (Prevention and Control of Pollution) Act,-Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act ,Public awareness for Population growth, Family Welfare Programme, Environment and Human Rights, HIV/AIDS, Women and Child Welfare programs, Role of information Technology in Environment and human health, Visit to a local area to document environmental assets/River /forest

grassland/hill/mountain/ /Urban/Rural/industrial/ Agricultural or any local polluted site /Study of simple eco systems/ pond, river, hill slopes, etc.

Recommended Books:

1. Bharucha, E. (2005). Textbook of Environmental Studies for Undergraduate Courses, Mapin Publishing Pvt. Ltd, India.
2. Rajagopalan, R. (2015). Environmental studies: from crisis to cure (No. Ed. 3), Oxford University Press, UK.
3. Masters, G. M., & Ela, W. P. (1991). Introduction to environmental engineering and science (Vol. 3), Englewood Cliffs, NJ: Pearson, USA.
4. Paul Warde Libby Robin Sverker Sorlin Jan 2019, "The Environment: A History of the Idea"

Course Code	Course Name	L-T-P	Credits
CL101	English I	0+0+4	2

Course Learning Outcomes (CO):

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.

Recommended Books:

1. Inlingua Student Book English A and B
2. Elementary (cutting edge), starter (cutting edge), pre intermediate (cutting edge)
3. The Quick and Easy Way to Effective Speaking by Dale Carnegie
4. Word Power Made Easy" by Norman Lewis

Course Code	Course Name	L-T-P	Credits
PH103	Engineering Physics Lab	0+0+2	1

Course Learning Outcomes (CO):

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.
CLO6: Apply the fundamental concepts of physics to related engineering problems.

Course Outlines:

Susceptibility of FeCl3 by Quinke's Method , e/m ratio of electron using Thomson method, Plateau curve for a GM counter, Dead time of G M counter, Absorption of beta particles in aluminum using a G M Counter, Ionization potential of mercury using a gas filled diode, Wavelength of light using Michelson's Interferometer., Resolving power of a plane transmission grating, Specific rotation of cane sugar solution using Laurent's half shade polarimeter, Laser beam characteristics like wave length, Aperture & divergence etc., Diffraction using Laser beam, Numerical aperture of an optical fiber, Attenuation & propagation losses in optical fibres.

Recommended Books:

1. Malik, H. K., & Singh, A. K. (2010). 'Engineering physics', McGraw-Hill Education, New Delhi.
2. Halliday, D., Resnick, R., & Merrill, J. (1981). 'Fundamentals of physics (Vol. 3)', John Wiley & Sons, New York.
3. Gersten, J. I., & Smith, F. W. (2001). 'The physics and chemistry of materials', John Wiley & Sons, New York.
4. M. N. Avadhanulu and Dr P.G. Kshirsagar "Engineering Physics" S. Chand & Company PVT. LTD.

Course Code	Course Name	L-T-P	Credits
ME153	Engineering Graphics Lab	0+0+2	1

Course Learning Outcomes:

CLO1: Introduce CAD (computer aided drafting) software and its utilities in the engineering field.
CLO2: Perform initial software setting and able to draw 2D entities. Edit the edit the drawings using modify commands skills.
CLO3: Draw basic isometric drawings using auto CAD will achieve perfectness in experimental.

Course Outlines:

Introduction of the CAD (computer aided drafting) software and its utilities in the engineering software. Study of the various toolbar options and exercises to familiarize all the drawing tools, Study the basic initial setting and viewing of the drafting software interfaces, Use of basic entities in 2D, Uses of various modify commands of the drafting software, Dimensioning in 2D and 3D entries, Study and implementing of coordinate systems.

Recommended Books:

1. Chitkara University Lab Manual
2. Dhananjay, A. J. (2010). 'Engineering Drawing: With an Introduction to Auto Cad'. Tata McGraw Hill Education Private Limited, New Delhi.
3. Giesecke, F. E., Hill, I. L., Spencer, H. C., Mitchell, A. E., Dygdon, J. T., Novak, J. E., & Goodman, M. (2016). Technical drawing with engineering graphics. Peachpit Press, USA.
4. Madsen, D. A., & Madsen, D. P. (2016). 'Engineering drawing and design', Nelson Education, Canada.

Course Code	Course Name	L-T-P	Credits
AS101	Engineering Exploration	3+1+0	Credits Offered Next semester

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 Outlines:

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.

Semester II

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

Semester-2					
S. No	**Course Code**	**Title of the Course**	**Category**	**L-T-P**	**Credits**
1	AM102	Engineering Mathematics II	Basic Science	4+1+0	5
2	CE101	Engineering Mechanics	Professional Core	3+1+0	4
3	EE103	Basics of Electrical & Electronics Engineering	Engineering Science	3+0+0	3
4	CE102	Surveying	Professional Core	3+0+0	3
5	CE104	Introduction to Civil Engineering	Professional Core	2+0+0	2
6	EE104	Basics of Electrical & Electronics Engineering Lab	Engineering Science	0+0+2	1
7	CE103	Surveying Lab	Professional Core	0+0+2	1

8	AS101	Engineering Exploration	Project Work/ Special Course	2+0+0	3
		Total		**23**	**22**

Course Code	Course Name	L-T-P	Credits
AM102	Engineering Mathematics-II	4+1+0	5

Course Learning Outcomes (CO):

CLO1: To analyze and correlate many real life problems mathematically and thus find the appropriate solution 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 others, which are governed by partial differential equations subject to boundary conditions.

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

Course Outlines:

Fourier series: Introduction, Fourier Series on Arbitrary Intervals, Half-range cosine and sine series, Fourier Transform with properties, Convolution, Fourier Cosine and Sine transforms and properties: Fourier Cosine and Sine Transform, Linearity, Shifting and Scaling, Fourier Cosine and Sine transforms of Derivatives. Parseval's Identity.

Ordinary Differential Equations: Differential equations of first order and first degree – exact, linear and Bernoulli, Clairauts, Exact differential equations. Clairaut's equation 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.

Laplace Transform: Laplace Transform, Inverse transforms properties, Transforms of derivatives and integrals, Unit step function, Dirac's delta function, Differentiation and Integration of transforms. Applications to differential equations.

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. 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 (without proof, Cauchy's Theorem (without proof, Cauchy Integral formula (without proof) Taylors and Laurent's Expansion..

Recommended Books:

1. Ramana, B. V. (2006). Higher Engineering Mathematics. Tata McGraw-Hill Education, New Delhi.
2. Advanced Engineering Mathematics. John Wiley & Sons, USA.
3. Higher Engineering Mathematics". Tata McGraw-Hill Education.
4. Introduction to Linear Algebra", 3rd Edition Gilbert Strang

Course Code	Course Name	L-T-P	Credits
CE101	Engineering Mechanics	3+1+0	4

Course Learning Outcomes (CO):

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 Outlines:

Introduction to Engineering Mechanics covering, Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; 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. Friction covering, Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack.

Basic Structural Analysis covering, Equilibrium in three dimensions; Centroid and Centre of Gravity covering, Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Virtual Work and Energy Method- Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and

gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. 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; Newton's 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular); Impact (Direct and oblique). Introduction to Kinetics of Rigid Bodies covering, Basic terms, general principles in dynamics; Types of motion, Instantaneous center of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation;

Recommended Books:

1. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall
2. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill
3. R. C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.
4. Shanes and Rao (2006), Engineering Mechanics, Pearson Education,
5. Hibler and Gupta (2010), Engineering Mechanics (Statics, Dynamics) by Pearson Education
6. Reddy Vijaykumar K. and K. Suresh Kumar (2010), Singer's Engineering Mechanics
7. Bansal R.K. (2010), A Text Book of Engineering Mechanics, Laxmi Publications
8. Khurmi R.S. (2010), Engineering Mechanics, S. Chand & Co.
9. Tayal A.K. (2010), Engineering Mechanics, Umesh Publications.

Course Code	Course Name	L-T-P	Credits
EE103	Basics of Electrical & Electronics Engineering	3+1+0	3

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 Outlines:

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. M.S. Sukhija, T.K. Nagsarkar, 2012 'Basic Electrical and Electronics Engineering', Oxford University.
2. Muthusubramanian, R., & Salivahanan, S. (2000). Basic Electrical and Electronics Engineering (Vol. 107, p. 6). Tata Mcgraw Hill, New Delhi.
3. 'Kulshreshtha, D. C. (2012). Basic Electrical Engineering. Tata McGraw Hill.
4. J.B. Gupta "A Textbook of Basic Electrical and Electronics Engineering." McGraw Hill Education.

Course Code	Course Name	L-T-P	Credits
CE102	Surveying	3+1+0	3

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 Outlines:

Introduction to Surveying: Principles, Linear, angular and graphical methods, Survey stations, Survey lines- ranging, Bearing of survey lines, Levelling: 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; areas and volumes. Triangulation and Trilateration (6 Hours)**:** 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 - Axis single corrections.

Curves (6 hours) 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 (8 Hours): 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 Surveying with GPS, Co-ordinate transformation, accuracy considerations.

Recommended Books:

1. Madhu, N, Sathikumar, R and Satheesh Gobi, Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson India, 2006.
2. Manoj, K. Arora and Badjatia, Geomatics Engineering, Nem Chand & Bros, 2011.
3. Bhavikatti, S.S., Surveying and Levelling, Vol. I and II, I.K. International, 2010.
4. Chandra, A.M., Higher Surveying, Third Edition, New Age International (P) Limited, 2002.
5. Anji Reddy, M., Remote sensing and Geographical information system, B.S.Publications, 2001.
6. Arora, K.R., Surveying, Vol-I, II and III, Standard Book House, 2015.

Course Code	Course Name	L-T-P	Credits
CE104	Introduction to Civil Engineering	2+0+0	2

Course Learning Outcomes:

CLO1: Introduction to what constitutes Civil Engineering.
CLO2: Identifying the various areas available to pursue and specialize within the overall field of Civil Engineering.
CLO3: Student will be able to illustrate the types, uses and properties of various building materials
CLO4: Providing inspiration for doing creative and innovative work.

CLO5: Student will be able to explain the method of construction of different components of a building.
CLO6: Providing a foundation for the student to launch off upon an inspired academic pursuit into this branch of engineering.

Course Outlines:

Basic Understanding: What is Civil Engineering/ Infrastructure? Basics of Engineering and Civil Engineering; Broad disciplines of Civil Engineering; Importance of Civil Engineering, Possible scopes for a career

History of Civil engineering: Early constructions and developments over time; Ancient monuments & Modern marvels; Development of various materials of construction and methods of construction; Works of Eminent civil engineers.

Overview of National Planning for Construction and Infrastructure Development: Position of construction industry vis-à-vis other industries, five-year plan outlays for construction; current budgets for infrastructure works;

Ocean Engineering: Basics of Wave and Current Systems; Sediment transport systems; Ports & Harbours and other marine structures

Power Plant Structures: Chimneys, Natural & Induced Draught Colling towers, coal handling systems, ash handling systems; nuclear containment structures; hydro power projects

Structural Engineering: Types of buildings; tall structures; various types of bridges; Water retaining structures; Other structural systems; Experimental Stress Analysis; Wind tunnel studies;

Surveying & Geomatics: Traditional surveying techniques, Total Stations, Development of Digital Terrain Models; GPS, LIDAR;

Traffic &Transportation Engineering: Investments in transport infrastructure development in India for different modes of transport; Developments and challenges in integrated transport development in India: road, rail, port and harbour and airport sector; PPP in transport sector; Intelligent Transport Systems; Urban Public and Freight Transportation; Road Safety under heterogeneous traffic; Sustainable and resilient pavement materials, design, construction and management; Case studies and examples.

Recommended Books:

1. Patil, B.S. (1974), Legal Aspects of Building and Engineering Contract
2. The National Building Code, BIS, (2017)
3. RERA Act, (2017)
4. Meena Rao (2006), Fundamental concepts in Law of Contract, 3rd Edn. Professional Offset
5. Chandiramani, Neelima (2000), the Law of Contract: An Outline, 2nd Edn. Avinash Publications Mumbai.
6. Avtarsingh (2002), Law of Contract, Eastern Book Co.
7. Dutt (1994), Indian Contract Act, Eastern Law House

Course Code	Course Name	L-T-P	Credits
EE104	Basics of Electrical & Electronics Engineering Lab	0+0+2	1

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 Outlines:

Introduction to various basic electronic components and use of multimeter, Verification of Kirchhoff's laws in D.C circuits, (A) Analysis of AC Circuits: To find the voltage, current relationship and power factor of a given R-L-C series circuit, Measurement of Power, To start and reverse the direction of rotation of three phase induction motors, Measurement of self-inductance, mutual inductance and coupling coefficient of windings, Analyze the truth tables of various basic digital gates, Plot and analyze the forward and reverse characteristics of PN junction Si and Ge diodes and determine their knee and breakdown voltages, To plot the temperature versus resistance characteristics for RTD, To study the concept of electrical protection devices such as Fuse and MCB, To perform open- circuit and short circuit test on a transformer and determine (i) efficiency, (ii) voltage regulation, To analyze Zener diode as voltage regulator.

Recommended Books:

1. M.S. Sukhija, T.K. Nagsarkar, 2012 'Basic Electrical and Electronics Engineering', Oxford University.
2. Muthusubramanian, R., & Salivahanan, S. (2000). Basic Electrical and Electronics Engineering (Vol. 107, p. 6). Tata Mcgraw Hill, New Delhi.
3. 'Kulshreshtha, D. C. (2012). Basic Electrical Engineering. Tata McGraw Hill.
4. J.B. Gupta "A Textbook of Basic Electrical and Electronics Engineering." McGraw Hill Education.

Course Code	Course Name	L-T-P	Credits
CE103	Surveying Lab	0+0+2	1

Course Learning Outcomes:

CLO1: Survey an area under various topographical feature and obstructions.
CLO2: Skill development to prepare the plan or map of the area surveyed.
CLO3: Analyze, report and where appropriate distribute the survey errors.

CLO4: Perform instruments checks to ensure they meet the specifications.
CLO5: Surveying practice skills enhanced.
CLO6: To make student ready for industry in field of surveying and thus enhances employability.

Course Outlines:

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

Recommended Books:

1. Lab manual Geodesy- I (surveying- I), Chitkara University
2. Lab Manual Geodesy- II (Surveying- II), Chitkara University
3. Madhu, N, Sathikumar, R and Satheesh Gobi," Advanced Surveying: Total Station, GIS and Remote Sensing", Pearson India, 2006.
4. Manoj, K. Arora and Badjatia," Geomatics Engineering", Nem Chand & Bros, 2011.

Course Code	Course Name	L-T-P	Credits
AS101	Engineering Exploration	2+0+0	3

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. 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 III

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

Semester-3					
S. No	**Course code**	**Title of the Course**	**Category**	**L-T-P**	**Credits**
1	CE201	Fluid Mechanics	Professional Core	3+0+0	3
2	CE202	Mechanics of solids	Professional Core	3+0+0	3
3	CE203	Building Material and Construction	Professional Core	3+0+0	3
4	CE204	Structural Analysis I	Professional Core	3+1+0	4
5	HU201	Human Rights and values	Humanities	2+0+0	2
6	CE205	Fluid Mechanics lab	Professional Core	0+0+2	1
7	CE206	Mechanics of solids lab	Professional Core	0+0+2	1
8	CE207	Building Material and Construction Lab	Professional Core	0+0+2	1
9	CE208	Structure analysis-I Lab	Professional Core	0+0+2	1
10	CE209	Computer Aided Design I	Professional Core	One week course	2
11	CL201	English-II	Humanities	0+0+4	**2**
12	AS102	Engineering Exploration II (One year duration)	Project Work/ Special Course	0+0+2	Credits Offered Next
Summer Course					
13	ME152	Manufacturing Practices	Engineering Science	0+0+4	2
14	CE210	Survey Camp	Professional Core	Summer Camp	5
		Total		**33**	**30**

Course Code	Course Name	L-T-P	Credits
CE201	Fluid Mechanics	3+0+0	3

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 Outlines:

Basic Concepts and Definitions – Distinction between a fluid and a solid; Density, Specific weight, Specific gravity, Kinematic and dynamic viscosity; variation of viscosity with temperature, Newton law of viscosity; vapour pressure, boiling point, cavitation; surface tension, capillarity, Bulk modulus of elasticity, compressibility.

Fluid Statics - Fluid Pressure: Pressure at a point, Pascals law, pressure variation with temperature, density and altitude. Piezometer, U-Tube Manometer, Single Column Manometer, U-Tube Differential Manometer, Micro manometers. Pressure gauges, Hydrostatic pressure and force: horizontal, vertical and inclined surfaces. Buoyancy and stability of floating bodies.

Fluid Kinematics- Classification of fluid flow: steady and unsteady flow; uniform and non-uniform flow; laminar and turbulent flow; rotational and irrotational flow; compressible and incompressible flow; ideal and real fluid flow; one, two and three dimensional flows; Stream line, path line, streak line and stream tube; stream function, velocity potential function. One-, two- and three -dimensional continuity equations in Cartesian coordinates

Fluid Dynamics- Surface and body forces; Equations of motion - Euler's equation; Bernoulli's equation – derivation; Energy Principle; Practical applications of Bernoulli's equation : venturimeter, orifice meter and pitot tube; Momentum principle; Forces exerted by

fluid flow on pipe bend; Vortex Flow – Free and Forced; Dimensional Analysis and Dynamic Similitude - Definitions of Reynolds Number, Froude Number, Mach Number, Weber *Number and Euler Number; Buckingham's* π-Theorem.

Recommended Books:

1. Ojha, C., Berndtsson, R., & Chandramouli, P. (2010). Fluid mechanics and Machinery. Oxford University Press.
2. Modi P.N. & Seth S.M. (2002), 'Hydraulics & Mechanics', Standard Book House, New Delhi.
3. Subramanya, K. (1993). Theory and applications of fluid mechanics. Tata McGraw-Hill.
4. Finnemore, E. J., & Franzini, J. B. (2002). Fluid mechanics with engineering applications (Vol. 10, p. 707). New York: McGraw-Hill.

Course Code	Course Name	L-T-P	Credits
CE202	Mechanics of solids	3+0+0	3

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 Outlines:

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.
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. Relationship between elastic constants.
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.
Shear Stresses- Derivation of formula – Shear stress distribution across various beam sections like rectangular, circular, triangular, I, T angle sections.
Slope and deflection- Relationship between moment, slope and deflection, Moment area method, Macaulay's method. Use of these methods to calculate slope and deflection for determinant beams.
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:

1. Timoshenko, S., & MacCullough, G. H. (1949). Elements of strength of materials.
2. Kazmi, S. M. A., "Solid Mechanics" TMH, Delhi, India.
3. Hibbeler, "R. C. (2004). Mechanics of Materials", 6th ed. East Rutherford, NJ: Pearson Prentice Hall.

4. Crandall, S. H., N. C. Dahl, and T. J. Lardner (1979). "An Introduction to the Mechanics of Solids" New York, NY: McGraw Hill.
5. Laboratory Manual of Testing Materials - William Kendrick Hall
6. Beer, F. P., Johnston, E. R., DeWolf, J. T., & Mazurek, D. F. (2018). Mechanics of Materials. Instructor.
7. Subramanian, R. (2016) "Strength of Materials", Oxford University Press, New Delhi.

Course Code	Course Name	L-T-P	Credits
CE203	Building Material and Construction	3+0+0	3

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 Outlines:

Specifications, details and sequence of activities and construction co-ordination – Site Clearance – Marking – Earthwork - masonry – stone masonry – Bond in masonry - concrete hollow block masonry – flooring – damp proof courses – construction joints – movement and expansion joints – pre cast pavements – Building foundations – basements – temporary shed – centering and shuttering – slip forms – scaffoldings – de-shuttering forms – Fabrication and erection of steel trusses – frames – braced domes – laying brick — weather and water proof – roof finishes – acoustic and fire protection; Sub Structure Construction- Techniques of Box jacking – Pipe Jacking – under water construction of diaphragm walls and basement-Tunnelling techniques – Piling techniques - well and caisson - sinking cofferdam - cable anchoring and grouting-driving diaphragm walls, sheet piles - shoring for deep cutting - well points -Dewatering and stand by Plant equipment for underground open excavation; Super Structure Construction- Launching girders, bridge decks, off shore platforms – special forms for shells - techniques for heavy decks – in-situ pre-stressing in high rise structures, Material handling - erecting light weight components on tall structures - Support structure for heavy Equipment and conveyors - Erection of articulated structures, braced domes and space decks; Design, production, application, specification, and quality control of construction materials unique to civil engineering. Stones, bricks, mortars, Plain, Reinforced & Prestressed Concrete, Construction Chemicals; Structural Steel, High Tensile Steel, Carbon Composites; Plastics in Construction; 3D printing; Recycling of Construction & Demolition wastes.

Recommended Books:

1. Brian Cooke (2011) "Construction Practice", Wiley-Blackwell,
2. Gurcharan Singh, (2017) "Building Construction and Material", Standard Book House.
3. B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain (2016). "Building Construction", Laxmi Publications.
4. SK Duggal, "Building Materials", 4th Edition, New Age Publishers.

Course Code	Course Name	L-T-P	Credits
CE204	Structural Analysis I	3+1+0	4

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.
CLO5: To impart the principles of elastic structural analysis and behaviour of indeterminate structures focusing on employability.

Course Outlines:

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 antisymmetry –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.

Recommended Books:

1. Wang C.K., (1983). 'Intermediate Structural Analysis', Tata McGraw Hill, New Delhi.
2. Punmia B.C, Jain R.K., (2005). 'Strength of Materials and theory of structures Vol I & II', Laxmi Publication New Delhi.

3. W. SPENCER, (1988). "Fundamental Structural Analysis", Springer-Verlag New York.
4. Todd, Joseph Derwent, (1974). "Structural Theory and Analysis", Palgrave Macmillan UK.

Course Code	Course Name	L-T-P	Credits
HU201	Human Values & Professional Ethics/(Human Rights and values)	2+0+0	2

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 Outlines:

Concept of human values and value education, Personal development, Character formation towards positive personality, Value education towards national and global development - national, Professional, Religious and Social Values, Impact of global development on ethics and values, Therapeutic measures, Human rights – general, Human rights of women and children, Institutions for implementation. Self-analysis, gender equality, respect to age, experience, maturity, family member, co-worker. Personality development and its importance in professional world.

Recommended Books:

1. Freeman, Michael (2002). 'Human rights: An interdisciplinary approach', Cambridge: Polity Press, Cambridge.
2. Grose, D. N. (2005). 'A text book of value education' Dominant Publishers and Distributors, New Delhi.
3. Austrian Development Agency (2010). 'Human Rights Manual', Vienna.
4. Senthil kumar, V. S. "Professional Ethics And Human Values

Course Code	Course Name	L-T-P	Credits
CE205	Fluid Mechanics lab	0+0+2	1

Course Learning Outcomes:

CLO1: Identify, name, and characterize flow patterns and regimes.

CLO2: Understand basic units of measurement, convert units, and appreciate their magnitudes.

CLO3: 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 an employability.

Course Outlines:

Measurement of viscosity, Study of Pressure Measuring Devices, Stability of Floating Body, Hydrostatics Force on Flat Surfaces/Curved Surfaces, Verification of Bernoulli's Theorem, Venturimeter, Orifice meter, Flow Visualisation -Ideal Flow, Velocity distribution in pipes. Laminar Flow. Determine the stability of a floating body by calculating the metacentric height of a ship model.

Recommended Books:

1. Ojha, C.S.P., Berndtsson, Chadramouli, P. N., R (2010). Fluid Mechanics and Machinery, Oxford University Press.
2. Hydraulics and Fluid Mechanics, P M Modi and S M Seth, Standard Book House.
3. Subramanya, K. (2001) Theory and Applications of Fluid Mechanics, Tata McGraw Hill
4. Daugherty, R.L., Franzini, J.B., Finnemore, E.J., (2001). Fluid Mechanics with Engineering Applications, Mc Graw Hill.

Course Code	Course Name	L-T-P	Credits
CE206	Mechanics of solids lab	0+0+2	1

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 Outlines:

Study of Universal Testing Machine (U.T.M.). Determine tensile strength of mild steel specimen in the U.T.M. Determine tensile strength of cast iron specimen in the U.T.M. Determine the hardness of a mild steel specimen using Rockwell hardness tester Determine torsional strength of mild steel & calculate modulus of rigidity in the torsion testing machine. Determine the compressive strength of cast iron specimen in the U.T.M. Determine the impact strength of mild steel by Izod impact test. Determine the impact strength of mild steel by Charpy impact test.

Recommended Books:

1. Timoshenko, S. and Young, D. H, (1968) "Elements of Strength of Materials", DVNC, New York, USA.
2. Kazmi, S. M. A., (1976) "Solid Mechanics" TMH, Delhi, India.
3. Hibbeler, R. C., (2004) "Mechanics of Materials". 6th ed. East Rutherford, NJ: Pearson Prentice Hall,
4. Crandall, S. H., N. C. Dahl, and T. J. Lardner. (1979) "An Introduction to the Mechanics of Solids". 2nd Ed. New York, NY: McGraw Hill.
5. Laboratory Manual of Testing Materials - William Kendrick Hall

Course Code	Course Name	L-T-P	Credits
CE207	Building Material and Construction Lab	0+0+2	1

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 Outlines:

Gradation of coarse and fine aggregates, Different corresponding tests and need/application of these tests in design and quality control, Compressive strength test on aggregates, Tension III - Heat Treatment, Torsion test, Hardness tests (Brinnel's and Rockwell), Tests on closely coiled and open coiled springs, Theories of Failure and Corroboration with Experiments, Concrete Mix Design as per BIS.

Recommended Books:

1. Bhavikatti, S. S. (2009). 'Design of Steel Structures (By Limit State Method as Per Is: 800 2007)', IK International Pvt Ltd, India.
2. Kuldeep Saluja, (2015), 'Building Construction', Diamond Pocket Books, India.

3. Allen, E., & Iano, J. (2013). 'Fundamentals of building construction: materials and methods', John Wiley & Sons, New Jersey.
4. Varghese, P. C. Edition: Second Edition "Building Construction

Course Code	Course Name	L-T-P	Credits
CE208	Structure Analysis-I Lab	0+0+2	1

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 Outlines:

Deflection of a pine connected truss, Flexural rigidity (E1) of a given beam, Moment-Area Theorems for slope and deflection of a beam, Different types of struts, Experimentally the influence line for the horizontal thrust in a two hinged arch, Elastic displacement of curved members, Displacement of the roller end in a curved beam, Theoretical verification of the above experiments.

Recommended Books:

1. Wang C.K., (1983). 'Intermediate Structural Analysis', Tata McGraw Hill, New Delhi.
2. Punmia B.C, Jain R.K., (2005). 'Strength of Materials and theory of structures Vol I & II', Laxmi Publication New Delhi.
3. W. SPENCER, (1988). "Fundamental Structural Analysis", Springer-Verlag, New York.
4. Todd, Joseph Derwent, (1974). "Structural Theory and Analysis", Palgrave Macmillan UK.

Course Code	Course Name	L-T-P	Credits
CE209	Computer Aided Design I	One week course	2

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:

Basic concepts of AutoCAD tools -Basic drawing-drawing of various building elements like slab, beam, columns, footing and stair cases etc.-Building plans and elevation-design projects.

Recommended Books:

1. Mastering AutoCAD 2019 by George Omura and Brian C. Benton
2. Lalit Narayan, K., Mallikarjuna Rao, K., Sarcar, M.M.M." Computer Aided Design and Manufacturing"
3. Ghoshal s." Computer-Aided Analysis and Design"
4. Chaudhuri, p. Pal, Edition: Third," Computer Organization and Design"

Course Code	Course Name	L-T-P	Credits
CL201	English-II	0+0+4	2

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:

Introduction, Realia (Individual/ Duo), JAM, Role Plays, Flip (Individual/ Duo), Extempore, and AD Mad show, OHD, Flipped Classroom, Decision Making, Talk Show (Topic Based), Rapid GD's, Survey Activity (Formulation of the questionnaire + On campus survey), Survey Report Presentation, Presentation Making.

Recommended Book(s):

1. Inlingua Student Book English A and B
2. Elementary (cutting edge), starter (cutting edge), pre intermediate (cutting edge)
3. The Quick and Easy Way to Effective Speaking by Dale Carnegie
4. Word Power Made Easy by Norman Lewis

Course Code	Course Name	L-T-P	Credits
AS102	Engineering Exploration II	0+0+1	Credit offered next semester

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 Outlines:

Basic concepts of AutoCAD Tools-Basic drawing-drawing of various building elements like slab, Beam, columns, footing and stair cases etc.-Building plans and elevation-design projects.

Course Code	Course Name	L-T-P	Credits
ME152	Manufacturing Practice Lab	0+0+4	2

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:

Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods, CNC machining, Additive manufacturing, fitting operations & power tools,

Electrical & Electronics, Carpentry, Plastic moulding, glass cutting, Metal casting, welding (arc welding & gas welding), brazing.

Recommended Books:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2. Kalpakjian S. And Steven S. Schmid, (2002) "Manufacturing Engineering and Technology", Pearson Education India Edition.
3. Gowri P. Hariharan and A. Suresh Babu, (2008) Manufacturing Technology – I Pearson Education.
4. Roy A. Lindberg, (1998) "Processes and Materials of Manufacture", 4th edition, Prentice Hall India.

Semester IV

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

Semester-4					
S. No	**Course Code**	**Title of the Course**	**Category**	**L-T-P**	**Credits**
1	CE211	Design of Concrete Structures I	Professional Core	3+1+0	4
2	CE212	Structural Analysis II	Professional Core	3+1+0	4
3	CE213	Hydrology and Water Resource Engineering	Professional Core	2+1+0	3
4	CE214	Environmental Engineering	Professional Core	4+1+0	4
5	CS501	CYBER SECURITY	Engineering Science	2+0+0	2
6	CE216	Design of Concrete Structures Lab	Professional Core	0+0+2	1
7	CE217	Environmental Engineering Lab	Professional Core	0+0+2	1
8	AS102	Engineering Exploration II	Project Work/ Special Course	0+0+2	**2**
				23	**21**

Course Code	Course Name	L-T-P	Credits
CE211	Design of Concrete Structures I	3+1+0	4

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 analyZe and design of simple bolted and welded connections.

Course Outlines:

Study of the strength, behaviour, and design of indeterminate reinforced concrete structures, Load and stresses, load combinations, Working stress and limit state approach. Analysis and design of sections in bending – working stress and limit state method, Rectangular and T-sections, Beams with reinforcement in compression, One-

way slab. Design for shear and bond, Mechanism of shear and bond failure, Design of shear using limit state concept, Development length of bars; Design of sections in torsion. Design of two-way slabs; Design of flat slab – direct method; Circular slab; Slab type staircase, Placement of reinforcement in slabs; voided slab. Design of compression members, Short column, Columns with uni- axial and bi-axial bending; Long columns, use of design charts. Design of foundation; Wall footing, Isolated and combined footing for columns. All designs to be as per the most recent BIS standards as applicable.

Recommended Books:

1. Jain A.K., (2009) 'Reinforced Concrete Design - Limit State Method', Nem Chand Brothers, Roorkee.
2. Sinha S.N., (2002). 'RC Design', Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
3. Gu, Xianglin, Jin, Xianyu, Zhou, Yong. (2016), "Basic Principles of Concrete Structures", Springer-Verlag Berlin Heidelberg, China.
4. Setareh, Mehdi, Darvas, Robert, (2017), "Concrete Structures", Springer International Publishing, Switzerland.

Course Code	Course Name	L-T-P	Credits
CE212	Structural Analysis II	3+1+0	4

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 Outlines:

Analysis of building frames – Kani's method – Stiffness matrix method - Element and global stiffness matrices – Analysis of continuous beams – Co-ordinate transformations – Rotation matrix – Transformations of stiffness matrices, load vectors and displacements vectors – Analysis of pin-jointed plane frames and rigid frames (with redundancy limited to two) – Flexibility matrix method –Application to simple problems of beams and frames - Equilibrium and compatibility – Determinate vs Indeterminate structures – Indeterminacy - Primary structure – Compatibility conditions – Analysis of indeterminate pin-jointed plane frames, continuous beams, rigid jointed plane frames (with redundancy restricted to two) – Cables and suspension bridges - Analysis of Space trusses using method of tension coefficients – Beams curved in plan Suspension cables – suspension bridges with two and three hinged stiffening girders – Introduction to finite element method for plane stress and plane strain - Introduction – Discretisation of a structure – Displacement functions – Truss element –Beam element.

Recommended Books:

1. Yuan Yu Hsieh (1987). Elementry Theory of Structures, 3rd edition, Prentice Hall, New York.
2. Ghali, A., Neville, A. M., (1987). 'Structural Analysis (Unified Classical and Matrix Approach)', Chapman and Hall Ltd, Uk.
3. Menon, Devdas., (2008). 'Structural Analysis Structural Analysis', Narosa Publishing House Pvt. Ltd., New Delhi.
4. Menon, Devdas., (2009). 'Advanced Structural Analysis', Narosa Publishing House, New Delhi. House, New Delhi.

Course Code	Course Name	L-T-P	Credits
CE213	Hydrology and Water Resources Engineering	2+1+0=3	3

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 Outlines:

Introduction - hydrologic cycle, water-budget equation, history of hydrology, world water balance, applications in engineering, sources of data.
Precipitation - forms of precipitation, characteristics of precipitation in India, measurement of precipitation, rain gauge network, mean precipitation over an area, depth area- duration relationships, maximum intensity/depth-duration-frequency relationship, Probable Maximum Precipitation (PMP), rainfall data in India.
Abstractions from precipitation - evaporation process, evaporimeters, analytical methods of evaporation estimation, reservoir evaporation and methods for its reduction, evapotranspiration, measurement of evapotranspiration, evapotranspiration equations, potential evapotranspiration over India, actual evapotranspiration, interception, depression storage, infiltration, infiltration capacity, measurement of infiltration, modelling infiltration capacity, classification of infiltration capacities, infiltration indices.
Runoff - runoff volume, SCS-CN method of estimating runoff volume, flow duration curve, flow-mass curve, hydrograph, factors affecting runoff hydrograph, components of hydrograph, base flow separation, effective rainfall, unit hydrograph surface water resources of India, environmental flows.
Ground water and well hydrology - forms of subsurface water, saturated formation, aquifer properties, geologic formations of aquifers, well hydraulics: steady state flow in wells, equilibrium equations for confined and unconfined aquifers, aquifer tests.

Lining. Dams and spillways Reservoirs.

Recommended Books:

1. Subramanya, K. (2013). Engineering Hydrology, 4e. Tata McGraw-Hill Education, India.
2. Mutreja, K. N. (1986). Applied Hydrology Tata McGraw Hill Publication Cooperative Ltd. New Delhi, 40-109.
3. K Subramanya, 1990, "Water Resources Engineering through Objective Questions", Tata Mc-Graw Hill.
4. Asawa, G. L. (1993). Irrigation engineering. Wiley Eastern Limited.
5. Mays, L. W. (2010). Water resources engineering. John Wiley & Sons.
6. Zimmerman, J. D. (1966). Irrigation. In Irrigation. New York, London, Sydney: John Wiley and Sons, Inc.

Course Code	Course Name	L-T-P	Credits
CE214	Environmental Engineering	4+1+0=5	4

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 Outlines:

Water: -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; Transmission of water, Distribution system, Various valves used in W/S systems, service reservoirs and design. Water Treatment: aeration, sedimentation, coagulation flocculation, filtration, disinfection, advanced treatments like adsorption, ion exchange, membrane processes

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

Small bore systems, 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, Chemistry of combustion, Automobile engines, quality of fuel, operating conditions and interrelationship. Air quality standards, Control measures for Air pollution, construction and limitations
Noise- Basic concept, measurement and various control methods.
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.

Recommended Books:

1. Gilbert M Masters (1997), Introduction to Environmental Engineering and Science (2nd Edition), Prentice Hall.
2. 2. Vesilind P Aarne (1997), Introduction to environmental engineering, PWS Publishing Company, Boston
3. 3. Tchobanoglous, G., Peavy, H. S., & Rowe, D. R. (1985). Environmental engineering. McGraw-Hill Interamericana.
4. Metcalf, I. N. C. (2003). Wastewater engineering; treatment and reuse. McGraw-Hill.

Course Code	Course Name	L-T-P	Credits
CS501	Cyber Security	2+0+0=2	2

Course Learning Outcomes:

CLO1: Ability to analyze 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 Outlines:

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, Cyber café and Cybercrimes, Botnetsthe 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, 3 14% 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,

Recommended Books:

1. Introduction to cyber security: stay safe online', The Open University, Asia Pacific Holdings Private Limited (India).
2. Perry, A. M., 'Online Safety: Scams, SPAM, Viruses and Clouds', 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. A Practical Handbook of Software Construction. by Steve McConnell.

Course Code	Course Name	L-T-P	Credits
CE215	Hydraulic Engineering	3+1+0=4	3

Course Learning Outcomes:

CLO1: Ability to develop the open channel flow equations from the basic conservation equations.
CLO2: Analyze 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 Outlines:

Laminar Flow- Laminar flow through: circular pipes, annulus and parallel plates. Stoke's law, Measurement of viscosity.
Turbulent Flow- Reynolds experiment, Transition from laminar to turbulent flow. Definition of turbulence, scale and intensity, Causes of turbulence, instability,

mechanism of turbulence and effect of turbulent flow in pipes. Reynolds stresses, semi-empirical theories of turbulence thickness, displacement, momentum & energy thickness, laminar and turbulent boundary layers on a flat plate; laminar sub-layer, smooth and rough boundaries. Local and average friction coefficients. Separation and Control.

Dimensional Analysis and Hydraulic Similitude: Dimensional homogeneity, Rayleigh method, Buckingham's Pi method and other methods. Dimensionless groups. Similitude, Model studies, Types, Prandtl's mixing length theory, universal velocity distribution equation. Resistance to flow of fluid in smooth and rough pipes, Moody's diagram.

Boundary Layer Analysis-Assumption and concept of boundary layer theory. Boundary-layer

of models. Application of dimensional analysis and model studies to fluid flow problem.

Introduction to Open Channel Flow-Comparison between open channel flow and pipe flow, geometrical parameters of a channel, classification of open channels, classification of open channel flow, Velocity Distribution of channel section.

Uniform Flow-Continuity Equation, Energy Equation and Momentum Equation, Characteristics of uniform flow, Chezy's formula, Manning's formula. Factors affecting Manning's Roughness Coefficient "*Most economical section of ch*annel. Computation of Uniform flow, Normal depth.

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. Modi P.N. & Seth S.M. (2002), 'Hydraulics & Mechanics', Standard Book House, New Delhi.
2. Subramanya, K. (1993). Theory and applications of fluid mechanics. Tata McGraw-Hill.
3. Subramanya, K. (1982). Flow in Open Channels, 3e. Tata McGraw-Hill Education.
4. Perry, B. (1960). Open-Channel Hydraulics. Ven Te Chow. McGraw-Hill, New York, 1959. Xviii+ 680 pp. Illus. $17.

Course Code	Course Name	L-T-P	Credits
CE216	Design of concrete structure lab	0+0+2=2	1

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 Outlines:

Tests on cement, Fine aggregate testing, coarse aggregate testing, workability of concrete, strength tests on concrete, Non-destructive testing of concrete Design of Concrete Mix (As per Indian Standard Method), Failure of RC beams in bending by two point and one point loading, Failure of RC beam under shear with shear reinforcement.

Recommended Book(s):

1. Lab manual Design of concrete structures", Chitkara University.
2. Jain A.K., (2009) "'Reinforced Concrete Design" - Limit State Method', Nem Chand Brothers, Roorkee.
3. Gu, Xianglin, Jin, Xianyu, Zhou, Yong. (2016), "Basic Principles of Concrete Structures", Springer-Verlag Berlin Heidelberg, China.
4. Setareh, Mehdi, Darvas, Robert, (2017), "Concrete Structures", Springer International Publishing, Switzerland.

Course Code	Course Name	L-T-P	Credits
CE217	Environmental Engineering Lab	0+0+2=2	**1**

Course Learning Outcomes:

CLO1: Statistically analyze 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.
CO5: Able to determine the population forecast for a city to meet its water requirement enhancing skills for employability in town planning projects.
CO6: Understand the impact of water and wastewater treatment on people and the environment.

Course Outlines:

Physical Characterization of water: Turbidity, Electrical Conductivity, pH, Analysis

of solids content of water: Dissolved, Settle able, suspended, total, volatile, inorganic etc., Alkalinity and acidity, Hardness: total hardness, calcium and magnesium hardness, Analysis of ions: copper, chloride and sulphate, Optimum coagulant dose, Chemical Oxygen Demand (COD), Dissolved Oxygen (D.O) and Biochemical Oxygen Demand (BOD), Break point Chlorination,

Recommended Books:

1. Gilbert M Masters (1997), Introduction to Environmental Engineering and Science (2nd Edition), Prentice Hall.
2. Vesilind P Aarne (1997), Introduction to environmental engineering, PWS Publishing Company, Boston
3. Tchobanoglous, G., Peavy, H. S., & Rowe, D. R. (1985). Environmental engineering. McGraw-Hill.
4. Metcalf, I. N. C. (2003). Wastewater engineering; treatment and reuse. McGraw-Hill.
5. India. Ministry of Urban Development. Expert Committee, Central Public Health, & Environmental Engineering Organisation (India). (1999). Manual on water supply and treatment. Central Public Health and Environmental Engineering Organisation, Ministry of Urban Development.
6. Plumbing Engineering. Theory, Design and Practice, S.M. Patil, 1999
7. Tchobanoglous, G., Theisen, H., Vigil, S. A., & Alaniz, V. M. (1993). Integrated solid waste management: engineering principles and management issues (Vol. 4). New York: McGraw-Hill.
8. Manual on Sewerage and Sewage Treatment Systems, Part A, B and C. Central Public Health and Environmental Engineering Organization, Ministry of Urban Development.

Course Code	Course Name	L-T-P	Credits
AS102	Engineering Exploration II	0+0+1=1	**2**

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 Outlines:

Projects related to Civil Engineering

Semester V

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

Semester-5					
S. No	**Course Code**	**Title of the Course**	**Category**	**L-T-P**	**Credits**
1	CE301	Transportation Engineering	Professional Core	3+0+0	3
2	CE302	Geotechnical Engineering	Professional Core	3+1+0	4
3	CE303	Design of Steel Structures	Professional Core	3+1+0	4
4	CE304	Estimation & Costing	Professional Core	3+0+0	3
5	CE305	Computer Aided Design II	Professional Core	0+0+2	1
6	CE306	Transportation Engineering lab	Professional Core	0+0+2	1
7	CE307	Geotechnical Engineering lab	Professional Core	0+0+2	1
8	AS103	Engineering Exploration III (One year duration)	Project Work/ Special Course	0+0+2	Credits Offered Next semester
9	Track 1	Structural Engineering	Professional Electives, Student need to select any one track	3+0+0	**3**
10	Track 2	Environmental Engineering			
11	Track 3	Geotechnical Engineering			
12	Track 4	Transportation Engineering			
		Total		**25**	**20**

Course Code	Course Name	L-T-P	Credits
CE301	Transportation Engineering	3+0+0	3

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 Outlines:

Highway development and Planning-Classification of roads, road development in India, Current road projects in India; highway alignment and project preparation.
Geometric design of highways-: Introduction; highway cross section elements; sight distance, design of horizontal alignment; design of vertical alignment; design of intersections, problems
Traffic engineering & control- Traffic Characteristics, traffic engineering studies, traffic flow and capacity, traffic regulation and control; design of road intersections; design of parking facilities; highway lighting; problems
Pavement materials- Materials used in Highway Construction- Soils, Stone aggregates, bituminous binders, bituminous paving mixes; Portland cement and cement concrete: desirable properties, tests, requirements for different types of pavements. Problems
Design of pavements- Introduction; flexible pavements, factors affecting design and performance; stresses in flexible pavements; design of flexible pavements as per IRC;

Recommended Books:

1. L.R. Kadiyali, (2013) 'Traffic Engineering & Transport Planning', Khanna Publishers, India.
2. 2. Khanna & Justo, (1973) 'Highway Engineering", Nemchand & Bros-Roorkee (UA).
3. 3. Chakroborty, P., & Das, A. (2017). Principles of transportation engineering. PHI Learning Pvt. Ltd.
4. 4. Mannering, F., Kilareski, W., & Washburn, S. (2007). Principles of highway engineering and traffic analysis. John Wiley & Sons.
5. 5. Srinivasa Kumar, R., 2011, "Textbook of Highway Engineering", Universities Press.

Course Code	Course Name	L-T-P	Credits
CE302	Geotechnical Engineering	3+1+0=4	4

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 Outlines:

Introduction - Types of soils, their formation and deposition, Definitions: soil mechanics, soil engineering, rock mechanics, geotechnical engineering. Scope of soil engineering. Comparison and difference between soil and rock. Basic Definitions and Relationships-Soil as three-phase system in terms of weight, volume, voids ratio, and porosity. Definitions: moisture content, unit weights, degree of saturation, voids ratio, porosity, specific gravity, mass specific gravity, etc. Relationship between volume weights, voids ratio- moisture content, unit weight- percent air voids, saturation- moisture content, moisture content- specific gravity etc. Determination of various parameters such as: Moisture content by oven dry method, pycnometer, sand bath method, torsional balance method, nuclear method, alcohol method and sensors. Specific gravity by density bottle method, pycnometer method, measuring flask method. Unit weight by water displacement method, submerged weight method, core-cutter method, sand-replacement method.
Plasticity Characteristics of Soil - Introduction to definitions of: plasticity of soil, consistency limits-liquid limit, plastic limit, shrinkage limit, plasticity, liquidity and consistency indices, flow & toughness indices, definitions of activity and sensitivity. Determination of: liquid limit, plastic limit and shrinkage limit. Use of consistency limits. Classification of Soils-Introduction of soil classification: particle size classification, textural classification, unified soil classification system, Indian standard soil classification system. Identification: field identification of soils, general characteristics of soil in different groups.
Stresses in soils – Introduction, stresses due to point load, line load, strip load, uniformly loaded circular area, rectangular loaded area. Influence factors, Isobars, Boussinesq's equation, Newmark's Influence Chart. Contact pressure under rigid and flexible area, computation of displacements from elastic theory.
Stability of Slopes - Introduction, types of slopes and their failure mechanisms, factor of safety, analysis of finite and infinite slopes, wedge failure Swedish circle method, friction circle method, stability numbers and charts.

Recommended Books:

1. Craig, R.F., (1983). 'Soil Mechanics' by ELBS and Van Nostrand Reinhold Co. Ltd., Berkshire.
2. Taylor, 1949, "Fundamentals of Soil Engineering", John Wiley & Sons.
3. Holtz, R. D., Kovacs, W. D., & Sheahan, T. C. (1981). An introduction to geotechnical engineering (Vol. 733). Englewood Cliffs, NJ: Prentice-Hall.
4. Das, B. M., & Sobhan, K. (2013). Principles of geotechnical engineering. Cengage learning.
5. Das, B. M. (2015). Principles of foundation engineering. Cengage learning.

Course Code	Course Name	L-T-P	Credits
CE303	Design of Steel Structures	4+1+0=5	4

Course Outcomes:

CO1: Understand and appreciate various aspects of steel construction like different types of steel sections, their specifications, advantages of steel construction etc
CO2: Analyse and design various types of steel connections using rivets, bolts and weld to enhance the analytical skills.
CO3: Design basic elements of a steel building like beam, column, and column bases etc. for given conditions and loading.
CO4: 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.
CO5: Ability to design steel framing system and connections of a building in a team setting.

Course Outlines:

Properties of materials; loads and stresses, Design of semi-rigid, rigid and moment resistant connections; Built-up sections Design of tension members subjected to axial tension and bending, splicing of tension member, Design of compression members, Beam-column connections, Design of columns and their bases Design of flexural members and Plate girder; loads, specification and design Industrial buildings; loads, design of purlins, trusses, bracings; gantry girders.

Recommended Books:

1. Arya A.S. and Ajmani J.L., (1974). 'Design of Steel Structure', Nemchand & Brothers, Roorkee.
2. Duggal S.K. 'Design of Steel Structure', Tata McGraw-Hill Publishing Co. Ltd, India.
3. Kazmi and Jindal, (2002). 'Design of Steel Structures', Prentice Hall of India, New Delhi.
4. Abu-Saba, Elias G, (1995). "Design of Steel Structures", Springer US.

Course Code	Course Name	L-T-P	Credits
CE304	Estimation & Costing	3+0+0	3

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 analyse present worth, future worth and annual worth analyses on one of more economic alternatives.

Course Outlines:

Rules and methods of measurements: rules for rounding off numerical values, general rules for measurement of works, earthwork, concrete work, brick work, and masonry work, wood work and joinery, piling well foundation. Analysis of rates: purpose of rate analysis and its importance, requirements, factors affecting, procedure requirements of materials for different items of works analysis of main construction items. Valuation and rent fixation: objects of valuation, free hold and lease hold property, property income, different values municipal taxes, annuity mortgage, easement rights capital cost, capitalized cost, depreciation valuation of a property. Specification; Aims and types of specification, methods of preparation of specification, general and detailed specification of all items, carriage of all material, earth work, supplying and stacking of materials. Detailed estimates of building: principles of estimating, general and detailed estimates, degree of accuracy, out to out and into method, crossing and centre line method, estimates of buildings, load bearing/R.C.C. framed, dams, weirs, R.C.C. structures, Contract and laws: types of contracts, Lump-sum contract, item rate, percentage contract, contract documents, security for performance of contracts power of accepting tenders, tender notice, building Bye laws, technical design data.

Recommended Books:

1. Mankiw Gregory N. (2002), Principles of Economics, Thompson Asia
2. V. Mote, S. Paul, G. Gupta (2004), Managerial Economics, Tata McGraw Hill
3. Misra, S.K. and Puri (2009), Indian Economy, Himalaya
4. Pareek Saroj (2003), Textbook of Business Economics, Sunrise Publishers
5. Chakraborti, M (2006) Estimating, Costing Specifications & Valuation
6. Joy P K, Handbook of Construction Management, Macmillan
7. B.S. Patil, (2011) Building & Engineering Contracts, Mrs. S.B.Patil.
8. Relevant Indian Standard Specifications.

Course Code	Course Name	L-T-P	Credits
CE305	Computer Aided Design II	0+0+2=2	1

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 Outlines:

Concept of computer aided design and introduction of software packages used for analysis and design of structures including STAAD.Pro.
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.

Recommended Books:

1. Staad Pro V8i for Beginners: With Indian Examples by T.S.Sarma
2. Exploring Bentley STAAD.Pro V8i (SELECTseries 6) by Sham Purdue University Northwest.
3. Ghoshal s.” Computer-Aided Analysis and Design”
4. Chaudhuri, p. Pal, Edition: Third,” Computer Organization and Design”

Course Code	Course Name	L-T-P	Credits
CE306	Transportation Engineering lab	0+0+2=2	1

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: Recognize 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 subgrade soil by CBR test

Course Outlines:

Los- Angeles abrasion testing machine, Marshall Stability apparatus, Viscosity test, Ductility test, Impact test machine, Flakiness and elongation index Apparatus, Sample container and weights, Bitumen penetration testing, Apparatus with brass cone.

Recommended Books:

1. L.R. Kadiyali, (2013) 'Traffic Engineering & Transport Planning', Khanna Publishers, India.
2. Khanna & Justo, (1973) 'Highway Engineering", Nemchand & Bros-Roorkee (UA).
3. Chakroborty, P., & Das, A. (2017). Principles of transportation engineering. PHI Learning Pvt. Ltd.
4. Mannering, F., Kilareski, W., & Washburn, S. (2007). Principles of highway engineering and traffic analysis. John Wiley & Sons.
5. Srinivasa Kumar, R, Textbook of Highway Engineering, Universities Press, 2011.
6. Paul H. Wright and Karen K. Dixon, (2009) Highway Engineering, Wiley Student Edition.

Course Code	Course Name	L-T-P	Credits
CE307	Geotechnical Engineering lab	0+0+2=2	1

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 behavior 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.

Course Outlines:

Field Density using Core Cutter method, Field Density using Sand replacement method, Natural moisture content using Oven Drying method, Field identification of Fine Grained soils, Specific gravity of Soils, Grain size distribution by Sieve Analysis, Grain size distribution by Hydrometer Analysis, Consistency limits by Liquid limit, Consistency limits by Plastic limit, Consistency limits by Shrinkage limit, Permeability test using Constant-head test method, Permeability test using Falling-head method, Compaction test: Standard Proctor test, Compaction test: Modified Proctor test, Relative density, Consolidation Test, Triaxial Test (UU), Vane shear test, Direct Shear Test, Unconfined Compression Strength Test.

Recommended Books:

1. Craig, R.F., (1983). 'Soil Mechanics' by ELBS and Van Nostrand Reinhold Co. Ltd., Berkshire.

2. 2. Fundamentals of Soil Engineering by Taylor, John Wiley & Sons
3. 3. Holtz, R. D., Kovacs, W. D., & Sheahan, T. C. (1981). An introduction to geotechnical engineering (Vol. 733). Englewood Cliffs, NJ: Prentice-Hall.
4. 4. Das, B. M., & Sobhan, K. (2013). Principles of geotechnical engineering. Cengage learning.
5. 5. Das, B. M. (2015). Principles of foundation engineering. Cengage learning.
6. 6. McCarthy, D. F., & McCarthy, D. F. (1977). Essentials of soil mechanics and foundations (p. 505). Virginia: Reston Publishing Company.
7. 7. Terzaghi, K., Peck, R. B., & Mesri, G. (1996). Soil mechanics in engineering practice. John Wiley & Sons.
8. 8. Murthy, V. N. S. (2002). Geotechnical engineering: principles and practices of soil mechanics and foundation engineering. CRC press.

Course Code	Course Name	L-T-P	Credits
AS103	Engineering Exploration III	0+0+2=2	2

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:

Projects related to Civil Engineering/EPICS.

Semester VI

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

Semester-6					
S. No	**Course Code**	**Title of the Course**	**Category**	**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	CE310	Geo-informatics	Professional Core	3+0+0=3	3
4	CE311	Geo-informatics Lab	Professional Core	0+0+2=2	1
5	AS103	Engineering Exploration III (One year duration)	Project Work /Special Course	0+0+2=2	2
6	GTI4301	Numerical Ability and Logical Reasoning	Professional Electives	3+0+0=3	3
7	Track 1	Structural Engineering	Professional Electives, Student need to follow the selected track in previous semester	3+0+0=3	3
8	Track 2	Environmental Engineering			
9	Track 3	Geotechnical Engineering			
10	Track 4	Transportation Engineering			
		Total		**20**	**19**

Course Code	Course Name	L-T-P	Credits
CE308	Design of Concrete Structures – II	3+1+0	4

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 Outlines:

Design of continuous beams and building frames, Moment redistribution, Estimation of wind and seismic loads, Desirable features of earthquake resistant construction, detailing for earthquake resistant construction – ductility criteria; Water tank and staging; Introduction, Design criteria, Design of rectangular and circular water tank, Design of Intze tank, Staging for overhead tank; Introduction to bridge engineering, Investigation for bridges, IRC loadings, Design of slab culvert; Design of Masonry walls and columns; Pre-stressed concrete, Introduction, pre-stressing system, losses in pre-stress, Design of simple span girders.

Recommended Books:

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

Course Code	Course Name	L-T-P	Credits
CE309	Construction Planning and Management	3+0+0	3

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 Outlines:

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 break-down structure, activity lists, assessment of work content, concept of productivities, estimating durations, sequence of activities, activity utility data; Techniques of planning- Bar charts, Gantt Charts. 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.
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. Varghese, P.C., 2007 "*Building Construction"*, Prentice Hall India.
2. *National Building Code,* 2017 "Bureau of Indian Standards", New Delhi.
3. Chudley, R., 2007, "*Construction Technology"*, ELBS Publishers.
4. Peurifoy, R.L. 2011, "Construction Planning, Methods and Equipment", McGraw Hill.
5. Nunnally, S.W. 2006, "Construction Methods and Management", Prentice Hall.
6. Jha, Kumar Neeraj., 2015, "Construction Project management, Theory & Practice", Pearson Education India.

Course Code	Course Name	L-T-P	Credits
CE310	Geo-informatics	3+0+0	3

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.

CLO5: Apply remote sensing in different thematic studies and enhance skill and Employability development.

Course Outlines:

INTRODUCTION: Data Information, Geodesy and Cartography, Photogrammetry (Analogical Analytic, Digital) Remote Sensing- Global Satellite Positioning System, Laser Scanning, Geographical Information System, Decision Support Systems and Expert Systems, Spatial Information.

REMOTE SENSING: Interaction of EMR with atmosphere – Interaction of EMR with Earth's surface. Data acquisition system – sensor – platform, ISRO.

MULTISPECTRAL REMOTE SENSING: Multispectral Photography–Multispectral Scanning. Thermal Infrared Region–Emissivity–thermal Infrared Sensors–Characteristics of thermal Images. Microwave Region–Passive and active Systems–satellite radar systems– Radar Image interpretation.

SATELLITE REMOTE SENSING: Introduction – landsat – IRS and other satellites. Image interpretation – Visual and Digital Image processing – applications if satellite remote sensing

PHOTOGRAMMETRY: Introduction – types – aerial photograph – types — comparison of aerial photograph and map. Aerial photo interoperation, Aerial Photography - Introduction, Stereoscopes, Marginal and extra marginal information.

STEREOSCOPIC VISION: Introduction – Binocular observation – separation of stereoscope pair – types of stereoscopes – measurement of height from photographs – stereo model – model deformation.

GLOBAL POSITIONING SYSTEM: Introduction; Components of GPS – operational principle – Facts and limitations of GPS

Recommended Books:

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

Course Code	Course Name	L-T-P	Credits
CE311	Geo-informatics Lab	0+0+2=2	1

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 Outlines:

Introduction to GIS; engineering applications: utility system maintenance, urban hydrologic modeling, urban flood control, water supply, water distribution system design, stormwater quality monitoring/control, sold waste management and hazardous waste management. Introduction to ArcGIS Desktop GIS; exploring the ArcMap interface and ArcCatalog for spatial data management. GIS spatial data sources on the Internet; creating new data sets from xy events; heads-up digitizing; GPS for GIS data capture. Spatial data structures in GIS; map projections and coordinate systems; map scale; raster and vector spatial data models; topology and relational query; selecting and editing features; displaying and editing tables; joining and linking tables. GIS analysis functions and operations; feature proximity, containment, intersection; spatial joins;

Recommended Books:

1. ArcGIS documentation, 2009, ESRI Press.
2. Rencz, A.N. (ed.), Manual of Remote Sensing, American Society for Photogrammetry and Remote Sensing, Bethesda, Maryland, 2004.
3. ERDAS Field Guide, 2009, ERDAS.
4. Selected papers from journals and conference proceedings.

Course Code	Course Name	L-T-P	Credits
AS103	Engineering Exploration III	0+0+2=2	2

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 Outlines:

Projects related to Civil Engineering/EPICS

Semester-7					
S. No	**Course Code**	**Title of the Course**	**Category**	**L-T-P**	**Credits**
1	CE401	Environmental Impact Assessment and Life cycle Analysis	Professional Core	3+0+0	3
2	CE402	Programming for Problem Solving	Engineering Science	2+0+4	4
3	DM101	Disaster Management	Professional Core	2+0+0	2
4	CE404	Computer Aided Design III	Professional Core	0+0+4	2
5	AS104	Engineering Exploration IV (One year duration)	Project Work /Special Course	0+0+4	2

6	CE405	Professional Practices (Entrepreneurship / Gate)	Professional Elective	2+0+0	2
8	Track 1	Structural Engineering	Professional Electives, Student need to select any one track	2+1+0	3
9	Track 2	Environmental Engineering			
10	Track 3	Geotechnical Engineering			
11	Track 4	Transportation Engineering			
		Total		**24**	**18**

Course Code	Course Name	L-T-P	Credits
CE401	Environmental Impact Assessment and Life Cycle Analysis	3-0-0	3

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 Outlines:

Evolution of EIA: Concepts of EIA methodologies, Screening and scoping; Rapid EIA and Comprehensive EIA; 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. Canter, R.L., (1996), "Environmental Impact Assessment", McGraw Hill Inc., New Delhi.
2. Shukla, S.K. and Srivastava, P.R., (1992), "Concepts in Environmental Impact

Analysis", Common Wealth Publishers, New Delhi.
3. Lerche, Ian, Glaesser, Walte, (2006), "Environmental Risk Assessment", Springer-Verlag Berlin Heidelberg.
4. Tchobanoglous, G., Theisen, H., Vigil, S. A., & Alaniz, V. M. (1993). Integrated solid waste management: engineering principles and management issues (Vol. 4). New York: McGraw-Hill.

Course Code	Course Name	L-T-P	Credits
CE402	Programming for Problem Solving	2-0-4	4

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 Outlines:

Unit 1: Introduction to Programming (2 hrs)
Introduction to Programming (Flow chart/pseudocode, compilation etc.), Variables (including data types)
Unit 2: Arithmetic expressions and precedence (2 hrs)
Unit 2: Conditional Branching and Loops (8 hrs), Writing and evaluation of conditionals and consequent branching, Iteration and loops
Unit 3: Arrays (6 hrs), Arrays (1-D, 2-D), Character arrays and Strings
Unit 4: Basic Algorithms (6 hrs), Searching, Basic Sorting Algorithms, Finding roots of equations, idea of time complexity
Unit 5: Function and Recursion (8 hrs), Functions (including using built in libraries), Recursion with example programs such as Quick sort, Ackerman function etc.
Unit 6: Structure and Pointers (6 hrs), Pointers, Structures (including self-referential structures e.g., linked list, notional introduction)
Unit 7: File handling (2 hrs)
Tutorial and Lab:
Tutorial 1: Problem solving using computers: Lab1: Familiarization with programming Environment
Tutorial 2: Variable types and type conversions: Lab 2: Simple computational problems using arithmetic expressions
Tutorial 3: Branching and logical expressions: Lab 3: Problems involving if-then-else structures
Tutorial 4: Loops, while and for loops: Lab 4: Iterative problems e.g., sum of series
Tutorial 5: 1D Arrays: searching, sorting: Lab 5: 1D Array manipulation
Tutorial 6: 2D arrays and Strings, memory structure: Lab 6: Matrix problems, String operations

Tutorial 7: Functions, call by value: Lab 7: Simple functions
Tutorial 8 & 9: Numerical methods (Root finding, numerical differentiation, numerical
integration): Lab 8 and 9: Numerical methods problems
Tutorial 10: Recursion, structure of recursive calls: Lab 10: Recursive functions

Recommended Books:

1. Byron Gottfried, Schaum's 2017, "Outline of Programming with C", McGraw-Hill.
2. E. Balaguruswamy, 1998, "Programming in ANSI C", Tata McGraw-Hill.
3. Brian W. Kernighan and Dennis M. Ritchie, 1988, "The C Programming Language",
4. Prentice Hall of India.

Course Code	Course Name	L-T-P	Credits
DM101	Disaster Management	2-0-0	2

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.

Course Outlines:

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, landuse changes, urbanization etc.), sustainable and environmental friendly recovery; reconstruction and development methods.

Recommended Books:

1. http://ndma.gov.in/ (Home page of National Disaster Management Authority)
2. 2. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs).
3. 3. Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.
4. 4. Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication.
5. 5. Ghosh G.K., 2006, Disaster Management, APH Publishing Corporation
6. 6. Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June 2003
7. Inter-Agency Standing Committee (IASC) (Feb. 2007). IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings. Geneva: IASC.

Course Code	Course Name	L-T-P	Credits
CE404	Computer Aided Design III	0-0-4	2

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 Outlines:

Basic concepts of AutoCAD and STAAD Pro tools- Analysis and design of various building Elements - Design projects.

Course Code	Course Name	L-T-P	Credits
AS104	**Engineering Exploration-IV**	0+0+2=2	**2**

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:
Projects related to Civil Engineering

Course Code	Course Name	L-T-P	Credits
CE405	**Professional Practices**	2+0+0=2	**2**

Course Learning Outcomes:

CLO1: To know the pattern of Various Examinations.
CLO2: To get the information about the exams conducted for the entry into jobs.
CLO3: To become aware about the various soft skills and entrepreneurship skills
CLO4: To use the time effectively.
CLO5: To become aware about the goals of life and employability development.

Course Contents:

General studies-English-Quant ability and data interpretation-Verbal ability and Logical Reasoning-core technical.

Professional Electives Courses

Track 1 Structural Engineering

Course Code	Course Name	L-T-P	Credits
CE350	Engineering Materials for Sustainability	2+1+0=3	3

Course Learning Outcomes:

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: To acquire skills in sustainable practice.
CLO5: Design a PCC mixture and an HMA mixture using sustainability concepts for skill and employability development.

Course Outlines:

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

Recommended Books:

1. Materials and Sustainable Development, by Michael F. Ashby, Butterworth-Heinemann
2. Sustainable Materials, by Julian Allwood, Jonathan Cullen, UIT Cambridge, 2011.
3. Dejan Mumovic, Mat Santamouris, 2004,"A Handbook of Sustainable Building Design and Engineering", Routledge.
4. Anthony Johnson Andy Gibson, 2014, "Sustainability in Engineering Design", Academic Press.

Course Code	Course Name	L-T-P	Credits
CE351	Wood Structures	3-1-0	3

Course Learning Outcomes:

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.

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.

Prescribed Text Book(s):

1. Donald E Breyer, 1993, —Design of wood structure, Mcgraw-Hill.
2. Judith J, Stalnaker, 2012, —Structural design and wood, Springer.
3. Ram S. Gupta, 2014, —Principles of Structural Design: Wood, Steel, and Concrete, CRC Press.
4. Structural Wood Design" Asd/Lrfd 2Nd Edition 2017 by Abi Aghayere, Jason Vigil , Taylor & Francis Ltd

Course Code	Course Name	L-T-P	Credits
CE352	Masonry Structures	3-1-0	3

Course Learning Outcomes:

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

Course Outlines:

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 behavior of masonry structural components. Strength and behaviour of unreinforced bearing walls. Detailed design of reinforced masonry beams, columns, structural walls with and without openings, and complete lateral-force resisting building systems.

Recommended Books:

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.
4. Sustainable Materials", by Julian Allwood, Jonathan Cullen, UIT Cambridge, 2011

Course Code	Course Name	L-T-P	Credits
CE353	Prestressed Concrete	3-1-0	3

Course Learning Outcomes:

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.

Course Outlines:

Study of strength, behavior, 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 Books:

1. N. Krishna Raju, 2018, "Prestressed Concrete", McGraw Hill Education.
2. G.S. Pandit, S.P. Gupta, 2008, "Prestressed Concrete", CBS Publishers and Distributors Pvt Ltd.
3. N C Sinha, Sujit Kumar Roy, S., 2011, "Fundamentals of Pre-Stressed Concrete", Chand Publishing.
4. Muthu, K. U, Ibrahim, Azmi, Janardhana, Maganti, Vijayanand, M.," "Prestressed Concrete"

Course Code	Course Name	L-T-P	Credits
CE354	Earthquake Engineering	3-1-0	3

Course Learning Outcomes:

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

Course Outlines:

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 Books:

1. Roberto Villaverde, 2009, "Fundamental Concepts of Earthquake Engineering", CRC Press.
2. Shashikant K, 2013, Duggal Earthquake Resistant Design of Structures, Oxford.
3. Srinivas Vasam & Dr. K. Jagannadha Rao, 2018, "Structural Dynamics and Earthquake Engineering", S.K. KATARIA & SONS.
4. Prasad, Bharat Bhushan, "Advanced Soil Dynamics and Earthquake Engineering"

Track 2: Environmental Engineering

Course Code	Course Name	L-T-P	Credits
CE322	Environmental Laws and Policy	3-1-0	3

Course Learning Outcomes:

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
CLO5: Students will develop practical skills for procedure followed by various environmental law enforcing agencies/bodies.

Course Outlines:

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 Books:

1. Divan Shyam, Rosencranz Armin, 2002, "Environmental Law and Policy in India: Cases, Material & Statutes", Oxford.
2. Jane Holder and Maria Lee, 2012, "Environmental Protection, Law and Policy", Cambridge University Press.
3. Sengar, Dharmendra S., "Environmental Law"
4. Behera, D.K., Das, R.C., "Principles and Practice"

Course Code	Course Name	L-T-P	Credits
CE320	Municipal Solid Waste Management	3-1-0	3

Course Learning Outcomes:

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.

Course Outlines:

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 Books:

1. Municipal Solid Waste Management in Developing Countries, Sunil Kumar, Taylor & Francis
2. Solid Waste Management Principles and Practice, Ramesha Chandrappa, Diganta Bhusan Das, Springer
3. Rajaram, Vasudevan, Siddiqui, Faisal Zia, Agrawal, Sanjeev, Khan, Mohammad Emran." "Solid and liquid waste management waste to wealth"
4. Metcalf & Eddy, "Wastewater engineering Treatment disposal reuse", Tata McGraw Hill

Course Code	Course Name	L-T-P	Credits
CE323	Sustainable Design Engineering & Technology	3-1-0	3

Course Learning Outcomes:

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.

Course Outlines:

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 Books:

1. Dejan Mumovic, Mat Santamouris, 2004, ―A Handbook of Sustainable Building Design and Engineering‖, Routledge.
2. Anthony Johnson Andy Gibson, 2014, ―Sustainability in Engineering Design‖, Academic Press.
3. Engineering Applications in Sustainable Design and Development "by Bradley Striebig, Cengage Learning
4. Sustainable Engineering: Concepts, Design and Case Studies; Pearson

Course Code	Course Name	L-T-P	Credits
CE321	Industrial wastewater Management	3-1-0	3

Course Learning Outcomes:

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.

Course Outlines:

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 and 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.

Recommended Books:

1. Metcalf & Eddy, "Wastewater engineering Treatment disposal reuse", Tata McGraw Hill.
2. Eckenfelder, W.W., "Industrial Water Pollution Control", McGraw-Hill
3. Industrial Waste Treatment Handbook, Frank W., Butterworth Heinemann
4. "Industrial Wastewater Management, Treatment", and Disposal, 3e MOP FD-3

Track 3: Geotechnical Engineering

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

Course Learning Outcomes:

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.

Course Outlines:

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

Recommended Books:

1. Swami Saran, 2006, "Analysis and Design of Substructures: Limit State Design".
2. "INTRODUCTION to Geotechnical Engineering" by Braja M Das
3. "Analysis and design of geotechnical structures" by Manuel Matos Fernandes
4. "Geotechnical Engineering" Design by Ming Xiao

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

Course Learning Outcomes:

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

Course Outlines:

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.

Recommended Books:

1. T.V. Ramakrishnan, 2007, "Marine and Offshore Engineering", Gene-Tech Books.
2. Subrata K. Chakrabarti, 2005, "Handbook of Offshore Engineering", Elsevier.
3. Arctic Offshore Engineering" by Andrew Clennel Palmer
4. "Offshore Structural Engineering: Reliability and Risk Assessment" by Srinivasan Chandrasekaran

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

Course Learning Outcomes:

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.

Course Outlines:
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 Books:
1. J. A. Hudson and J. P. Harrison, 2000, "Engineering Rock Mechanics: An Introduction to the Principles", Elsevier.
2. Barry H.G. Brady, "Rock Mechanics: For Underground Mining", Elsevier
3. John Conrad Jaeger, Neville G. W. Cook, Robert Zimmerman, 2007, "Fundamentals of Rock Mechanics, 4th Edition" Wiley-Blackwell.
4. Introduction to Rock Mechanics" by Richard E

Track 4: Transportation Engineering

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

Course Learning Outcomes:
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.

Course Outlines:
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 Books:
1. Khanna Sk, Nem Chand, 1999, "Airport Planning and Design", Nem Chand Brothers.
2. Asheesh Kumar, 2016, "Planning and Design of Airport", Vayu Education of India.
3. Airport Engineering" Book by Norman Ashford and Paul H. Wright
4. "Airport Systems: Planning, Design, and Management" Book by Amedeo Odoni and Richard De Neufville

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

Course Learning Outcomes:

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.

Course Outlines:

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 Books:

1. S.C. Saxena., S.P. Arora, Dhanpat Rai, 2010, "A Text Book of Railway Engineering", Publications (p) Ltd.-new Delhi.
2. JS Mundrey, 2017, "Railway Track Engineering", McGraw Hill Education.
3. Railway Engineerin, Book by M. M. Agarwal and Satish Chandra
4. Railway engineering, Book by V. A. Profillidis

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

Course Learning Outcomes:

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.

Course Outlines:

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 Traveler 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 Books:

1. Pradip Kumar Sarkar, Amit Kumar, 2017, "Jain Intelligent Transport Systems", PHI Learning Private Limited.
2. 2. Paolo Pagano, 2016, "Intelligent Transportation Systems: From Good Practices to Standards", CRC Press.
3. Fundamentals of Intelligent Transportation Systems Planning" Book by Adel Wadid Sadek and Mashrur Chowdhury
4. Intelligent Transportation Systems: Smart and Green Infrastructure Design", Second Edition Book by Sumit Ghosh and Tony S. Lee

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

Course Learning Outcomes:

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;

Course Outlines:

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, light houses, beacon lights, floating navigational aids, light ships, 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 Books:

1. Adrian Jarvis, Routledge, 1998, "Port and Harbour Engineering". CRC Press.
2. R. P. Rathaliya, 2019, "Harbour Airport Engineering", Atul Prakashan
3. Principle of Tunnelling Ports & Harbours" by Parbin Singh, S.K. Kataria & Sons
4. 'The Design and Construction of Harbours "(English, Paperback, Stevenson Thomas

Semester-8					
S. No	**Course Code**	**Title of the Course**	**Category**	**L-T-P**	**Credits**
1	CET 9403	Industry Oriented Hands- on Experience	Training	- - -	25
2	CET 9410	Coopt Training Module (optional)	Training	-	**25**
Total Credits (8th Semester)					**25**

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

Course Learning Outcomes:

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.

Course Outlines:

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 A: Mapping of Programme Outcomes (Pos) with Course Outcomes (Cos)

Course Code	Title of the Course	Course Learning Outcomes (COs)	Programme Outcome (PO)											
			1	2	3	4	5	6	7	8	9	10	11	12
AM101	Engineering Mathematics I	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.					H							L
CE101	Engineering Mechanics	CLO1: 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					M			
		CLO3: 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 Lab	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	M			M								H

		shops.												
		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 Electrical & Electronics 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							M			
		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							M			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.				H					M			
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.								L				
		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.					H							
		CLO6: Drafting skills beneficial for civil drafting and intensifying employability.				L								M
EE104	Basics of Electrical & Electronics Engineering Lab	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						H					M
		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								M		
		CLO4: Simulate laboratory experiments in the software.												M
		CLO5: Perform tests on motor-generator set.	M											

AM102	Engineering Mathematics II	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.		H						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
PH101	Engineering 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									H		M
		CLO3: Apply fundamental principles of physics together with analytic tools to evaluate and describe physical situations appropriate to address a scientific problem.		M					H					
		CLO4: Apply the fundamental principles involved in Physics to solve a variety of practical problems in engineering domain.		L					M				M	
		CLO5: Develop skills for critical thinking and problem solving involving the various concepts of physics.				H						M		

GEL4101	Environmental Sciences (EVS)	CLO1: Describe about all the natural resources, various ecosystems and energy resources, environmental pollution, waste management, biodiversity and human population.		M					L					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						H		
		CLO3: Analyse the societal and environmental impacts of energy with respect to meet the growing energy needs for sustainable growth.		H						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		L				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						M			
		CLO3: Use various conventional instruments involved in surveying with respect to utility and precision.		M			H						M		
		CLO4: Plan a survey for applications such as road alignment and height of the building.									M				
		CLO5: Undertake measurement and plotting as field surveyor with focus on employability.	M			L									
PH103	Engineering Physics Lab	CLO1: Possess an ability to apply knowledge of fundamental physical concepts and appropriate mathematics involved in the course.	H	L									H		

		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									M	
		CLO5: Possess an ability to evaluate and analyze scientific measurement and error analysis.		M		L					L	H			
		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
CE104	Introduction to Civil Engineering	CLO1: Introduction to what constitutes Civil Engineering.		M										H
		CLO2: Identifying the various areas available to pursue and specialize within the overall field of Civil Engineering.		H		M								
		CLO3: Student will be able to illustrate the types, uses and properties of various building materials to upgrade the skills.								M	M			
		CLO4: Providing inspiration for doing creative and innovative work to raise the employability.	M											H
		CLO5: Student will be able to explain the method of construction of different components of a building.	M							L				H
		CLO6: Providing a foundation for the student to launch off upon an inspired academic pursuit into this branch of engineering.		M										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 discipline can play in social contexts.						M						H
		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.			H								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				L				
		CLO3: Conduct flexural and torsion test to determine elastic constants.				M				H				M
		CLO4: Determine hardness of metals.	H									M		
		CLO5: Analyze the behavior of the solid bodies subjected to various types of loading.	M						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						M		
		CLO4: Recognition of the need for, and ability to engage in life-long learning.	M						H					

		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.			H								M	
CE203	Building Material and Construction	CLO1: Evaluate various properties of concrete to gain the construction skills.	H							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 and materials for structural repairs.	H						M				L	
		CLO5: Perform various quality control tests for the various civil engineering materials by performing different lab tests on materials.	M								H			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						L					M
		CLO3: Develop qualitative diagrams showing the displaced				M						L		

		shape, bending moments and support reactions for an indeterminate plane frame.													
		CLO4: Develop effective structural analysis skills for building design activities.	M						H						
		CLO5: To impart the principles of elastic structural analysis and behaviour of indeterminate structures focusing on employability.	M			L									M
HU201	Human Rights and values	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.	L	M					H	L					L
		CLO3: The Students will be able to take active part in social, political, economic and cultural activities with responsibility.		M		M						H			
		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.	H	M						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.	L			M								H	L
CE402	Programming for Problem Solving	CLO1: Describe the basics of computer and understand the problem-solving aspect.	H	L			M					H		L	
		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					L					M
CE205	Fluid Mechanics Lab	CLO1: Identify, name, and characterize flow patterns and regimes.	H				M							
		CLO2: Understand basic units of measurement, convert units, and appreciate their magnitudes.	L	M					H	L				L
		CLO3: Utilize basic measurement techniques of fluid mechanics.		M		M						H		
		CLO4: Enhancing skills to differentiate among measurement techniques, their relevance and applications.	H	M						M				
		CLO5: Prove good understanding of concepts and their applications in the laboratory.	L			M							H	L
		CLO6: Compare the results of analytical models introduced in lecture to the actual behavior of real fluid flows and draw correct and sustainable conclusions.	L	M					H	L				L
		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.							M					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	CLO1: Distinguish between statically determinate and	M											L

	Analysis-I Lab	indeterminate structures.												
		CLO2: Apply equations of equilibrium to structures and compute the reactions.	L	M					H	L				L
		CLO3: Draw the shearing force and bending moment diagrams.		M		M						H		
		CLO4: Calculate the internal forces in cable and arch type structures to extent employability skills.	H	M						M				
		CLO5: Evaluate and draw the influence lines for reactions, shears, and bending moments in beams and girders due to moving loads.	L			M							H	L
		CLO6: Calculate the deflections of truss structures, beams, and portal frames.	H						M				L	H
CE209	Computer Aided Design I	CLO1: Demonstrate basic concepts of the AutoCAD software to gain employability.					H					H		
		CLO2: Apply basic skills to develop construction (drawing) techniques.		M								H		
		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.			H								H	
		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		M										L

		to a range of typical geotechnical problems in order to predict the ground response under different conditions of loading, soil type and groundwater states.												
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			
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	H	H										

		aggregates												
		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							L			
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		H					M					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											
		CLO5: 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									M	
		CLO5: Ability to design steel framing system and connections of a building in a team setting.					H					H		L
CE304	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

		CLO4: Understand about various aspects of civil engineering Tenders and contracts.				M						L		
		CLO5: 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	CLO1: 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
		CLO3: 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								
		CLO5: Use of relevant Indian Standard specifications applicable to Reinforced concrete structures.	L			H								
CS501	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						M			
		CLO3: Skills to communicate effectively with a range of audiences about technical information.							H				L	
		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		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						H			
		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						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	M						L					H

		effective management of construction projects.												
		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 employability development.	M	L		M								L
		CLO5: Be capable of using relevant software packages for planning, scheduling, executing and controlling of construction projects.	M						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.										L		
CE401	Environmenta	CLO1: Be able to find the necessary	H	L			M						H	

	l Impact Assessment and Life Cycle Analysis	information/legislation/procedures for an assessment of environmental impact of a "Project".												
		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	
		CLO4: 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
DM101	Disaster 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
		CLO5: Knowledge about existing global frameworks and existing agreements for employability and skill development.			M				H					
CE404	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	L	M				M						

		student industry ready for employability development.												
CE405	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
		CO3: To become aware about the various soft skills and entrepreneurship skills				L				M			H	
		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				
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	M	L										

		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.					H					L		
		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.						H						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			
CE350	Engineering Materials for Sustainability	CLO1: Compare the advantages and disadvantages of current and potential energy conversion	H						L					M
		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			
		CLO5: Design a PCC mixture and an HMA mixture using sustainability concepts for skill and employability development.				L				H				
CE351	Wood Structures	CLO1: Ability to perform detail modeling of vertical and lateral loads on structures.		M								H		
		CLO2: Understanding of properties of sawn lumber, glued				H			M					L

		laminated timber, and structural panels.												
		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 real life problems				L			H					L
		CLO5: The students will learn to understand the theoretical and practical aspects of earthquake engineering along with the				M								H

		planning and design aspects												
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
		CLO3: 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	CLO1: Gain a solid understanding of core concepts of SWM, with a focus on municipal solid waste (MSW), and the	M		H		M		L			L		M

	Management	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.	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			L					M
		CLO2: The students will get a diverse knowledge of geotechnical engineering practices applied to real life problems of designing of structures.			H	M					L			
		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
CE332	Offshore Engineering	CLO1: Flotation and stability of floating offshore platforms	M	L		L								M
		CLO2: Deep and shallow water wave kinematics	L		H									H
		CLO3: Wave, wind, current and motion induced loading on floating offshore renewable energy structures	L		M									M
		CLO4: Skill development to analyse wind and current force formulations		M				M		L	M			
		CLO5: Derivation and solution of dynamic motion equations	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				
		CLO3: 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 queueing models	H			M									H
		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	CLO1: Implement the ITS in public transportation systems.	M		M					M	M				

	Transportation Systems	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						