Academic Programme Guide
of
Bachelor of Engineering
(Civil Engineering)

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

CHITKARA UNIVERSITY
HIMACHAL PRADESH
NAAC ACCREDITED

w.e.f.
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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 first year of all Bachelor of Engineering programs is common and is detailed in the Section 9 of this guide.

1.1 Programme Educational Objectives (PEO)

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

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

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

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

1.2 Programme Outcomes (PO)

The department expects undergraduate students to be able to demonstrate the following outcomes. The students are expected to be able to:

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to 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 the public health and safety, and the 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 modelling 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 ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

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

1.3 University Vision and Mission

Vision:

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

Mission:

M1. To carry out the academic processes in accordance with global standards through active teacher-student-industry participation.

M2. To promote research, innovation and entrepreneurship in collaboration with industry, research laboratories and academic institutions of global repute.

M3. To inculcate high moral, ethical and professional values amongst our students, faculty & staff.

M4. To contribute in building skillful society.

The Programme Educational Objectives (PEOs) of B.E Civil Engineering programme, are well-designed on the mission of imparting the knowledge and expertise required in the field of Civil Engineering and equip the students with the necessary technical and interpersonal skills for working in industries or to become an entrepreneur.

This programme prepares the students to compete in a global environment with ample opportunities available around different business domains. Every year, faculty from different reputed universities across the globe visit Chitkara University to provide international exposure, cross-cultural competence and knowledge sharing among the students. This programme offers "Engineering Exploration" course to the students which provide an opportunity for students to be aware of the diverse technology that best meets their interest which in turn develops confidence and motivation among the students. 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", "Algorithm" have been

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 have been in accordance with the Programme Educational Objectives (PEO).

Programme Educational Objectives (PEO) and Programme Outcomes (PO) are designed and oriented to meet the mission of the university. The PEOs ensure that the graduating students are well equipped with strong technical knowledge, excellent communication skills, leadership quality, serving the community and society, helping establish a balanced social and professional environment which in turn transform the society into a knowledgeable and sustainable society.

2. Eligibility for Admission

The student seeking admission in B.E. program should have a minimum aggregate of 60% marks or must have secured 60% in Physics, Chemistry and Mathematics in 12th grade. He / She should have appeared in JEE-Mains for the admission year. The admission is based purely on merit. During admission process, the University follows reservation policy as decided by the State.

3. Programme Duration

The duration of the BE program is four years - divided into 8 semesters. University conducts 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.

The maximum duration of completion of the degree is 6 years.

4. Pedagogical Aspects

The structural layout of the program and its courses requires that each course be divided into lecture, tutorial and practical sessions. Duration of each session as given in the column against the course in the course scheme is 50 minutes.

Lecture Sessions: Lectures are delivered by traditional - chalkboard method, supplemented by modern Information Communication Technology (ICT) methods. The students are encouraged to ask questions and involve in a group discussion to the extent allowed by the teacher. In some courses 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 a prescribed list of experiments and do what they have learnt in the lecture/tutorial sessions.

5. Programme Structure

The various courses prescribed for a Program is categorized in terms of their functional objectives as follows:

5.1 **Core Courses:** Core courses are the foundation courses that cater to develop the breadth of Computer Science stream and also include Humanities, Social Science, Management, Mathematics, Basic Science and Engineering Science courses.

5.2 **Elective Courses:** The technical courses apart from core courses are offered as electives to the students. These are the professional courses that are offered to students to cover the depth in a specific area of computer science for their employment, research or higher education. It also includes courses from other departments and/or streams. The students may also choose a specialization track to enhance their skills in a particular area and to gain industry exposure

5.3 **Mandatory Courses:** These courses are intended for students to gain general knowledge, learn a new skill or develop personal interests. Students have to pass these courses; however, no credits will be added for these courses. These courses may be offered in any semester of the program.

5.4 **Special Courses (SC):**

a) Projects and Industry Oriented Hands-on Experience (IOHE): These are hands-on courses to apply the knowledge gained through core/elective courses. The students identify their team-mates and work on a unique project. The projects can be suggested by faculty or by students after getting due approval from faculty-in-charge. The projects are allotted to them at the start of the semester. 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.

b) Engineering Exploration Courses: Students are given a choice of technical and industry-oriented courses to get the knowledge of new technologies/skills. Students also have an option of choosing the courses from online platforms like MOOC (NPTEL/SWAYAM) or Nanodegree courses.

c) Courses for Global Exposure: To provide global exposure to students, the short duration courses are offered by professors from Universities across the globe. The students may choose or may be offered these courses to earn additional credits. These courses are decided for each batch as per the expertise of the teaching faculty and will be informed to the students before offering in a semester.

Model Programme Structure

Semester-I			
Code	**Title of the Course**	**L-T-P**	**Credits**
AML5101	Engineering Mathematics- I	4-1-0	5
PYL5101	Engineering Physics	3-1-0	4
EEL5102	Basics of Electrical & Electronics Engineering	3-1-0	4
MEL4102	Engineering Graphics	4-0-0	4
HUL2101	Disaster Management	1-0-0	1
GEL4101	Environmental Sciences	4-0-0	4
PYP1101	Engineering Physics Lab	0-0-2	1
EEP1102	Basics of Electrical & Electronics Engineering Lab	0-0-2	1
MEP1102	Engineering Graphics Lab	0-0-2	1
Total		**28**	**25**

Semester-II			
S. No	**Title of the Course**	**L-T-P**	**Credits**
CHL4101	Engineering Chemistry	3-1-0	4
CEL5102	Engineering Mechanics	3-1-0	4
AML5102	Engineering Mathematics-II	4-1-0	5
CEL3205	Building Material & Construction	3-0-0	3
CEP1215	Building Material Construction Lab	0-0-2	1
CHP1101	Engineering Chemistry Lab	0-0-2	1
MEW2101	Manufacturing Practice	Summer	2
ASE3101	Engineering Exploration	0-0-6	3
Total		**26**	**23**

Semester-III			
Code	**Title of the Course**	**L-T-P**	**Credits**
CEL3203	Fluid Mechanics I	3-0-0	3
CEL3209	Mechanics of Solid	3-0-0	3
CEL3207	Surveying	3-0-0	3
CEL3208	Water Resource Engineering	3-0-0	3
HUL 3301	Human Rights and values	2-0-0	2
CEP1203	Fluid Mechanics Lab I	0-0-2	1
CEP1211	Mechanics of Solids Lab	0-0-2	1
CEP1227	Surveying Lab	0-0-2	1
CEP2209	Computer Aided Design - I	One week Course	2
CLP2401	Language Skills - I	0-0-4	2
Total		**24**	**21**

Semester-IV			
Code	**Title of the Course**	**L-T-P**	**Credits**
CEL4206	Structural Analysis I	4-1-0	5
CEL4212	Design of Concrete Structures I	3-1-0	4
CEL3202	Fluid Mechanics II	3-0-0	3
HUL	Cyber Security	2-0-0	2
CEP1206	Structure analysis-I Lab	0-0-2	1

CEP1212	Design of Concrete structures lab I	0-0-2	1
CEP1202	Fluid Mechanics - II Lab	0-0-2	1
CLP2402	Language Skills - II	0-0-4	2
AS102	Engineering Exploration - II	0-0-4	2
Total		**28**	**21**

Semester-V			
Code	**Title of the Course**	**L-T-P**	**Credits**
CEL 5308	Analysis of Structures II	4-1-0	5
CEL 3311	Transportation Engineering, I	3-0-0	3
CEL 3303	Environmental Engineering, I	3-0-0	3
CEL 4305	Geotechnical Engineering, I	3-1-0	4
CEP 2309	Computer Aided Design II	One week	2
CEP 1311	Transportation Engineering lab I	0-0-2	1
CEP 1303	Environmental Engineering Lab I	0-0-2	1
CEP 1308	Geotechnical Engineering, I lab	0-0-2	1
CET5301	Survey Camp	Two-week	5
Total		**21**	**25**

Semester-VI			
Code	**Title of the Course**	**L-T-P**	**Credits**
CEL3308	Construction Planning and Management	3-0-0	3
CEL3310	Environmental Engineering-II	3-0-0	3
CEL3302	Estimating and Costing	3-0-0	3
CEL4304	Design of Steel Structures	3-1-0	4
CEL5314	Design of Concrete Structures-II	4-1-0	5
CEP1310	Environmental Engineering-II Lab	0-0-2	1
AS103	Engineering Exploration-III	0-0-4	2
GTI4301	Numerical Ability and Logical Reasoning	4-0-0	4
Total		**28**	**25**

Semester-VII			
Code	**Title of the Course**	**L-T-P**	**Credits**
CEL4306	Geotechnical Engineering II	3-1-0	4
CEL3427	Geo-informatics	3-0-0	3
CEL3408	Environmental Impact Assessment and Life Cycle	3-0-0	3
CEP1302	Geotechnical Engineering II Lab	0-0-2	1
CEP1427	Geo-informatics Lab	0-0-2	1
CEP3431	Computer Aided Design-III	0-0-4	2
GTI2401	Professional Practices	2-0-0	2
AS104	Engineering Exploration IV	0-0-4	2
Total		**24**	**18**

Semester-VIII			
Code	**Title of the Course**	**L-T-P**	**Credits**
CET9403	Industry Oriented Hands-on Experience	- - -	25
		-	**25 ***

*** Students can earn these credits by opting co-op training in seventh and eighth semesters**

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	CE323	Sustainable Design Engineering & Technology	3-1-0	3
Track 3: Geotechnical Engineering				
8	CE331	Geotechnical Design	3-1-0	3
9	CE332	Offshore Engineering	3-1-0	3
10	CE333	Rock Mechanics	3-1-0	3
Track 4: Transportation Engineering				
11	CE340	Airport Planning and Design	3-1-0	3
12	CE341	Railway Engineering	3-1-0	3
13	CE342	Intelligent Transportation Systems	3-1-0	3
14	CE343	Port and Harbour Engineering	3-1-0	3

6. Assessment and Evaluation

The evaluation will be continuous and the weight-age of various components is as given in Tables specified for each type of course. The evaluation of all courses will be detailed in the course handout document prepared by the course coordinator with the approval of Dean. The document will be shared with students before the start of the session.

Evaluation for Core / Elective / Specialization Course:

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**

There are three Sessional Tests (STs) for all theory papers, the average of the best two are considered. However, the course coordinator, with the approval of Dean may decide the number of STs required for a specific course. The policy on the evaluation component – 'Quizzes / Tutorials / Assignments' (if applicable else weightage is merged in STs) as decided by the course coordinator and Dean and is announced separately for each course.

The evaluation components for Lab Courses have weightage for regular lab performances, internal viva-voce, conducted at the end of the academic semester. The

End Term Examination for lab courses includes the conduct of experiments and an oral examination (viva voce).

Lab Courses	
Lab Performances / File work	40
Internal Viva – Voce	20
End Term	40
Total	**100**

Evaluation for Integrated / Lab Oriented Project Courses:

Project Courses	
Planning	10
Performance	20
Internal Viva-Voce/Presentation/ Project Report	30
End Term/ Project Display/ External viva-voce	40
Total	**100**

Evaluation for Co-op Projects / Industry Oriented Hands-on Experience Courses:

Industry Oriented Specific Courses	
Employer / Industry Expert Assessment	20
Synopsis	10
Mid Term Evaluation	30
Final Evaluation	40
Total	**100**

Evaluation for Engineering Exploration Courses: There are two mid-term evaluation and one evaluation at the end of the course. The type of evaluation may vary depending on the course type on the discretion of course Expert. It is decided before the commencement of the course and provided prior information to the students.

Evaluation for MOOC Courses: There is one evaluation at the end of the course. The certificate is issued by the host institute. Upon submission of the certificate, credits will be awarded to the student.

Evaluation for Global Exposure Courses: There is only one evaluation at the end of the course. The type of evaluation may vary depending on the course type on the discretion of course Expert. It is decided before the commencement of the course and provided prior information to the students.

Evaluation for Mandatory Courses: There is only End term Examination for these courses with 100% weightage.

7. Rules for Attendance

The program being highly rigorous, all the students are expected to show utmost regularity in attendance. Even a day's absence is detrimental to a student's interest. Therefore, the University's requirements in this regard are very stringent.

The University expects its students to be regular in attending the classes. 75% attendance (of all held sessions – lectures, tutorials, project work) is compulsory in a course to be eligible to appear for End Term Examination. The students are also encouraged for participation in co-curricular activities and can do so in 25% cushion provided in the attendance requirements. 10% concession in attendance requirements is possible only in case of extreme circumstances and at the sole discretion of the Vice-Chancellor.

8. Grading System

The list of Letter Grades is given below:

% Marks Range of total	Grade	Grade Point	Qualitative Meaning
80-100	O	10	Outstanding
70-79	A+	9	Excellent
60-69	A	8	Very Good
55-59	B+	7	Good
50-54	B	6	Above Average

45-49	C	5	Average
40-44	P	4	Pass
0-39	F	0	Fail
	I	0	Incomplete / Absent

If a student obtains grade P or above, he/she is declared pass in that course. The grade F is equivalent to failing in that course, in which case, the student has to reappear in the end term examination of that course again, whenever its exam is conducted again with the regular examination, after payment of appropriate examination fee. The rules for grading in reappear exam will be applicable as per the examination policy of the University.

If the student is detained from appearing in the end term examination because of the shortage of attendance in the regular semester or is absent at the end term exam, his/her grade in that course is I, till he/she appears again in the end term examination and obtains a new grade.

Calculation of CGPA:

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

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

Where n = number of courses in the semester; N = number of semesters; SGPA_i = SGPA for the ith semester; C_{ij} = number of credits for the jth course in the i^{th} semester; and G_j= Grade point corresponding to the grade obtained in the jth course.

Example to understand the calculation of CGPA:

Semester-1

Suppose a student is registered in eight courses 'C1', 'C2', 'C3', 'C4', 'C5', 'C6', 'C7' and 'C8' in 1ST semester as mentioned below in the Column – I of the table-1. Column – II in the table below depicts the number of credits, which those courses carried. At the end of the semester, 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 and Column – VI indicate essentially the Credit value and Grade Points for every course completed by a student in that particular semester.

Courses in which student registered (Column – I)	**Credits (Column – II)**	**Letter Grade Column – III**	**Grade Value (Column – IV)**	**Credit Value (Column – V)**	**Grade Points (Column – VI)**
C1	3	A	8	3 x 8	24
C2	3	O	10	3 x 10	30

C3	3	A+	9	3 x 9	27
C4	2	B	6	2 x 6	12
C5	1	C	5	1x 5	5
C6	4	P	4	4x 4	16
C7	4	B	6	4x 6	24
C8	4.5	C	5	4.5x 5	22.5
Total	**24.5**	**-------**	**-------**	**-------**	**160.5**

Thus, the total SGPA of the student would be =

$$SGPA = \frac{Total gradepts}{Total no of credits} = \frac{(3x8.0)+(3x10)+(3x9)+(2x6)+(1x5)+(4x4)+(4x6)+(4.5x5)}{3+3+3+2+1+4+4+45} = \frac{1605}{245} = 6.55102$$

Suppose, the SGPA of the student in two successive semesters is 6.55 and 6.40 with respective course credits being 24.5 and 26.5, then the

$$CGPA = \frac{(6.55102 \times 24.5)+(6.39623 \times 26.5)}{24.5+26.5} = \frac{160.50+169.50}{51} = \frac{330}{51} = 6.47$$

9. Promotion and Registration

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

All students are eligible to register for next semester irrespective of the number of backlogs. A student is not permitted to register in a term if

(a) He/She has dues outstanding to the University, hostel, or any recognized authority or body of the University, or
(b) His/Her grade sheet in his/her immediately preceding term is withheld, or
(c) 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 Dean of Department 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 the following reasons:

(a) If the registration of a student in a course is not found to be as per 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 case 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/she 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/she must seek prior permission of Dean of Department to drop the term. If such permission has not been requested or after a request, the permission has been denied, his/her name would be struck off the rolls of the University and he would no longer be a student of the University. His/her case will be automatically processed and the file will be closed. However, if such a student, after his/her name has been struck off the rolls of the University, is permitted to come back, his/her case can be considered at the sole discretion of the competent authority of the University with the provision that all his/her 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 a 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 the 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."

In case a student undergoes international exchange programme or internship for 1 semester/ 1 year/ 2 years, then the courses, credits and grades earned by the student in abroad during that period should be reflected on the grade card issued by the Chitkara University.

In case of availability of seats, a student can apply for branch change. The student shall have to pass all papers of the first year and possess minimum CGPA criteria. Preference will be given to high CGPA.

11. Eligibility to Award the Degree

To be eligible for award of B.E. degree in Civil Engineering, a student must complete all the courses in which he/she has registered with minimum 183 credits and a minimum CGPA of 4.5.

12. Program Overview

Semester – I

Semester-I			
Code	**Title of the Course**	**L-T-P**	**Credits**
AML5101	Engineering Mathematics- I	4-1-0	5
PYL5101	Engineering Physics	3-1-0	4
EEL5102	Basics of Electrical & Electronics Engineering	3-1-0	4
MEL4102	Engineering Graphics	4-0-0	4
HUL2101	Disaster Management	1-0-0	1
GEL4101	Environmental Sciences	4-0-0	4
PYP1101	Engineering Physics Lab	0-0-2	1
EEP1102	Basics of Electrical & Electronics Engineering Lab	0-0-2	1
MEP1102	Engineering Graphics Lab	0-0-2	1
Total		**28**	**25**

Course Code	Course Name	L-T-P	Credits
AML5101	Engineering Mathematics- I	4-1-0	5

Course Learning Outcomes:

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

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

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

CLO4: Synthesize and apply multivariable vector-valued functions, their derivatives and integrals to live problems, graphically and analytically.

Course Outlines:

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

Partial Differentiation & its applications: Introduction to Partial Derivatives: Function of several variables, Limit and continuity Partial Differentiation, Euler's Theorem, Total derivatives, Error & Approximation, 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, Moment of Inertia,

Centroid, Center of Gravity, Improper integrals of first and second kind , Special Functions: Beta and Gamma functions

Introduction to Scalars and Vector: Vector Function (Derivative and integral), 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, Line Integrals, Surface & Volume Integral, Green's Theorem in the Plane (without proof) and applications, Stokes's Theorem (without proof) and applications, Gauss Divergence Theorem (without proof) and applications.

Suggested Books:

1. Ramana, B. V. (2006). 'Higher Engineering Mathematics', Tata McGraw-Hill Education, New Delhi.
2. Kreyszig, E. (2010). 'Advanced engineering mathematics', John Wiley & Sons, USA.
3. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall
4. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill
5. R. C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.

Course Code	Course Name	L-T-P	Credits
PYL5101	Engineering Physics	3-1-0	4

Course Learning Outcomes:

CLO1: After completing this course, the students will be able to analyze and solve mathematical problems relating to Gradient, Divergence and Curl of scalar and vector field and establish their relationship with propagation of Electromagnetic waves in free space using Maxwell's equation.

CLO2: The students will be able to differentiate between different types of LASERs and optical fibres their operation, advantages, and disadvantages and solve related problems and their application in engineering domain.

CLO3: The students will be able to differentiate between characteristics and properties of various magnetic and superconducting materials and establish their applications in engineering disciplines.

CLO4: The students will be able to describe the dual nature of waves and particles in context of Quantum Mechanics and to apply the Schrodinger Wave Equation in solving different physical systems and processes.

Course Outlines:

Introduction to Vector and Scalar fields, Concept of Gradient, Divergence and Curl in vector & scalar field, Statement & proof of Gauss's and Stoke's theorem, Concept of Displacement current and equation of continuity in Electromagnetism, Electromagnetic waves & Maxwell's equations, Definition of Frames of reference & Postulates of Special Relativity, Lorentz transformations & its applications, Nuclear composition & definition of basic nuclear terms, Concept of binding energy & its derivation based on liquid drop model, shell model & its consequences, Basic properties of nuclear forces, Various types of nuclear decay processes, nuclear fission & nuclear fusion, Concept of Interference phenomena of light, Types of Diffraction in light, Diffraction grating and its applications, Types of polarization in light, Definition of various parameters used in optical fiber, Types of optical fiber, Application of optical fibers, Basic principle of laser light production, Types of laser, Construction & working of commonly used solid, gas & semiconductor lasers, Concept and applications of Holography, Introduction to quantum mechanics & its need, De-Broglie waves, Concept of group velocity and phase velocity, uncertainty principle & its applications, Concept of wave function & operators in quantum mechanics, Schrodinger wave equation & its applications, quantum computing [basic idea only].

Suggested 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)'. Wiley &
3. John, New York.
4. Gersten, J. I., & Smith, F. W. (2001). 'The physics and chemistry of materials', Wiley & John,
5. New York.
6. Dr S Mani Naidu, "Engineering Physics", Pearson.
7. Dattu R Joshi, "Engineering Physics", Mc Graw Hill Education

Course Code	Course Name	L-T-P	Credits
EEL5102	Basics of Electrical and Electronics Engineering	3-1-0	4

Course Learning Outcomes:

CLO1: Apply knowledge of mathematics, science, and engineering.

CLO2: Identify, formulate, and solve engineering problems

CLO3: Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

Course Outlines:

Analysis of DC circuits using Kirchhoff's laws, Thevenin's, Norton's and Superposition theorem, A.C fundamental, Generation of alternating emf, Analysis of R-L, R-C and R-L-C circuits, Series and Parallel resonance, 3-phase star and delta connected systems, Power and Power factor, Magnetic circuits and transformer, Three phase induction motor, Single phase induction motor, Starters, Universal motor, Stepper motor, Servomotors, Classification of instruments, Moving Iron Instrument, Moving Coil Instrument, Transistors, Amplifiers, Number Systems, Logic gates, Flip flops, Integrated circuits.

Suggested Books:

1. 'Hughes, E., Hiley, J., Brown, K., & Smith, I. M. (2008). 'Hughes Electrical and Electronic Technology', Pearson education, England.
2. Bobrow, L. S. (1996). 'Fundamentals of Electrical Engineering', Oxford University Press, UK.
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
MEL4102	Engineering Graphics	4-0-0	4

Course Learning Outcomes:

CLO1: Understand the fundamentals of engineering drawing and geometrical objects

CLO2: Construct the technical letters and different types of scales.

CLO3: Develop the ability of drawing a wide range of geometrical figures.

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. Special Curves-Cycloids, Epicycloids, Hypocycloids. Sectioning of solids, Isometric Projection, Orthographic projections and development of surfaces. Conversion of orthographic views to isometric projections vice-versa.

Suggested Books:

1. Dhananjay, A. J. (2010). 'Engineering Drawing: With An Introduction To Auto Cad'. Tata McGraw Hill Education Private Limited, New Delhi.
2. 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.
3. 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
HUL2101	Disaster Management	1-0-0	1

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

Course Outlines:

Disasters: Classification, Causes, Impacts - Introduction to Disasters: Concepts, and definitions (Disaster, Hazard, Vulnerability, Resilience, Risks), Impacts (including social, economic, political, environmental, health, psychosocial, etc. Differential impacts- in terms of caste, class, gender, age, location, disability), Classification of hazards/disasters (including Pandemics) and causes.

Principles of disaster management: Approaches to Disaster Risk reduction: Disaster cycle - its analysis, Phases, Culture of safety, prevention, mitigation and preparedness - Community based DRR, Components of Disaster Relief: Water, Food, Sanitation, Shelter, and Health - Structural and non-structural measures.

Hazard Profile (India), Disaster Risk Management in India: Hazard and Vulnerability profile of India, Institutional arrangements (Mitigation, Response and Preparedness ,DM Act and Policy, Other related policies, plans, programmes and legislation). Role of Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), states, Centre, and other stake-holders.

Inter-relationship between Disasters and Development: Factors affecting Vulnerabilities, impact of Development projects such as dams, embankments, changes in Land-use etc. urban disasters, Waste Management.

Global trends in disasters & Adaptation: Complex emergencies, Climate change and Adaptation, Relevance of indigenous knowledge, appropriate technology and local resources.

Suggested Books:

1. Coppola, D. P. (2006). 'Introduction to international disaster management', Elsevier, UK.
2. Carter, W. N. (2008). Disaster management: A disaster manager's handbook, Asian Development Bank.
3. Singh B.K., 2008, "Handbook of Disaster Management: Techniques & Guidelines", Rajat Publication.
4. Ghosh G.K., 2006, "Disaster Management, APH Publishing Corporation"
5. "Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California", EMSA no.214, June2003

Course Code	Course Name	L-T-P	Credits
GEL4101	Environmental Sciences	4-0-0	4

Course Learning Outcomes:

CO1: Understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales.

CO2: Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes.

CO3: Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.

CO4: Demonstrate proficiency in quantitative methods, qualitative analysis, critical thinking, and written and oral communication needed to conduct high-level work as interdisciplinary scholars and/or practitioners.

Course Outlines:

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.

Suggested 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. G. M., & Ela, W. P. (1991). “Introduction to environmental engineering and science” (Vol. 3), Englewood Cliffs, NJ: Pearson, USA.
5. Paul Warde Libby Robin Sverker Sorlin Jan 2019, “The Environment: A History of the Idea”

Course Code	Course Name	L-T-P	Credits
PYP1101	Engineering Physics Lab	0-0-2	1

Course Learning Outcomes:

CLO1: Students will be able to co-relate practical knowledge with theoretical studies.

CLO2: Students will achieve perfectness in experimental skills.

CLO3: The study of practical applications will bring more confidence and ability to develop and fabricate engineering and technical equipment's.

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 a optical fibre, Attenuation & propagation losses in optical fibres.

Suggested 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
EEP1102	Basics of Electrical and Electronics Engineering Lab	0-0-2	1

Course Learning Outcomes:

CLO1: Get knowledge of various parts of an electrical machine.

CLO2: Conduct speed control of different types of DC motors.

CLO3: Elaborate the characteristics of DC servo motor.

CLO4: Simulate laboratory experiments in the software.

CLO5: Perform tests on motor-generator set.

CLO6: Find different losses on machines.

Course Outlines:

Introduction to various measuring instruments, Verification of Kirchhoff's laws in D.C circuits, Verification of Superposition Theorem, Maximum Power Transfer theorem, Thevenin's Theorem, To find voltage, current relationship and power, power factor, Resonance in RLC circuit. Measurement of self-inductance , mutual inductance and coupling coefficient of windings, To perform open- circuit and short circuit test on a transformer , To connect, start and reverse the direction of rotation of a 3- phase induction motor, To plot the forward and reverse characteristics of PN junction diode, Clipper & Clamper, To plot input and output characteristics of a transistor in CE configuration, To analyze the truth tables of various basic digital gates and build R-S, J-K &D flip-flops using NAND/NOR gates, To demonstrate the use of operational amplifier for performing mathematical operations such as summation and difference.

Suggested Books:

1. Hughes, E., Hiley, J., Brown, K., & Smith, I. M. (2008). 'Hughes Electrical and Electronic Technology', Pearson education, England.
2. Bobrow, L. S. (1996). 'Fundamentals of Electrical Engineering', Oxford University Press, UK.

Course Code	Course Name	L-T-P	Credits
MEP1102	Engineering Graphics Lab	0-0-2	1

Course Learning Outcomes:

CLO1: Identify and implement basic concepts of BIS conventions to sketch Engineering drawing.
CLO2: Create geometric constructions with hand tools.
CLO3: Construct orthographic projection and sectional view of a machine part.
CLO4: Create isometric projection from Multiview drawings of an object.
CLO5: Sketch projection of solids and development of lateral surfaces of solids.

Course Outlines:

Polygons-Construction of Regular Polygons using given length of a side; Ellipse- General method and Oblong Methods for Construction of ellipse; Scales-Plain,Vernier and Diagonal Scales. Introduction to Orthographic Projections; Projections of Points; Projections of Straight Lines parallel to both planes; Projections of Straight Lines-Parallel to one and inclined to other plane. Projections of Straight Lines inclined to both planes, determination of true lengths, angle of inclinations and traces. Projections of Planes; Regular Planes Perpendicular / Parallel to one Reference Plane and inclined to other Reference Plane; inclined to both the Reference Planes.

Suggested Books:

1. DHANANJAY, A. J. (2010). 'Engineering Drawing: With an Introduction To Auto Cad', Tata McGraw Hill Education Private Limited, New Delhi.
2. 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. Prentice Hall, New York.
3. Madsen, D. A., & Madsen, D. P. (2016). Engineering drawing and design. Nelson Education, Canada.
4. H. C., Mitchell, A. E., Dygdon, J. T., Novak, J. E., & Goodman, M. (2016). "Technical drawing with engineering graphics"; Peachpit Press, USA.

SEMESTER-II

Semester-II			
Code	**Title of the Course**	**L-T-P**	**Credits**
CHL4101	Engineering Chemistry	3-1-0	4
CEL5102	Engineering Mechanics	3-1-0	4
AML5102	Engineering Mathematics-II	4-1-0	5
CEL3205	Building Material & Construction	3-0-0	3
CEP1215	Building Material Construction Lab	0-0-2	1
CHP1101	Engineering Chemistry Lab	0-0-2	1
MEW2101	Manufacturing Practice	Summer course	2
ASE3101	Engineering Exploration	0-0-6	3
Total		**26**	**23**

Course Code	Course Name	L-T-P	Credits
CHL4101	Engineering Chemistry	3-1-0	4

Course Learning Outcomes:

CLO1: Develop innovative methods to produce soft water for industrial use and potable water at cheaper cost.

CLO2: Substitute metals with conducting polymers and also produce cheaper biodegradable polymers to reduce environmental pollution.

CLO3: Design economically and new methods of synthesis nano materials.

CLO4: Apply their knowledge for protection of different metals from corrosion.

CLO5: Have the knowledge of converting solar energy into most needy electrical energy efficiently and economically to reduce the environmental pollution.

Course Outlines:

Introduction to water technology, Sources & Specification for water, Water impurities, Hard and soft water & Units to express degree of hardness, Scale and sludge formation, Boiler feed water & Boiler problems, External treatment-Lime –soda process, Zeolite process, Ion exchange process, Internal treatment, Water for domestic use & Treatment for domestic water, Saline water, Desalination of water, Introduction to Corrosion, Causes & effects of Corrosion, Electrolysis and various terms related to Electrolysis, Electrolysis & Electrode Potential, Basic principle of electroplating & Electro less plating, Electrochemical techniques of forming, Machining and Etching, Introduction to different phases, Gibbs phase rule & its Application to one component system – water, carbon dioxide. Materials, Cementing and Binding materials, Lime, Gypsum, Cement, Admixtures for concrete, Ceramics, Composites, Lubricants, Adhesives, Thermoplastics and Thermosetting, Polymer composites, Introduction & Principles of green chemistry, Pathways to Green Chemistry for Traditional and alternative synthesis of Ibuprofen, Feedstock in the synthesis of Adipic acid, Green chemistry at Nike, Green Chemistry in India

Suggested Books:

1. Sivasankar, B. (2008). Engineering Chemistry, Tata McGraw-Hill, New Delhi.
2. Palanna, O. G. (2009). Engineering Chemistry. Tata McGraw-Hill Education, New Delhi.
3. Fogler, H. S., (1999). 'Elements of Chemical Reaction Engineering', Prentice-Hall International, Inc., New Jersey.
4. Gersten, J. I., & Smith, F. W. (2001). "The physics and chemistry of materials", John Wiley & Sons, New York.

Course Code	Course Name	L-T-P	Credits
CEL5102	Engineering Mechanics	3-1-0	4

Course Learning Outcomes:

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

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

CLO3: Solve problems in kinematic and dynamic systems

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

CLO5: Understand basic dynamics concepts – force, momentum, work and energy.

CLO6: Undertake laboratory practical and report results

Course Outlines:

To analyze and predict the deformation (both elastic and plastic) of objects under known forces. To identify formulate and solve engineering problems. To apply the knowledge gained from this course to other core civil engineering subjects. To use techniques learnt to solve numerical problems in various other civil engineering subjects. Mass moment inertia of Circular plate, Cylinder, Cone, Sphere.

Suggested Books:

1. Khurmi, R. S. (1986). 'A text book of hydraulics, fluid mechanics and hydraulic machines', S. Chand & Company Limited, India.
2. Timoshenko, S. P., & Young, D. H. (1956). 'Engineering mechanics', McGraw-Hill Book Company, Inc., New York.
3. Bhavikatti, S. S., & Rajashekarappa, K. G. (1994). 'Engineering Mechanics', New Age International, New Delhi.
4. Andy Ruina and Rudra Pratap (2011), "Introduction to Statics and Dynamics", Oxford University Press
5. Shanes and Rao (2006), "Engineering Mechanics", Pearson Education",

Course Code	Course Name	L-T-P	Credits
AML5102	Engineering Mathematics-II	4-1-0	5

Course Learning Outcomes:

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

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

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

Course 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. Equation solvable for p, y and x, 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, Cauchy's Theorem, Cauchy Integral formula, Taylors and Laurent's Expansion.

Suggested Books:

1. Khurmi, R. S. (1986). 'A text book of hydraulics, fluid mechanics and hydraulic machines', S. Chand & Company Limited, India.
2. Timoshenko, S. P., & Young, D. H. (1956). 'Engineering mechanics', McGraw-Hill Book Company, Inc., New York.
3. Bhavikatti, S. S., & Rajashekarappa, K. G. (1994). 'Engineering Mechanics', New Age International, New Delhi.
4. Introduction to Linear Algebra, 3rd Edition Gilbert Strang
5. Linear Algebra Jump Start and Catch Up; Jonathan D Tullis 2017

Course Code	Course Name	L-T-P	Credits
CEL3205	Building Materials and Construction	3-0-0	3

Course Learning Outcomes:

CLO1: Evaluate various properties of concrete

CLO2: Evaluate various properties of the basic construction materials such as brick, stone timber, metals

CLO3: Develop skills to work in field of building materials quality control.

CLO4: Evaluate the properties of miscellaneous materials such as bitumen, paints, distempering, 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:

Building materials: physical and chemical characteristic of commonly used building materials in civil engineering construction - clay, sand, stone, lime, cement, concrete, bricks, silica, aluminum and timber with reference to its specifications. Plywood, asbestos, plastics and polymer-based materials. Protective material: Paints and varnishes, Building construction: bricks and stone masonry. Setting and laying out a building, safe bearing capacity of soils, types of building foundation. Construction detail of foundation, floors, roofs and stairs. Damp proof course, plastering and pointing. Different types of doors and windows. Tests on cement fine aggregate, coarse aggregate, fresh concrete and hardened concrete, tests for various strengths of concrete, stress-strain curve and tests on bricks. Wall Finishes: Plastering, pointing, distempering and painting: Purpose, methods, defects and their solutions. Vertical communication: Stairs: Terminology, requirements of good staircase, classification; ramps, lifts and escalators. Damp proofing: causes, effects, prevention and treatments, Fire resistant construction: Fire resistant properties of common building materials, requirements for various building components.

Suggested 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. Brian Cooke (2011) "Construction Practice", Wiley-Blackwell.

5. Gurcharan Singh (2017) "Building Construction and Material", Standard Book House. Laxmi Publications.

Course Code	Course Name	L-T-P	Credits
CEP1215	Building Materials 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:

Identification of various types of stones, Bricks, Metals, Timber and Wood products and their application in Construction works; Tests on Bricks: Field tests, Water absorption test, Crushing strength; Tests on cement: Field tests of cement, Fineness of cement, Normal Consistency test, Initial and final setting times of cement; Tests on aggregate: Bulking of Sand, Standard Proctor Compaction test, Percentage of voids in coarse aggregate and fine aggregate, Fineness Modulus; Tests on Metals: Tension test on mild steel, Double Shear test on mild steel rod; Rockwell and Brinell hardness tests on steel/brass; Izod and Charpy impact tests on steel/brass; Tests on Concrete: Preparation of cement mortar for given proportion, Workability test-Slump test, compressive strength test; Study of Manufacturing/Preparation of Construction Materials at Site/Factory; Concrete mixing methods; Compaction methods of concrete – by tamping and by using Vibrators.

Suggested 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. Kuldeep Saluja, (2015), "Building Construction", Diamond Pocket Books, India.
5. Allen, E., & Iano, J. (2013). "Fundamentals Of Building Construction: Materials And Methods", John Wiley & Sons, New Jersey.

Course Code	Course Name	L-T-P	Credits
CHP1101	Engineering, Chemistry Lab	0-0-2	1

Course Learning Outcomes:

CLO1: Determination of parameters like hardness and chloride content in water.

CLO2: Estimation of rate constant of a reaction from concentration – time relationships.

CLO3: Determination of physical properties like adsorption, surface tension and viscosity.

Course Outlines:

Determination of total hardness, permanent hardness and temporary hardness by Complexometric method, Determination of residual chlorine in water, To determine the alkalinity of a given water sample, Determination of dissolved oxygen in the given water sample, Demonstration of different types of corrosion and to identify corrosion by collecting different samples, Surface tension by drop number method using Stalgamometer, Preparation of urea –formaldehyde resin, Preparation of Bakelite using phenol-formaldehyde,

Acid strength using pH meter, Acid strength by using conduct meter, To determine the % moisture, volatile, Virtual experiment on phase changes.

Suggested Books:

1. Sivasankar, B. (2008). Engineering Chemistry, Tata McGraw-Hill, New Delhi.
2. Palanna, O. G. (2009). Engineering Chemistry. Tata McGraw-Hill Education, New Delhi.
3. Fogler, H. S., (1999). 'Elements of Chemical Reaction Engineering', Prentice-Hall International, Inc., New Jersey.

Course Code	Course Name	L-T-P	Credits
MEW2101	Manufacturing Practice	Summer Course	2

Course Learning Outcomes:

CLO1: To acquire skills in basic mechanical engineering practice.
CLO2: To identify the hand tools and instrument
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 projects

Course Outlines:

CARPENTRY AND PATTERN MAKING: Classification, properties and defects of timber. Different shaping operations for making various joints. FOUNDRY SHOP: Introduction to foundry. Exercises involving preparation of sand moulds and castings. FORGING PRACTICE: Introduction to forging, Forging tools, equipment and exercises on simple forging operations. MACHINE SHOP: Introduction to metal cutting machines, tools and exercises on basic metal cutting operations. WELDING SHOP: Basic concept on different welding methods, equipment, welding joints, and welding defects related to gas/electric arc welding. SHEET METAL: Basic concept of sheet metal work involving different surface generations using different joining process. FITTING SHOP: Introduction to fitting and fitting practice. ELECTRICAL SHOP: Introduction to electrical wiring. ELECTRONICS SHOP: Introduction to electronics components (Diode, Resistor, Transistors, Capacitors LED's, and PCB's). Preparation of PCBs involving soldering applied to electrical & electronic applications. COMPUTER SHOP: Introduction to computer Hardware & peripherals. Assembly/Disassembly of simple P C. Awareness of faults and its diagnosis.

Suggested Books:

1. Raghuwanshi, B. S. (2009). A course in Workshop Technology Vol. II (Machine Tools), Dhanpat Rai & Company Pvt.
2. Bhargava, N. N., & Kulshreshtha, N. B. S. G. D. (1984). Basic Electronics and Linear Circuits. Tata McGraw-Hill Education.
3. Sinha, P. K. (2003). Computer fundamentals: concepts, systems & applications. BPB publications.
4. Rosch, W. L. (2003). Winn L. Rosch hardware bible. Que Publishing.

Semester-III			
Code	**Title of the Course**	**L-T-P**	**Credits**
CEL3203	Fluid Mechanics I	3-0-0	3
CEL3209	Mechanics of Solid	3-0-0	3
CEL3207	Surveying	3-0-0	3
CEL3208	Water Resource Engineering	3-0-0	3
HUL 3301	Human Rights and values	2-0-0	2
CEP1203	Fluid Mechanics Lab I	0-0-2	1
CEP1211	Mechanics of Solids Lab	0-0-2	1
CEP1227	Surveying Lab	0-0-2	1
CEP2209	Computer Aided Design - I	One week Course	2
CLP2401	Language Skills - I	0-0-4	2
Total		**24**	**21**

Course Code	Course Name	L-T-P	Credits
CEL3203	Fluid Mechanics I	3-0-0	3

Course Learning Outcomes:

CLO1: solve hydrostatic problems.
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.

Course Outlines:

Introduction, fluid properties, fluid statistics, manometers, static forces on immersed plane and curved surfaces, Buoyancy, stability of floating and submersed bodies, fluid kinematics, conservation of mass, rotation, vorticity and circulation, stream function and velocity potential flow net, Euler's equation, Bernoulli's equation, momentum and angular momentum equations, Kinetic energy and momentum correction factors, Dimensional analysis, Rayleigh's method and Buckingham Pi theorem, similarity principles, dimensionless numbers, model scales. Pipe flow, energy losses, Darcy-Weisbach equation, estimation of friction factor, minor losses, pipe flow computations, hydraulic gradient and total energy lines, concept of equivalent pipe, pipes in series and parallel, flow measuring devices.

Suggested Books:

1. Hunter Rouse, (1946). 'Elementary Mechanics of Fluids', John Wiley & Sons, London.
2. Streeter V.L. and Wylie E.B. (1988), 'Fluid Mechanics', MacGraw Hill Book Co, New York.
3. Modi P.N. & Seth S.M. (2002), 'Hydraulics & Mechanics', Standard Book House, New Delhi.
4. Finemore, 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
CEL3209	Mechanics of Solid	3-0-0	3

Course Learning Outcomes:

CLO1: Determine resultants and apply conditions of static equilibrium to plane force systems.
CLO2: Identify and quantify all forces associated with a static framework.

Course Outlines:

Stresses and strains, stress-strain diagrams, relation between elastic constants, composite bars in tension and compression, temperature stresses, factor of safety, principal stresses and strains, Mohr's circle. Bending moment and shear force diagrams for beams. Simple theory of bending, bending and shear stresses in beams. Torsion of circular shafts. Slope and deflection of beams by integration, area, moment and conjugate beam methods. Thin and thick cylinders. Theories of elastic failures. Close coiled, open coiled and leaf springs. Derivation of torsion equation and its assumptions. Applications of the equation of the hollow and solid circular shafts, torsional rigidity

Suggested Books:

1. Ryder G.H. (2002), 'Strength of Materials', Macmillan Publishers India Limited, India.
2. Srinath L.S., Desayi P., Murthy N.S & Ramu. (2009), 'Strength of Materials', Macmillan Publishers India Limited, India.
3. Beer, F.P., and Johnston, JR, E.R. (1985), 'Mechanics of Materials' (2nd Edition), McGraw Hill, New York.
4. Laboratory Manual of Testing Materials" - William Kendrick Hall.
5. Beer, F. P., Johnston, E. R., DeWolf, J. T., & Mazurek, D. F. (2018). "Mechanics of Materials Instructor".

Course Code	Course Name	L-T-P	Credits
CEL3207	Surveying	3-0-0	3

Course Learning Outcomes:

CLO1: Skill 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 in civil engineering

Course Outlines:

Elements of surveying and mapping, types of surveys and maps. Measurement of distance, direction and elevation. Chain surveying, compass surveying. Leveling and contouring. Plane table surveying. Theodolite surveying. Tacheometry. Triangulation, grades, baseline, eccentric station, reduction to centre, indivisibility. Theory of error, adjustment of triangulation nets and level nets.

Suggested Book(s):

1. Kanetkar T.P.and Kulkarni S.V., (2010). 'Surveying and Levelling Vol. I and II', Vidyarthi Griha Prakashan, Pune.
2. Charles D. Ghilani, (2011). 'Elementary Surveying: An Introduction to Geomatics, (13 edition)', Prentice Hall, U.S.A.
3. Bhavikatti, S. S. (2010). "Surveying and levelling" (Vol. 1). IK International Pvt Ltd.
4. Chandra, A. M. (2005). "Higher Surveying", New Age International.

Course Code	Course Name	L-T-P	Credits
CEL3208	Water Resource Engineering	3-0-0	3

Course Learning Outcomes:

CLO1: Apply science and engineering fundamentals to solve current problems and to anticipate, mitigate and prevent future problems in the area of water resources management

CLO2: An ability to manipulate hydrological data and undertake widely-used data analysis. a systematic understanding of the nature of hydrological stores and fluxes and a critical awareness of the methods used to measure, analyze and forecast their variability; and the appropriate contexts for their application.

CLO3: Can define the key components of a functioning groundwater, can determine the main aquifer properties – permeability, transmissivity and storage Identify geological formations capable of storing and transporting groundwater.

Course

Water resources planning and development, elements and objectives. Irrigation: Definition, systems of irrigation, soil-water-crop-relationships, water requirement of crops, irrigation efficiencies, consumptive use, duty and delta. Storage on River: Reservoirs, Principles of Planning and Operation. Hydrologic-cycle, Meteorological aspects of hydrology. Rain-fall, types, measurement, average depth over a basin, depth duration curves. Water losses: Interception, evaporation, transpiration. Runoff, factors affecting runoff, stream flow measurement and hydrograph representation, estimation of runoff from rain fall by empirical formulae, rational & infiltration method, unit hydrograph method and S-curve method. Urban runoff: Hydrological models. Construction and use of mass and flow duration curves, Floods, Hydrologic Routing, reservoir routing, channel routing-analytical and graphical methods. Elements of sediment transportation. River engineering - Stages of river, meanders, river training. Land erosion and control. Ground water: Aquifers ground water availability and yield. Groundwater withdrawals, infiltration wells and galleries, artesian, open and tube wells.

Suggested Book(s):

1. Kohler, M. A., & Paulhus, J. L. (1958). 'Hydrology for engineers', McGraw-Hill Book Company Inc, New York.
2. Subramanya, K. (2013). Engineering Hydrology, 4e. Tata McGraw-Hill Education, India.
3. Todd, D. K. (1959). Ground water hydrology. John Wiley and Sons, Inc, New York.
4. Subramanya, K. (1993). "Theory and applications of fluid mechanics". Tata McGraw-Hill.
5. Subramanya, K. (1982). "Flow in Open Channels", 3e. Tata McGraw-Hill Education.

Course Code	Course Name	L-T-P	Credits
HUL3301	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 understand the core values 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

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.

Suggested 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. Austrian Development Agency (2010). "Human Rights Manual", Vienna.

5. Senthil kumar, V. S. "Professional Ethics and Human Values"

Course Code	Course Name	L-T-P	Credits
CEP1203	Fluid Mechanics I 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: Discuss the differences 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.

Course Outlines:

Verification of Bernoulli's Theorem, calibration of venturimeter, orifice meter, rotameter, notches, verification of momentum equation, determination of Cc, Cv, and Cd of an orifice, determination of friction factor for pipes of different material, Determination of loss coefficients for pipe fittings, Determination of centre of pressure of a vertically immersed surface, Visualization of laminar and turbulent flow, Demonstration of free vortex, forced vortex, Study of water turbines, pumps, to check the stability of a ship model under loaded conditions.

Suggested Books:

1. Hunter Rouse, (1946). 'Elementary Mechanics of Fluids', John Wiley & Sons.
2. Streeter V.L. and Wylie E.B., (1988). 'Fluid Mechanics', MacGraw Hill Book Co, New York.
3. Modi P.N. & Seth S.M., (2002). 'Hydraulics & Mechanics', Standard Book House, New Delhi.
4. Subramanya, K. (2001) "Theory and Applications of Fluid Mechanics", Tata Mc Graw Hill.
5. 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
CEP1211	Mechanics of solids Lab	0-0-2	1

Course Learning Outcomes:

CLO1: Conduct tension test on Materials like steel etc.
CLO2: Conduct compression tests on spring, wood and concrete
CLO3: Conduct flexural and torsion test to determine elastic constants
CLO4: Determine hardness of metals

Course Outlines:

Experiment on axial tension of mild steel and cast iron; compression on concrete; bending of beams; buckling of columns. Experiments on shear centre; continuous and interconnected beams; unsymmetrical bending of angle sections; buckling of columns of various cross-section and end conditions, buckling analysis of long and intermediate-length columns loaded in compression.

Suggested Books:

1. Lab manual on Mechanics of Solid Lab, Chitkara University, HP.
2. Beer, F.P., and Johnston, JR, E.R. (1985), 'Mechanics of Materials' (2nd Edition), McGraw Hill, New York.

Course Code	Course Name	L-T-P	Credits
CEP1227	Surveying Lab	0-0-2	1

Course Learning Outcomes:

CLO1: Survey an area under various topographical feature and obstructions.
CLO2: Prepare the plan or map of the area surveyed.
CLO3: Annalise, 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:

Chaining, offsets, field book entry, triangulation and traversing, compass surveying and traversing, plane table surveying, two point and three-point problems, leveling, level book entry, preparation of contour map, study of theodolites and angle measurements, theodolite traversing, tacheometric traversing, use of distomat / theomat, interpretation of aerial photographs and satellite imagery.

Suggested Books:

1. Lab manual Geodesy- I and II, Chitkara University, HP
2. Punmia B.C, (2016). 'Surveying Vol. I and II', Laxmi Publication Pvt. Ltd., New Delhi.
3. Kanetkar T.P.and Kulkarni S.V., (2010). 'Surveying and Levelling Vol. I and II', Vidyarthi Griha Prakashan, Pune.

SEMESTER – IV

Semester-IV			
Code	**Title of the Course**	**L-T-P**	**Credits**
CEL4206	Structural Analysis I	4-1-0	5
CEL4212	Design of Concrete Structures I	3-1-0	4
CEL3202	Fluid Mechanics II	3-0-0	3
HUL 2401	Cyber Security	2-0-0	2
CEP1206	Structure analysis-I Lab	0-0-2	1
CEP1212	Design of Concrete structures lab I	0-0-2	1
CEP1202	Fluid Mechanics - II Lab	0-0-2	1
CLP2402	Language Skills - II	0-0-4	2
AS102	Engineering Exploration - II	0-0-4	2
Total		**28**	**21**

Course Code	Course Name	L-T-P	Credits
CEL4206	Structural Analysis-I	4-1-0	5

Course Learning Outcomes:

CLO1: Calculate deformation of statically determinate structures using geometric and energy
CLO2: methods.
CLO3: Analyze statically indeterminate beams using classical and conventional methods.
CLO4: Develop qualitative diagrams showing the displaced shape, bending moments and
CLO5: support reactions for an indeterminate plane frame.
CLO6: Develop effective structural analysis skills for building design activities.

Course Outlines:

Introduction: Forms of structure, idealization, elastic and linear behavior, equations of equilibrium, free body diagrams, principle of superposition, relations between load, shear and bending moments. Analysis of determinate structures: plane trusses, compound and complex trusses, analysis of pin jointed space trusses using tension coefficients and equilibrium equations, determine the stability and determinacy of space trusses, determine member forces of space trusses using tension coefficient analysis. displacements. geometric methods: deflected shapes, moment-area method, and conjugate-beam method, energy methods: strain energy in members, Betti's and Maxwell's Laws of reciprocal deflections, Concept of Virtual work and its applications, Castigliano's theorems, unit load method, deflections of trusses and 2D-frames, Indeterminate Structures: Introduction, static and kinematic indeterminacies, stability of structures, internal forces in two and three-dimensional structures.

Suggested 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
CEL4212	Design of Concrete Structures	3-1-0	4

Course Learning Outcomes:

CLO1: Identify and compute the main mechanical properties of concrete and steel.
CLO2: Identify and calculate the design loads and distribution.
CLO3: Apply the strength method to design R.C. structural members.
CLO4: Analyze and design R.C. beams for flexure and shear.
CLO5: Analyze and design short and slender R.C. columns.
CLO6: Analyze and design R.C. slabs, footings.
CLO7: Apply relevant IS Code provisions to ensure safety and serviceability of structural elements.
CLO8: To acquire skills in basic civil engineering design practice.

Course Outlines:

Materials for reinforced concrete, concrete mix design. Limit state and working stress concepts for under-reinforced balanced and over-reinforced sections, rectangular, T-beam and design of singly and doubly reinforced & L beams. One way and two-way slabs. Columns isolated and combined footings, retaining walls, stair cases. Short term and long deflections, estimation of probable maximum crack width, Design Laboratory: Design and drawing of continuous or two-way slabs; continuous beam; Column with a footing; joint details beam-slab; beam-column and column-footing.

Suggested Books:

1. Jain A.K., 'Reinforced Concrete Design - Limit State Method', Nemchand Brothers, Roorkee.
2. Sinha S.N., (2002). 'RC Design', Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
3. Setareh, Mehdi, Darvas, Robert, (2017), "Concrete Structures", Springer International Publishing, Switzerland.
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
CEL3202	Fluid Mechanics II	3-0-0	3

Course Learning Outcomes:

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

CLO2: Ability to explain the terms of the open channel flow equations and explain the interactions among the terms.

Course Outlines:

Review of basic concepts of fluid mechanics, Continuity equation in cylindrical polar co-ordinates, Free and forced vortex motion. Laminar flow, Navier-Stokes, equation of motion (no derivation), Laminar flow through a pipe, Parallel Plates, Plates having relative motion, annulus, laminar flow past a sphere, turbulent flow, transition from laminar to turbulent flow, shear stress in turbulent flow, eddy viscosity, mixing length concept, smooth and rough surfaces, velocity distribution in turbulent flow, resistance of smooth and artificially roughened pipes, commercial pipes, boundary layer thickness and its characteristics, laminar and turbulent boundary layers, von-karman integral momentum equation and its application for different velocity profiles, separation of boundary layer and methods for its preventions. steady state open channel flow, uniform flow, critical flow, analysis of rapidly varied flow, hydraulic jump, channel transitions: gradually varied flow; method of integration of varied flow equation, elements of particle dynamics.

Suggested Books:

1. Subramanya, K. (1982). Flow in Open Channels, 3e. Tata McGraw-Hill Education, New Delhi.
2. Pillai, N. N., & Ramakrishnan, C. R. (2006). Principles of fluid mechanics and fluid machines. Universities Press.
3. Munson, B. R., Okiishi, T. H., Huebsch, W. W., & Rothmayer, A. P. (2013). Fluid mechanics. Singapore: John Wiley & Sons, USA.
4. Fay, J. A. (1994). Introduction to fluid mechanics, MIT press, Cambridge, Massachusetts, United States.

Course Code	Course Name	L-T-P	Credits
HUL2401	Cyber Security	2-0-0	2

Course Learning Outcomes:

CLO1: An ability to analyze a problem, and to identify and define the computing requirements appropriate to its solution.

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

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

CLO4: An ability to make informed judgements 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, Cybercafé 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. Forensics: Best Practices for Organizations, Media and Asset Protection, Importance of Endpoint Security in Organizations, Cybercrime and Cyber terrorism: Social, Political, Ethical and Psychological Dimensions, Introduction, Intellectual Property in the Cyberspace, The Ethical Dimension of Cybercrimes, and The Psychology, Mindset and Skills of Hackers and Other Cyber criminals. Cybercrime: Illustrations, Examples and Mini-Cases.

Suggested 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. Perry, A. M., Online Safety: Scams, SPAM, "Viruses and Clouds, Asia Pacific" Holdings Private Limited (India).
5. "The Quick Guide to Cloud Computing and Cyber Security" Pistorious, Marcia, R.T., Asia Pacific Holdings Private Limited (India).

Course Code	Course Name	L-T-P	Credits
CEP1206	Structural 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.
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:

Verify Betti's Law, 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, three suspension rods supporting an elastic beam, 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. Determine the behavior of column and struts with different end conditions. Assess the deflections and the buckling loads.

Suggested 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
CEP1212	Design of Concrete Structures Lab– I	0-0-2	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.

Course Outlines:

Tests on cement, Fine aggregate testing, coarse aggregate testing, workability of concrete, strength tests on concrete, Non-destructive testing of concrete

Suggested Books:

1. Lab Manual on Design of Concrete Structures, Chitkara Univeristy, Himachal Pradesh
2. Jain A.K., 'Reinforced Concrete Design - Limit State Method', Nemchand Brothers, Roorkee.
3. Setareh, Mehdi, Darvas, Robert, (2017), "Concrete Structures", Springer International Publishing, Switzerland.
4. Lab manual Design of concrete structures", Chitkara University.
5. Jain A.K., (2009) "'Reinforced Concrete Design" - Limit State Method', Nem Chand Brothers, Roorkee.

Course Code	Course Name	L-T-P	Credits
CEP1202	Fluid Mechanics II Lab	0-0-2	1

Course Learning Outcomes:

CLO1: Utilize basic measurement techniques of fluid mechanics.
CLO2: Discuss the differences among measurement techniques, their relevance and applications.
CLO3: Prove good understanding of concepts and their applications in the laboratory.
CLO4: Compare the results of analytical models introduced in lecture to the actual behavior of real fluid flows and draw correct and sustainable conclusions.
CLO5: Understand ethical issues associated with decision making and professional conduct.

Course Outlines:

Stokes law and to study the variation of drag coefficient with Reynolds no., viscosity of a given liquid by capillary-tube-viscometer, manning's co-efficient of roughness for the bed of a given flume, velocity distribution in a rectangular flume and to determine the energy and momentum correction factors, horizontal contraction in a rectangular open channel, profile of a free and forced vortex motion, pressure distribution along the spillway surface, calibrate a bend meter, calibrate a broad-crested weir and to study the pressure distribution along its surface, distribution around a cylinder places in a wind stream and to calculate the coefficient of drag, calibrate a venturi flume, characteristics of a single stage centrifugal pump. This study analyzed the hydraulic characteristics of a venturi flume

Suggested Books:

1. Lab Manual on Fluid Mechanics, Chitkara University, Himachal Pradesh.
2. Subramanya, K. (1982). Flow in Open Channels, 3e. Tata McGraw-Hill Education, New Delhi.
3. Fay, J. A. (1994). Introduction to fluid mechanics, MIT press, Cambridge, Massachusetts, United States.
4. Ojha, C.S.P., Berndtsson, Chadramouli, P. N., R (2010). "Fluid Mechanics and Machinery", Oxford University Press.
5. "Hydraulics and Fluid Mechanics", P M Modi and S M Seth, Standard Book House.
6. Subramanya, K. (2001) "Theory and Applications of Fluid Mechanics", Tata Mc Graw Hill.
7. Daugherty, R.L., Franzini, J.B, Finnemore, E.J., (2001). "Fluid Mechanics with Engineering

Applications", Mc Graw Hill.

Semester-V			
Code	**Title of the Course**	**L-T-P**	**Credits**
CEL 5308	Analysis of Structures II	4-1-0	5
CEL 3311	Transportation Engineering, I	3-0-0	3
CEL 3303	Environmental Engineering, I	3-0-0	3
CEL 4305	Geotechnical Engineering, I	3-1-0	4
CEP 2309	Computer Aided Design II	One week	2
CEP 1311	Transportation Engineering lab I	0-0-2	1
CEP 1303	Environmental Engineering Lab I	0-0-2	1
CEP 1308	Geotechnical Engineering, I lab	0-0-2	1
CET5301	Survey Camp	Two-week	5
Total		**21**	**25**

Course Code	Course Name	L-T-P	Credits
CEL5308	Analysis of Structure II	4-1-0	5

Course Learning Outcomes:

CLO1: To understand analysis of indeterminate structures and adopt an appropriate structural analysis technique

CLO2: Determine response of structures by classical, iterative and matrix methods

Course Outlines:

Analysis of Cables and Suspension Bridges: General cable theorem, shape, elastic stretch of cable, maximum tension in cable and back-stays, pressure on supporting towers, suspension bridges, three hinged and two hinged stiffening girders. Revision of Matrix Algebra: Solution of simultaneous algebraic equations. Introduction to systems approach: Force and Displacement methods. Matrix Force Method: Introduction to flexibility approach, Choice of redundant, static equilibrium matrix, deformation compatibility matrix, member flexibility matrix, static equilibrium and deformation compatibility checks. Application for trusses, continuous beams and rigid frames. The matrix displacement or Stiffness Method: Conditions of stress-strain relationships, equilibrium and compatibility: Structures with axial force members - trusses, Structures with flexural members - continuous beams and rigid frames. Formulation of various matrices: Static equilibrium matrix - deformation compatibility matrix, member stiffness matrix, global stiffness matrix, external load matrix, static equilibrium and deformation, compatibility checks and effects of support settlement and lack of fit. Conversion of member loads into joint loads. Partitioning of global stiffness matrix. Direct Stiffness Method: Derivation of global matrix from energy considerations, transformation matrices, member stiffness matrix with respect to member coordinate system, member stiffness matrix for global coordinates and global stiffness matrix. Displacement boundary conditions, computer generation of global stiffness matrix, effect of temperature and lack of fit. Comparison between stiffness and flexibility methods. Introduction to Finite Element Method: 1-D bar element. The Direct Stiffness Method and the Stiffness Matrix.

Suggested Books:

1. Yuan Yu Hsieh (1987). Elementary 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. Punmia B.C, Jain R.K., (2005). "Strength of Materials and theory of structures" Vol I & II', Laxmi

Publication New Delhi.

Course Code	Course Name	L-T-P	Credits
CEL3311	Transportation Engineering, I	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 relationship between the environment and transportation infrastructure and the importance the environment plays in project development of transportation projects.

CLO3: Utilize CAD software to prepare a plan, profile, and x-sections depicting a typical roadway design.

CLO4: Prepare well written design narratives documenting the various parameters and standards used in the design process so another individual could review the work and understand what decisions and assumptions were used and why.

CLO5: Understand the mathematics behind the development of tables and charts for determining highway design criteria.

Course Outlines:

Introduction, importance of various modes of transportation. Highway engineering: developments in road construction, highway planning, alignment and surveys, geometric design, materials and elements of pavement design, construction of pavements, construction and maintenance of drainage, arboriculture. Traffic engineering: traffic characteristics, speed, journey time and delays, vehicle volume counts, origin and destination, analysis and interpretation of survey data, traffic operations, design and signals and rotary intersections, parking space design, lighting, planning and administration, road accidents and safety measures.

Suggested Books:

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

Course Code	Course Name	L-T-P	Credits
CEL3303	Environmental Engineering-I	3-0-0	3

Course Learning Outcomes:

CLO1: Understand different methods are used to purify the water and rectify the water which improves the standard and living style of the community.

CLO2: Able to determine the population forecast for a city to meet its water requirement.

CLO3: Able to design water and waste water treatment plant by different methods.

Course Outlines:

Sources of water, Water quality parameters: significance and standards. Fundamentals of environmental hydraulics (including pumping) related to water supply and waste water collection, pipe network analysis and design for water supply systems. Sewerage system: Types of collection and disposal system. Design approach for sanitary and storm sewers. Sewer appurtenances, street inlets, inverted siphon. Elements of house plumbing for water supply and waste water drainage. Air pollution and control: Sources, effects, standards, monitoring and general overview of engineering control. Solid waste management: Types, sources and characteristics, collection and disposal systems.

Suggested Books:

1. Peavy, H.S. and Rowe, Techobanoglaus D.R., (1987), 'Environmental Engineering", Tata McGraw Hill International Edition, New York.
2. Sincero, A. P., & Sincero, G. A. (1996). Environmental Engineering: A design approach., Prentice Hall, New York.
3. Garg, S. K. (2010). 'Water supply engineering', Khanna Publishers, New Delhi.
4. Bharucha, E., "Textbook of Environmental Studies", Universities Press (2005).

Course Code	Course Name	L-T-P	Credits
CEL4305	Geotechnical Engineering, I	3-1-0	4

Course Learning Outcomes:

CLO1: Understand 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

Course Outlines:

Introduction to geotechnical problems in civil engineering; Soil types and formation; Simple soil properties, Grain size distribution, Atterberg limits; Soil identification and classification; Total, effective and neutral stresses; Darcy's law; Permeability and capillarity of soil, Seepage, Flow nets, Piping, Design of filters; Stress distribution in soils; Laboratory compaction and field compaction; One-dimensional consolidation and simple settlement analysis; Shear strength; Determination of total and effective strength parameters; Factors Influencing Shear Strength, Mohr-Coulomb Failure Criteria, Earth pressure : classical theories, graphical methods;

Suggested Books:

1. Craig, R.F., (1983). 'Soil Mechanics' by ELBS and Van Nostrand Reinhold Co. Ltd., Berkshire.
2. Lambe, T.W. and Whitman, R.V, (1979). 'Soil Mechanics' by John Wiley and Sons, New York, USA.
3. Ranjan, G. and Rao, (2000). 'Basic and Applied Soil Mechanics' A.S.R. New Age International Publishers, New Delhi.
4. Taylor, 1949, Fundamentals of Soil Engineering, John Wiley &Sons
5. Holtz, R. D., Kovacs, W. D., &Sheahan, T. C. (1981). "An introduction to geotechnical engineering" (Vol. 733).
6. Englewood Cliffs, NJ: Prentice-Hall.
7. Das, B. M., & Sobhan, K. (2013). "Principles of geotechnical engineering". Cengage learning.

Course Code	Course Name	L-T-P	Credits
CEP1311	Transportation Engineering Lab	0-0-2	1

Course Learning Outcomes:

CLO1: Design and validate technological solutions to defined problems and communicate clearly and effectively for the practical application of their work. Identify engineering properties of aggregate.
CLO2: Design and validate technological solutions to defined problems and communicate clearly and effectively for the practical application of their work. Identify the grade & properties of bitumen.
CLO3: Design and validate technological solutions to defined problems and communicate clearly and effectively for the practical application of their work. Find out peak hour traffic & peak time for a given location on the road.

CLO4: Calculate design speed, maximum speed & minimum speed limits of a location through spot speed.
CLO5: Draw parking accumulation curve and find out parking duration & turnover of parking lot/stretch

Course Outlines:

Aggregate crushing value test, abrasion test, aggregate impact test, shape test, water absorption and specific gravity tests, penetration test, stripping value test, ductility test, softening point test, flash & fire point test, viscosity test, soundness test. Determination of speed by radar, determination of spot speed by endoscopes, study of driving skills.

Suggested Books:

1. Lab Manual Transportation Engineering- I, Chitkara University, Himachal Pradesh
2. L.R. Kadiyali, (2013) 'Traffic Engineering & Transport Planning', Khanna Publishers.
3. Khanna & Justo, (1973) 'Highway Engineering", Nemchand & Bros-Roorkee (UA).
4. Garber, N.J., Hoel, L.A., (2014) 'Traffic and Highway Engineering', West Publishing Company, New York.

Course Code	Course Name	L-T-P	Credits
CEP1303	Environmental Engineering-I Lab	0-0-2	1

Course Learning Outcomes:

CLO1: Perform common environmental experiments relating to water and wastewater quality, and know which tests are appropriate for given environmental problems, and thus enhances skills of students and make them industry read.
CLO2: Statistically analyze and interpret laboratorial results.
CLO3: Apply the laboratorial results to problem identification, quantification, and basic environmental design and technical solutions.
CLO4: Understand and use the water and wastewater sampling procedures and sample preservations.
CLO5: Obtain the necessary background for subsequent courses in environmental engineering.
CLO6: Understand the impact of water and wastewater treatment on people and the environment.
CLO7: Understand and apply ethical issues associated with decision making and professional conduct in the laboratorial and field environment.

Course Outlines:

Flow measurements in closed conduits / venturimeter, orifices. Determination of color and turbidity. Determination of solids: total, dissolved and suspended, dissolved solids through conductivity. Determination of alkalinity and its species. Determination of pH, acidity and its species. Determination of hardness (different types). Determination of chlorides and fluorides. Jar test for optimum coagulant dose estimation.

Suggested Books:

1. Peavy, H.S. and Rowe, Techobanoglaus D.R., (1987), 'Environmental Engineering", Tata McGraw Hill International Edition, Pp.
2. Sincero, A. P., & Sincero, G. A. (1996). Environmental Engineering: A design approach., Prentice Hall.
3. Garg, S. K. (2010). "Water supply engineering", Khanna Publishers, New Delhi:
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).
6. Manual on water supply and treatment. Central Public Health and Environmental Engineering Organisation, Ministry of Urban Development.

Course Code	Course Name	L-T-P	Credits
CEP1308	Geotechnical Engineering, I Lab	0-0-2	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: Be able 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:

Specific gravity test, In-situ density test, Sieve analysis, Hydrometer analysis, Atterberg's limits test, Permeability tests, Proctor Compaction test, Maximum and minimum density of sand, Direct shear test, Unconfined compression test, vane shear test, Tri-axial tests, Interpretation of triaxial test results, Consolidation test, the pre-consolidation stress, Swelling pressure test

Suggested Books:

1. Lab Manual Geotechnical Engineering-I Chitkara University, Himachal Pradesh.
2. Craig, R.F., (1983). 'Soil Mechanics' by ELBS and Van Nostrand Reinhold Co. Ltd., Berkshire.
3. Lambe, T.W. and Whitman, R.V, (1979). 'Soil Mechanics' by John Wiley and Sons, New York, USA.
4. Ranjan, G. and Rao, (2000). 'Basic and Applied Soil Mechanics' A.S.R. New Age International Publishers, New Delhi.

Course Code	Course Name	L-T-P	Credits
CET5301	Survey Camp	-	5

Course Learning Outcomes:

CLO1: Survey an area under various topographical feature and obstructions.

CLO2: Prepare the plan or map of the area surveyed.

CLO3: Annalise, 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:

Survey Camp: Reconnaissance and establishing the stations; Base line measurements, Triangulation readings on various stations; computation and preparation of triangulation map; contouring; preparation of map; preparation of report.

Suggested Books:

1. Lab manual Geodesy- I and II, Chitkara University, HP.
2. Juny Pilapil La Putt (1985). Surveying: Lab Manual, Baguio Research & Publishing Center.
3. Manoj, K. Arora and Badjatia, 2011 “Geomatics Engineering”, Nem Chand & Bros.
4. Bhavikatti, S. S. (2010). “Surveying and levelling” (Vol. 1). IK International Pvt Ltd.

Semester-VI			
Code	**Title of the Course**	**L-T-P**	**Credits**
CEL3308	Construction Planning and Management	3-0-0	3

CEL3310	Environmental Engineering-II	3-0-0	3
CEL3302	Estimating and Costing	3-0-0	3
CEL4304	Design of Steel Structures	3-1-0	4
CEL5314	Design of Concrete Structures-II	4-1-0	5
CEP1310	Environmental Engineering-II Lab	0-0-2	1
AS103	Engineering Exploration-III	0-0-4	2
GTI4301	Numerical Ability and Logical Reasoning	4-0-0	4
Total		**28**	**25**

Course Code	Course Name	L-T-P	Credits
CEL3308	Construction Planning and Management	3-1-0	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
CLO5: Be capable of using relevant software packages for planning, scheduling, executing and controlling of construction projects.

Course Outlines:

Engineering economics: cash flow diagram, tune value of money, inflation, interest, depreciation, present worth and capitalized cost, equivalent uniform annual cost and rate of return evaluations, benefit cost analysis, analysis of variable costs, types of capital financing, valuation. Tendering and contract: organizational structure, methods of tendering, specifications, conditions of contract, contract law, disputes and arbitrations. construction planning and management: time, cost and research management of projects for planning, scheduling, control and forecasting using networks with CPM/PERT. Personnel, material and finance management, safety engineering. construction equipment's selection, planning and cost equipment's, earthmoving, excavating, hauling, compacting, drilling and blasting, grouting, conveying and dewatering equipment's. Aggregate cement concrete and asphalt concrete plants.

Suggested Books:

1. Jebsen, J, (1990). 'Cost and Optimisation Engineering', McGraw Hill, New York.
2. Moder, J.J. & Phillips, C.R, (1970). 'Project Management with CPM and PERT', Van Nostrand Reinhold Co, New York.
3. Sengupta, B. and Guha, H., (2006) 'Construction Management and Planning', Tata McGraw Hill, New Delhi.
4. National Building Code, 2017" Bureau of Indian Standards", New Delhi.
5. Chudley, R., 2007, "Construction Technology", ELBS Publishers.
6. Peurifoy, R.L. 2011, "Construction Planning", Method sand Equipment", Mc Graw Hill.

Course Code	Course Name	L-T-P	Credits
CEL3310	Environmental Engineering-II	3-0-0	3

Course Learning Outcomes:

CLO1: Design of unit processes for conventional and advanced wastewater treatment systems
CLO2: Analyze wastewater treatment processes and operations.
CLO3: Characterize wastewater and the best available technologies for treatment of wastewater.
CLO4: Identify health and environmental issues related to solid waste management, apply steps in solid waste management-waste reduction at source and collection technique
CLO5: Identify and analyze of air and noise pollution including methods for prevention, control, measures and management of the pollution.

Course Outlines:

Wastewater characteristics; bio-chemical kinetics, self-purification of streams. Basic concepts of physical, chemical, physico-chemical & biological unit operations, & processes for wastewater treatment. Conventional treatment of water: Aeration and coagulation-flocculation sedimentation, filtration, disinfection. Primary treatment of wastewater: Screening, grit separation, primary sedimentation. Secondary treatment of wastewater: Principles of aerobic & anaerobic biological treatment, various aerobic biological treatment units - trickling filter, activated sludge process, waste stabilization pond and aerated lagoon. Anaerobic treatment systems - septic tank and digesters. Design of low and high-rate anaerobic digesters and septic tank. Basic concept of anaerobic contact process Elements of environmental impact assessment and auditing with a few illustrative (case) studies.

Suggested Books:

1. Peavy, H.S. and Rowe, Techobanoglaus D.R., (1987), 'Environmental Engineering", Tata McGraw Hill International Edition, New York.
2. Sincero, A. P., & Sincero, G. A. (1996). Environmental Engineering: A design approach., Prentice Hall, New York.
3. 'Garg, S. K. (2010). 'Water supply engineering', Khanna Publishers, New Delhi.
4. Jane Holder and Maria Lee, 2012, "Environmental Protection, Law And Policy‖", Cambridge Universitypress.

Course Code	Course Name	L-T-P	Credits
CEL3302	Estimating and Costing	3-0-0	3

Course Learning Outcomes:

CLO1: Will have a basic knowledge on methods and types of estimation and its merits and demerits.

CLO2: Have knowledge on specifications and tendering process for contracts

CLO3: Will have the ability to understand the types, formation, terms and conditions in contracts and arbitration

CLO4: Will have the knowledge of rate analysis of different item of work and MB and bill of quantities

CLO5: Will able to value a property, price escalation recommendations and auditing

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.

Suggested Books:

1. Dutta, B.N., (1991). 'Estimating and Costing' Tagor Palli, Lucknow.
2. Basin P.L., (1987). 'Quantity Surveying', S. Chand and Company, New Delhi.
3. Cooper G.H., (1971). 'Building Construction and Estimating', McGraw-Hill.

4. Mankiw Gregory N. (2002), "Principles of Economics", Thompson Asia
5. V. Mote, S. Paul, G. Gupta (2004)," Managerial Economics", Tata McGraw Hill
6. Misra, S.K. and Puri (2009), "Indian Economy", Himalaya

Course Code	Course Name	L-T-P	Credits
CEL4304	Design of Steel Structures	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: Ability to analyze and design of simple bolted and welded connections
CLO6: Ability to design steel framing system and connections of a building in a team setting

Course Outlines:

Structural steel and their properties. Riveted, bolted and welded connections. Tension, compression and flexural members. Roof trusses, plate girders, gantry girders and industrial buildings. Column bases and grillage foundations. Timber and masonry structures. Design Laboratory: Design and drawing of built-up compression members; plate girder design, design and drawing of laced/battened columns with base plate; moment resistant designs. Design of welded plate Girders - Optimum depth - Design of main section - Design of end

bearing, stiffness bearing and intermediate stiffness. Connection between web and flange -
Design of flange splice and web splices.

Suggested 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. Farkas, József, Jármai, Károly, (2013). "Optimum Design of Steel Structures", Springer-Verlag Berlin Heidelberg, Switzerland.
4. Abu-Saba, Elias G, (1995). "Design of Steel Structures", Springer US.

Course Code	Course Name	L-T-P	Credits
CEL5314	Design of Concrete Structure – II	4-1-0	5

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

Course Outlines:

Retaining Wall Design – Introduction, types of Retaining Walls and Earth pressures. Depth of foundation. Design and stability of cantilever retaining wall. Design of counterfort retaining walls.

Design of stair Cases - Design of water Tanks- Introduction - Design Requirement, Method of analysis. Design of Circular Tanks resting on ground, design constants - rectangular tanks Resting on ground.

Underground tanks Overhead water tanks. Rectangular overhead water tanks.

Intze Overhead tank. Design of towers supporting overhead tanks. Building frames, effective span, stiffness, loads, Analysis, Moment redistribution, Critical Sections - R.C Details.Design of Concrete bridges. Yield Analysis of Slabs

Suggested Books:

1. Gambhir, M. L. (2008). 'Design of reinforced concrete structures' PHI Learning Pvt. Ltd, India.
2. Varghese, P. C. (2009). Advanced reinforced concrete design. PHI Learning Pvt. Ltd, India.
3. Setareh, Mehdi, Darvas, Robert, (2017), "Concrete Structures", Springer International Publishing, Switzerland.
4. Jain A.K., (2009) '"Reinforced Concrete Design" - Limit State Method', Nem Chand Brothers, Roorkee

Course Code	Course Name	L-T-P	Credits
CEP1310	Environmental Engineering-II Lab	0-0-2	1

Course Learning Outcomes:

CLO1: Perform common environmental experiments relating to water and wastewater quality, and know which tests are appropriate for given environmental problems, and thus enhances skills of students and make them industry read.

CLO2: Statistically analyze and interpret laboratorial results.

CLO3: Apply the laboratorial results to problem identification, quantification, and basic environmental design and technical solutions.

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

CLO5: Obtain the necessary background for subsequent courses in environmental engineering.

Course Outlines:

Determination of DO, BOD & COD. Determination of sulphates, nitrite and nitrate nitrogen, determination of ammonia and total kjeldhal nitrogen. Determination of phosphorus (total and available), determination of SVI (including MLSS and MLVSS estimations), settling column test for primary settling tank design, settling column test for secondary setting tank design.

Suggested Books:

1. Peavy, H.S. and Rowe, Techobanoglaus D.R., (1987), 'Environmental Engineering", Tata McGraw Hill International Edition, New York.
2. Sincero, A. P., & Sincero, G. A. (1996). Environmental Engineering: A design approach., Prentice Hall, New York.
3. 'Garg, S. K. (2010). 'Water supply engineering', Khanna Publishers, New Delhi.
4. Vesilind P Aarne (1997)," Introduction to environmental engineering", PWS Publishing Company, Boston
5. Tchobanoglous, G., Peavy, H. S., & Rowe, D. R. (1985). Environmental engineering. Mc Graw-Hill.

Course Code	Course Name	L-T-P	Credits
GTI4301	Numerical Ability and LogicalReasoning	4-0-0	4

Course Learning Outcomes:

CLO1: Student will be able to improve answers during the Aptitude test and develop an all-around personality with a mature outlook.

CLO2: Student will be able to enhance their logical thinking, verbal reasoning and numerical reasoning.

CLO3: Students will take part effectively and confidently not only in campus placements programs but also in other exams like CAT, GMAT, SSC, Bank Po, UPSC etc.

Course Outlines:

Vedic module: Introduction with aptitude, Cube and cube root, Division, Addition and Subtraction, Algebraic formula base, Approximation, Number System, Ratio, Percentage, Simple Interest, Compound Interest, Profit and Loss, Discount, Work and Time, Permutation and Combination, Geometry, Coordinate Geometry, Reasoning, Distance and Direction, Blood Relation, Analogy and Venn diagram, Syllogism and Classification and Mathematical operation, Coding – Decoding, and Alphabet Test, Problem on Ages and dictionary, Series Cube and Dice and Missing number, Ranking, Clock, and Calendar, Inequalities and I/P and O/P, Puzzle, Sitting Arrangement, Statement –Argument, Statement- course of Action, Non-verbal.

Suggested Books:

1. Quantitative Aptitude & Verbal – Nonverbal Reasoning by R.S. Aggarwal, Quantum Cat by Arihant Publications.

SEMESTER VII

Semester-VII			
Code	**Title of the Course**	**L-T-P**	**Credits**
CEL4306	Geotechnical Engineering II	3-1-0	4
CEL3427	Geo-informatics	3-0-0	3
CEL3408	Environmental Impact Assessment and Life Cycle	3-0-0	3
CEP1302	Geotechnical Engineering II Lab	0-0-2	1
CEP1427	Geo-informatics Lab	0-0-2	1
CEP3431	Computer Aided Design-III	0-0-4	2
GTI2401	Professional Practices	2-0-0	2
AS104	Engineering Exploration IV	0-0-4	2
Total		**24**	**18**

Course Code	Course Name	L-T-P	Credits
CEL4306	Geotechnical Engineering II	3-1-0	4

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.

Course Outlines:

Foundation requirements and selection; different methods for determining bearing capacity of shallow foundations; settlement considerations, allowable, total and differential settlements, settlement of structures; eccentrically loaded footings, methods of proportioning; raft foundations; pile foundations, types of piles; allowable load of piles, pile driving, pile load test, dynamic formulae, group action; well and caisson foundations, design principles; bearing capacity analysis and methods of construction; excavation and bracings; design of bulk- heads; dewatering and excavations; ground improvement techniques; underpinning of foundations; elements of machine foundation design; soil exploration, types of samples, location and spacing of boring, depth of exploration and sample requirements, boring methods for sample collection.

Suggested Book(s):

1. Tomlinson, M.J. (1988). 'Foundation Design and Construction' 6th Edition, English Language Book society, Longman.
2. Cernica, J.N. (1995). 'Geotechnical Engineering- Foundation Engineering' John Wiley & Sons Inc, New York.
3. Bowles, J.E. (1997). 'Foundation Analysis and Design' The McGraw Hill Co., New York.
4. Terzaghi, K., Peck, R. B., & Mesri, G. (1996)." Soil mechanics in engineering practice". John Wiley &Sons.
5. 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
CEL3427	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

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.

Suggested Book(s):

- Srivastava, G. S. (2014). 'An Introduction to Geoinformatics', McGraw-Hill Education, New Delhi.
- Bhatta, Basudeb (2012). 'Remote Sensing and GIS', Oxford University Press, USA.
- Gopi, Satheesh., Sathikumar, R and Madhu, N (2007). Advanced Surveying, Total Station, GIS and Remote Sensing, Dorling Kindersly, India.
- Anji Reddy, M., 2001, "Remote sensing and Geographical information system", B.S. Publications.
- Arora, K.R., 2015, "Surveying", Vol-I, II and III", Standard Book House.

Course Code	Course Name	L-T-P	Credits
CEL3408	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 develop an EMS for a" Project"
CLO6: Be able to conduct a LCA on a selected process

Course Outlines:
Purpose of EIA, Steps in EIA process, Hierarchy in EIA, Environmental impact statement (EIS), impact indicators, Evaluation of EIA: Evaluation of EIA works wide, Evaluation of EIA in India. Establishment of the initial reference state, predicting the future state in the presence of action. Project screening, scoping, consideration of alternatives, establishing the environmental baseline, impact identification. Methodos of EIA Check lists, Matrices, Networks. Lifecycle Assessment (LCA), Environmental Managemental Plan, Case studies.

Suggested Book(s):
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. Canter, R.L., (1996), "Environmental Impact Assessment", McGraw Hill Inc., New Delhi.

Course Code	Course Name	L-T-P	Credits
CEP1302	Geotechnical Engineering II Lab	0-0-2	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: Be able 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:
Relative density of coarse grained soils in dry and saturated conditions, Shear strength at different densities by Direct shear test, MDD and OMC at different compactive effort by compaction test, Unconfined compressive strength at different compactive effort, Compressibility characteristics of fine grained soils by Consolidation test, Bearing capacity by Standard Penetration test, Shear strength of dry sands by Tri-axial shear test, Shear strength of saturated sands by Tri-axial test, Bearing capacity by Plate load test, Bearing capacity by Cone Penetration test, Bearing capacity by Pressure meter test.

Suggested Book(s):
1. Lab manual on Geotechnical Engineering II, Chitkara University, Himachal Pradesh.
2. Tomlinson, M.J. (1988). 'Foundation Design and Construction' 6th Edition, English Language Book society, Longman.
3. Terzaghi, K., Peck, R. B., & Mesri, G. (1996)." Soil mechanics in engineering practice". John Wiley &Sons.
4. 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
CEP1427	Geo-informatics Lab	0-0-2	1

Course Learning Outcomes:

CLO1: Iterpret hard copy satellite FCC images.

CLO2: Understand the effect of different resolutions of satellite image on identifying terrestrial features.

CLO3: Generate field spectra for various land cover features and draw inferences

CLO4: Extract different features from satellite image.

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.

Suggested Book(s):

1. ArcGIS documentation, 2009, ESRIPress.
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. Srivastava, G. S. (2014). 'An Introduction to Geoinformatics', McGraw-Hill Education, New Delhi.

Course Code	Course Name	L-T-P	Credits
CEP3431	Computer Aided Design-III	One week Training	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.

Course Outlines:

Basic concepts of AutoCAD and STAAD Pro tools- Analysis and design of various building elements- Design project. Wind load analysis on RCC building, Analysis and design of Steel truss. Analysis and design of Isolated footing

Course Code	Course Name	L-T-P	Credits
GTI2401	Professional Practices	2-0-0	2

Course Learning Outcomes:

CLO1: Students will be able to 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: Students will be able to 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: Students will be able to apply the principles of Integral Calculus to solve a variety of practical problems in Engineering and applied Sciences.
CLO4: Students will be able 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.

Course Outlines:
Differentiation, matrices, normal form, Eigen values and vectors, partial differentiation & its applications, Euler's theorem, Taylor's series expansion, Maclaurin's series, Lagrange's method of undetermined multipliers, multiple integration & its applications, change of order, change of variables, Beta and Gamma functions, introduction to scalar & vector, green's theorem, Stokes' theorem, Gauss divergence theorem.

Suggested Books:

1. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley India Pvt. Ltd.
2. Engineering Mathematics, Srimanta Pal & Subodh C. Bhunia, Edition 2015, Oxford University Press.
3. The Engineering Mathematics, 2nd Edition, Chitkara University Publication, Vol. I.
4. Higher Engineering Mathematics, B.V. Ramana, Tata McGraw-Hill Education.
5. Advanced Engineering Mathematics, R.K. Jain and S.R.K. Iyengar, Alpha Science International Ltd.
6. Higher Engineering Mathematics, B.S. Grewal, Khanna Publications.
7. A text book of Engineering Mathematics, N. P. Bali and Manish Goyal, Laxmi Publications.

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
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

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 – VIII

Semester-VIII			
Code	**Title of the Course**	**L-T-P**	**Credits**
CET9403	Industry Oriented Hands-on Experience	- - -	25
		-	**25 ***

Cumulative Credits at the end fourth year: 48+42+50+43 = 183 Credits

0B**Appendix A: Mapping of Programme Outcomes (Pos) with Course Outcomes (Cos)**

Course Code	Title of the Course	Learning Outcomes (COs)	Programme Outcome (PO)											
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
AML5101	**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: Synthesize and apply multivariable vector-valued functions, their derivatives and integrals to live problems, graphically and analytically.					M			L	L			M

PYL5101	**Engineering Physics**	**CLO**1: After completing this course, the students will be able to analyze and solve mathematical problems relating to Gradient, Divergence and Curl of scalar and vector field and establish their relationship with propagation of Electromagnetic waves in free space using Maxwell's equation.				M			H					
		CLO2: The students will be able to differentiate between different types of LASERs and optical fibres their operation, advantages, and disadvantages and solve related problems and their application in engineering domain.	H						H					
		CLO3: The students will be able to differentiate between characteristics and properties of various magnetic and superconducting materials and establish their applications in engineering disciplines.							M					
		CLO4: The students will be able to describe the dual nature of waves and particles in context of Quantum Mechanics and to apply the Schrodinger Wave Equation in solving different physical systems and processes.							L					M
EEL5102	**Basics of Electrical and Electronics Engineering**	**CLO1:** Apply knowledge of mathematics, science, and engineering.	M	M		L								H
		CLO2: Identify, formulate, and solve engineering problems	L			H								
		CLO3: Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.	H	H						L	L			M
MEL4102	**Engineering Graphics**	**CLO1:** Understand the fundamentals of engineering drawing and geometrical objects	H	H		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	M	L										
HUL2101	**Disaster Management**	**CLO1:** Acquire the knowledge disaster management.	L	L										
		CLO2: Understand the vulnerability of ecosystem and infrastructure due to a disaster.	H	H			M							H
		CLO3: Acquire the knowledge of disaster management Phases.		H										H
		CLO4: Understand the hazard and vulnerability profile of India				H								
GEL4101	**Environmental Sciences**	**CO1**: Understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales	H	H										
		CO2: Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes.				H						M		
		CO3: Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world	H						M					
		CO4: Demonstrate proficiency in quantitative methods, qualitative analysis, critical thinking, and written and oral communication needed to conduct high-level work as interdisciplinary scholars and/or practitioners.		H								M		H
PYP1101	**Engineering Physics Lab**	**CO1**: Students will be able to co-relate practical knowledge with theoretical studies.	L											M
		CO2: Students will achieve perfectness in experimental skills.							L					
		CO3: The study of practical applications will bring more confidence and ability to develop and fabricate engineering and technical equipment's.	H	H										
EEP1102	**Basics of Electrical and Electronics**	**CLO1:** Get knowledge of various parts of an electrical machine	H				M							
		CLO2: Conduct speed control of different types of DC motors								M	M			L
		CLO3: Elaborate the characteristics of DC servo motor		M					L					
		CLO4: Simulate laboratory experiments in the software	M											H

		CLO5: Perform tests on motor-generator set.												
CHL4101	**Engineering Chemistry**	**CLO1:** Develop innovative methods to produce soft water for industrial use and potable water at cheaper cost.		H				L						
		CLO2: Substitute metals with conducting polymers and also produce cheaper biodegradable polymers to reduce environmental pollution.	M											M
		CLO3: Design economically and new methods of synthesis nano materials.		M										
		CLO4: Apply their knowledge for protection of different metals from corrosion.												
		CLO5: Have the knowledge of converting solar energy into most needy electrical energy efficiently and economically to reduce the environmental pollution.												
CEL5102	**Engineering Mechanics**	**CLO1:** Determine resultants and apply conditions of static equilibrium to plane force systems			H									H
		CLO2: Identify and quantify all forces associated with a static framework	M			L						H		
		CLO3: Solve problems in kinematic and dynamic systems		M			H							
		CLO4: Understand basic kinematics concepts – displacement, velocity and acceleration.									L			
		CLO5: Understand basic dynamics concepts – force, momentum, work and energy.	M			L							M	
AML5102	**Engineering Mathematics-II**	**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).	H	L							L			M
		CLO2: Using ordinary differential equations student will be able to solve various practical problems in Science and Engineering.		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 others, which are governed by partial differential equations subject to boundary conditions.						L							M
		CLO4: Student will be able to analyze functions of complex variables, techniques of complex integrals and compute integrals over complex surfaces.	H	L								H			
CEL3205	**Building Materials and Construction**	**CLO1:** Evaluate various properties of concrete													
		CLO2: Evaluate various properties of the basic construction materials such as brick, stone timber, metals													
		CLO3: Develop skills to work in field of building materials quality control.													
		CLO4: Evaluate the properties of miscellaneous materials such as bitumen, paints, distempering, materials for structural repairs													
		CLO5: Perform various quality control tests for the various civil engineering materials by performing different lab tests on materials													
CEP1215	**Building Materials 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.		H		M									
		CLO3: Able to design and test the materials either in the laboratory or in the field before their actual use at the site.								M	M				
		CLO4: Able to attain the knowledge of different building materials, their classification.	M												H
		CLO5: Enhances skills in quality control and thus helps in employability	M							L					H

CHP1101	**Engineering, Chemistry Lab**	**CLO1:** Determination of parameters like hardness and chloride content in water.	H	H		H								H
		CLO2: Estimation of rate constant of a reaction from concentration – time relationships.												H
		CLO3: Determination of physical properties like adsorption, surface tension and viscosity.			M							M		
MEW2101	**Manufacturing Practice**	**CLO1:** To acquire skills in basic mechanical engineering practice.	H							M	M			M
		CLO2: To identify the hand tools and instrument				M								M
		CLO3: To acquire measuring skills	M											
		CLO4: To provides the knowledge of job materials in various shops					M						M	
		CLO5: To provides the knowledge of core technical subjects for making and working of any type of projects											M	
CEL5203	**Fluid Mechanics I**	**CLO1:** solve hydrostatic problems.	H			M								H
		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											
		CLO5: demonstrate the application point of hydrostatic forces on plane and curved surfaces.	H			L								M
CEL5201	**Mechanics of Solid**	**CLO1:** Determine resultants and apply conditions of static equilibrium to plane force systems.	H							M	M			M
		CLO2: Identify and quantify all forces associated with a static framework.				M								M
CEL3207	**Surveying**	**CLO1:** Skill enhanced to carry out preliminary surveying in the field of civil engineering applications such as structural, highway engineering and geotechnical engineering.	H										L	M

		CLO2: Plan a survey, taking accurate measurements, field booking, plotting and adjustment of traverse.		M		M								
		CLO3: Use various conventional instruments involved in surveying with respect to utility and precision.				M								M
		CLO4: Plan a survey for applications such as road alignment and height of the building.	H							M				
		CLO5: Undertake measurement and plotting in civil engineering	M											M
CEL3208	**Water Resource Engineering**	**CLO1:** Apply science and engineering fundamentals to solve current problems and to anticipate	H			M								H
		CLO2: ability to manipulate hydrological data and undertake widely-used data analysis. a systematic understanding of the nature of hydrological stores and fluxes and a critical awareness of the methods used to measure	M											M
		CLO3: Can define the key components of a functioning groundwater												
HUL3301	**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 understand the core values that shape their ethical behavior.		H										
		CLO3: The students will be able to take active part in social, political, economic and cultural activities with responsibility.				H			M					
		CLO4: The students will gain thorough knowledge in the field of human rights and this will add to the academic qualification	L						M					
CEP1203	**Fluid Mechanics I Lab**	**CLO1:** Identify, name, and characterize flow patterns and regimes.	H	L			M							
		CLO2: Understand basic units of measurement, convert units, and appreciate their magnitudes.	M	H					M					
		CLO3: Utilize basic measurement techniques of fluid mechanics.	H										M	
		CLO4: Discuss the differences among measurement techniques, their relevance and applications.	M							L	L			H

		CLO5: Prove good understanding of concepts and their applications in the laboratory.	M	H										M
CEP1227	**Surveying Lab**	**CLO1:** Survey an area under various topographical feature and obstructions.	H				M							
		CLO2: Prepare the plan or map of the area surveyed.	M				L							
		CLO3: Annalise, report and where appropriate distribute the survey errors.										L		M
		CLO4: Perform instruments checks to ensure they meet the specifications.				M								
		CLO5: Surveying practice skills enhanced.				M								
CEP1211	**Mechanics of Solid Lab**	**CLO1:** Conduct tension test on Materials like steel etc.	M			H								
		CLO2: Conduct compression tests on spring, wood and concrete												L
		CLO3: Conduct flexural and torsion test to determine elastic constants		H					L					M
		CLO4: Determine hardness of metals		M										M
CEL4206	**Structural Analysis-I**	**CLO1:** Calculate deformation of statically determinate structures using geometric and energy method	M											L
		CLO2: Analyze statically indeterminate beams using classical and conventional methods.												
		CLO3: Develop qualitative diagrams showing the displaced shape, bending moments and		M		M								
		CLO4: support reactions for an indeterminate plane frame.	H	M										
		CLO5: Develop effective structural analysis skills for building design activities.	H											M
CEL4212	**Design of Concrete Structures**	**CLO1:** Identify and compute the main mechanical properties of concrete and steel.	M						L					
		CLO2: Identify and calculate the design loads and distribution.				H							M	
		CLO3: Apply the strength method to design R.C. structural members.							M					

		CLO4: Analyze and design R.C. beams for flexure and shear.	L						M					
		CLO5: Analyze and design short and slender R.C. columns	M						M					
CEL3202	**Fluid Mechanics II**	**CLO1**: Ability to develop the open channel flow equations from the basic conservation equations.	M	M										M
		CLO2: Ability to explain the terms of the open channel flow equations and explain the interactions among the terms.	L		M							H		
HUL2401	**Cyber Security**	**CLO1:** ability to analyze a problem, and to identify and define the computing requirements appropriate to its solution.	H		L				M					
		CLO2: ability to design, implement and evaluate a computer-based solution to meet a given set of computing requirements in the context of the discipline.	L				L							L
		CLO3: An ability to communicate effectively with a range of audiences about technical information.	M							H	M			
		CLO4: An ability to make informed judgments in computing practice based on legal and ethical principles.	L			M							H	
		CLO5: An ability to analyze and evaluate systems with respect to maintaining operations in the presence of risks and threats	H						M				L	
CEP1206	**Structural Analysis-I Lab**	**CLO1:** Distinguish between statically determinate and indeterminate structures.	L			H							H	
		CLO2: Apply equations of equilibrium to structures and compute the reactions.	H							M	M			L
		CLO3: Draw the shearing force and bending moment diagrams.						H				M		
		CLO4: Calculate the internal forces in cable and arch type structures.		H		L								
		CLO5: Evaluate and draw the influence lines for reactions, shears, and bending moments in beams and girders due to moving loads.		M										L
CEP1212	**Design of Concrete Structures Lab– I**	**CLO1:** Able to check quality of constituent material of concrete.	H							M	M			L
		CLO2: Able to design a concrete mix.						H				M		
		CLO3: Able to perform laboratory tests for properties of fresh and hardened concrete.		H		L								
		CLO4: Students will achieve perfectness in experimental skills.	H		L				M					

CEP1202	**Fluid Mechanics II Lab**	**CLO1:** Utilize basic measurement techniques of fluid mechanics.	H				M							
		CLO2: Discuss the differences among measurement techniques, their relevance and applications.	L		M							H		
		CLO3: Prove good understanding of concepts and their applications in the laboratory.										L		M
		CLO4: Compare the results of analytical models introduced in lecture to the actual behavior of real fluid flows and draw correct and sustainable conclusions.				M								
		CLO5: Understand ethical issues associated with decision making and professional conduct.				M								
CEL5308	**Analysis of Structure II**	**CLO1:** To understand analysis of indeterminate structures and adopt an appropriate structural analysis technique	H							M	M			L
		CLO2: Determine response of structures by classical, iterative and matrix methods						H				M		
CEL3311	**Transportation Engineering, I**	**CLO1**: Given basic information, prepare a horizontal and vertical alignment, including super elevation, which complies with AASHTO standards.	M				H							
		CLO2: Understand the relationship between the environment and transportation infrastructure and the importance the environment plays in project development of transportation projects.	L	L										
		CLO3: Utilize CAD software to prepare a plan, profile, and x-sections depicting a typical roadway design.	H	H			M							M
		CLO4: Prepare well written design narratives documenting the various parameters and standards used in the design process so another individual could review the work and understand what decisions and assumptions were used and why.	H	H								L		
		CLO5: Understand the mathematics behind the development of tables and charts for determining highway design criteria.	M					L						
		CLO 6: Familiar with professional and ethical issues related to liability and conduct	H											M

CEL3303	**Environmental Engineering-I**	**CLO1:** Understand different methods are used to purify the water and rectify the water which improves the standard and living style	H	H										M
		CLO2: Able to determine the population forecast for a city to meet its water requirement.	M				M							
		CLO3: Able to design water and waste water treatment plant by different methods.		M					L					
		CLO4: Able to know about the drainage and plumbing system in commercial, residential and industrial area	M	M										H
CEL4305	**Geotechnical Engineering, I**	**CLO1:** Understand the origin of soil and to identify different types of soil.		L						L				M
		CLO2: To understand the various physical and engineering characteristics of different types of soil	M		L	M								L
		CLO3: To understand the concept of slope stability.	M		M					M	M			
		CLO4: To appreciate the use of modern technology in the field of geotechnical engineering	L							H	M			M
CEP1311	**Transportation Engineering Lab**	**CLO1:** Design and validate technological solutions to defined problems and communicate clearly and effectively for the practical application of their work. Identify engineering properties of aggregate.	M	M										
		CLO2: Design and validate technological solutions to defined problems and communicate clearly and effectively for the practical application of their work. Identify the grade & properties of bitumen.		M										L
		CLO3: Design and validate technological solutions to defined problems and communicate clearly and effectively for the practical application of their work. Find out peak hour traffic & peak time for a given location on the road.						L					M	
		CLO4: Calculate design speed, maximum speed & minimum speed limits of a location through spot speed.	H											

		CLO5: Draw parking accumulation curve and find out parking duration & turnover of parking lot/stretch	M	M										
CEP1303	**Environmental Engineering-I Lab**	**CLO1:** Perform common environmental experiments relating to water and wastewater quality, and know which tests are appropriate for given environmental problems, and thus enhances skills of students and make them industry read.				H								L
		CLO2: Statistically analyze and interpret laboratorial results.	M				H							
		CLO3: Apply the laboratorial results to problem identification, quantification, and basic environmental design and technical solutions.	H											M
		CO4: Understand and use the water and wastewater sampling procedures and sample preservations.	M											
		CLO5: Obtain the necessary background for subsequent courses in environmental engineering.				L								M
CEP1308	**Geotechnical Engineering I Lab**	**CLO1:** Have thorough knowledge about the procedures of laboratory tests used for determination of physical, index and engineering properties of soils		M										L
		CLO2: Have the capability to classify soils based on test results and interpret engineering behavior based on test results		H					M					
		CLO3: Be able to evaluate the permeability and shear strength of soils	H							H	H			
		CLO4: Be able to evaluate settlement characteristics of soils		L										
		CLO5: Be able to evaluate compaction characteristics required for field application					H					H		L
CET5301	**Survey Camp**	**CLO1:** Survey an area under various topographical feature and obstructions.	M											M
		CLO2: Prepare the plan or map of the area surveyed.			H									
		CLO3: Annalise, report and where appropriate distribute the survey errors.							H					

		CLO4: Perform instruments checks to ensure they meet the specifications.		M		M								
		CLO5: Surveying practice skills enhanced.	M											M
CEL3308	**Construction Planning and Management**	**CLO1:** Apply theoretical and practical aspects of project management techniques to achieve project goals.	M			M								L
		CLO2: Possess organizational and leadership capabilities for effective management of construction projects	M						L					H
		CLO3: Be able to apply knowledge and skills of modern construction practices and techniques		L								M		H
		CLO4: Have necessary knowledge and skills in accounting, financing, risk analysis and contracting	M	L		M								L
		CLO5: Be capable of using relevant software packages for planning, scheduling, executing and controlling of construction projects.	M											H
CEL3310	**Environmental Engineering-II**	**CLO1:** Design of unit processes for conventional and advanced wastewater treatment systems								H	H			M
		CLO2: Analyze wastewater treatment processes and operations.			H					H	H			H
		CLO3: Characterize wastewater and the best available technologies for treatment of wastewater.	M		M									
		CLO4: Identify health and environmental issues related to solid waste management, apply steps in solid waste management-waste reduction				L						M		
		CLO5: Identify and analyze of air and noise pollution including methods for prevention, control, measures and management of the pollution.	M		L	M								L
CEL3302	**Estimating and Costing**	**CLO1:** Will have a basic knowledge on methods and types of estimation and its merits and demerits.	M	M										M
		CLO2: Have knowledge on specifications and tendering process for contracts	L		M									

		CLO3: Will have the ability to understand the types, formation, terms and conditions in contracts and arbitration			H									
		CLO4: Will have the knowledge of rate analysis of different item of work and MB and bill of quantities							H					M
		CLO5: Will able to value a property, price escalation recommendations and auditing	M	M										
CEL4304	**Design of Steel Structures**	**CLO1**: Learn the basic elements of a steel structure	H				M							
		CLO2: Learn the fundamentals of structural steel fasteners	H		M					L	L			
		CLO3: Able to design basic elements of steel structure like tension members, compression members, beams and beam-columns	L									L		M
		CLO4: Able to design column splices and bases.	M			M								L
		CLO5: Ability to analyze and design of simple bolted and welded connections	H			M							M	
CEL5314	**Design of Concrete Structure – II**	**CLO1:** Apply principles of engineering mechanics and use appropriate tools to solve problems in structural engineering.	M			M								L
		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.	M						L					H
		CLO3: Plan, compose, and integrate verbal, written, and graphical communication to technical and non-technical audiences.		L								M		H
		CLO4: Function effectively as a member of an engineering team.	M	L		M								L
		CLO5: Discuss professional responsibility in light of social context of engineering problems	M											H
CEP1310	**Environmental Engineering-II Lab**	**CLO1:** Perform common environmental experiments relating to water and wastewater quality, and know which tests are appropriate for given environmental problems, and thus enhances skills of students and make them industry read.	H		H									H
		CLO2: Statistically analyze and interpret laboratorial results.	M	H		L								M

		CLO3: Apply the laboratorial results to problem identification, quantification, and basic environmental design and technical solutions.		M			H							
		CLO4: Understand and use the water and wastewater sampling procedures and sample preservations.		H		L			M					M
		CLO5: Obtain the necessary background for subsequent courses in environmental engineering.	M									H		
GTI4301	**Numerical Ability and Logical Reasoning**	**CLO1:** Student will be able to improve answers during the Aptitude test and develop an all-around personality with a mature outlook.				H			M					
		CLO2: Student will be able to enhance their logical thinking, verbal reasoning and numerical reasoning.	L						H					
		CLO3: Students will take part effectively and confidently not only in campus placements programs but also in other exams like CAT, GMAT, SSC, Bank Po, UPSC etc.	M			H			L					M
CEL3408	**Environmental Impact Assessment and Life Cycle Analysis**	**CLO1:** Be able to find the necessary Information/legislation/procedures for an assessment of environmental impact of a "Project"	H	L			M						H	
		CLO2: Be able to conduct an EIA on a proposed project	L									M		H
		CLO3: Be able to conduct an environmental audit on a selected company/industry	L			L							L	
		CLO4: Be able to develop a waste reduction and minimization plan for a selected company/industry			L							H		H
CEL4306	**Geotechnical Engineering II**	**CLO1:** The students will gain an experience in the implementation of Geotechnical Engineering on engineering concepts which are applied in field Geotechnical Engineering.	L			H							H	
		CLO2: The students will get a diverse knowledge of geotechnical engineering practices applied to real life problems of designing of structures.	H							M	M			L

		CLO3: The students will learn to understand the theoretical and practical aspects of geotechnical engineering along with the design and management applications						H				M			
CEP1302	**Geotechnical Engineering II Lab**	**CLO1:** Have thorough knowledge about the procedures of laboratory tests used for determination of physical, index and engineering properties of soils.	M	M										M
		CLO2: Have the capability to classify soils based on test results and interpret engineering behavior based on test results	L		M					M	M			
		CLO3: Be able to evaluate the permeability and shear strength of soils			H							L		
		CLO4: Be able to evaluate settlement characteristics of soils							H					M
		CLO5: Be able to evaluate compaction characteristics required for field application			M				H					
CEL3427	**Geo-informatics**	**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	M											
CEP3431	**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		
		CLO 6: To acquire skills in design-analysis and thus make student industry ready.	L	M				M						
CEP1427	**Geo-informatics Lab**	**CLO1:** Interpret hard copy satellite FCC images.							M					
		CLO2: Understand the effect of different resolutions of satellite image on identifying terrestrial features.	H	M		H								M
		CLO3: Generate field spectra for various land cover features and draw inferences							H				H	
		CLO4: Extract different features from satellite image												
GTI2401	**Professional Practices**	**CLO1**: Students will be able to 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
		CLO2: Students will be able to 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							L	M			M
		CLO3: Students will be able to apply the principles of Integral Calculus to solve a variety of practical problems in Engineering and applied Sciences.				M								
		CLO4: Students will be able 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

AS104	**Engineering Exploration IV**	**CO1:** 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.						M							
CET9403	**Industry Oriented Hands-on Experience**	**CLO1:** Capability to acquire and apply fundamental Principles of engineering.	M		L					H					
		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						H
		CLO4: To get awareness of professional ethics and responsibility. Ability to communicate efficiently.	M	L											
		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		
CE350	**Engineering Materials for**	CLO1: Compare the advantages and disadvantages of current and potential energy conversion.	H						L						M

	Sustainability	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 laminated timber, and structural panels.				H			M					L
		CLO3: Ability to raise the skills to analyze and design beams.							H	M	M			
		CLO4: Ability to analyze and design columns and members under combined bending and axial force.	M			H								M
		CLO5: Ability to analyze and design simple nailed and bolted connections.	H					M				L		
CE352	**Masonry Structures**	CLO1: Able to design masonry structures to achieve employability.	H				H							L
		CLO2: Able to analyze masonry structures.	M			H						L		
		CLO3: Design skills enhanced.	H			L			H					

		CLO4: Explain engineering properties, uses of masonry units, defects, crack in masonry.				L			H					L
		CLO5: To enhance the skills in remedial measures and factors affecting compressive strength of masonry units.				M								H
CE354	**Earthquake Engineering**	CLO1: The students will gain an experience in the implementation of Earthquake Engineering on engineering concepts which are applied in field Structural Engineering.	H				H							L
		CLO2: The students will get a diverse knowledge of earthquake engineering practices for skill and employability development.	M			H						L		
		CLO3: The students will learn to understand the theoretical and practical aspects of earthquake engineering along with the planning and design aspects.	H			L			H					
		CLO4: The students will get a diverse knowledge of earthquake engineering practices applied to real life problems				L			H					L
		CLO5: The students will learn to understand the theoretical and practical aspects of earthquake engineering along with the planning and design aspects				M								H
CE353	**Prestressed Concrete**	CLO1: Understanding of the behavior of prestressed concrete structures which is an advanced topic of civil engineering.		M								H		
		CLO2: Knowledge of calculation of effect of prestressing on statically determinate structures and statically indeterminate structures.				H			M					L
		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
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
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 Transportation Systems**	CLO1: Implement the ITS in public transportation systems.	M		M					M	M			
		CLO2: Use ITS for the travel demand management.	L							H	M			M
		CLO3: Use ITS for evaluation of bridge performance.	M					M		M	L			H
		CLO4: Select appropriate ITS technology depending upon site specific conditions.	L		M									M
		CLO5: Design and implement ITS components skills.			H	M								
CE343	**Port and Harbour Engineering**	CLO1: Design, plan and integrate port and harbour infrastructure.	H						M				L	
		CLO2: Explain the construction, maintenance and renovation aspects of ports and inland waterways.		L			M							H
		CLO3: Use ITS for evaluation of bridge performance.	M				H							
		CLO4: Demonstrate highly developed analytical and problem-solving skills.	H			H								M
		CLO5: Demonstrate a knowledge of the fundamental topics of port and harbour engineering.	M					M						