CURRICULUM
&
SYLLABUS
B.Tech (CE)



ICFAI Foundation for Higher Education
(Deemed-to-be University under Section 3 of the UGC Act, 1956)

IcfaiTech
Faculty of Science & Technology (FST

REGISTRAR
ICFAI FOUNDATION FOR HIGHER EDUCATION
(Deemed-to-be University established under Section 3 of UGC Act 1956.)

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1. INTRODUCTION

1.1 The ICFAI Foundation for Higher Education

The ICFAI Foundation for Higher Education (IFHE) is declared as a Deemed-to-be University, under Section 3 of the UGC Act, 1956. It has evolved a comprehensive student-centric learning approach consisting of several stages, designed to add significant values to the learner's understanding in an integrated manner, covering relevant knowledge, practical skills and positive attitudes. IFHE comprises of:

- Faculty of Management (IBS Hyderabad),
- Faculty of Science and Technology (IcfaiTech), and
- Faculty of Law (FoL).

Vision and Mission of IFHE

The Vision of IFHE is to emerge as an Institution of Excellence known for research, teaching and practice.

The Mission of IFHE is 'Learning for Leadership'. It aims at developing a cadre of professionals possessing specialized skills having a sense of social and moral responsibility and the ability to address problems from a broader perspective.

1.2 Faculty of Science and Technology (IcfaiTech)

Faculty of Science and Technology (IcfaiTech), Hyderabad is a constituent of the ICFAI Foundation for Higher Education. It has been established to promote quality education in the field of Science andTechnology. IcfaiTech strives to acquire a reputation as a highly purposive, innovative institution setting the pace for workable reforms in professional education suitable and most relevant for the Indian cultural milieu.

VISION

The IcfaiTech campus shall become a leading institute for scientific research as well as innovative teaching and learning, keeping pace with evolving knowledge domains. It shall emerge as an attractive destination for the excellent students and the faculties. IcfaiTech aspires to be highly ranked amongst the group of other peer institutes.

MISSION

The mission of the IcfaiTech is to provide high quality teaching and learning experience through our first degree and higher degree programs.

• Teaching Excellence: IcfaiTech periodically reviews and redesigns existing courses and introduces new courses and programs geared towards current research and industry. It explores new dimensions in teaching and learning and uses various platforms and methodologies.

• Research Excellence: The faculty members of the department carry out research in almost all the major areas. The department is now vigorously scaling up its research activity and giving more visibility to it. The volume of research publications in peer reviewed journals of repute and the research funding received by the department has been increasing steadily.

• Faculty Leadership in Administration: The faculty members of the department make significant contribution to administrative leadership and various institute activities and initiatives.

1.3 Educational Philosophy

The core philosophy of education at IcfaiTech is empowering students with the right knowledge and modern skill sets in order that they are ready to face the challenges of the competitive world. IcfaiTech strives to provide its students with the fine edge that is required in the making of a successful professional. The programs at IcfaiTech have been uniquely designed by including courses drawn from varied areas like humanities, arts, and management combined with science, engineering and industry-based internships. IcfaiTech ensures that students gain exposure and knowledge across different disciplines, develop inter-personal skills and leadership qualities that takes them beyond traditional thinking and practice. Today's era of globalization and integrated economies presents talented professionals huge opportunities

from across the world. The curriculum at IcfaiTech is truly global and modern in perspective and exposes its students to the latest practices and techniques. The curriculum offers a cafeteria approach allowing them to choose courses from across the disciplines. This exposure also helps them to develop interests in tune with the current inter-disciplinary nature of research. The educational philosophy practices at IcfaiTech allows it to integrate into its learning system, an innovative and emerging body of knowledge. The highlights of the academic program are summarized below:

• Cutting-edge course curriculum with contemporary and effective pedagogic methods that lay emphasis on application-oriented learning.

• Encouraging students to not only articulate Science and Technology needs but also provide appropriate solutions.

• Developing appreciation for synthesized multidisciplinary learning by way of workshops, internships and other group learning assignments.

1.4 Objectives of IcfaiTech

• To provide high quality, cutting-edge and career-oriented education programs in Science and Technology.

• To offer practice-oriented, contemporary and flexible programs developed through regular assessment and consultation with leading institutions, academicians, professionals and practitioners.

• To turn out highly motivated and successful Science and Technology graduates to meet the current and projected needs of the knowledge workforce.

1.5 Flexibilities

A few of the flexibilities available to the students are mentioned below. The principle of merit, preference of the students and the facilities available at the Institute generally guide the decisions regarding flexibilities. Transfer: Every year, various branches of engineering are ranked based on the preferences and demands of the admitted batch of students. After two semesters of study (end of the first year), students can seek transfer across branches. Requests from students seeking transfer from a less preferred branch to the most preferred branch of B.Tech would be considered if they maintain a CGPA of not less than 9.00, by the end of the first year of degree program. For a branch transfer to the second most preferred branch, a student should have a CGPA of not less than 7.00 by the end of the first year of degree

program. A branch transfer from a more preferred branch to a less preferred branch would be permitted without any restrictions on CGPA. Audit: Over the years of study at IcfaiTech, a student may develop interest in areas that go beyond the scope of his/her program of studies. IcfaiTech permits students to take such courses as audit courses. Certain courses like Foreign Languages, Music, etc. which are not the part of a degree program could be opted for on an audit basis, on payment of additional fees. Audit courses do not count for the CGPA calculation.

Other Flexibilities: The Academic Regulations also provide flexibilities like choice of electives, number of electives, repetition of courses, departure from normal pace, withdrawal from or substitution of course(s).

1.6 Admissios at IcfaiTech:

Admission Test for IcfaiTech (ATIT) is an All India Admission Test conducted by IcfaiTech, IFHE, Hyderabad for students seeking admission into the 4 year Integrated B.Tech. Programs and 3 year Integrated B.Sc Programs.

ATIT 2020 is an aptitude test conducted through online & offline tests constitute objective type questions in Mathematics, Physics, Chemistry, English and logical reasoning in multiple choice format. Question paper pattern is given below and syllabus given in website www.ifheindia.org/icfaitech.

Eligibility for admission into the B.Tech/BSc Program:

- Pass with 60% and above aggregate marks in Class XII ("or its equivalent") with Mathematics, Physics, Chemistry and English as subjects.

- Class XII (or icfaitech equivalent) students awaiting final examination results may also apply.

- Applicants should have completed 12 years of formal schooling in order to apply for the program.

- The applicant should fulfil the minimum age requirements as prescribed by the respective Board through which the applicant has appeared for the qualifying examination.

1.7 Programs at IcfaiTech

At IcfaiTech, the programs offered are divided into three tiers, namely the first degree programs, the higher degree programs and the doctoral programs falling into the first, second and the third tiers respectively. All the undergraduate, integrated programs fall under the first degree programs. The various masters programs fall under the category of the higher degree programs. The Ph.D. programs offered by various departments fall under the category of doctoral programs. The academic structures of each of these programs are discussed below.

First Degree Programs (First Tier)

There are three first degree programs being offered at IcfaiTech, the details of which are available in the prospectus/view book. Without going into the details of the regulatory processes, it is necessary to touch upon the subject to obtain a better understanding of these processes, which are controlled by these regulations in respect to operation.

There may be some restrictions from time to time in terms of flexibilities like transfer or dual degree concerning these degree programs. This will be notified in the prospectus/view book as per periodic decision of the Academic Council. All operational matters concerning this will be controlled by the PGC.

Program Courses

The various courses prescribed for a program of study may be categorized in terms of their academic affinity or their functional objectives. Depending on overall educational goals of programs, it is possible to have fixed named courses in a particular category, to have fixed number of electives; to have a range of named courses in a particular category and to have a number of electives within a range. Named courses are those indicated by course number and course title in the semester-wise- pattern prescribed for a program

For first degree students the named courses include all mandatory courses under the General Institutional Requirement and the Discipline Specific Core courses, known as Compulsory Discipline courses (CDCs), for the program(s). The Elective courses fall under three categories: Discipline Electives, Humanities Electives and Open Electives. Open Electives enable students to pursue courses that are neither part of the discipline requirement nor part of the humanities requirement. Normally any elective course will be treated as an Open Elective once the student's requirement under Discipline Electives and Humanities Electives have been accounted for. Open elective requirement of Dual degree students is met by counting the Discipline Electives of one

degree as Open Electives of the other degree. A first degree student may also choose, where permitted, up to a certain prescribed maximum of his/her elective courses from the offerings in the higher degree, subject to the approval by the DCA and the prerequisite requirements and clause 3.18 regarding over preparedness and under preparedness. Provided that, if such a student after graduation is admitted to a higher degree program his/her total requirement in the latter cannot ipso facto be reduced.

The prior preparation required of a student who intends to choose courses from a higher degree program of the Institute for the fulfillment of his/her elective requirement(s) are given in clause 3.15.

In a program all courses outside the elective categories are defined as named courses, in view of the fact that they have already been named in the semester-wise-patterns in the prospectus/view book or have been named by an appointed authority through subsequent operation on the basis of guidelines given in the prospectus/view book .The electives are, on the other hand, selected by the student himself/herself from outside the named courses in his/her program. The intended regions where he/she goes for the search will be designated as host regions. Certain specialized courses, Internship programs, Thesis etc., These courses are named courses for some specific programs and they are debarred to other students as electives in the same way as they are debarred to students who wish to take them on audit.

For each program the number of electives, under each of the categories, required to be taken by a student will be prescribed either through the prospectus/view book or through an appropriate committee. Over and above the prescribed number of electives, a student of an integrated first degree program will be allowed to take, on his/her own option, up to a maximum number of four electives. In extraordinary cases, the number may be increased by the DCA without violating limit. For the purpose of eligibility for degree(s),a student should get valid grades in at least the prescribed number of electives – under each of the categories, of his/her program(s). The student above a particular CGPA as prescribed by ACC will be allowed to register in maximum of one higher degree course per semester. This will be counted as open elective unless the course is listed in pool of discipline electives for his/her program.

Once a first degree student is declared to have fulfilled the requirements of graduation the student may be permitted to register for at most one additional semester with prior permission of his/her Coordinator(s)of Department and Chairperson-Academics. Any first degree student who is interested in pursuing open elective(s) above the graduation requirements and/or completing a minor

program he/she is pursuing and if that necessitates overstay, he/she should obtain permission from Chairperson- Academics at least one semester before the start of the overstay period. The overstay period can be at most one semester during which the student must register for at least three new courses of at least 9 units. In case a student withdraws from one or more of his/her courses or otherwise is found not to be pursuing his/her courses in all earnestness Chairperson-Academics in concurrence with the student's department Coordinator is authorized to get him/her graduated and evacuate the student from the campus.

The structure contains a category of courses such as Internship Program (IP)/Thesis (TS), which attempts a synthesis of earlier courses and gives a glimpse of the application of these courses. They carry a large number of units and are to be pursued when student can ensure sufficient time and attention throughout the allotted period. In particular, IP components are to be pursued exclusively full time throughout the allotted period. There is no provision for taking other courses along with an IP component. In case of a Thesis a student may choose between 12 units worth of thesis work or 20 units worth of thesis work with the concurrence of his/her supervisor. A student pursuing a 20 unit thesis must pursue it exclusively full time throughout the allotted period and there is no provision for taking other courses along with it. A student pursuing a 12 unit thesis may concurrently pursue at most 3 courses (totaling at most 9 units) and will not be allowed to pursue any other course/component.

The Higher Degree Programs (Second Tier)

At higher degree level, structure of the program is classified into courses, like, Research Methods, CDCs, electives, IP and thesis. Registration for the IP can be done only after all other required courses have been completed.

In the case of thesis, while normal registration can be done only after completion of all other courses, in extraordinary cases, the DCA may allow registration in Dissertation, spread over various semesters, along with other courses. A student of higher degree program can register up to a maximum of one elective more than those prescribed in a semester. This additional elective can be from the pool of electives of the concerned degree or named/electives courses from other disciplines' with the permission of DCAs – namely the DCA of the student's Department and the DCA of the Department offering the course that the student wants to pursue. The grade obtained in such additional electives will also be counted towards the CGPA. Each course in the Core Requirement or in the List of Electives must be a graduate level (5th or 6th level) course or an advanced under-graduate course (4th level) with the restriction that a student may use at the most

two 4th level courses to meet the requirements in above.

Ph. D Program (Third Tier)

The Ph.D. program is designed for the student to achieve a broad competence before research begins. He/she is required to clear certain course work, if not already cleared, and pass the Qualifying Examination to satisfy the institute that his/her spectrum of knowledge is such as to enable him to undertake the demands of interdisciplinary research. Working knowledge of a modern European language, wherever specified, Teaching Practice, Independent Study, Research Methodology and specified units of Thesis course and Seminar are significant components of the Ph.D. program. The pursuit of research through the Thesis-Seminar course will continue and terminate in a thesis which meets the standards and requirements of the committee of scholars.

1.8 . The Academic Year

At IcfaiTech, the academic year is divided into two semesters (First Semester and the Second Semester) and a term called Summer Term. Each semester is of 18 weeks duration and summer term of 8 weeks duration. There are eight semesters during the four year B.Tech program. After completing the first four semesters, the students undertake an Internship Program (IP-1) for two months. During the final year, students go for five and half month's duration Internship Program-II (IP-II) in either of the two semesters and the adjoining summer term. Instead of the Internship Programs, a student can opt for Thesis/Seminar in the final year.

Structure of B.Tech Program

The program of studies leading to the award of a B.Tech degree consists of the prescribed courses sequentially distributed over the required number of semesters known as Semesterwise pattern.

The program is planned in such a way that in the normal course, a student will complete the program in 8 semesters. Categorization of Courses The courses are categorized as

- Basic Sciences Courses
- Analysis Oriented Courses
- Engineering Science Courses
- Humanities Courses
- Technical Art Course

Discipline Courses

Discipline Courses of the Specific branch of B.Tech Program consists of Compulsory Discipline Course (CDC) and Discipline Courses other than Compulsory (DCOC).The Compulsory Discipline Courses (CDC), twelve in number for each branch are to be completed by every student of the branch taking 2 CDCs in the second semester of the second year, and 10 CDCs in the two semesters of the third year of the Program.

Discipline Courses in the category of DCOC, may be taken as electives. A student must take up a minimum of 6 electives to earn the required credits for the completion of the program. Additionally, a student can take up to 4 optional electives. This is however not mandatory. Students can also opt for DCOCs from other branches as electives, provided he/ she completes all the prerequisites for the same.

Credits calculation

Each course in the program structure is associated with an LPU (three digits) which describes the nature of the course.The first digit denotes the number of lecture hours per week, the second digit denotes the number of practical hours per week and the third denotes the credits or units given to the course for calculation of CGPA. Wherever, a single number appears, it indicates the total number of units only; its break-up may be announced through the time table or the Course Handout.

The effort that has to be put in by a student for a course is quantified in terms of 'units'. One unit in a theory course denotes three hours per week of study. This includes one lecture hour and two hours spent towards self-study. One unit in a laboratory-based course denotes two hours per week of laboratory work and one hour of self-study.

For example, a three unit theory course requires students to work on that course for about 9 hours per week. 3 Hrs of formal contact hours/ week + 6 Hrs of self-study outside classroom/ week = 9 Hrs per week.

The eligibility for a degree is determined on the basis of number of units completed. The minimum stipulated number of units for various degree programs are given below

Integrated First Degree (First tier)

B. Tech.	172
B. Sc.	133
B. Sc. – B. Tech Degree	209
B.Tech – B.Tech Degree	243

Higher Degree (Second tier)

M. Tech	90
Ph.D. (Thesis)	40

STATEMENTS OF PEOs, POs AND PSOs

PROGRAM EDUCATIONAL OBJECTIVES, PROGRAMOUTCOMES AND PROGRAM SPECIFIC OUTCOMES

Program Educational Objectives (PEOs):

Program educational objectives are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve.

Program Outcomes (POs):

Program outcomes describe what students are expected to know and would be able to do by the time of graduation. These relate to the skills, knowledge, and behaviors that students acquire as they progress through the program.

Program Specific Outcomes (PSOs):

(Civil Engineering)

PSO1	Graduates will have an ability to understand, describe, analyse and solve problems related to Civil Engineering.
PSO2	Graduates will have an ability to plan, execute, prepare cost estimates for various Civil Engineering projects.
PSO3	Interdisciplinary approach help the graduates to interact and work seamlessly in multi disciplinary teams.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

PEO1-PROFESSIONAL DEVELOPMENT

To develop in the students the ability to acquire knowledge of Mathematics,Science & Engineering and apply it professionally within realistic constraintssuch as economic, environmental, social, political, ethical, health and safety,manufacturability and sustainability with due ethical responsibility.

PEO2-CORE PROFICIENCY

To provide ability to identify, formulate, comprehend, analyze, design and solve engineering problems with hands on experience in varioustechnologiesusing modern tools necessary for engineering practice to satisfy the needs ofsociety and the industry.

PEO3- TECHNICAL ACCOMPLISHMENTS

To equip the students with the ability to design, simulate, experiment, analyze,optimize and interpret in their core applications through multi disciplinaryconcepts and contemporary learning to build them into industry readygraduates.

PEO4- PROFESSIONALISM

To provide training, exposure and awareness on importance of soft skills forbetter career and holistic personality development as well as professionalattitude towards ethical issues, team work, responsiblility, accountability,multidisciplinary approach and capability to relate engineering issues tobroader social context.

PEO5- LEARNING ENVIRONMENT

To provide students with an academic environment and make them aware of excellence, develop the urge of discovery, creativity, inventiveness, leadership, written ethical codes and guidelines and the life-long learning to become a successful professional in Electronics and Communication Engineering.

PROGRAM OUTCOMES (POs):

2. Civil Engineering (CE) - Semester-wise pattern

PO1	**Engineering knowledge**	An ability to apply knowledge of mathematics (including probability, statistics and discrete mathematics), science, and engineering for solving Engineering problems and modeling
PO2	**Problem analysis**	An ability to design, simulate and conduct experiments, as well as to analyze and interpret data including hardware and software components
PO3	**Design / development of solutions**	An ability to design a complex system or process to meet desired specifications and needs
PO4	**Conduct investigations of complex problems**	An ability to identify, formulate, comprehend, analyze, design synthesis of the information to solve complex engineering problems and provide valid conclusions.
PO5	**Modern tool usage**	An ability to use the techniques, skills and modern engineering tools necessary for engineering practice
PO6	**The engineer and society**	An understanding of professional, health, safety, legal, cultural and social responsibilities
PO7	**Environment and sustainability**	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and demonstrate the knowledge need for sustainable development.
PO8	**Ethics**	Apply ethical principles, responsibility and norms of the engineering practice
PO9	**Individual and team work**	An ability to function on multi-disciplinary teams.
PO10	**Communication**	An ability to communicate and present effectively
PO11	**Project management and finance**	An ability to use the modern engineering tools, techniques, skills and management principles to do work as a member and leader in a team, to manage projects in multi-disciplinary environments
PO12	**Life-long learning**	A recognition of the need for, and an ability to engage in, to resolve contemporary issues and acquire lifelong learning

Year	Course Code	Semester-I	L	P	U	Course Code	Semester-II	L	P	U
I	CECHEM111	Chemistry	3	0	3	CEES121	Thermodynamics	3	0	3
	CEEGL112	English Language Skills	3	0	3	CEAO122	Probability & Statistics	3	0	3
	CEMATH113	Linear Algebra	3	0	3	CEMATH123	Higher Calculus	3	0	3
	CEPHY114	Physics I	3	0	3	CEPHY124	Physics II	3	0	3
	CETA115	Engineering Graphics	2	4	4	CETA125	Scientific Measurements	0	4	2
	CETA116	Computer Programming I	3	0	3	CETA126	Workshop Practice	2	4	4
	CEEVS117	Environmental Science	2	0	2	CETA127	Computer Programming II	3	0	3
	Total No of Credits				**21**	**Total No of Credits**				**21**
II	**Semester-III**					**Semester-IV**				
	CEES211	Electrical Sciences I	3	0	3	CEES221	Electrical Sciences II	3	0	3
	CEES212	Digital Electronics	2	2	3	CETA222	Engineering Measurements	1	8	4
	CEES213	Engineering Mechanics	3	0	3	CETA223	Professional Communication	3	0	3
	CEECON214	Principles of Economics	3	0	3	CEMGTS224	Principles of Management	3	0	3
	CEMATH215	Complex Variables	3	0	3	CEAO225	Optimization Techniques	3	0	3
	CEMATH216	Differential Equations & Fourier Series	3	0	3	CEES226	Structure & Properties of Materials	3	0	3
	CE211	Surveying	2	2	3	CE221	Mechanics of Solids	2	2	3
	Total No of Credits				**21**	**Total No of Credits**				**22**
SUMMER TERM IP 221 INTERNSHIP PROGRAM I (for Internship option only)										**5**
III	**Semester-V**					**Semester-VI**				
	CEAO311	Numerical Methods	3	0	3	–	Humanities Elective	3	0	3
	CEAO312	Control Systems	3	0	3	CE321	Construction Materials & Practices	3	2	4
	CE311	Fluid Mechanics	2	2	3	CE322	Design of Concrete Structures	3	0	3
	CE312	Soil Mechanics	3	2	4	CE323	Transportation Engineering	3	0	3
	CE313	Analysis of Structures	3	0	3	CE324	Data Structures	2	2	3
	CE314	Water Resources Engineering	3	0	3		Elective (1)	3	0	3
	TIP 491	Special Project / TIP	0	0	3	TIP 492	Special Project / TIP	0	0	3
	Total No of Credits				**22**	**Total No of Credits**				**22**
IV	**Semester-VII**					**Semester-VIII**				
	IP401/	Internship Program II	20			–	Electives (4)	18		
	TS401	Thesis & Seminar				–	Humanities Elective (2)			
	–	Electives (4)	18			IP401/	Internship Program II	20		
	–	Humanities Elective (2)				TS401	Thesis & Seminar			
	Total No of Credits		**20/18**			**Total No of Credits**		**18/20**		
Total No of Credits										**172**

Table : Discipline Core Courses for the B.Tech. Programs

Civil Engineering (CE)				
Course Code	**Course Title**	**L**	**P**	**U**
CE211	Surveying	2	2	3
CE221	Mechanics of Solids	2	2	3

Table : Compulsory Discipline Courses for the B.Tech Programs

Civil Engineering (CE)				
Course Code	**Course Title**	**L**	**P**	**U**
CE311	Fluid Mechanics	2	2	3
CE312	Soil Mechanics	3	2	4
CE313	Analysis of Structures	3	0	3
CE314	Water Resource Engineering	3	0	3
CE321	Construction Materials &Practices	3	2	4
CE322	Design of Concrete Structures	3	0	3
CE323	Transportation Engineering	3	0	3
CE324	Data Structures	2	2	3

Table : List of Electives for B.Tech. (Civil Engineering)

1) Structural Design Specialization

Course Code	Course Title	L	P	U
CE401	Finite Element Methods	2	2	3
CE402	Design of Steel Structures	3	0	3
CE403	Computer Aided Design	1	2	2
CE404	Design of Industrial Structures	3	0	3
CE405	Stability of Structures	3	0	3
CE406	Building Drawing, Estimation & Costing	2	2	3

2) Geotechnical Engineering Specialization

Course Code	Course Title	L	P	U
CE407	Foundation Engineering	3	0	3
CE408	Ground Improvement Techniques	3	0	3
CE409	Soil Dynamics and Machine Foundations	3	0	3
CE 410	Structures on Expansive Soils	2	0	2
CE 411	Environmental Geo-technology	3	0	3

3) Transportation Engineering Specialization

Course Code	Course Title	L	P	U
CE412	Geo-Informatics in Transportation Engineering	3	0	3
CE413	Railway, Dock and Harbor Engineering	3	0	3
CE414	Urban Transportation Planning	2	0	2
CE415	Pavement Evaluation, Rehabilitation And Maintenance	3	0	3

4) Environmental Engineering Specialization

Course Code	Course Title	L	P	U
CE 416	Hazardous Waste Management	3	0	3
CE417	Remote Sensing & GIS	3	0	3
CE418	Environmental Impact Assessment	2	0	2
CE419	Environmental Systems	3	0	3
CE421	Water Supply & Waste Water Engineering	3	0	3

5) Management Specialization

Course Code	Course Title	L	P	U
CE422	Project Planning and Management	3	0	3
CE423	Natural Disaster Mitigation and Management	2	0	2
CE424	Infrastructure Financing	3	0	3
CE425	Policies, Reforms, Law and Risk Management in Infrastructure Projects	3	0	3
CE426	Materials , Management and Estimation	3	0	3

6) Emerging Trends in Civil Engineering

Course Code	Course Title	L	P	U
CE427	Emerging Trends in Structural engineering	1	0	1
CE428	Emerging Trends in Geotechnical Engineering	1	0	1
CE429	Emerging Trends in Transportation Engineering	1	0	1
CE430	Emerging Trends in Environmental Engineering	1	0	1
CE431	Emerging Trends in Construction Management	1	0	1

7) List of Humanities Electives

Course Code	Course Title	L	P	U
HS311	Dynamics of Social Change	3	0	3
HS312	Introduction to Psychology	3	0	3
HS313	Heritage of India	3	0	3
HS314	Modern Political Science	3	0	3
HS315	Public Administration	3	0	3
HS316	Professional Ethics	3	0	3

3. B.Tech Program Course Descriptions

Semester-wise Institute Courses

Course Code	Course Title	L	P	U	Course Description
CECHEM111	Chemistry	3	0	3	Coordination Chemistry: Effective atomic number, Nomenclature of coordination compounds, Shapes of d-orbitals, Valence Bond Theory, Magnetism, Crystal Field Theory of Octahedral Complexes, Tetragonal distortions of Octahedral Complexes (Jahn-Teller Distortions), Square Planar and Tetrahedral Complexes, Thermodynamics-First Law: Work and Heat, Internal Energy and Enthalpy, Thermo chemistry: Enthalpy changes accompanying physical change and chemical change e.g. Thermodynamics -Second Law: Entropy and 2nd Law, The Gibb's Free Energy, Phase equilibria: Pure substances The thermodynamics of phase transition, Phase diagrams, Phase diagrams of typical materials Principles of chemical equilibria: The reaction Gibb's energy, Reactions at equilibrium, The response of equilibria to the conditions Consequences of equilibrium: Proton transfer equilibria, Salts in water, Solubility equilibria, Common ion effect Electrochemistry: The migration of ions, Electrochemical cells. The cell potential. Application of standard potentials, The rates of reactions: Empirical chemical kinetics, Reaction rates, Temperature dependence of reaction rates.
CEEGL112	English Language Skills	3	0	3	Familiarizing students with basic English sound system to enhance their power of articulation. It provides intensive practice and extensive exposure to listening, speaking, reading and writing Skills. It would enhance not only their comprehensive knowledge of vocabulary but also strengthens their all four skills. The design and content of the course are aimed at making students gain language proficiency and also improve their communication skills
CEMATH113	Linear Algebra	3	0	3	Matrices, Elementary row operations, Row and column equivalence, Row Reduced Echelon Matrices, Invertible Matrices, Gauss Jordan method to find the inverse, Solving system of linear equations (homogeneous and non-homogeneous), Vector spaces, subspaces, Bases and Dimension, and Computations of Subspaces, Linear Transformations, The Algebra of linear Transformations, Isomorphism between Matrices and Linear Transformations, Representation of Linear Transformations by Matrices, Eigen values, Eigen vectors, Diagonalization, Quadratic forms, Canonical forms.
CEPHY114	Physics I	3	0	3	Momentum and impulse; two and many particle system; Rotational kinematics and dynamics; work and energy; conservation principles; oscillations and wave motion; interference, diffraction and polarization.
CETA115	Engineering Graphics	2	4	4	Angle of projections; free hand sketching; orthographic views; pictorial views; auxiliary views; lines and planes;

Course Code	Course Title	L	P	U	Course Description
					intersection and development; AutoCAD command and simple drawings using AutoCAD.
CETA116	Computer Programming I	3	0	3	Basics of Problem solving, Solve with an example, Introduction to python, Data Types, Python Program Flow Control, Python Sequences, Python Functions, Python Modules, Python Packages, Python Object Oriented Programming, Exception Handling, My First Cloud Program - Powered by AWS (Cloud Inventor) :Overview of computer and internet, Introduction and basics of cyber security, General idea of data analysis, Basics of programming and algorithms, Overview of computing, Introduction to cloud computing, Overview of cloud models, General idea of cloud computing, Problem solving – Case Study
CEEVS117	Environmental Science	2	0	2	Meaning of Environment, Types and components of environment, nature and scope of the subject, Need for environment studies, goals of environmental education, environmental education programs. Man-environment relationship, biogeochemical cycles. Concept of ecology, subdivisions and developmental phases of ecology; concept of the ecosystem, Structural and functional aspects of ecosystems; Productivity concept of ecosystem, food chains & food webs in ecosystems. Ecological energetic, ecological interactions. Population ecology, Population dynamics Soil, Land use patterns, Waste lands, Desertification, Water resources, Air resources, Energy resources, Waste management, Waste water management, Biomedical waste management, Environmental policies and laws
CEES121	Thermodynamics	3	0	3	Concepts and laws of thermodynamics; macroscopic thermodynamic properties; application to closed and open system; microscopic approach to entropy; equations of state; thermodynamics of non reacting mixtures.
CEAO122	Probability & Statistics	3	0	3	Probability spaces; conditional probability and independence; random variables and probability distributions; marginal and conditional distributions; independent random variables; mathematical expectations; mean and variance; binomial; Poisson and distributions; sum of independent random variables; law of large numbers; central limit theorem (without proof); sampling distributions.
CEMATH123	Higher Calculus	3	0	3	Polar coordinates: Definition, graphing and conics , Cylindrical and spherical coordinates, Jacobian, Limits, Continuity and Differentiability of vector functions, Velocity & unit Tangent vector, Normal vectors, Curvature, Torsion and the Bi normal, Tangential &

Course Code	Course Title	L	P	U	Course Description
					normal components of velocity and acceleration, Functions of several variables, Limits and continuity in higher dimensions, Partial derivatives, differentials, linearization, Taylors formula for two variables, Chain rule for derivative, Directions derivatives, Gradient and Tangent planes, Maxima, Minima with application Convergence of sequences and series , Maclaurin, s Series, Taylors series, Vector calculus inRn, Vector analysis, Theorem of Green Gauss and Stokes
CEPHY124	Physics II	3	0	3	Electrical fied; magnetic field; electric current; electromagnetic induction; Max well's equation; Electromagnetic waves; wave particle duality; uncertainty principle and Bohr model of atom.
CETA125	Scientific Measurements	0	4	2	A laboratory course that covers the lab components associated with six core science courses in the integrated first degree structure. While the exact component and assignments may vary from time to time. The assignments would invariably be illustrative of the theory covered in this portion as well as aim to emphasize the aspects of measurement as a theme in experimental science. This course is a compulsory requirement for all students who have to compulsorily do the six core science courses.
CETA126	Workshop Practice	2	4	4	Basics of manufacturing processes, Technical and economical considerations of manufacturing, Significance of material properties with respect to selection of manufacturing processes, Fitting & Carpentry, Metal forming processes, Sheet-metal working, Mechanical joining processes, Smithy tools and making various parts, Casting processes, laboratory exercises involving machining, fitting & carpentry, joining, CNC, house wiring, foundry and smithy etc.
CETA127	Computer Programming II	3	0	3	Java Programming Fundamentals, features of Object oriented programming, primitive data types and operators, various program control Statements, Classes, Objects and Methods, more data types and operators, Strings and other Operators, A closer look at methods and Classes, learn and implement Inheritance, Interfaces and Packages, Exception Handling, File I/O, Multithreading, database connectivity, Exploring My Cloud Powered by AWS : Essentials in Cloud Computing, Fundamentals of Big Data and Analytics, Introduction to Database Management System, Basics of Web Technologies, Basics of Storage and Networking, Cloud Computing Fundamentals and Services, AWS Analytics and Database Services, AWS Developer and Management Tools, AWS Storage Services, AWS Networking and Content Delivery Services.
CEES211	Electrical Sciences I	3	0	3	Introduction; basic circuit elements; sources (dependent and independent); Kirchoff's current and voltage law, source representation and conversion; Network theorems, response of RL,RC and RLC circuits; sinusoidal steady state analysis of circuits; three phase circuits, transformers; basics of

Course Code	Course Title	L	P	U	Course Description
					rotating machines; DC machines; induction machine
CEES212	Digital Electronics	2	2	3	Number systems and machine representation, Boolean algebra, minimization techniques, combinational and synchronous sequential circuits, logic minimization, programmable logic devices, state table and state diagrams, digital integrated circuits, asynchronous circuits, arithmetic operations and algorithms. The course will also consist of laboratory practice
CEES213	Engineering Mechanics	3	0	3	Introduction, System of Forces; Laws of Mechanics; Types of Supports and their reactions; Equilibrium of rigid bodies; Force resolution and Resultant force; Friction; Moments and couples; Varignon's Theorem; Center of Gravity; Moment of Inertia, product of inertia, Mass moment of inertia; Dynamics of particles- displacement, velocity and acceleration, D' Alembert's principle; Rectilinear motion; Impulse momentum principle; Impact of elastic bodies; Curvilinear motion; Work-energy principal.
CEECON214	Principles of Economics	3	0	3	Nature and Scope of economic science, its relationship with other social sciences; quantification of economic variables, theories of consumer behavior and of the firm; linear economic models; market structures; social accounting and basic elements of economic planning
CEMATH215	Complex Variables	3	0	3	Regions in the Complex plane, Functions of Complex Variable, limits. Mappings, Theorems on limits, Continuity, Derivatives, Cauchy-Riemann equations, Analytic Functions, harmonic functions, Exponential logarithmic functions, complex exponents, Trigonometric, Hyperbolic functions and their inverses, Contour integrals, Anti derivatives, Cauchy theorem, Cauchy Integral Formula, Morera's theorem, Liouville's Theorem, Maximum Modulus Principle, Convergence of sequences of series, Taylor's and Laurent series, Residues poles and zeros of analytic functions, Applications of residues, Conformal mapping, Fourier Transforms and Z Transforms.
CEMATH216	Differential Equations & Fourier Series	3	0	3	First order differential equations, Reduction of order, Second order equations with applications bending of beams and electrical circuits, The homogeneous equation with constant coefficients and the Method of Undetermined Coefficients, Variation of parameters, Higher order linear equations, Power series solutions and ordinary points, Frobenius Method &Regular singular points, Gauss' hyper-geometric equation, Legendre polynomials & Bessel functions, Laplace Transform & Inverse Laplace Transform, Convolution of Laplace Transform & application to differential equations, Fourier series and convergence, Cosine and Sine series, Sturm-Liouville problem, one dimensional Heat and Wave equations and Laplace equations in rectangular form.
ES221	Electrical Sciences II	3	0	3	Semiconductor physics, doped semiconductors, junction diode, ideal diode, non-ideal diode models, Zener diode and their applications, effects of capacitance, PNP

Course Code	Course Title	L	P	U	Course Description
					transistor, NPN transistor, cut off and saturation, application to digital logic circuits, Junction Field effect transistors, MOSFETs, MOSFET Logic gates, Complementary MOSFETs, BJT Amplifiers, FET amplifiers biasing and small signal analysis ,Frequency response, power amplifiers, IC amplifiers, Operational amplifiers
CETA222	Engineering Measurements	1	8	4	Measurement of basic electrical and non-electrical quantities; system performance measurements; analysis of experimental data. The course shall aim to train the student in the skill of operation of instruments in the electrical and electronics, chemical, civil and mechanical engineering applications. Precise lab exercises will be prescribed from time to time.
CETA223	Professional Communication	3	0	3	Basics of Communication; Verbal and Non-verbal Communication; Barriers to Communication; Business Correspondence; E-mail Communication; Memo-Reports; Notice, Agenda and Minutes of Meetings; Effective Writing; Report: Its Features: Types of Reports; Formal Reports; Gathering Information; Organization of the Material; Uses of Visual Aids; Writing Abstract and Summaries; Writing Definitions; Reading and Listening Skills; Note-making; Précis Writing; Audio Visual Aids; Oral Presentation; Editing; Mechanics of Writing.
CEMGTS 224	Principles of Management	3	0	3	Fundamental concepts of management-planning-organizing; staffing; directing and controlling; production, financial, personnel, legal and marketing functions; accounting and budgeting, balance sheets.
CEAO225	Optimization Techniques	3	0	3	Optimization of functions of one and more variables with and without constraints, Kuhn-Tucker conditions, Gradient Methods, Linear Programming, Simplex based and integer programming methods, Duality Theory, Transportation and assignment problems, Dynamic programming, Branch and bound methods, Models of linear production systems
CEAO311	Numerical Methods	3	0	3	Solution of non-linear algebraic equations; interpolation and approximation; numerical differentiation and quadrature; solution of ordinary differential equations; system of linear equations; matrix inversion; Eigen-value and Eigenvector problems.
CEAO312	Control Systems	3	0	3	Mathematical models of physical systems, feedback characteristics of control systems, control system components, time response analysis, stability, frequency response, state-space analysis
HS311	Dynamics of Social Change	3	0	3	Nature of Society, social institutions; concept and nature of socio-cultural change, obstacles, rate and direction of change; factors of social change ideological, economic,

Course Code	Course Title	L	P	U	Course Description
					technological and political demographics; agencies of social change-education, leadership, propaganda, legislative reforms; five-year plans and social change, peasant and land reform, bhoodan and gramdan; changing pattern of family, marriage, caste and religion
HS312	Introduction to Psychology	3	0	3	The development of psychology as a science individual and the environment; nature; kinds and determinants of perceptions; response mechanism and kinds of responses, motivations, modifications of behaviour through learning, memory and transfer of training; thought process, problem solving and creative thinking; nature and evaluation techniques of intelligence and personality.
HS313	Heritage of India	3	0	3	Foundations of India; India and its ancient culture; life of the people; systems of Indian philosophy; art and archeology; languages and literature; impact of world civilization; Western influence.
HS314	Modern Political Science	3	0	3	Nature and scope of political science; emergence and basis of the state; rights and duties; forms of government; democracy, fascism, capitalism, socialism, anarchism, communism, Maoism, radicalism and Gandhism.
HS315	Public Administration	3	0	3	Definition, nature and scope of public administration; the chief executive; leadership qualities of an administrator; principles of organization; organization of Ministries of Home and Finance; personnel administration-bureaucracy; recruitment, promotion, conduct and discipline, employer employee relations; administration at work-planning, policy formulation, decision making, supervision, coordination; integrity in administration; public corporations in India; financial administration in India; local administration in India.
HS316	Professional Ethics	3	0	3	Ethics, nature and purpose; ethical theories; ethics in business and management; ethics in engineering, global ethical issues.
DS491 CE491 CS491 EC491 EE491 ME491 MEC491	Special Projects	0	0	3	This is an unstructured open ended where under the overall supervision of an instructor-in-charge, batches of students will be attached to different instructors. Each batch will work on a specific time bound which is of basic or peripheral concern of student's discipline. Each student must submit a project report as a culmination of his endeavor and investigation. The instructor-in-charge will determine the choice of the project and also whether or not the project report is to be submitted jointly by a group or individually by a student. This course will aim to evaluate the student actual ability to use the fundamentals of knowledge and to meet the new unknown situations as demonstrated by the student's interaction with the instructors and instructor-in-charge. The instructor-in-charge may assign specific hours of formal brain storming sessions.

Course Code	Course Title	L	P	U	Course Description
CECHEM111	Chemistry	3	0	3	Coordination Chemistry: Effective atomic number,

Course Code	Course Title	L	P	U	Course Description
					Nomenclature of coordination compounds, Shapes of d-orbitals, Valence Bond Theory, Magnetism, Crystal Field Theory of Octahedral Complexes, Tetragonal distortions of Octahedral Complexes (Jahn-Teller Distortions), Square Planar and Tetrahedral Complexes, Thermodynamics-First Law: Work and Heat, Internal Energy and Enthalpy, Thermo chemistry: Enthalpy changes accompanying physical change and chemical change e.g. Thermodynamics -Second Law: Entropy and 2nd Law, The Gibb's Free Energy, Phase equilibria: Pure substances The thermodynamics of phase transition, Phase diagrams, Phase diagrams of typical materials Principles of chemical equilibria: The reaction Gibb's energy, Reactions at equilibrium, The response of equilibria to the conditions Consequences of equilibrium: Proton transfer equilibria, Salts in water, Solubility equilibria, Common ion effect Electrochemistry: The migration of ions, Electrochemical cells. The cell potential. Application of standard potentials, The rates of reactions: Empirical chemical kinetics, Reaction rates, Temperature dependence of reaction rates.
CEEGL112	English Language Skills	3	0	3	Familiarizing students with basic English sound system to enhance their power of articulation. It provides intensive practice and extensive exposure to listening, speaking, reading and writing Skills. It would enhance not only their comprehensive knowledge of vocabulary but also strengthens their all four skills. The design and content of the course are aimed at making students gain language proficiency and also improve their communication skills
CEMATH113	Linear Algebra	3	0	3	Matrices,Elementary row operations, Row and columnequivalence, Row Reduced Echelon Matrices, Invertible Matrices, Gauss Jordan method to find the inverse, Solving system of linear equations (homogeneous and non-homogeneous), Vector spaces, subspaces, Bases and Dimension, and Computations of Subspaces, Linear Transformations, The Algebra of linear Transformations, Isomorphism between Matrices and Linear Transformations, Representation of Linear Transformations byMatrices, Eigen values, Eigen vectors,Diagonalization,Quadratic forms, Canonical forms.
CEPHY114	Physics I	3	0	3	Momentum and impulse; two and many particle system; Rotational kinematics and dynamics; work and energy; conservation principles; oscillations and wave motion; interference, diffraction and polarization.
CETA115	Engineering Graphics	2	4	4	Angle of projections; free hand sketching; orthographic views; pictorial views; auxiliary views; lines and planes; intersection and development; AutoCAD command and simple drawings using AutoCAD.

Course Code	Course Title	L	P	U	Course Description
CETA116	Computer Programming I	3	0	3	Basics of Problem solving, Solve with an example, Introduction to python, Data Types, Python Program Flow Control, Python Sequences, Python Functions, Python Modules, Python Packages, Python Object Oriented Programming, Exception Handling, My First Cloud Program - Powered by AWS (Cloud Inventor) :Overview of computer and internet, Introduction and basics of cyber security, General idea of data analysis, Basics of programming and algorithms, Overview of computing, Introduction to cloud computing, Overview of cloud models, General idea of cloud computing, Problem solving – Case Study
CEEVS117	Environmental Science	2	0	2	Meaning of Environment, Types and components of environment, nature and scope of the subject, Need for environment studies, goals of environmental education, environmental education programs. Man-environment relationship, biogeochemical cycles. Concept of ecology, subdivisions and developmental phases of ecology; concept of the ecosystem, Structural and functional aspects of ecosystems; Productivity concept of ecosystem, food chains & food webs in ecosystems. Ecological energetic, ecological interactions. Population ecology, Population dynamics Soil, Land use patterns, Waste lands, Desertification, Water resources, Air resources, Energy resources, Waste management, Waste water management, Biomedical waste management, Environmental policies and laws
CEES121	Thermodynamics	3	0	3	Concepts and laws of thermodynamics; macroscopic thermodynamic properties; application to closed and open system; microscopic approach to entropy; equations of state; thermodynamics of non reacting mixtures.
CEAO122	Probability & Statistics	3	0	3	Probability spaces; conditional probability and independence; random variables and probability distributions; marginal and conditional distributions; independent random variables; mathematical expectations; mean and variance; binomial; Poisson and distributions; sum of independent random variables; law of large numbers; central limit theorem (without proof); sampling distributions.
CEMATH123	Higher Calculus	3	0	3	Polar coordinates: Definition, graphing and conics ,Cylindrical and spherical coordinates, Jacobian, Limits, Continuity and Differentiability of vector functions, Velocity & unit Tangent vector, Normal vectors, Curvature, Torsion and the Bi normal, Tangential & normal components of velocity and acceleration, Functions of several variables, Limits and continuity in higher dimensions, Partial derivatives, differentials,

Course Code	Course Title	L	P	U	Course Description
					linearization, Taylors formula for two variables, Chain rule for derivative, Directions derivatives, Gradient and Tangent planes, Maxima, Minima with application Convergence of sequences and series , Maclaurin, s Series, Taylors series, Vector calculus inRn, Vector analysis, Theorem of Green Gauss and Stokes
CEPHY124	Physics II	3	0	3	Electrical fied; magnetic field; electric current; electromagnetic induction; Max well's equation; Electromagnetic waves; wave particle duality; uncertainty principle and Bohr model of atom.
CETA125	Scientific Measurements	0	4	2	A laboratory course that covers the lab components associated with six core science courses in the integrated first degree structure. While the exact component and assignments may vary from time to time. The assignments would invariably be illustrative of the theory covered in this portion as well as aim to emphasize the aspects of measurement as a theme in experimental science. This course is a compulsory requirement for all students who have to compulsorily do the six core science courses.
CETA126	Workshop Practice	2	4	4	Basics of manufacturing processes, Technical and economical considerations of manufacturing, Significance of material properties with respect to selection of manufacturing processes, Fitting& Carpentry, Metal forming processes, Sheet-metal working, Mechanical joining processes, Smithy tools and making various parts, Casting processes, laboratory exercises involving machining, fitting & carpentry, joining, CNC, house wiring, foundry and smithy etc.
CETA127	Computer Programming II	3	0	3	Java Programming Fundamentals, features of Object oriented programming, primitive data types and operators, various program control Statements, Classes, Objects and Methods, more data types and operators, Strings and other Operators, A closer look at methods and Classes, learn and implement Inheritance, Interfaces and Packages, Exception Handling, File I/O, Multithreading, database connectivity, Exploring My Cloud Powered by AWS:Essentials in Cloud Computing, Fundamentals of Big Data and Analytics, Introduction to Database Management System, Basics of Web Technologies, Basics of Storage and Networking, Cloud Computing Fundamentals and Services, AWS Analytics and Database Services, AWS Developer and Management Tools,AWS Storage Services, AWS Networking and Content Delivery Services.
CEES211	Electrical Sciences I	3	0	3	Introduction; basic circuit elements; sources (dependent and independent); Kirchoff's current and voltage law, source representation and conversion; Network theorems, response of RL,RC and RLC circuits; sinusoidal steady state analysis of circuits; three phase circuits, transformers; basics of rotating machines; DC machines; induction machine
CEES212	Digital	2	2	3	Number systems and machine representation, Boolean

Course Code	Course Title	L	P	U	Course Description
	Electronics				algebra, minimization techniques, combinational and synchronous sequential circuits, logic minimization, programmable logic devices, state table and state diagrams, digital integrated circuits, asynchronous circuits, arithmetic operations and algorithms. The course will also consist of laboratory practice
CEES213	Engineering Mechanics	3	0	3	Introduction, System of Forces; Laws of Mechanics; Types of Supports and their reactions; Equilibrium of rigid bodies; Force resolution and Resultant force; Friction; Moments and couples; Varignon's Theorem; Center of Gravity; Moment of Inertia, product of inertia, Mass moment of inertia; Dynamics of particles- displacement, velocity and acceleration, D' Alembert's principle; Rectilinear motion; Impulse momentum principle; Impact of elastic bodies; Curvilinear motion; Work-energy principal.
CEECON214	Principles of Economics	3	0	3	Nature and Scope of economic science, its relationship with other social sciences; quantification of economic variables, theories of consumer behavior and of the firm; linear economic models; market structures; social accounting and basic elements of economic planning
CEMATH215	Complex Variables	3	0	3	Regions in the Complex plane, Functions of Complex Variable, limits. Mappings, Theorems on limits, Continuity, Derivatives, Cauchy-Riemann equations, Analytic Functions, harmonic functions, Exponential logarithmic functions, complex exponents, Trigonometric, Hyperbolic functions and their inverses, Contour integrals, Anti derivatives, Cauchy theorem, Cauchy Integral Formula, Morera's theorem, Liouville's Theorem, Maximum Modulus Principle, Convergence of sequences of series, Taylor's and Laurent series, Residues poles and zeros of analytic functions, Applications of residues, Conformal mapping, Fourier Transforms and Z Transforms.
CEMATH216	Differential Equations & Fourier Series	3	0	3	First order differential equations, Reduction of order, Second order equations with applications bending of beams and electrical circuits, The homogeneous equation with constant coefficients and the MethodofUndetermined Coefficients, Variation ofparameters, Higher order linear equations, Power series solutions and ordinary points, Frobenius Method &Regular singular points, Gauss' hyper-geometric equation, Legendre polynomials & Bessel functions, Laplace Transform & Inverse Laplace Transform, Convolution of Laplace Transform & application to differential equations, Fourier series and convergence, Cosine and Sine series, Sturm-Liouville problem, one dimensionalHeat andWaveequations and Laplace equations in rectangular form.
CEES221	Electrical Sciences II	3	0	3	Semiconductor physics, doped semiconductors, junction diode, ideal diode,non-ideal diode models, Zener diode and their applications, effects of capacitance, PNP transistor, NPN transistor, cut off and saturation, application to digital logic circuits, Junction Field effect

Course Code	Course Title	L	P	U	Course Description
					transistors, MOSFETs, MOSFET Logic gates, Complementary MOSFETs, BJT Amplifiers, FET amplifiers biasing and small signal analysis ,Frequency response, power amplifiers, IC amplifiers, Operational amplifiers
CETA222	Engineering Measurements	1	8	4	Measurement of basic electrical and non-electrical quantities; system performance measurements; analysis of experimental data. The course shall aim to train the student in the skill of operation of instruments in the electrical and electronics, chemical, civil and mechanical engineering applications. Precise lab exercises will be prescribed from time to time.
CETA223	Professional Communication	3	0	3	Basics of Communication; Verbal and Non-verbal Communication; Barriers to Communication; Business Correspondence; E-mail Communication; Memo-Reports; Notice, Agenda and Minutes of Meetings; Effective Writing; Report: Its Features: Types of Reports; Formal Reports; Gathering Information; Organization of the Material; Uses of Visual Aids; Writing Abstract and Summaries; Writing Definitions; Reading and Listening Skills; Note-making; Précis Writing; Audio Visual Aids; Oral Presentation; Editing; Mechanics of Writing.
CEMGTS 224	Principles of Management	3	0	3	Fundamental concepts of management-planning-organizing; staffing; directing and controlling; production, financial, personnel, legal and marketing functions; accounting and budgeting, balance sheets.
CEAO225	Optimization Techniques	3	0	3	Optimization of functions of one and more variables with and without constraints, Kuhn-Tucker conditions, Gradient Methods, Linear Programming, Simplex based and integer programming methods, Duality Theory, Transportation and assignment problems, Dynamic programming, Branch and bound methods, Models of linear production systems
CEES226	Structure & Properties of Materials	3	0	3	Study of the basic properties of materials in relation to their molecular structure; emphasis on the structure of metallic, polymeric and ceramic materials in relation to their mechanical, electrical, electronic and chemical properties, methods of imparting desirable properties to materials by inducing changes in molecular structure; property requirements and material selection, criteria for widely ranging service conditions.
CEAO311	Numerical Methods	3	0	3	Solution of non-linear algebraic equations; interpolation and approximation; numerical differentiation and quadrature; solution of ordinary differential equations; system of linear equations; matrix inversion; Eigen-value and Eigenvector problems.

Course Code	Course Title	L	P	U	Course Description
CEAO312	Control Systems	3	0	3	Mathematical models of physical systems, feedback characteristics of control systems, control system components, time response analysis, stability, frequency response, state-space analysis
HS311	Dynamics of Social Change	3	0	3	Nature of Society, social institutions; concept and nature of socio-cultural change, obstacles, rate and direction of change; factors of social change ideological, economic, technological and political demographics; agencies of social change-education, leadership, propaganda, legislative reforms; five-year plans and social change, peasant and land reform, bhoodan and gramdan; changing pattern of family, marriage, caste and religion
HS312	Introduction to Psychology	3	0	3	The development of psychology as a science individual and the environment; nature; kinds and determinants of perceptions; response mechanism and kinds of responses, motivations, modifications of behaviour through learning, memory and transfer of training; thought process, problem solving and creative thinking; nature and evaluation techniques of intelligence and personality.
HS313	Heritage of India	3	0	3	Foundations of India; India and its ancient culture; life of the people; systems of Indian philosophy; art and archeology; languages and literature; impact of world civilization; Western influence.
HS314	Modern Political Science	3	0	3	Nature and scope of political science; emergence and basis of the state; rights and duties; forms of government; democracy, fascism, capitalism, socialism, anarchism, communism, Maoism, radicalism and Gandhism.
HS315	Public Administration	3	0	3	Definition, nature and scope of public administration; the chief executive; leadership qualities of an administrator; principles of organization; organization of Ministries of Home and Finance; personnel administration-bureaucracy; recruitment, promotion, conduct and discipline, employer employee relations; administration at work-planning, policy formulation, decision making, supervision, coordination; integrity in administration; public corporations in India; financial administration in India; local administration in India.
HS316	Professional Ethics	3	0	3	Ethics, nature and purpose; ethical theories; ethics in business and management; ethics in engineering, global ethical issues.
DS491 CE491 CS491 EC491 EE491 ME491 MEC491	Special Projects	0	0	3	This is an unstructured open ended where under the overall supervision of an instructor-in-charge, batches of students will be attached to different instructors. Each batch will work on a specific time bound which is of basic or peripheral concern of student's discipline. Each student must submit a project report as a culmination of his endeavor and investigation. The instructor-in-charge will determine the choice of the project and also whether or not the project report is to be submitted jointly by a group or individually by a student. This course will aim to evaluate the student actual ability to use the fundamentals of

Course Code	Course Title	L	P	U	Course Description
					knowledge and to meet the new unknown situations as demonstrated by the student's interaction with the instructors and instructor-in-charge. The instructor-in-charge may assign specific hours of formal brain storming sessions.
IP 221	Internship Program I	0	0	5	This course is run during the summer term at various industries and is of about 8 week duration.
IP 401	Internship Program II	0	0	20	This course is run during one of the two semesters in the final year and is a part of adjoining summer vacation. The duration of this program is about five and half months. Students will be working at industries on the live projects under the supervision of the FST faculty.
TS 401	Thesis & seminar	--	--	--	TS 401 is a required course for all the students with thesis option.
TIP 491	**Technology Innovation Project**	0	0	3	A unique opportunity for the students in the form of a course that facilitate the combination of academics with the industry by involving an in-depth innovation, investigation under the supervision of mentor from Industry and a faculty member for performing the real-life projects with the support from various organizations. Students working in groups will be required to perform research, customer and problem discovery, ideation, concept creation and validation, and technical implementation for a real-world challenge. The specific time-bound based on the students registered for the course will be graded based on the performance feedback from both the industry and the Faculty supervisor. The student will be able to improve the skills and knowledge for improving written and oral communication with indicative content which includes innovation methodology, customer & problem discovery, problem validation, innovation experiments with innovative presentations.

3.1 B.Tech Civil Engineering Program (CE)

Course Description

Course Code	Course Title	L	P	U	Description
CE211	Surveying	2	2	3	At the end of this course, students will understand the basic concepts involved in different types of surveying and carry out linear and angular measurements. Introduction to chain, compass and plane table surveying. Leveling, tacheometry, elements of simple curve, surveying using the odolite and total station will be discussed. The course will also consist of laboratory practice.
CE221	Mechanics of Solids	2	2	3	The objective of the course is to learn the concepts of simple stress and strain, compound stress, shear force diagram, bending moment diagram, theory of simple bending, section modulus, deflection in beams, torsion of shaft and springs, columns and struts, analysis of thin walled and thick walled cylinders, theories of failures.
CE311	Fluid Mechanics	2	2	3	Concepts & definitions, properties of fluids, fluid pressure and measurement, hydrostatic forces, buoyancy & flotation, fundamental of fluid flow, Kinematics and dynamics equations of motion and energy, impulse momentum equations and applications, flow through pipes, orifices and mouth pieces, flow over notches & weirs, dimensional analysis and model similtude; Boundary layer theory. The course will also consist of laboratory practice.
CE312	Soil Mechanics	3	2	4	This course deals with the basics of geotechnical engineering, including soil types, classification, index and engineering properties of soil. The course also covers the basics such as flow through porous media (hydraulic conductivity and seepage); compaction and consolidation, stress distribution and settlements in a soil mass; shear strength of soils and stability of slopes, which are required to get a general idea about the soil behavior. The course will also consist of laboratory practice.
CE313	Analysis of Structures	3	0	3	The objective of this course is to know the different techniques available for the analysis of structures. Course content of this course includes: Stability and Determinacy of Structures; review of shear force and bending moment concepts; Deflection of trusses: Strain Energy; Shear centre; Maxwell Betti's theorem - Muller Breslau's principle and its application; Analysis of Arches; ILD and moving loads; Analysis of Statically Indeterminate Structures, Settlement of supports and sway using Slope deflection method, Moment distribution method, Kani's method.
CE314	Water Resources Engineering	3	0	3	The objective of this course is to give the student a fundamental knowledge of the characteristics of water in all aspects such as occurrence, circulation and distribution etc. Which are pertinent to planning, design and operation of hydraulic engineering projects. The students will be exposed to hydrology, Hydrograph, capacity of reservoir, catchment area, flood, river morphology, irrigation engineering, design of lined canal, irrigation projects, flood routing and different irrigation methods in depth

Course Code	Course Title	L	P	U	Description
CE321	Construction Materials & Practices	3	2	4	Students will be able to illustrate the types, uses and properties of various building materials and various construction practices in the industry. Different construction materials like bricks, stones, wood, ferrous metals & non-ferrous metals, cement, aggregates and its testing, admixtures will be discussed in detail. Apart from that the properties of fresh and hardened concrete, Design of concrete mix will be discussed. Construction practices such as stone brick and hollow block masonry and selection of equipment for earth work, earth moving operations will be exposed to the students. The course will also consist of laboratory practice.
CE322	Design of Concrete Structures	3	0	3	Learning objective of the course is to understand the concepts of concrete design. Course content of this course includes: Method of design for concrete structures; working stress method; load factor method; limit state method; code of practice; partial safety factor; theory of singly reinforced members in flexure; doubly reinforced members; design for shear; flanged beams; serviceability requirements; bond; anchorage; development lengths & splicing; one way & two way slabs; axially loaded columns; columns with load & moments; Footing design, Introduction to Pre-stressed structure. On completion of the course, the students will be able to use IS code of practice for the design of concrete elements.
CE323	Transportation Engineering	3	0	3	This course introduces students to the transportation engineering principles necessary for the Geometric Design, Materials, construction and efficient and safe operation of roadways; design of flexible and rigid pavements. It also introduces air transport characteristics, Planning and runway design.
CE324	Data Structures	2	2	3	Introduction to Software Design Principles- Modularity, Abstract Data Types. Data Structures And Algorithms. Analysis Of Algorithms. Linear Data Structures – Stacks, Arrays, Lists, Queues And Linked List. Representations- Pre-Fix, In-Fix and Post-Fix Expressions. Recursion. Set Operations. Hashing and Hash Functions. Binary and Other Trees. Traversal Algorithms. Huffman Codes. Search Trees. Priority Queues. Heaps and Balanced Trees. Sorting Techniques. Graphs and Digraphs. Algorithmic Design Techniques. Data Structures for External Storage. Multi-Way Search and B-Trees.
CE401	Finite Element Methods	2	2	3	Basics of Finite element methods, FEA procedure and its applications. Stiffness method. Element and global stiffness matrix for various structural elements. Isoperimetric elements, axisymmetric and 3D analysis using Ansys.
CE402	Design of Steel Structures	3	0	3	Learning objective of the course is to understand the concepts of steel design. Course content of this course includes: Introduction to structural steels, tension & compression members; methods of design; specifications & code of practice; loads and stresses; load combinations for design; steel work connections; riveted, bolted and pin joints, welded connections; design of tension, compression and bending members; column bases and footings; Welded beam connections; Design of plate girders. On completion of the course, the students will be able to apply the IS code of practice for the design of steel structural elements.

Course Code	Course Title	L	P	U	Description
CE403	Computer Aided Design	1	2	2	This course imparts a thorough knowledge in analysis and design of multi storied building using software., IS:456 code requirements for structural designing of individual houses & multi storied buildings(limit state designs), deciding columns/beams/slabs positions, orientations of columns, load calculations, analysis and design by using software are included.
CE404	Design of Industrial Structures	3	0	3	This course aims at design of industrial structures such as gantry girders, roof trusses, different types of steel tanks and chimneys. And also it gives emphasis on design of plate girder bridges with reference to Indian standard code of practice and design aids
CE405	Stability of Structures	3	0	3	This course deals with the stability aspects of the structures. Topics covers under this course includes: Basics of structural analysis: static & dynamic loading, linear & nonlinear structural behavior, geometric & material nonlinearity, hysteretic behavior; Classical linear analysis of frames and trusses: displacement method, slope deflection equations & matrix displacement method, effect of foundation settlement and temperature; Geometric nonlinear analysis of frames and trusses: displacement method, nonlinear slope-deflection equations & nonlinear behavior, linearized iterative matrix displacement method, geometric stiffness matrix, tangent stiffness matrix, P- Δ effect, buckling of frames, tension structures.
CE406	Building Drawing, Estimation & Costing	2	2	3	This course deals with the various aspects of estimating quantities of items of works involved in buildings, canals and road works. Apart from above this course give introduction to the rate analysis, preparation of schedule of bars of RC roof slab, beams, columns and foundations, valuation of properties and contracts, tendering, introduction to NBC will be discussed in the class room. This course is associated with lab where the students will be drawing building plan, elevation and sections by using AutoCAD software
CE407	Foundation Engineering	3	0	3	This course covers the basics of soil exploration and selection of foundation, determination of bearing capacity and settlement analysis. In addition to that, it also deals with earth pressure calculations and retaining walls; Pile foundations, well foundations, machine foundations.
CE408	Ground Improvement Techniques	3	0	3	The course addresses various ground improvement techniques along with principles, design issues and construction procedures. The course will cover topics like densification methods for various types of soils, Preloading and Principles of loading (Static and Dynamic); drainage and dewatering, grouting; Geo synthetics and soil reinforcement, Vertical drains and Granular piles; Soil nailing and Anchors; Design methods and case studies.

Course Code	Course Title	L	P	U	Description
CE409	Soil Dynamics and Machine Foundations	3	0	3	This course covers dynamics of elastic systems; Single and multi-degrees of freedom systems; Empirical and semi-empirical approaches to the theory of soil dynamics; Elastic theories of soil dynamics; Wave propagation; Dynamic soil properties; Design of machine foundations; Vibration isolation; Pile dynamics.
CE410	Structures on Expansive soil	2	0	2	This course presents guidance and information for the geotechnical investigation necessary for the selection and design of foundations for heavy and light buildings constructed in expansive clay soil areas. This course covers topics like origin, occurrence and distribution of expansive soils of India, soil characteristics; distress symptoms, identification tests, field exploration, remedial procedure alternatives, recommendations for type of foundation in expansive soils; Soil stabilization, suitability of type of stabilization techniques.
CE411	Environmental Geo-technology	3	0	3	The course discusses Concepts and principles of Geo environmental Engineering. Waste disposal facilities; site selection criteria for waste disposal; methods of disposal; Soil mineralogy characterization and its significance in determining soil behavior; geotechnical aspects of planning and design of MSW and Hazardous Waste Landfills; Soil remediation technologies.
CE412	Geo-Informatics in Transportation Engineering	3	0	3	The students will be learning the basic concepts of geo-informatics in brief that includes Geographical Information System (GIS), Remote Sensing (RS), and Global Positioning System (GPS), transportation models and their applications in GIS: Intelligent Transport Systems (ITS), architecture and integration with GIS. Analysis and visualizations of traffic data in GIS. Integration of GPS and GIS.
CE413	Railway, Dock and Harbor Engineering	3	0	3	At the end of this course, students will be able to visualize the different aspects related to railway, dock and harbor engineering. Railway transportation and its development, railway track, rails, sleepers, track fittings and fastenings, ballast, subgrade and embankments, track alignment, geometric design of the track will be discussed under railways. Introduction to harbors and ports: tides, wind and waves, types of breakwaters and various docking facilities etc will be discussed under docks and harbors.
CE414	Urban Transportation Planning	2	0	2	At the end of the course, the students will be having better understanding about transportation planning in the overall regional system. The course includes fundamentals of transportation planning, components of transportation system and their interaction, The role of transportation planning in the overall regional system, Travel Demands Forecasting, urban transport problems, urban freight transportation and urban mass transportation systems. Intelligent Logistics methods for transportation Planning & Optimization

Course Code	Course Title	L	P	U	Description
CE415	Pavement Evaluation, Rehabilitation And Maintenance	3	0	3	Through this course, the students will be able to understand and know when and how to use non-destructive testing for pavement evaluation, and various maintenance and rehabilitation methods to extend the useful life of pavements. Structural and functional requirements of flexible and rigid pavements; pavement distress; different types of failures, causes, methods of measurement of skid resistance, pavement surface condition evaluation, role of computers in pavement management will be discussed in detail
CE416	Hazardous Waste Management	3	0	3	The course would cover-general introduction including solid wastes–municipal waste, biomedical waste, hazardous waste, e-waste; legal issues and requirements for solid waste management; sampling and characterization of solid waste; analysis of hazardous waste constituents; health and environmental issues related to solid waste management; steps in solid waste management-waste reduction at source, collection techniques, materials and resource recovery/recycling, transport, optimization of solid waste transport, treatment and disposal techniques; economics of the onsite vs. offsite waste management options; and waste minimization.
CE417	Remote Sensing & GIS	3	0	3	This objective the course is to introduce the application of remote sensing and GIS in civil engineering. The course content includes: Introduction, Basic concepts of remote sensing, Energy sources and radiation principles, Energy interactions with atmosphere and earth surface features, Spectral reflectance curves, Polar orbiting satellites, Spectral, radiometric and spatial resolutions, Multispectral, thermal and hyper spectral sensing. Introduction to automated geography; geographic data; maps and automation, map scale and characteristics; map projections; grid system, cartographic process, cartographic and GIS data structures; GIS data models for multiple coverage, input storage and editing; elementary spatial analysis measurement; classifications; statistical surfaces; special arrangements, comparing variables among coverage; cartographic modeling; GIS output ; GIS Design.
CE418	Environmental Impact Assessment	2	0	2	At the end of this course, the students will understand the use of EIA procedures and methods within the project and planning cycle to promote more sustainable forms of development. Basic concepts of EIA, EIA procedure, EIA as a planning tool for major project activities, environmental monitoring and management plan, methodology for the prediction and assessment of impacts on soil and groundwater references, concepts of environmental remote sensing, environmental impact of industrial development will be discussed in this course.

Course Code	Course Title	L	P	U	Description
CE419	Environmental Systems	3	0	3	Introduction to the concepts and applications of environmental systems analysis. Application of mathematical programming and modeling to the design, planning and management of engineered environmental systems, regional environmental systems, and environmental policy. Economic analysis, including benefit-cost analysis and management strategies. Concepts of tradeoff, non-inferior sets, single and multi-objective optimization. Practical application to case studies to convey an understanding of the complexity and data collection challenges of actual design practice.
CE421	Water Supply and Waste Water Engineering	3	0	3	The course provides an overview of engineering approaches with an emphasis on fundamental principles of domestic water treatment, supply and domestic wastewater collection and treatment. The following topics will be discussed in the course – water supply, waste water treatment systems, capacity requirements, analysis of water and waste water, treatment requirements, unit operation , processes of treatment, design of treatment units, waste water and sludge disposal, design of sewers and water distribution networks, rural sanitation, effluent purification and reuse.
CE422	Project Planning and Management	3	0	3	Basics of Construction- Unique features of construction, construction projects- types and features, phases of a project, agencies involved and their methods of execution; Construction project planning- Stages of project planning: pre-tender, pre-construction, detailed construction planning, role of client and contractor. Process of development of plans and schedules, techniques of planning- Bar charts, Gantt Charts, CPM-PERT Networks. Common building construction methods. Study of Construction Equipments. Contracts Management basics
CE423	Natural Disaster Mitigation and Management	2	0	2	This course helps students to develop skills in various stages of disaster preparedness, mitigation and management. Natural disasters around the world, natural disaster risk assessment, major disasters such as earthquake, landslides, human impact on the mountainous terrain and its relationship with rainfall, liquefaction, tsunami, tornadoes , cyclones, floods and droughts etc, its mitigation, preparation, assessment and monitoring, risk analysis, impacts on community and involvement of social organizations will be discussed.
CE424	Infrastructure Financing	3	0	3	This course gives a detailed understanding on infrastructure development, project financing, Financial instruments, Public-private partnership, PPP Procurement process, concession design, project viability & security arrangements, preparing the project financing plan, credit rating of infrastructure projects, credit enhancement, financial institutions, insurance and bonding, restructuring projects. Relevant case studies will be discussed

Course Code	Course Title	L	P	U	Description
CE425	Policies, Reforms, Law and Risk Management in Infrastructure Projects	3	0	3	Through this course, the students will be learning the legal aspects in infrastructure projects. Constitutional aspects, policy formulation, private participation, dispute resolution, general legal context of infrastructure business, environmental aspects, infrastructure polices, reforms, and laws various sectors, feasibilities of infrastructure projects, risk analysis and management of infrastructure projects, financial derivatives will be discussed
CE426	Materials , Management and Estimation	3	0	3	At the end of this course, students will be able to carry out linear and angular measurements. Levelling and total station concepts will be discussed. Classification of Construction projects, Construction stages, Resources- Functions of Construction Management and its Applications .Preliminary Planning-Collection of Data-Contract Planning — Scientific Methods of Management: Network Techniques in construction management – Bar chart, Gant chart, CPM, PERT. Different construction materials like bricks, stones, wood, ferrous metals & non-ferrous metals, cement, aggregates and admixtures will be discussed. Introduction to building plans and estimating quantities of items of works involved in buildings.
CE427	Emerging trends in Structural Engineering	1	0	1	The course briefs innovative solutions to various structural related problems in terms of materials, testing, design procedures, applications and case studies.
CE428	Emerging Trends in Geotechnical Engineering	1	0	1	The course briefs innovative solutions to various geotechnical problems in terms of materials, testing, design procedures, applications and case studies.
CE429	Emerging Trends in Transportation Engineering	1	0	1	The course briefs innovative solutions to various problems in terms of materials, testing, design procedures, applications and case studies
CE430	Emerging Trends in Environmental Engineering	1	0	1	The course briefs innovative solutions to various problems in the field of environmental engineering with the aid of case studies.
CE431	Emerging Trends in Construction Management	1	0	1	The course briefs latest trends in materials management and construction technology.

4. Institute Core Courses Handouts

Course No: **CECHEM111**	Course Title: **Chemistry**	L	P	U
		3	0	3

Course Learning Objectives

- To integrate the principles of Inorganic, Physical and Industrial chemistry with the relevant domains of core engineering courses offered at B.Tech level.
- To provide a broad foundation in chemistry that stresses scientific reasoning and analytical problem solving with a molecular perspective.
- Provides a comprehensive survey of underlying principles that govern the properties and behavior of chemical systems.
- The student will understand the interdisciplinary nature of chemistry and to integrate knowledge of mathematics, physics and other disciplines to a wide variety of chemical problems.

Course Contents

UNIT-I

Werner's work, recent studies on complexes, Effective atomic number, Nomenclature of coordination compounds, Shapes of d-orbitals, Valence Bond Theory, Crystal Field Theory of Octahedral Complexes, Magnetism, Thermodynamic aspects of crystal field splitting, Tetragonal distortions of Octahedral Complexes (Jahn-Teller Distortions), Square Planar and Tetrahedral Complexes.

UNIT-II

Work and Heat, Internal Energy and Enthalpy, Enthalpy changes accompanying physical change and chemical change, Entropy and 2^{nd} Law, Absolute Entropies and 3^{rd} Law, The Gibb's Energy, The thermodynamics of transition, Phase diagrams, and Phase diagrams of typical materials, The reaction Gibb's energy, Variation of reaction Gibbs energy with composition, Reactions at equilibrium, The standard reaction Gibbs energy, Equilibrium composition, Equilibrium constant in terms of concentration, The response of equilibria to the conditions, Proton transfer equilibria, Salts in water, Solubility equilibria.

UNIT-III

The migration of ions, Half reactions and electrodes, Reactions at electrodes, varieties of cells, The cell reactions, Cell potential, Cells at equilibrium, standard potentials, The variation of potential with pH, Determination of pH, Electrochemical series, Determination of thermodynamic functions.

UNIT-IV

Empirical chemical kinetics, Reaction rates, Temperature dependence of reaction rates, Reaction schemes and reaction mechanisms.

UNIT-V

Basic industrial processes like distillation, solvent extraction, solid-liquid leaching and liquid-liquidextraction, separation by absorption and adsorption. An introduction into thescope of different types of equipment needed in chemical technology, includingreactors, distillation columns, extruders, pumps, mills, Emulgator, Scaling upoperations in chemical industry, Introduction to clean technology, Introduction to synthesis, properties and application of nano-materials

Text Books:

1. Lee J. D., "*Concise Inorganic Chemistry*", 5th Edition, Blackwell Science, Oxford University Press, New Delhi, 1996.
2. Atkins Peter and De Paula Julio, "*The Elements of Physical Chemistry*", 6thEdition, Oxford University Press, New Delhi, 2015.
3. Felder R.M., Rousseau R.W. "*Elementary Principles of Chemical Processes*", Wiley Publishers, New Delhi, 2006.
4. Dieter Vollath, "*An introduction to synthesis, properties and application of nano-materials*", 2nd Edition, Willey, New York, 2013.

Reference Books:

1. Levine Ira N., "*Physical Chemistry*", 5th Edition, Tata McGraw-Hill, 2002.

2. Mahan Bruce M. and Mayers Rollie J., "*University Chemistry*", 4th Edition, Addison, Wesley Longman, 1998.

3. Huheey James E, Keiter Ellen A and Keiter Richard L., "*Inorganic Chemistry*", 4th Edition, Harper Collins College Publishers, 1993.

4. Stocchi E, "*Industrial Chemistry*" Vol-I, Ellis Horwood Ltd. UK.2006.

Course Outcomes

Upon successful completion of the course student will be able to:

- Understand the chemical behaviour of matter and materials using fundamental knowledge of their nature (i.e. electrons and intermolecular forces)
- Correlate the concepts of thermodynamics learnt with the study of engineering devices covered in Mechanical Engineering.
- Use fundamental chemical principles to make predictions about reactivity and general properties of materials of the built environment.
- Predict potential complications from combining various chemicals or metals in an engineering setting.
- Apply concepts learnt to the basic requirements of Civil Engineering, particularly focusing to the built environment
- Collect, represent and interpret experimental results accurately and concisely using technical narrative, graphs, and tables.

Skill Development / Employability / Entrepreneurship

List of Experiments in Chemistry

Sl. No	Name of the Experiment
1.	Estimation of iron (Fe^{+2}) by Dichrometry
2.	Estimation of copper by Iodometry
3.	pH curve of an acid base titration using Potentiometer
4.	Dissociation constant of a weak electrolyte by conductometry
5.	Colorimetric estimation of Iron
6.	Estimation of strength of oxalic acid using potassium permanganate as an intermediate solution
7.	Kinetics of iodination of acetone
8.	Synthesis of trans-dichlorobis (ethylenediamine) Cobalt (III) chloride
9.	Synthesis of Nickel(II)-Dimethylglyoxime complex
10.	Determination of rate constant and activation energy of the given ester catalysed by an acid
11.	Estimation of Copper by Complexometry

Course No: **CEELS112**	Course Title: **English Language Skills**	L	P	U
		2	4	4

Course Learning Objectives

- Tofamiliarizing learners with aspects of pronunciation to attain intelligibility and grammatical accuracy in spoken and written English.
- To provides intensive practice and extensive exposure to the four basic skills; listening, speaking, reading and writing

Course Contents

UNIT-I

English Sound System: distinction between letters and sounds, classification of English sounds, syllable structure, confusing sounds for practice, words and sentences for practicing vowel contrasts.

Accent Patterns: accentual patterns of single words, accentual patterns of compound words, accent change according to function, sentence accent.

Effective speech: elision of sounds or syllables, addition of sounds or syllables, transposition sounds, pronunciation based on semantics, inflectional suffixes and some common word endings, general suggestions for pronunciation, Pronunciation of consecutive consonants.

Listening skills: hearing and listening, phonetic features of listening, purpose of listening, barrier to listening, guidelines for improving listening.

Art of conversation: small talk, body language, principles of a good conversationalist.

Debate: process of organization, purpose, rebuttal, participating in a debate, preparation for the debate.

Group Discussion: conversation, debate and GD, kinds of groups, importance and features of GD (oral communication skill, leadership skills, intensive listening skills, nonverbal communication clues), strategies of a group interaction, barriers to an effective GD, suggestions for self-improvement.

UNIT-II

Uses of dictionary: the meaning, spelling and pronunciation of a word, antonyms and synonyms, grammar, abbreviations and dictionary symbols, use of thesaurus.

Punctuation: end punctuation marks, internal punctuation marks, direct quotation punctuation marks, word punctuation, spacing with punctuation, too much punctuation.

Prepositions and phrasal verbs: prepositions and phrasal verbs prepositions, Idiomatic combinations, phrasal verbs, Vocabulary extension: context clues, word analysis, semantic change, word-formation methods, antonyms, synonyms, one word substitutions.

Effective use of words: word order, words: its meaning, avoid clichés

Common errors in English: errors in using nouns, errors in using pronouns, errors in using prepositions, errors in using verbs, errors in using gerund/infinitive, use an infinitive not a gerund, errors in using adjectives, errors in using adverbs, errors in using conjunction, errors in using punctuation, common errors due to commonly confused words

UNIT-III

Effective use of sentences: unity and emphasis on sentences, coordination and subordination. Paragraph writing: unity, coherence and development of the paragraph, types of paragraphs, paragraph development.

Essay writing: features of an essay, thesis statement, organization of the material, modes of developing essays, Revise and proofread essay, practice essay.

UNIT-IV

Reading Skill: mechanics of reading, types of reading, reading speed.

UNIT- V

Business correspondence: structure and layout of business letters, enquiry letter and important points, complaint and adjustment letters, complaint letter, important points, sales letter.

Resume writing: elements of resume, preparing a resume, writing a job application letter Presentation Skills: Tips for making presentations.

Text Books:

1. Koneru. A. (2011). English Language Skills. McGraw Hill

Reference Books:

1. Langan, J. (2010). College writing skills. McGraw-Hill, Eighth Edition.
2. Langan, J., & Jenkins, L. (2010). Ten steps to advancing college reading skills. Townsend Press.
3. Swan, M. (2016). Practical English Usage 4th edition.

Course Outcomes

Upon successful completion of the course, student will be able to:

- Develop listening skills to distinguish between letters and sound to use them effectively in speech during standard communication or debates and group discussions.
- Use dictionary and grammar effectively to overcome errors in reading and writing.
- Frame sentences and effectively use while writing paragraphs, essays, business letters and resumes etc.

Skill Development / Employability / Entrepreneurship

English communication Skills Lab

Cycle 1	**Cycle 2**
Why study spoken English	Debates
Phrases and Conversations	Group discussion
Letters and sounds	Presentation skills
Phonetics	Interview skills
Lab Exercises	e-Correspondence
Word accent and Stress shifts	Resume Writing
Telephone skills	Idioms
Intonation Body Language	Common errors in English
Grammar	
Vocabulary	

Course No: **CEMATH113**	Course Title: **Linear Algebra**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

- To solve systems of linear equations
- To compute standard forms of given matrices
- To compute eigenvalues and eigenvectors of 3x3 real matrices
- To compute quadratic forms and diagonalize matrices.
- To introduce complex matrices and obtain analogues of real matrix theorems

Course Contents

UNIT-I

Matrices, Matrix addition, Vectors and Scalar Multiplication, Matrix Multiplication, Rank of a matrix Symmetric, Skew-symmetric matrices Row Operation, Row Equivalence, Row Reduced Echelon Matrices

UNIT-II

Linear systems of Equations, Gauss Elimination, Determinant method: Cramer's Rule Solutions of Linear systems, Existence and Uniqueness, Inverse, Gauss-Jordan Method

UNIT-III

The matrix eigenvalue problem, Determining eigenvalues and eigenvectors, applications

UNIT-IV

Vector spaces,Linear Independence, Inner product spaces,subspaces Linear Transformations, Algebra of linear Transformations, Isomorphism between Matrices and Linear Transformations

UNIT- V

Similarity of Matrices, Diagonalization, Quadratic Forms, Canonical forms Complex Matrices and Forms Hermitian, Skew-Hermitian, Unitary matrices and Orthogonal matrices

Text Books:

1. Advanced Engineering Mathematics, Erwin Kreyszig ,10th Edition, John Wiley &Sons, 2012.
2. An Introduction to Linear Algebra, V. Krishnamurthy, V. P. Mainra, J. L. Arora, East West Press,2002

Reference Books:

1. Linear Algebra and its Applications, Gilbert Strang,
2. 4th Edition, Thomson Brooks, 2006

Course Outcomes

Upon successful completion of the course, student will be able to:

- Systematically solve sets of linear equations of small size
- Analyse eigenvalue/eigenvector problems and compute the same
- Apply the concept of rank for a variety of problems
- Perform diagonalization and related operations on quadratic forms

Course No: **CEPHY114**	Course Title: **Physics-I**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

Develop an understanding of the basic principles of Mechanics and wave optics and the application of the principles with emphasis on problem solving skills.

Course Content:

UNIT I

Conservation of Momentum: Collisions, Impulse-Momentum Theorem, Conservation of Momentum, Two-body collisions, Complex Motions, Many-particle systems, Center of Mass and Conservation of momentum

UNIT II

Rotational motion: Rotational Kinematics, Relation between linear and angular variables, Torque and Rotational inertia, rolling without slipping, Angular momentum for system of particles, Conservation of angular momentum

UNIT III

Conservation of Energy: Work, Energy and Power, Work-Energy theorem, Conservative forces, Potential energy, Conservation of mech. Energy, Work done by ext. force, Frictional force, Conservation of total energy

UNIT IV

Oscillators and Waves: Simple Harmonic Oscillator, Free, Damped and Forced Oscillations, Types of waves, Traveling waves, Interference of waves, Standing waves etc

UNIT V

Optics: Double-Slit interference, Interference due to thin films, Single Slit diffraction Intensity calculation, Multiple slits, Diffraction gratings, Dispersion and Resolving power

Text Books:

1. Robert Resnick, David Halliday and Kenneth S. Krane "Physics", Vol. I and II, 5th Edition John Wiley Inc, Singapore, 2002.

Reference Books:

1. Robert Resnick, David Halliday and Jearl Walker "*Fundamentals of Physics*", 6th Edition, John Wiley Inc, Singapore, 2001.
2. Cutnell and Johnson, "*Physics*", 5th Edition, John Wiley, Asia, 2001.

Course Outcomes

- Apply conservation of linear momentum to two/many body systems in lab and centre of mass frame of reference.
- Apply conservation of angular momentum to two/many body systems in lab and centre of mass frame of reference.
- Apply the conservation of energy principle and find the work done by a body under the influence of conservative/non-conservative forces.
- Understand the types of oscillations/waves and the fundamental equations governing them.
- Understand the physics of the most important phenomena in wave optics, namely, interference, diffraction.

Skill Development / Employability / Entrepreneurship

This being a first level course, the following aspects are included into the curriculum to enhance the analytical, mathematical and logical thinking abilities of the students. These following tasks will help them to apply physical concepts to various real life situations and areas of engineering and enhance their intuitive abilities with respect to concepts taught in this course.

1. Assignments: The course has assignments as a component of evaluation and these are spread over the entire semester. In this, students are given numerical and situational questions are given, related to the concepts taught.

a) These will help them to acquire problem solving and critical thinking skills and reasoning abilities allowing them to apply the concepts of physics to real life problems
b) Social and organizational skills like time management, team work are the skills which can be acquired

2. Experiments: The scientific measurement course which runs in parallel to this course has experiments related to the concepts taught in the physics courses. The experiments relavent to this course are

1. Graphical analysis
2. Error analysis
3. Simple Pendulum
4. Compound Pendulum
5. Fly wheel
6. Law of parallelogram

The skills that can be developed include

1. Associating the experiment to the relevant concepts
2. Understanding the principles and the working of various equipment and tools used.
3. Correct usage of equipment
4. data collection and organization
5. graphical and numerical analysis of data
6. interpretation of experimental results and arriving at conclusions
7. Writing a technical report

   In addition, the social and organizational skills developed are team work, coordination, time management, collaboration and communication.

Course No: CETA115	Course Title: **Engineering Graphics**	L	P	U
		2	4	4

Course Learning Objectives

- To enhance the visualization and imagination abilities
- To promote creative thinking for solving engineering problems.
- To take data and transform it into drawings.
- To learn basic Auto CAD skills
- To learn basic Engineering formats

Course Contents

UNIT-I

Drawing conventions & Practices, Dimensioning, Geometrical terms, bisecting a line, angle, arc. Regular polygons, curves.

Introduction to CAD, limits, toolbars, starting new drawing, saving new drawing, etc. Simple commands like line, circle, polygon, etc and formatting commands, 2D exercises

UNIT-II

First and third angle projections, Multi view drawing from pictorial views. Projections of points, Projection of lines, true lengths, true inclinations, shortest distances between lines.

UNIT-III

Projections of planes, Primary and Secondary auxiliary views, true shapes. Projections of solids inclined to both the planes.

UNIT-IV

Construction of Sectional views of truncated solids, Development of surfaces - Parallel Line method, Radial Line Method, Intersection of surfaces

UNIT- V

Construction of isometric views from orthographic projections, Missing Views- identifying missing Views.

Text Books

1. Engineering Drawing with an Introduction to AutoCAD, D.A.Jolhe, TMH, 5th edition, 2010
2. Fundamentals of Engineering Drawing, Warren J. Luzzader & Duff J. M., PHI, 11th edition., 2015

Reference Books

1. Engineering Drawing, K.Venugopal, New Age International (P)., 2006
2. Engineering Drawing, N.D.Bhatt, V.M.Panchal , Charotar Publishing, 53rd edition, 2014
3. Engineering Graphics with Auto CAD 2002", James D. Bethune, PHI, 2002

Course Outcomes

Upon successful completion of the course, student will be able to:

- To specify units, limits of drawing. It also includes creating and editing 2 D computer geometry, and constructing lines, arcs, chamfers and fillets.
- Draw parallel and perpendicular lines, and to construct circles, arcs, tangencies and curves.
- Apply standard vertical, horizontal, radius, diameter, and other dimensions to an engineering drawing.
- Generate Engineering Drawings using drafting tools
- Visualize geometrical solids in 3D space through exercises in Orthographic Projections
- Draw auxiliary views and isometric views
- Develop the surfaces of geometrical solids

Skill Development / Employability / Entrepreneurship

Name of the Laboratory: Engineering Graphics	
Sl. No.	**List of Topics for practice**
1	Methods of dimensioning
2	Geometric constructions
3	Construction of engineering curves, conics and scales
4	Orthographic Projections
5	Projections of Points and Lines
6	Auxiliary Views
7	Shortest Distance between graphical elements
8	Obtaining true shape of planes
9	Projections of Planes and Solids
10	Sections of solids
11	Development of Surfaces
12	Intersection of Surfaces
13	Isometric Views
14	Perspective projections

Course No: **CETA116**	Course Title: **Computer Programming I**	L	P	U
		3	0	3

Course Learning Objectives

- To introduce the basic concepts of UNIX operating systems.
- To understand the fundamentals of Problem Solving.
- To learn how to design and program Python applications.
- To learn how to design object-oriented programs with Python classes.
- To learn how to use exception handling in Python applications for error handling.

Course Contents

UNIT-I

Introduction to UNIX: Multi-programming, Time sharing, personal computer, and UNIX operating system, etc. **General Purpose Utilities & File System:** cal, date, and echo, etc directory related commands: pwd, cd, mkdir, rmdir, file related commands.**Simple and Advanced Filters:** head, tail, paste, sort, uniq, grep and sed, etc, **Basics of Problem solving: Building** blocks of algorithms (statements, state, control flow, functions), notation.

UNIT-II

Algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion), Example: find minimum in a list, insert a card in a list of sorted cards, and Towers of Hanoi etc. **Introduction to python:** History of Python, Need of Python Programming, Applications Basics of Python Programming, Data Types: Declaring and using Numeric data types.

UNIT-III

Data Types string data type and string operations, fining list and list slicing, Tuple, string, list and dictionaries **Python Program Flow Control:** if, else and else if, for loop, while loops continue, and break **Python Sequences:** String in build methods, List and dictionary manipulation, Programming using string, list and dictionary

UNIT-IV

Python Functions: Organizing python codes using functions **Python Modules:** Organizing python projects into modules, importing own module as well as external modules **Python Packages:** Lambda function, Programming using functions, modules and external packages

UNIT-V

Python Object Oriented Programming: Class, object and instances Constructor, class attributes and destructors, Real time use of class in live projects Inheritance, overlapping and

overloading operators, Adding and retrieving dynamic attributes of classes, **Exception Handling:** Avoiding code break using exception handling, Safe guarding file operation is using exception handling, Handling and helping developer with error code.**AWS Educate:** Introduction to Cloud Computing, Overview of Cloud Models, Cloud Inventor Certification.

Text Books:

1. Learning Python, Mark Lutz, Orielly, 5 Edition, 2013.

Reference Books:

1. How to Think Like a Computer Scientist: Learning with Python 3, Peter Wentworth, Jeffrey Elkner, Allen B. Downey and Chris Meyers, 3rd Edition, 2019.
2. Fundamentals of Python: First Programs, Kenneth A. Lambert, Cengage, 1st Edition, 2011.
3. Charles Dierbach, —Introduction to Computer Science using Python: A Computational Problem- Solving Focus, Wiley India Edition, 2013.
4. UNIX Concepts and Applications, Sumitabha Das, TMH, 4th edition, 2006.

Course Outcomes

After successful completion of the course student will be able to

- To execute shell commands in Linux.
- Understand, analyze and solve problems using algorithmic approach.
- Write Python programs using conditional statements, loops and functions.
- Use Python data structures –- lists, tuples, dictionaries.
- Do input/output with files in Python.
- Understand the Importance of cloud computing and its applications.

COMPUTER PROGRAMMING – I

LIST OF EXPERIMENTS

1. Programs to implement basic I/O operations.
2. Programs to implement conditional statements (if, if-else etc...).
3. Programs to implement loops (while, do while and for).

4. Programs to implement single and multidimensional array.
5. Programs to implement different types of functions.
6. Programs to implement basics of pointers.
7. Programs to implement structures and unions.
8. Programs to implement various string handling functions.
9. Programs to implement file I/O.
10. Programs to implement dynamic memory allocation functions.

Course No: CEEVS117	Course Title: **Environmental Science**	L	P	U
		2	0	2

Course Learning Objectives

- To understand the fundamentals of environment
- To understand the science of interrelationship between the living organisms and their environment
- To understand the relationship between the population and the environment.
- To have an understanding about the land resources, water resources, air recourses and their pollution, control methods
- To have an understanding about the waste management.
- To know about the environmental policies and laws.

Course Contents

UNIT-I

Meaning of Environment, Types and components of environment, nature and scope of the subject, Need for environment studies, goals of environmental education, environmental education programs, Man-environment relationship, biogeochemical cycles.

UNIT-II

Concept of ecology, Subdivisions and developmental phases of ecology, Concept of the ecosystem, Structural and functional aspects of ecosystem, Productivity concept of ecosystem, food chains and food webs in ecosystems, Ecological energitics, ecological interactions, Population ecology, Population characteristics, Population dynamics, population regulation.

UNIT-III

Nature and importance of soil, Formation of soil, soil properties, Nutrients in soil soil erosion, contamination of soil, Land use, Waste lands, Desertification.Introduction, properties of water, hydrological cycle, Water resources, waste water of India-its future, Water pollution, Pollution of ground water.

UNIT-IV

Origin of the atmosphere, composition of the air, structure of the atmosphere, Air pollution, Effects of air pollution on human health, flora and fauna, Global effects of air pollution.

UNIT-V

Energy, sources of energy, conventional and non conventional sources of energy, Waste water management, biomedical waste management, Air pollution control, Environmental policies and laws.

Text Books:

(1) A Text Book of Environment, Agarwal, K.M., Sikdar, P.K and Deb.S.C Mac Millan India Ltd., 2002.

Reference Books:

(1)A Text Book on Environmental Science, V. Subramanian, Third reprint, Narosa Publishing House, 2005.

(2) Environment, Raven, Peter H., and Linda R. Berg. 3rd ed., Fort Worth: Harcourt College Publishers, 2001.

Course Outcomes

After successful completion of the course student will be able to

- Understand the natural environment and its relationships with human activities.
- Characterize and analyze human impacts on the environment.
- Integrate facts, concepts, and methods from multiple disciplines and apply to environmental issues.
- Acquire practical skills; devise methodologies for scientific problem-solving, including familiarity with laboratory and field instrumentation.
- Understand and implement scientific research strategies, including collection, management, evaluation and interpretation of environmental data.
- Design and evaluate strategies, technologies, and methods for sustainable management of environmental systems and for the remediation or restoration of degraded environments.

Skill development / employability / entrepreneurship

List of experiments in environmental science

sl. No	Name of the experiment
1	To determine total hardness of water sample by edta method
2	Determination of oxygen dissolved in water by winkler's method
3	Estimation of chloride content in water by argentometric method [mohr's method]
4	Estimation of carbonates and bicarbonates in water sample
5	Determination of hexavalent chromium in water samples by colorimetric method
6	Determination of acid value of lubricating oil
7	Determination of percentage of copper in brass
8	Determination of viscosity of lubricating oil by redwood viscometer

Course No: **CEES121**	Course Title: **Thermodynamics**	L	P	U
		3	0	3

Course Learning Objectives

- To study the properties of pure substances and their use in widely used devices such as steam power plant, fuel cells, refrigerator, Turbine and Pumps.
- To know how to use the thermodynamic tables to identify the phase of a given state of matter and estimate the quality of saturated liquid vapor mixture
- To understand the concept of heat and work and estimate the same at the boundary of real time systems
- To know the application of first law for closed systems and the interpretation of thermodynamic properties such as Internal Energy and Enthalpy and determine their change during a process; To know the application of first law for control volume systems and to understand the transient process
- To know the application of second law of thermodynamics and to know the thermodynamic temperature scale; To understand the concept of entropy and entropy change in solid, liquid and liquids and gases
- To delimit the application of second law for control volume systems and to understand the concept of efficiency of engines

Course Contents

UNIT-I

Introduction to some devices like steam power plant, fuel cells etc.; Thermodynamic system, properties and state, processes and cycles, force, energy, pressure, specific volume, Zeroth law and numerical problems; Phase equilibrium, independent property, compressibility factor; Study of steam tables and solving numerical problems.

UNIT-II

The concept of heat and work: Definition of work, understanding of piston work; Understanding of heat concept, modes of heat transfer and numerical problems on it; Definition of first law, first law for a change of state, internal energy and enthalpy; Specific heat, internal energy and enthalpy of an ideal gas, first law as a rate equation and numerical problems

UNIT-III

Application of first law for control volume systems: Conservation of mass in control volume, first law for a control volume, SSSF process and examples on it viz. Heat exchangers, Nozzles and diffusers, Throttle, Compressor & Pump, Steam Power Plant and Refrigerator; Transient process: Study of USUF process, numerical problems on it

UNIT-IV

Application of second law of thermodynamics: Heat engines and refrigerators, the Clausius and the Kelvin plank statement, reversible and irreversible processes, study of Carnot cycle and efficiency of a cycle; Thermodynamic and ideal gas temperature scale, numerical problems on it

UNIT-V

The concept of entropy: Clausius inequality, study of entropy as a property, thermodynamic property relations, entropy change of reversible and irreversible processes, entropy generation and principle of increase of entropy; Entropy change in solid, liquid and gases, polytropic process, entropy as rate equation, numerical problems;Second law for control volume, study of entropy for both reversible and irreversible processes, principle of increase of entropy; Understanding efficiency and related numerical problems

Text Books:

1. Fundamentals of Thermodynamics ISV, Sonntag R E & Claus B John Wiley, 7th Edition, 2009.

Reference Books:

1. Thermodynamics, P.K.Nag, Tata Mc Graw Hill Publishing Company limited, New Delhi, 3rd Edition, 2004.
2. Fundamentals of Engineering Thermodynamics, Michael J Moran and Howard N Shapiro, John Wiley, 5th Edition, 2004.
3. Thermodynamics- An Engineering Approach, Yunus A. Cengel and Michael A Boles, Tata Mc Graw Hill Publishing Company limited, New Delhi, 5th Edition, 2006.

Course Outcomes

Upon successful completion of the course, student will be able to:

- *Identify* and explain the basic concepts of thermodynamics like system, properties and their quantification
- *Calculate* thermodynamic properties using steam tables and *analyze* the processes on T-v diagrams to solve advanced engineering problems
- *Explain* the concept of thermodynamic work. *Calculate* and *compare* work for systems executing different thermodynamic processes or different thermodynamic cycles
- *State* and *apply* the first law of thermodynamics for closed and open systems undergoing different thermodynamic processes. *Evaluate* the performance of steam power plants, refrigeration plants and their components
- *Evaluate* the feasibility of a thermodynamic cycle using the second law of thermodynamics for typical engineering problems
- *Quantify* the second law of thermodynamics for a cycle by establishing the inequality of Clausius. *Apply* the inequality of Clausius and *establish* the property, entropy of a system. *Apply* principle of increase of entropy to *evaluate* the feasibility of a thermodynamic process

Course No: CEAO122	Course Title: **Probability& Statistics**	L	P	U
		3	0	3

Course Learning Objectives

- This course introduces the concept of probability and enables the student to become familiar with probabilistic concepts,
- A selected study of discrete & continuous distributions and their characteristics

Course Contents:

UNIT-I

Sample Spaces and Events, Counting, Probability, The Axioms of Probability, Some elementary Theorems,Conditional Probability, Bayes' Theorem

UNIT-II

Random Variables, The Binomial Distribution, The Hypergeometric Distribution, The Mean and the Variance of a Probability Distribution, Chebyshev's Theorem, The Poisson Distribution, Poisson Processes, The Geometric and Negative Binomial Distribution, The Multinomial Distribution.

UNIT-III

Continuous Random Variables, Normal Distribution, Normal Approximation to theBinomial Distribution, Other Probability Densities, the Uniform Distribution, Log-Normal Distribution, Gamma Distribution, Beta Distribution, TheWeibull Distribution.

UNIT-IV

Joint Distributions—Discrete and Continuous, Moment Generating Functions.

UNIT- V

Populations and Samples, The Sampling Distribution of the Mean (σ known), The Sampling Distribution of the Mean (σ unknown), The Sampling Distribution of the Variance, representations of the Normal Theory Distributions.

Text Books:

1. Miller & Freund's Probability & Statistics for Engineers: Johnson Richard A., Eastern. Economy Edition, PHI, 7th Edition, 2006

Reference Books:

1. Mathematical Statistics: Freund, J.E.: Prentice Hall, 6th Edition,2002
2. Applied Statistics and Probability for Engineers: Douglas C. Montgomery, & George C. Runger, John Wiley & Sons, Inc., 3rd Edition, 2004

Course Outcomes

Upon successful completion of the course, student will be able to:

- Calculate probabilities and other relevant quantities by selecting suitable probability distributions.
- Work with certain multivariate distributions and derive marginal and conditional probability distributions.

Course No: CEMATH123	Course Title: **Higher Calculus**	L	P	U
		3	0	3

Course Learning Objectives

- Use calculus to study the paths, velocities, and accelerations of moving bodies
- To study the applications of derivative motion in space
- To understand the frame of mutually orthogonal unit vectors
- To study the functions of more than one independent variable, the way to graph them
- To understand the idea of directional derivatives and the equations of tangent planes and normal lines
- To find extreme values of functions of several variable
- To find the volume of three dimensional shapes using triple integrals
- To calculate the work done by variable forces alone paths in space and rates at which fluids flow along curves and cross boundaries
- To describe the relationship between the way an incompressible fluid flows across the boundary of a plane region and the way it moves inside the region
- To understand Infinite summations

Course Contents:

UNIT-I
Limits, Continuity and Differentiability of vector functions, Velocity & Unit tangent vector, Normal vectors, Curvature, Torsion and the binormal, Tangential & normal components of velocity and acceleration.

UNIT-II
Functions of several variables, Limits and continuity in higher dimensions, Partial derivatives, differentials, linearization, Taylors formula for two variables, Chain rule for derivative, Directions derivatives, Gradient and Tangent planes, Maxima,Minima with application, Polar coordinates: Definition, graphing and conics.

UNIT-III
Double integrals in rectangular coordinates, Double integrals in polar coordinates, Cylindrical and spherical coordinates, Triple integrals in rectangular, cylindrical and spherical coordinates (moments, masses and centroids), Substitution in multiple integrals, Jacobian.

UNIT-IV
Lines integrals, potential & Conservatives fields, Green's, Gauss, and Stokes theorems, Surface area and surface integrals.

UNIT-V
Infinites series, convergence & divergence, Integral, Comparison & Ratio Tests, Alternating series and absolute Convergence.

Text Books:

Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley &Sons, 2012.

Reference Books:

1. Thomas G.B. and Finney R. L., Calculus and Analytic Geometry, Pearson Education, 11th ed., 2008.
2. Salas S. L., Einar Hille and Garret J. Etgen, Calculus (One and Several variables), John Wiley, 8th Edition, 1999.

Course Outcomes

After successful completion of the course student will be able to

- Students will learn important tools of calculus in higher dimensions.
- Engineering applications will help the student appreciate the role of the course in B.Tech
- Geogebra software exposure for mathematical problem solving
- Students will become familiar with 2- and 3-dimensional coordinate systems.
- Students will also learn how to represent motion of objects in 3D using vector functions, how to represent velocity and acceleration using vector projections into tangential and centripetal coordinates of acceleration, and how to characterize curves in space by computing arc length and curvature.
- For functions of 3D surfaces, students will be able to characterize aspects of surfaces and volumes using partial derivatives and the gradient vector.
- Partial derivatives will also be used to describe approximating tangent planes to points on surfaces, and how to compute derivatives of multi-dimensional function compositions can be performed using a multidimensional version of the chain rule.
- Evaluating Double and Triple Integrals.

Course No: **CEPHY124**	Course Title: **Physics-II**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

Develop an understanding of the basic principles of electromagnetism and the application of the principles with emphasis on problem solving skills.

Course Content:

UNIT I

Coulomb's law, continuous charge distributions. Electric field of point charges, continuous charge distributions, field lines, point charge and dipole in an electric field. Flux of a vector field, flux of electric field, Gauss' law, its applications, Gauss' law and conductors.

UNIT II

Electric potential, potential due to point charges and continuous charge distribution, calculating field from potential, potential from field, equipotential surfaces, potential of a charged conductor. Types of materials, conductor in an electric field, Ohm's law, Ohmic materials. Capacitance, calculation of capacitance, capacitors in series and parallel, energy storage in an electric field, capacitor with dielectric

UNIT III

Magnetic interactions, magnetic poles, force on a moving charge, circulating charges, force on a current carrying wire, Hall effect, torque on a current loop. Magnetic field due to moving charge, due to current, parallel currents, field of a solenoid, Ampere's law.

UNIT IV

Faraday's law, Lenz' law, motional emf, induced electric fields. Magnetic dipole and force on a magnetic dipole in a non-uniform field, Magnetization, Gauss' law for magnetism. Inductance, calculating the inductance, energy storage in magnetic field

UNIT V

Equations of electromagnetism, Maxwell's equations, induced magnetic fields and Displacement currents. Concept of photons, Thermal radiation, photoelectric effect. Matter waves, de Broglie's hypothesis, experimental verification by Davison and Germer experiment, uncertainty principle.

Text Books:

1. Physics, Robert Resnick, David Halliday and Kenneth S. Krane Vol. 2, John Wiley, 5th ed., 2002.

Reference Books:

1. Fundamentals of Physics, Robert Resnick, David Halliday and Jearl Walker, John Wiley, 6th ed., 2001.
2. Physics, Cutnell and Johnson, John Wiley, 5th ed., 2001.
3. Introduction to Electrodynamics, David J Griffiths, PHI, 3rd ed., 2002.

Course Outcomes

Upon successful completion of the course student will be able to:

- Understand the main concepts of electromagnetic theory
- Develop the mathematical framework to explore electricity and magnetism
- Apply the mathematical framework quantitatively for solving relevant problems
- Appreciate qualitatively how they play a role in many aspects of daily life.

Course No: **CETA125**	Course Title: **Scientific Measurements**	**L**	**P**	**U**
		0	**4**	**2**

- **List of Physics experiments:**

No.s	Experiments	Duration
1.	Vernier calipers and Screw gauge	1:40 H
2	Graphical Analysis	1:40 H
3.	Error analysis and Graph drawing	1:40 H
4.	Compound pendulum	1:40 H
5.	Parallelogram law of forces and Lami's Theorem	1:40 H
6.	Dispersive power of the material of the a prism	1:40 H
7.	Fly Wheel	1:40 H
8.	Diffraction Grating	1:40 H
9.	Magnetic Field along the Axis of Current Carrying Coil – Stewart and Gees Method	1:40 H
10	Hall Effect	1:40 H

- **List of Chemistry experiments:**

No.s	Name of the Experiment	Duration
1.	Estimation of iron (Fe^{+2}) by Dichrometery	1:40 H
2.	Estimation of copper by Iodometry	1:40 H
3.	pH curve of an Acid Base titration	1:40 H
4.	Dissociation constant of a weak electrolyte by conductometry	1:40 H
5.	Colorimetric estimation of Iron	1:40 H
6.	Estimation of strength of oxalic acid using potassium permanganate as an intermediate solution	1:40 H
7.	Synthesis of Nickel(II)-Dimethylglyoxime complex	1:40 H
8.	Determination of rate constant and activation energy of the given ester catalysed by an acid	1:40 H

Course No: **CETA126**	Course Title: **Workshop Practice**	L	P	U
		2	4	4

Course Learning Objectives

1. To learn how the physical artifacts we use are manufactured and gain technical knowledge and skills.
2. The practical knowledge is supplemented by the lectures to provide the knowledge and genesis of various manufacturing processes.
3. To check the dimensional tolerances of machined components and acquire knowledge of handling basic machine tools for different applications.
4. To develop skills required for machining components by advanced manufacturing methods like CNC programming.
5. To analyse the difference between conventional and non-conventional manufacturing processes.

Course Contents

UNIT-I

Basics of Manufacturing:Basics, ethics and safety in workshop, Material properties, fracture, selection, mechanical properties, common engineering materials, Metrology, quality, Inspection measuring and gauging, Limits & fits, Examples.

UNIT-II

Metal Cutting Basics: Metal cutting, Machine tools, Cutting tools, Tool material, Types of tools, Tool geometry, Chips, Cutting fluid, Tool life, Lathe machine tool, Turning and other operations,Operating conditions, MRR, Examples.

UNIT-III

Machine Shop Activities:Introduction to other Machines, tools, operating conditions, Shaping & planing machines, Milling machine, types of milling operations, Operating conditions, Milling operations, MRR, Abrasive machine, abrasives, Grinding, Grinding wheel, Grinding machines, fine finishing operations.

UNIT-IV

Sheet metal working: Production of parts by forming processes, Metal forming processes, rolling, extrusion, forging, Punches and dies, Sheet metal operations.

UNIT- V

Mechanical joining processes: Production of parts by casting processes, Mechanical joining, Welding (arc, gas), Soldering, Brazing, Fasteners, Examples, Application of Computers in Manufacturing, CNC programming for machining components using co-ordinate system, Automation, Comparison between conventional machines and NC machines.

Text Books:

1. B S Nagendra Parashar and R K Mittal, Elements of Manufacturing Process, Prentice Hall of India, 2011, 10th reprint.

Reference Books:

1. Campbell J.S., Principles of Manufacturing Materials and Processes, Tata Mc-Graw-Hill, New Delhi, 1999 print.
2. Serope Kalpakjain, Steven Schmidt, Manufacturing Engineering and Technology, Pearson, 7th Edition, 2014.

Course Outcomes

Upon successful completion of the course, student will be able to:

- The course will provide an overview of the techniques and applications of basic manufacturing processes used for producing finished articles from raw materials.
- The course is practice-orientated and requires that basic skills in handling of tools, machines and machine tools used in different manufacturing processes are acquired through the hands-on experience.
- Much of the knowledge in the course is conceptual and this knowledge will be useful in whatever discipline the students are going to specialize.

Skill Development / Employability / Entrepreneurship

Name of the Laboratory: Workshop	
Sl. No.	**Name of the Experiment**
1	Metrology (To measure the Linear and angular measurements with various Measuring Instruments)
2	Fitting (To make a 'L' fit joint by using Mild steel plate)
3	Tin Smithy (To make a Square Box by using Galvonised Iron sheet)
4	Carpentry (To make the Dove tail lap joint by using wooden teak wood)
5	House wiring (To connect and performing the various connections)
6	Machine Shop (To make different operations by using Mild steel rod)
7	Welding (To make a different welding joints by using Arc welding machine)

8	Black Smithy (To make different shapes by using mild steel square rods in Black smithy)
9	Foundry (To make different moulded shapes by using different patterns)
10	Programming and performing on CNC Lathe Machine
11	Plumbing (Demonstration)
12	Demonstration on different machines

Course No: CETA127	Course Title: **Computer Programming II**	L	P	U
		3	0	3

Course Learning Objectives

- To introduce object-oriented programming (OOP) using the Java programming language.
- To learn how to use the Java SDK environment to create, debug and run simple Java programs.
- To introduce Arrays, Abstract Classes, Exception Handling, File I/O and Multithreading.
- To provide hands-on experience in developing Java applications using database connections.

Course Contents

UNIT-I

Introduction to Java: Java Development Kit, Keywords, Identifiers, Class libraries, Key Attributes of OOP, Primitive Data types, Literals, Variables, Scope and lifetime of variables, Operators, Type casting, Operator precedence, Expressions. If Statement, Loops, Nested loops. **Class Fundamentals**: Objects, Reference Variables and Assignment, Methods, Constructors, Parameterized Constructors, new operator, Garbage collection, finalizers, and this keyword.

UNIT-II

Arrays: Multidimensional arrays, Alternative Array declaration syntax, using length member, Constructing Strings, Operating on Strings, Array of Strings, Using a string to control switch statement, Command line arguments, Conditional operator. Controlling access to class members, passing objects to methods, Returning Objects, Method Overloading, Overloading Constructor, Recursion, static keyword, Nested and inner classes, vararags

UNIT-III

Inheritance: Basics, Member access, Constructor and Inheritance, using super keyword, multi-level hierarchy, method overriding, abstract classes, creating and implementing an interface, multiple interfaces. **Package:** Packages and member access, Importing packages, static import

UNIT-IV

Exception: Exception Hierarchy, Multiple catch clauses, catching sub class exception, nested try blocks, throwing an exception, finally, throws, Java's Built in Exceptions. Introduction to I/O, Byte stream and Character stream, Reading and writing files using

byte stream, Multithreading: Fundamentals, Life Cycle, Thread class, Runnable Interface, Multiple Threads, Thread priorities, Synchronization.

UNIT-V

Database Connectivity: Overview of RDBMS, Call Level Interface (CLI), JDBC, JDBC Architecture, types of JDBC Drivers, JDBC Connection using Statement, Prepared Statemen and Callable Statement, Scrollable and Updatable Result Set, Inserting & Fetching from BLOB Columns, Managing Transactions in JDBC. **Exploring My Cloud Powered by AWS:** Virtualization, Types of Virtualization, Cloud Containers, Client server computing, Big Data, Data Analytics, Data Visualization, DBMS, Relational and Non-Relational DBMS, Data Warehouse Basics, HTML basics to design a Web Page, QoS Factors, File System, Load Balancing, and Domain Name System.

Text Books:

1. Java Fundamentals A Comprehensive Introduction, Herbert Schildt, Dale Skrien. Tata McGraw Hill, 1st Edition, 2013.

Reference Books:

2. Java The Complete Reference, Herbert Schildt, 7th Ed. TataMcGrawHill (2007)
3. Programming with Java A Primer, E. Balaguruswamy,3rd Ed,TataMcGrawHill 2007
4. Object Oriented Programming with Java: Essentials and Applications, Rajkumar Buyya, Thamarai Selvi Somasundaram, Xingchen Chu, 1st Ed. TataMcGrawHill 2010
5. Java How to Program, Paul Dietel and Hervey Dietel, 9th Edition

Course Outcomes

After successful completion of the course student will be able to

1. Understand object-oriented programming concepts and basics of java programming
2. Solve real world problems using OOP techniques
3. Understand the use of abstract classes, packages and interfaces.
4. Expand their knowledge of AWS cloud computing models, services and tools through narrative-based scenarios and short interactive tasks.

Skill Development / Employability / Entrepreneurship

COMPUTER PROGRAMMING – II

LIST OF EXPERIMENTS

- Programs to implement pointers and its operations.
- Programs to implement pointers and arrays.
- Programs to implement pointers and strings.
- Programs to implement pointers and structures.
- Programs to implement linked list and its operations.
- Programs to implement stack using arrays.
- Programs to implement stack using pointer.
- Programs to implement queue using arrays.
- Program to implement queue using pointers.
- Programs to implement searching techniques.

Course No: CEES211	Course Title: **Electrical Sciences I**	L	P	U
		3	0	3

Course Learning Objectives

- To equip the students with a basic understanding of Electrical circuits and machines for specific types of applications.

Course Contents

UNIT-I

DC Circuits, Kirchhoff's Laws, Mesh & Nodal analysis, D.C transients- First order &second order circuits- The natural and complete Response

UNIT-II

Thevenins & Nortons theorem, Linearity, Superposition, Maximum power transfer theorems, Star- Delta transformation and Concept of Duality

UNIT-III

AC Circuits: Current, voltage, power, - circuit elements R, L and C, phasor diagram, impedance, real and reactive power in single phase circuits, Steady state analysis of AC circuits using Phasor Method, Resonance in series and parallel circuits

UNIT-IV

Transformers- Introduction, Ideal transformer with and without core losses, Transformer circuit model, Determination of parameters and voltage regulation &efficiency.

UNIT- V

Induction motor, circuit model & Rotating magnetic field, Torque-Slip characteristics, Synchronous machines and and applications.

Text Books:

1. Hughes revised by Mckenzie Smith with John Hilcy and Keith Brown, *'Electrical and Electronics Technology', 8th Edition, Pearson, 2012*

Reference Books:

1. D. P. Kothari and I. J. Nagrath, *Basic Electrical Engineering*,Tata McGraw Hill, 2009, Third edition
2. Leonard Bobrow, *Fundamentals of Electrical Engineering*, Oxford University Press 2nd edition 2005
3. W.H.Hayt, J.E. Kemmerly, *Engineering circuit analysis*, McGraw Hill Company, 6th Edition, 2000.

Course Outcomes

- The students shall develop an intuitive understanding of the circuit analysis, basic concepts of electrical machines and be able to apply them in practical situation.

Skill Development / Employability / Entrepreneurship

Electrical Science :

S No	Name of the Experiment
1	Study of measuring instruments
2	Verification of KCL and KVL
3	Super position theorem
4	Maximum power transfer theorem
5	Thevenin's and Norton's theorem
6	Sinusoidal response of RL circuit
7	Sinusoidal response of RLC circuit
8	OC and SC test on single phase transformer
9	Speed control of DC shunt motor
10	Load test on single phase transformer

Course No: CEES212	Course Title:Digital Electronics	L	P		U
		2	2		3

Course Learning Objectives

- To obtain the knowledge of basic tools for the design of digital circuits.
- To understand the methods, procedures suitable for a variety of digital computers and related applications.

Course Content

UNIT-I

Review of number systems-representation-conversions, Boolean algebra- theorems, sum of product and product of sum simplification, canonical forms-minterm and maxterm.

UNIT-II

Simplification of Boolean expressions-Karnaugh map, completely and incompletely specified functions, Quine Mc Cluskey method, Implementation of Boolean expressions using universal gates.

UNIT-III

Combinational logic circuits- adders, subtractors, BCD adder, ripple carry look ahead adders, parity generator, decoders, encoders, multiplexers, demultiplexers, Realization of Boolean expressions- using decoders-using multiplexers. Memories – ROM- organization, expansion. PROMs. Types of RAMs – Basic structure, organization, Static and dynamic RAMs, PLDs, PLAs, PALs, Dual Data RAM (DDR), FPGA

UNIT-IV

Sequential circuits – latches, flip flops, edge triggering, asynchronous inputs. Shift registers, Universal shift register, applications. Binary counters – Synchronous and asynchronous up/down counters, mod-N counter, Counters for random sequence.

UNIT-V

Synchronous circuit analysis and design: structure and operation, analysis-transition equations, state tables and state diagrams, Modelling- Moore machine and Mealy machines, Serial binary adder, sequence detector, state table reduction, state assignment. Hazard; Overview and comparison of logic families.

Text Books

1. M Morris Mano, *Digital Design*, 5th edition, Pearson Education ,New Delhi,2013.

Reference Books

1. Charles H. Roth, Jr, Fundamentals *of Logic Design*, 5thEdition, CENGAGE Learning, India, 2004.
2. ZVI Kohavi and Niraj K Jha, *Switching and Finite Automata Theory*, 3rdEdition, Cambridge University Press, New Delhi, 2011.

Course Outcomes

Upon successful completion of the course, student will be able to:

- Realize complex logic functions utilizing programmable logic.
- Apply the digital design principles in real time applications.

Skill Development / Employability / Entrepreneurship

Electronics:

S No	Name of Experiments / Exercises
1	Study of Electronic Components and Test Equipment's
2	Study of CRO
3	Characteristics of pn junction diode
4	Zener diode characteristics and its regulation
5	Non-linear wave shaping – clippers
6	Non-linear wave shaping – clamper
7	Transistor common-base configuration characteristics
8	Transistor common-Emitter configuration characteristics
9	Half-wave rectifier with and without filters
10	Full wave rectifier with and without filters

Course No: CEES213	Course Title: **Engineerng Mechanics**	L	P	U
		3	0	3

Course Learning Objectives

- To introduce the basic principles of engineering mechanics.
- To introduce concepts of equilibrium of bodies at rest and in dynamics, the motion of bodies and the forces that cause them.
- To emphasize analysis and application to practical engineering problems.
- To promote thinking and problem solving capacity of students.

Course Content

UNIT I

Concurrent forces on a plane – composition, Resolution and equilibrium of concurrent coplanar forces, Methods of moment, Friction, Parallel forces in a plane – General case of parallel forces,

UNIT II

Center of parallel forces and center of gravity- centroids of composite plane figure and curves, Moments of inertia - Plane figure with respect to an axis in its plane and perpendicular to the plane – parallel axis theorem

UNIT III

General case of forces in a plane – composition and, equilibrium of forces in a plane –plane trusses – method of joints and method of sections, Principle of virtual work equilibrium of ideal systems

UNIT IV

Rectilinear Translation – Kinematics – Principles of Dynamics - D' Alembert's Principle- Momentum and impulse- work and energy- impact

UNIT V

Curvilinear translation – Kinematics – equation of motion – projectile – D' Alembert'sPrinciple for curvilinear motion – Kinetics of Rotation of rigid body

Text Books

1. S Timoshenko & D.H Young , "*Engineering Mechanics*"McGraw Hill, 4th Edition

Reference Books

1. Fundamental of Engineering Mechanics: S. Rajesekharan& G. SankaraSubramanium ; Vikas Publishing House Pvt. Ltd., (2nd Edition)
2. Engineering Mechanics : K.L Kumar; Tata McGraw Hill, 4th Edition
3. A K Tayal, Engineering Mechanics, Umesh Publication, Delhi, 14th Edition.

Course Outcomes

Upon successful completion of this subject students should be able to:

- Apply the concepts of equilibrium to system of forces on rigid bodies.
- Simplify and clarify mechanics problems using free body diagrams.
- Analyze equilibrium of rigid bodies with frictional forces.
- Determine force couples, centre of gravity and moment of inertia of rigid bodies.
- Determine simple dynamic variables and solve simple dynamic problems involving kinematics, energy and momentum.
- Analyze simple statically determinate structures such as beams, pin jointed trusses and pin jointed frames subjected to various loading and supporting conditions.

Course No: **CEECON214**	Course Title: **Principles of Economics**	L	P	U
		3	0	3

Course Learning Objectives

The course aims to provide to the students an insight into the scientific & analytical methods, techniques and tools of economics, a precise and comprehensive coverage of fundamental concepts in economics; and give suitable examples to expose him/her to possibilities of applications of these concepts in business and economic policy.

Course Content

- Introduction to Economics
- Application of Supply & Demand & Elasticity
- Demand and Consumer Behaviour
- Production & Business Organization
- Analysis of Costs
- Input Pricing by marginal productivity
- Perfectly Competitive Markets
- Imperfect Competition and its polar case of monopoly
- Oligopoly and Monopolistic Competition
- Externalities, Public Goods & Imperfect Information
- Macroeconomic concerns and its components
- GDP, Growth, Unemployment & Inflation
- Multiplier, Fiscal Policy at work
- Monetary Policy at Work and Money Supply.
- Open Economy

Text Books

1. Principles of Economics, Case E. Karl & Fair C., Pearson Education, 6th Edition, 2002.

Reference Books

1. Economics, Samuelson & Nordhus, TMH, 16th Edition, 1998.
2. Principles of Economics, Lipsey, RG & K.A. Chrystal, Oxford University Press, 9th Edition, 1999

Skill Development / Employability / Entrepreneurship

1.Field Visit - for studying organization structure and ethical practices

2. Business proposal writing

3. Case studies - for each function.

4. Report writing based on field visit.

Course No: **CEMATHC215**	Course Title: **Complex Variables**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

- Identify and construct complex-differentiable functions.
- Use the general Cauchy integral theorem and formula.
- Use conformal mapping.
- Express functions as infinite series or products.

Course Content:

UNIT I: Regions in the Complex plane, Functions of Complex Variable, limits.Mappings, Theorems on limits, Continuity.

UNIT II: Derivatives, Analytic Functions, Cauchy-Riemann equations, harmonic functions, Exponential, logarithmic functions, complex exponents, Complex Trigonometric, Hyperbolic functions and their inverses.

UNIT III: Contour integrals, Anti derivatives, Cauchy theorem, Cauchy Integral Formula,

UNIT IV: Morera's theorem, Liouville's Theorem, Maximum Modulus Principle, Convergence of sequences of series, Taylor's and Laurent series,

UNIT V: Residues poles and zeros of analytic functions, Applications of residues, Conformal mapping, Fourier Transforms and Z Transforms.

Text Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, Latest Indian Edition

Reference Books:

1. Complex Variables and Applications, J.W. Brown, R.V. Churchill, Mc Graw-Hill, 7th ed, 2003.
2. Complex analysis for Mathematics & Engineering, , John H Mathews & Russel W Howell, Jones & Barlett Publishers, 2001
3. NPTEL Videos http://nptel.ac.in/courses/111103070/

Course Outcomes

Upon successful completion of the course, student will be able to:

- Define continuity and differentiability for complex functions,
- Prove the Cauchy-Riemann equations and apply them to complex functions in order to determine whether a given continuous function is complex differentiable,
- Compute the radius of convergence for complex power series,
- Define the complex exponential function, trigonometric and hyperbolic functions and use their basic properties,
- Evaluate integrals along a path - directly from the definition and also via the Fundamental Theorem of Contour Integration and Cauchy's Theorem,
- Compute the Taylor and Laurent expansions of simple functions, determining the nature of the singularities and calculating residues,
- Prove the Cauchy Residue Theorem and use it to evaluate integrals.

Course No: CEMATH216	Course Title: **Differential Equations and Fourier Series**	L	P	U
		3	0	3

Course Learning Objectives

- To solve first and second order Ordinary Differential Equations by standard methods
- To gain exposure to Engineering applications of Ordinary Differential Equations.
- Introduction to Laplace Transforms for future Engineering courses
- Basics of Fourier series required for Engineering
- Solving important Partial Differential Equations (Simple cases of Wave & Heat equations).

Course Contents

UNIT-I

First order differential equations, Reduction of order, second order equations with applications bending of beams and electrical circuits.

UNIT-II

Second order homogeneous equations with constant coefficients and the Method of Undetermined Coefficients, Variation of parameters, higher order linear equations.

UNIT-III

Power series solutions and ordinary points, Frobenius Method & Regular singular points, Gauss' hyper-geometric equation, Legendre polynomials & Bessel functions.

UNIT-IV

Laplace Transform & Inverse Laplace Transform, Convolution of Laplace Transform & application to differential equations,

UNIT- V

Fourier series and convergence, Cosine and Sine series, Sturm-Liouville problem, one dimensional Heat and Wave equations and Laplace equations in rectangular form.

Text Books:

Advanced Engineering Mathematics, Erwin Kreyszig 10th Edition, John Wiley &Sons, 2012.

Reference Books:

1 George F.Simmons and Steven. G. Krantz, Differential Equations: Theory, Technique and Practice Tata Mc-Graw Hill, 2007.

2 Elementary Differential Equations, W.E.Boyce and R.C.Diprima, 7th Edition, John Wiley, 2001.

Course Outcomes

Upon successful completion of the course, student will be able to:

- Solve standard ODEs of First and Second Order
- Compute Laplace and Inverse Laplace Transforms for functions in Engineering
- Expand functions in Fourier/Sine/Cosine series
- Obtain series solutions for standard PDEs in two variables

Course No: CEES221	Course Title: **Electrical Science II**	L	P	U
		3	0	3

Course Learning Objectives

- Characterize semiconductors, diodes, transistors and FETs
- To study behavior of Diod and its applications
- To study characteristics of electronic devices to understand their behavior.
- To design simple analog circuits using BJTs, FETs and Diodes.
- To design and evaluate audio, Power and Feedbak amplifiers.

Course Contents

UNIT-I

Semiconductors: intrinsic and doped; p-n junction. Junction Diode & its characteristics.Defferent types of modeling of Diodes. Ideal Diode and Practical diodes. Zener Diode & its characteristics. Applications of Zener Diode. Application of Practical Diodes:Clamper and Peak to Peak Detector.

UNIT-II

Introduction to transistors, PNP Transistor, NPN transistors and their characteristics & operation.

Types of biasing the transistors.CE & CB Configuaration. Different catergories of operation: active region, Cutoff and Saturation. Application to Digital Logic Circuits. Introduction to JFETs, their operation & characteristics. MOSFETs & its characteristic (Depletion and Enhancement MOSFET). Introduction MOSFET logic gates and characteristics. Introduction CMOS logic gates and characteristics.

UNIT-III

Introduction to JFETs, their operation & characteristics. MOSFETs & its characteristic (Depletion and Enhancement MOSFET). Introduction MOSFET logic gates and characteristics. Introduction CMOS logic gates and characteristics.

UNIT-IV

Biasing the BJT and Amplifier, Small Signal AC Models, Additional Amplifier Principles. FET Amplifier with common source, fixed biasing and self-bias. Biasing Enhancement MOSFETs. Small Signal AC Models, MOSFET feedback amplifiers. Effect of bypass capacitors, FET amplifiers. Class A Power Amplifier, Power terminology, Class B power amplifier maximum output power.

UNIT- V

Ideal Op-amp characteristic, equivalent circuit & Block diagram, Parameters of practical Op-amp, CMRR, skew rate, offset voltage and current Series parallel FB amplifier, non-ideal op-amp.

Text Books:

1. Leonard Bobrow, *Fundamentals of Electrical Engineering*, Oxford University Press, Asian Edition Adapted by Navneet Gupta.

Reference Books:

1. Alan R. Hambley, *Electrical Engineering: Principles and Applications*, Publisher, 6nd Edition 2013.
2. W.H.Hayt, J.E. Kemmerly, *Engineering circuit analysis*, McGraw Hill Company, 8th Edition, 2013.
3. Vincent Del Toro, *Electrical Engineering Fundamentals*, Phi Learning, 2nd Edition.

Course Outcomes

Upon successful completion of the course, student will be able to:

- Study and analyze the behavior of PN junction diodes.
- Characterize the current flow of a bipolar transistor in CB and CE configurations
- Bias the transistors and FETs for amplifier applications.
- Realize simple amplifier circuits using BJT and FET.

Course No: **CETA223**	Course Title: **Professional Communication**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

The course aims at acquiring the students

- to understand various aspects of business communication.
- to gain knowledge regarding the various ways of assembling information,
- to write clearly and concisely and to present information in an effective manner
- to train them for oral presentation.

Course Contents

UNIT-I

Basics of Communication process, Features of Techincal communication, differences between general purpose communication and technical communication, Verbal and non verbal communication and their differences, understanding and overcoming barriers of communication.

UNIT-II

Definition and characteristic features of a technical report, Classification of reports, Strucutre and Layout of report, Various elements of a report and features of each of the elements, Various ways of collection of data, principles of preparing a questionnaires, Practicing questionnaire preparation, Organization of materials, Preparation of the outline, Formatting techniques.

UNIT-III

Elements of effective writing, Mechanics of writing, Writing styles and use of suitable words and phrases for technical writing according to the context, Revision practices, Principle steps of writing a précis, making notes, abstract and executive summary.

UNIT-IV

Oral presentation features, Use of illustrations, tables and visual aids in presentation and technical writing, Non –verbal aspects in oral presentations, Reading skills for different purposes.

UNIT- V

Distinctive features of memo reports and letter reports, Preparing Notice, Minutes of meeting Brochures,Instructions manual and User's Manual, Understand the difference between Preparing Notice, Minutes of meeting Brochures,Instructions manual and User's Manual, Business Letter formats, layouts and its significance.

Text Books:

1. Koneru. A. (2008).*Professional Communication.* McGraw Hill

Reference Books:

1. Omfort, Jeremy et al (1984). *Business Report in English*. Cambridge University Press
2. Gerson & Gerson (2000). *Technical Writing Process and Product.* Pearson Education.

Course Outcomes

Upon successful completion of the course, student will be able to:

- Understand the aspects of verbal and non verbal communication in its significane in professional and personal communication
- Utilize their knowledge of report writing and write appropriate technical reports.
- Make oral presentations
- Distinguish between various busniness communicational formats and use them appropriately.

Skill Development / Employability / Entrepreneurship

Lab component

As part of the Professional Communications course work students are expected to make a technical/academic presentation of 15 minutes

The topic for the presentation would be the topic which the students chose to write a technical report which is part of the course evaluation.

Students make a presentation for 15 minutes considering the following given criteria of assessment

1. Non-verbal communication

2. Verbal communication aspects – Use of appropriate grammar, use of accurate vocabulary and fluency of the language

3. Preparation of PowerPoint slides

4. Public speaking ability

A final score/ marks is provided based on the presentations and these would be added to the student's final marks for the course.

Course No: **CEMGTS224**	Course Title: **Principles of Management**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

The course aims at acquainting the students with various aspects of modern management. During the past two decades a revolution has taken place in the area of management. The new era is one in which entrepreneurship; innovation & technology are seen as the backbone of management. The emphasis is on the modern management essentials, drawing up from the earlier principles & practices, so as to enable the students to be familiar with the basic concepts of management when they enter the professional world.

Course Content

- Introduction to Management: Science, Theory & Practice
- Management & Society: Social Responsibility and Ethics
- Essentials of Planning
- Setting Objectives
- Strategies, Policies & Planning Premises
- Decision- Making
- The Nature of Organizing
- Organizational Structure: Departmentation
- Line/ Staff Authority, Empowerment, & Decentralization
- Managing Change through Manager and Organization Development
- Human Resources Management and selection
- Performance Appraisal & Career Strategy
- Motivation
- Leadership
- Communication
- The System & Process of Controlling
- Control Techniques
- Marketing Management
- Production & Operations Management
- Information Technology
- International Management

Text Books

1. "Essentials of Management", Koontz H. and Weihrich H., 7th edition, Mcgraw Hill Int. ed.,2007.

Reference Books

1. "Management,PrinciplesandPracticesforTomorrow'sLeaders",GaryDessler,3rdedition, Prentice Hall,1998.
2. Engineering Management, Fraidoon Mazda, 1st edition, Addison-Wesley, 1999

Skill Development / Employability / Entrepreneurship

1.Field Visit - for studying organization structure and ethical practices

2. Business proposal writing

3. Case studies - for each function.

4. Report writing based on field visit.

Skill Development / Employability / Entrepreneurship

1.Field Visit - for studying organization structure and ethical practices

2. Business proposal writing

3. Case studies - for each function.

4. Report writing based on field visit.

Course No: CEAO225	Course Title: **Optimization Techniques**	L	P	U
		3	0	3

Course Learning Objectives:

- Introduction to optimization techniques using both linear and non-linear programming.
- Students will learn to frame minima maxima problems in the framework of optimization problems.

Course Content:

UNIT-I:

Introduction to Linear Programming, Assumptions of Linear Programming,the Simplex Method in Tabular Form,the Revised Simplex Method, Duality Theory, Primal-Dual Relationships

UNIT-II:
The Transportation Problem, Methods of solutions to transportation problem, The Assignment Problem, Hungarian Metod

UNIT-III:
Dynamic Programming, Characteristics of Dynamic Programming Problems, Deterministic Dynamic Programming

UNIT-IV
Integer Programming,Formulation,the Branch-and-Bound Technique, a Branch-and-Bound Algorithm for Mixed Integer Programming

UNIT-V:
Nonlinear Programming , Graphical Illustration of Nonlinear Programming Problems , Types of Nonlinear Programming Problems , One-Variable Unconstrained Optimization , Multivariable Unconstrained Optimization , The Karush-Kuhn-Tucker (KKT) Conditions for Constrained Optimization.

Text Books:

1.F.S.Hillier, G.J. Lieberman, Introduction to Operations Research, 9e, TMH, 2012

Reference Books:

1. H.A. Taha, Operations Research- An Introduction, 7e, PHI,

2. Ravindran, Phillips, Solberg, Operations Research:Principles and Practice, 2eJohn Wiley & Sons, 2007

Course Outcomes:

By the end of the course, students should be able to:

- Cast minima/maxima problems into optimization framework.
- Learn efficient computational procedures to solve optimization problems.

Course No: **CEES226**	Course Title: **Structure and Properties of Materials**	L	P	U
		3	0	3

Course Learning Objectives

- The course is interdisciplinary in nature, predominantly covering the fields of physics, chemistry, mechanical and metallurgical engineering
- The course is offered to students of all branches of engineering, and provides an excellent understanding of the structure of materials at the atomic and microscopic level
- The main objective is to show how the type of bonding and crystal structure affects properties of metallic, ceramic, electronic and polymeric materials
- The course aims at to establish correlation between processing/Structure/Performance of materials of importance and shed light on interesting materials and their applications

Course Contents

UNIT-I

General understanding of materials science, Bonding forces and their types: Atomic bonding in solids. Crystal structures and systems: Unit cells, crystallographic directions and planes, Crystalline and non crystalline materials, Single crystals and polycrystalline Materials, Metallic structures, Ceramic and polymer crystal structure, Density computations, Linear and planar densities, Polymorphism and allotropy, Imperfections in solids: Impurities in solids, specification of composition, Defects and dislocations, point defects, Linear defects, Interfacial and bulk defects.

UNIT-II

Diffusion in solids: Diffusion mechanisms, steady and non-steady state diffusions, Factors that affect diffusion, Diffusion in Ionic and polymeric materials. Dislocations and strengthening mechanism in metals: Dislocation characteristics, Slip systems, slip in single crystals, plastic deformation of polycrystalline solids, strengthening mechanisms and strain hardening. Mechanical Properties of solids: Concepts of stress and strain, Elastic and Plastic deformation, Hardness

UNIT-III

Structure and properties of ceramics: Mechanical test behavior of ceramics, Types and application of ceramics, Applications and processing of ceramics, Fabrication and processing of glasses: Glasses - Glass forming – properties, heat treatment of glasses and glass ceramics. Polymer structures: Molecular size, shape & structure of polymers, Important Characteristics of polymeric materials, Mechanical behavior, Crystallization and processing of polymers

UNIT-IV

Phases, microstructures, phase equilibrium: Phase diagrams, unary, binary and binary Eutectic phase diagrams, Lever Rule. Iron carbon systems: Fe-Fe_3C phase diagram, development of micro-structure in Fe-C alloys. Kinetics of phase transformations: Avarami rate equation, Correlation of properties to microstructures, Isothermal transformation diagrams - continuous cooling diagrams, Mechanical behavior of Fe-C alloys, tempered martensite

UNIT-V

Thermal properties of materials; Electronic properties: Energy band in semiconductors etc., Piezoelectricity and Ferro electric materials, applications. Magnetic properties: Super conductivity, superconducting materials and applications, Nanotechnology: Carbon Nano Tubes and their applications.

Text Books:

1. Callister's Materials Science & Engineering Adopted by R. Balasubramaniam, Wiley India Pvt. Ltd., 9th Edition, Reprint 2016.

Reference Books:

1. Engineering Materials: Properties and Selection, K.G. Budinski and M. K. Budinski, Prentice Hall of India, 9th Edition, 2008.

2. The Science and Engineering of Materials, Donald R. Askeland and Pradeep P. Phule, 4th Edition, Thomson book Company, 2003.

3. Principles of Materials Science and Engineering, William F. Smith, Mc Graw-Hill 3rd Edition 1996.

Course Outcomes

Upon successful completion of the course, student will be able to:

- Identify bonding in different material types; describe the lattice structure of materials; describe the lattice parameters for 7 crystal systems; specify the Miller indices for the planes in a unit cell of metals, ceramics and polymers. Define isotropy and anisotropy w.r.t. material properties; describe various types of defects and dislocations and interpret atomic structure within the vicinity of grain and twin boundaries.

- Describe the atomic mechanisms of diffusion in metallic, ionic and polymeric materials; distinguish between steady state and non-steady state diffusions; Explain the factors that affect the rate of diffusion; define slip systems and its relation to mechanical properties; Define stress, strain, state Hook's law, Poisson's ratio; Discuss various mechanical properties like strength, toughness, resilience and hardness

- Describe the process used to produce glass-ceramics; describe structure, composition of different types of ionic, covalent ceramics viz. cements, refractories, clay products, abrasives. Compute the flexural strength of ceramics by transverse bending test; Interpret the effect of porosity on strength of ceramics; explain the procedure of thermal tampering of glass; Describe polymer structure, classification based on shape, size, chemistry and molecular configuration; Thermosetting and thermoplastic polymers; Interpret mechanical properties of elastomers

- Describe phase, composition in binary phase diagram of alloys; explain the phase diagram of Fe-C systems and estimate the composition of individual phases Explain the kinetics of phase transformation; describe the microstructure of micro-constituents of iron alloy and cite mechanical characteristics of each; Isothermal cooling and C-C-T diagrams.

- Describe the electronic band structure; electrical conductivity of metals, semiconductors, electronic mobility; Describe the phenomenon of ferroelectricity and piezoelectricity; Describe the phenomenon of superconductivity; Define heat capacity and specific heat, thermal conductivity and thermal stress; Determine the linear coefficient of thermal expansion; explain the phenomenon of thermal expansion from an atomic perspective; Explain the structure, property and applications of nano materials.

Course No: CETA 222	Course Title:Engineering Measurements	L	P	U
		1	6	4

Course Learning Objectives

- To give introduction to the experimental methods and measurement techniques.
- To train the students in the operation of various instruments and equipments and the measurement of various parameters in electronics and mechanical engineering.

UNIT -I:

Generalized Measurement System, Calibration, Standards, Dimensions and Units, Impedence Matching, Experiment Planning, Causes and Types of errors, Error Analysis, Uncertainty Analysis, Evaluation of uncertainties, Method of Least Squares, TheCorrelation Coefficient, Multiple regression, Standard deviation of mean, Graphical Analysis and Curve fitting, Choice of Graph Formats, General considerations in Data Analysis

UNIT-II:

Basic analog meters, Basic digital meters, Basic input circuits, The Electronic Voltmeter, Digital voltmeters, The Oscilloscope, Variable resistance, LVDT, Capacitive Transducers Photo electric effects, Hall effect Transducers, Digital Displacement Transducers, Comparison of analog &digital instruments

UNIT-III:

Area measurements, Graphical measurement , Planimeter, Graphical and Numerical Methods for Area measurement, Mechanical pressure-measurement devices, Dead weight tester, Bourdon tube, Diaphragm & Bellow Gages, Bridgman Gage, Low- Pressure Measurement, McLeod Gage, Ionization Gage,Alphatron.

UNIT-IV

Flow measurements, Positive-Displacement methods, Flow obstruction methods, Sonic nozzle, Drag effects, Hot-wire and Hot-film Anemometers, Magnetic flowmetersFlow – visualization methods, Laser Doppler Anemometer, Smoke methods, Pressure probes, Impact pressure in supersonic flow.

UNIT-V

Temperature measurements, Temperature scales, Ideal-gas thermometer, Temperature measurements by mechanical effects, by electrical effects, by radiation, heat transfereffect,transient response of thermal systems, thermocouple compensation, Temperature measurements in high flow speed flow. Concepts of Radiation, types, Detection of Radiation, GM counter, Ionization chambers, Photographic detection , Scintillation Counter, Neutron detection

Text Books

J.P.Holman,Experimental Methods for Engineers, TMH , 7th Edition, 2007

Reference Book

E.O. Doebelin ,Measurement Systems; Application & Design, 6th Edition, 2011

Course Outcomes

Upon successful completion of the course student will be able to:

- Measure calibration errors in instruments
- Measure Area of a given curve
- Choose the graph format for any given curve: Can draw Semi-Log Graph.
- Operate and understanding the operation of pressure, flow, temperature, strain & stress measuring instruments

Skill Development / Employability / Entrepreneurship

Sl. No	Aim of the Experiment
1.	To determine the Young's modulus of a steel specimen by deflection test on a simply supported beam.
2.	To calculate shear stress generated in a shaft using strain gauge transducer (Torque Measurement)
3.	Determination of Grain Fineness Number using sand testing machine
4.	To Measure the temperature of a given knob using Thermistor
5.	Determination of Flash and Fire Point for a given Fuel using Pensky Marten's apparatus
6.	Determination of the coefficient of discharge through the Orifice meter.
7.	Determination of the Thermal Conductivity through metal rod.
8.	Study of the Micro Structure of pure metals like Mild Steel, Low Carbon Steel and High Carbon Steel.

Course No: **CEAO312**	Course Title: **Control System**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

- To equip the students with the fundamental concepts in control systems.

Course Content

UNIT-I

Modelling of physical systems: Differential equations of physical systems, mechanical systems and electrical analogies, Electrical systems - Electromechanical systems – Mechanical systems – Thermal systems. Concept of Transfer Function, Block diagrams and reduction methods, Construction of Signal flow graphs; Mason's Gain formula and its applications

UNIT-II

Feedback systems and effect of feedback on sensitivity and system dynamics, Effect of feedback on control systems with disturbance signals. Time domain analysis: Test signals and time domain response of first order system, Response of second order system; time domain specifications, Steady state errors and error constants for various types of systems

UNIT-III

Stability of control systems and effect of root locations, Routh-Hurwitz stability criterion. Concept of root locus and magnitude and angle criteria, Root locus construction rules, Effect of pole-zero additions on the root loci.

UNIT- IV

Frequency domain analysis: Bode plot - Polar plot - Nyquist plot - phase-margin - gain margin - Nyquist stability criterion.

UNIT- V

Controller design: Design of P, PI, PID, lag, lead, lead-lag compensator design.

Text Books

1. Katsuhiko Ogata, '*Modern Control Engineering*', 5th Edition, Pearson Education Publishers, New Delhi, 2010.
2. Nagrath I.J. and Gopal M, '*Control Systems Engineering*', 5th Edition, New Age International Publications, New Delhi, 2010.
3. Benjamin C.Kuo and Farid Golnaraghi, '*Automatic Control Systems*', 8th Edition John Wiley & Sons Publications, New Delhi, 2002.

Reference Books

1. Richard C. Dorf and Robert H. Bishop. '*Modern Control Systems*', 12th Edition Pearson Prentice Hall Publications, New Delhi, 2010.
2. Gene F. Franklin, J. David Powell and Abbas Emami-Naeini, '*Feedback Control of Dynamic Systems*', 6th Edition. Pearson Education India Publications, New Delhi, 2008.

Course Outcomes

Upon successful completion of the course, student will be able to:

- Understand the concepts of closed loop control systems.
- Analyze the stability of closed loop systems.
- Apply the control techniques to any electrical systems.
- Design the classical controllers such as P, PI, etc., for electrical systems.

Course No: CEAO 311	Course Title: **Numerical Methods**	L	P	U
		1	6	4

Course Learning Objectives: Enables one to devise algorithms for the numerical solutions of mathematical problems. Applications to problems from Engineering areincluded for each method.

Course Content:

UNIT 1:

Computer Arithmetic and Errors, Interval halving /Bisection, Linear interpolation methods, Newton's method, Muller's method, Fixed point iteration: x=g(x) method, Multiple roots.

UNIT II:

The Gaussian Elimination and Gauss- Jordan methods, LU-decomposition approach, Norms, Condition numbers and errors in solutions, Iterative methods-Gauss-Seidel and Jacobi methods.

Unit-III:

Interpolation; Newton and Lagrangian polynomials, divided differences, Derivatives from difference tables, Higher order derivatives, Newton – Cotes integration formulas, The trapezoidalrule-acomposite.

UNIT IV:

Simpson's rules, Gaussian integration, TheTaylor Series method,Euler and Modified Euler's method, Runge- Kutta methods, Multi step methods, Milne's method,The Adams-Moulton method, System of equations and higher order equations.

UNIT V:

Solution through set of equations, Derivative boundary conditions, Eigen – value problems (Power Method).

Text Books

1. Steven Chapra, Raymond Canale., *Numerical Methods for Engineers*, Tata McGraw Hill, New Delhi, 5th Edition, 2007.

Reference Books

1. Francis Scheid ,*Numerical Analysis*, Schaum's Outline, Tata McGraw Hill, New Delhi, 2009.

2. S.S.Sastry ,*Numerical Methods* , PHI, New Delhi, 2010.

3. Erwin Kreyszig, *Advanced Engineering Mathematics*, 9th Edition, John Wiley & Sons, Inc, Singapore, 2006.

Learning Outcomes Upon successful completion of the course the student will be able to

- To solve nonlinear equations by standard methods.
- To solve Linear equations by Gauss-Seidel and other methods.
- To perform Matrix inversion by Gauss-Jordan method.
- To do Numerical differentiation and integration by standard methods.
- To solve ODEs numerically by standard methods.
- To apply software packages to solve above problems.

Course No	Course Title	L	P	U
HS 311	Dynamics of Social Change	3	0	3

Learning Objectives

The objective of this course is to enable students to have an insight into the social processes, sociological thought, methodology, sociological concepts and recent trends in modernization so as to empower the students to become active citizens. Sociological study aids in comprehending one's identity, thinking and action, it makes one more tolerant of human differences.

Course Contents:

Unit I

Sociology: its fundamentals, development of its methods and theories; Sociology and its relationship with other social sciences. Society: concepts and theories. Socialization and its theories, Social groups: Crowd Community, Association, Institutions.

Unit II

Family & Marriage: concepts, theories of origin; types, functions and changing patterns. Demographic transition.

Culture and its determinants: Social norms, Folkways, Mores, Taboos, Social roles, Social responsibility. Culture and personality.

Unit III

Social stratification: Caste, class, their functions and changing patterns.

Social Change: Concepts, Theories and Process and Dynamics of social change, Factors, Resistance to social change.

Unit IV

Modernization Concept: Industry and social change, Urbanization and rural sociology.

The role of education as a vital force for social change and to highlight the role of social institutions in educational and social developments.

Unit V

Sociology of Religion: Aspects, origin, Hinduism. Social disorganization and delinquency.

Text Book

Fundamentals of Sociology, Gisbert. P, Orient Longman, 3rd Edition, 1994.

Reference book(s)

1. Sociology - Systematic Introduction. Johnson.M.Harry. Allied Publishers, 2001
2. Sociology – A Guide to Problems and Literature. Bottomore T. T. Blackie & Sons, 1986.

Learning Outcomes:

After going through this course, the student will be able to:

- Define what social change is.
- Differentiate between social change and cultural change.
- Understand various characteristics of social change.
- Understand various sources of social change.
- Understand various factors of social change.
- Understand various theories of social change given by various sociologists.
- Understand the role of education for social change.

Course No:HS312	Course Title:Introduction to Psychology	L	P	U
		3	0	3

Learning Objectives

- To familiarize the students with type concepts of mind processes, motives, reactions, feelings, motivation
- To inculcate group thinking
- To develop skills like conflict resolution, crisis management

Course Content

UNIT I

Introduction: Definition of psychology; historical antecedents of psychology and trends in the 21st century; psychology and scientific methods; psychology in relation to other social sciences and natural sciences; application of psychology to societal problems.
Methods of psychology: Types of research, descriptive, evaluative, diagnostic and prognostic; methods of research: survey, observation, case-study and experiments; characteristics of experimental design and non-experimental design, quasi-experimental designs; focussed group discussions, brain storming, grounded theory approach.

UNIT II

Development of Human Behaviour: Growth and development; principles of development, role of genetic and environmental factors in determining human behaviour; influence of cultural factors in socialization; life span development, characteristics, development tasks, promoting psychological well-being across major stages of the life span.
Sensation, attention and perception: Sensation; concepts of threshold, absolute and difference thresholds, signal-detection and vigilance; factors influencing attention including set and characteristics of stimulus; definition and concept of perception, biological factors in perception; perceptual organization-influence of past experiences, perceptual defence-factors influencing space and depth perception, size estimation and perceptual readiness; the plasticity of perception; extrasensory perception; culture and perception, subliminal perception.

UNIT III

Learning: Concept and theories of learning (behaviourists, gestaltalist and information processing models); the processes of extinction, discrimination and generalization; programmed learning, probability learning, self-instructional learning, concepts; types and the schedules of reinforcement, escape, avoidance and punishment, modeling and social learning.
Memory: Encoding and remembering; short term memory, long term memory, sensory memory, iconic memory, echoic memory: the multistore model, levels of processing; organization and mnemonic techniques to improve memory; theories of forgetting: decay, interference and retrieval failure: metamemory; amnesia: anterograde and retrograde.
Motivation and emotion: Psychological and physiological basis of motivation and emotion; measurement of motivation and emotion; effects of motivation and emotion on behaviour; extrinsic and intrinsic motivation; factors influencing intrinsic motivation; emotional competence and the related issues.

UNIT IV

Thinking, problem solving: Piaget's theory of cognitive development; concept formation processes; information processing, reasoning and problem solving, facilitating and hindering factors in problem solving, methods of problem solving: creative thinking and fostering creativity; factors influencing decision making and judgment; recent trends.
Intelligence and aptitude: Concept of intelligence and aptitude, nature and theories of intelligence - Spearman, Thurstone, Gullford Vernon, Sternberg and J.P; Das; emotional intelligence, social intelligence, measurement of intelligence and aptitudes, concept of IQ, deviation IQ, constancy of IQ; measurement of multiple intelligence; fluid intelligence and crystallized intelligence.

UNIT V

Personality: Definition and concept of personality; theories of personality (psychoanalytical, sociocultural, interpersonal, developmental, humanistic, behaviouristic, trait and type approaches); Measurement of personality (projective tests, pencil-paper test); The Indian approach to personality; training for personality development; latest approaches like big 5 factor theory; the notion of self in different traditions.
Work Psychology and Organisational Behaviour: Personnel selection and training; use of psychological tests in the industry; training and human resource development; theories of work motivation, Herzberg, Maslow, Adam Equity theory, Porter and Lawler, Vroom; Leadership and participatory management; advertising and marketing; stress and its management; ergonomics; consumer psychology; managerial effectiveness; transformational leadership; sensitivity training; power and politics in organizations.

Text Books

1. Passer, M.W. and Smith, R.E. (2010). *Psychology: The science of mind and behavior*. 4th edn. Boston, MA, USA: McGraw-Hill Higher Education.
2. Pareek, U. and Khanna, S. (2012). *Understanding organizational behaviour*. 3rd edn. New Delhi, India: Oxford University Press.

Reference Books

1. Luthans, F. (2010). *Organizational behavior: An evidence-based approach*. 12th edn. New York, NY, USA: McGraw Hill Higher Education.
2. Morris, C.G. and Maisto, A.A. (2004). *Psychology: An introduction*. 12th edn. Harlow, United Kingdom: Prentice Hall.

Learning Outcomes

Upon successful completion of the course student will be able to:

- Use critical thinking to evaluate and interpret evidence, and to apply psychological concepts, theories, and research findings to individual, social, and cultural issues
- Apply basic research methods in psychology, with sensitivity to ethical principles
- Demonstrate effective communication skills following professional conventions in psychology appropriate to purpose and context
- Understand the complexity of sociocultural diversity and societal inequality in the inquiry and analysis of psychological issues

Course No	Course Title	L	P	U
HS313	Heritage of India	3	0	3

Learning Objectives

Comprehending the heritage of the nation is a necessary pre condition for the making of conscientious citizenship. Knowledge of the nation's evolution and legacy enables to precisely define one's national self. Hence, this course is designed to serve the objective of enabling the students to take stock of the heritage and cultural evolution of their nation and its syncretic history.

Course Contents:

UNIT I: Indian Culture: An Introduction

Characteristics of Indian culture, Significance of Geography on Indian Culture. Society in India through ages- Ancient period- varna and jati, family and marriage in india, position of women in ancient india, Contemporary period; caste system and communalism. Religion and Philosophy in India: Ancient Period: Pre-Vedic and Vedic Religion, Buddhism and Jainism, Indian philosophy – Vedanta and Mimansa school of Philosophy.

UNIT II: Indian Languages and Literature

Evolution of script and languages in India: Harappan Script and Brahmi Script. Short History of the Sanskrit literature: The Vedas, The Brahmanas and Upanishads & Sutras, Epics: Ramayana and Mahabharata & Puranas. History of Buddhist and Jain Literature in Pali, Prakrit and Sanskrit, Sangama literature & Odia literature.

UNIT III: A Brief History of Indian Arts and Architecture

Indian Art & Architecture: Gandhara School and Mathura School of Art; Hindu Temple Architecture, Buddhist Architecture, Medieval Architecture and Colonial Architecture. Indian Painting Tradition: ancient, medieval, modern indian painting and odishan painting tradition. Performing Arts: Divisions of Indian classical music: Hindustani and Carnatic, Dances of India: Various Dance forms: Classical and Regional, Rise of modern theatre and Indian cinema.

UNIT IV: Spread of Indian Culture Abroad

Causes, Significance and Modes of Cultural Exchange - Through Traders, Teachers, Emissaries, Missionaries and Gypsies, Indian Culture in South East Asia, India, Central Asia and Western World through ages.

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UNIT V: Understand and appreciate the heritage of India in various fields of applied sciences

Applied Sciences: Geography, Astronomy, Mathematics, Physics, Chemistry, Physiology, Medicine, Coinage, Weights and Measures, India's contribution to the world civilizations and the external influences on Indian Heritage

Text Books

Basham, A.L, The Wonder That was India, Picador, London, 2004.

Reference Books

1. Nehru, Jawaharlal, the Discovery of India, Jawaharlal Memorial Fund, New Delhi, 1999.
2. Thapar, Romila, The History of India, Vol. I, Penguin, New Delhi, 1966
3. Basham, A.L, ed., A Cultural History of India, Penguin, New Delhi, 1988.
4. Jha, D.N, Ancient Indian in Historical Outline, Manohar, New Delhi, 2004.
5. Wolpert, Stanley, an Introduction to India, Penguin, New Delhi, 1994.
6. Mazumdar, R.C, et.al, an Advanced History of India, MUP, Michigan, 1969.
7. Malekandathil, Pius: Maritime India: Trade, Religion and Polity in the Indian Ocean, Primus Books, Delhi, 2010.
8. McPherson, Kenneth: The early Maritime Trade of the Indian Ocean, in: ib.: The Indian Ocean: A History of People and The Sea, OUP, 1993, pp. 16-75.
9. Christie, J.W., 1995, State formation In early Maritime Southeast Asia, BTLV

Course No	Course Title	L	P	U
HS314	Modern Political Science	3	0	3

Objectives

- To familiarise the students with the basic ideas of political science.
- To make them thorough in the concepts of political theory.
- To help them understand and distinguish between basic concepts like political theory, political thought and political philosophy.
- To help the students understand and relate the concepts and facts with the political realities of the country and different parts of the world.
- To equip them with the basics of the discipline and help them learn the basic underpinnings of the subject of Political Science.

UNIT I

Political Theory

Nature, scope and significance of political theory, procedure of different theoretical ideas in political theory, the various traditional and modern theories of political science., theories of origin of the state.

UNIT II

Political Theory

Concept of Democracy, its types and theories (Elitist, Pluralist and Marxist) relating to it, concept of Development and various views and Perspective relating to it. i.e. Liberal, Marxist, Sustainable Development, Human Development and Gandhian Model of Development, Understanding basic concepts of Justice, distributive justice, multiculturalism and social justice.

Unit III

Politics in India

Philosophy of Indian constitutions, introducing the Indian Constitution with a focus on the evolution of it and examining the essence of the Preamble, e Fundamental Rights and Duties of Indian citizens with a study of the significance and status of Directive Principles.

Analyzing the important institutions of the Indian Union: the Executive: President; Prime Minister, Council of Ministers; Governor, Chief Minister and Council of Ministers; The legislature: Rajya Sabha, Lok Sabha, Speaker, Committee System, State Legislature, The Judiciary: Supreme Court and the High Court: composition and functions- Judicial Activism

UNIT IV

Politics in India

Centre-State Relations with focus on the Legislative, Administrative and Financial Relations., evaluating the Indian Party system – its development and looking at the ideology of dominant national parties, the Electoral Process in India with focus on the Election Commission: Composition, Functions and Role, the challenges to National Integration: Terrorism, Regionalism and Casteism.

Unit V International Relations

Overview about the nature, evolution and scope of international relations, the basic ideas of international relations, the different approaches to the study of International Relations,historical background of the discipline which will help them understand international politics in a better way, basic concepts of International Relations and also develop a preliminary understanding of the global economy, formation, charter and objectives of United Nations and its working on Millennium Development Goals, the working of United Nations in resolving conflict and peacekeeping operations, the international security; Disarmament, Arms Control and Nuclear nonproliferation

Text Books:

1. J.C. Johari – "Principles of Modern Political Science", Sterling Publishers PVT. Ltd., New Delhi, 2007
2. Perter Harris, "Foundations of Political Science", Oxford University Press

References:

1. Amal Ray and Mohit Bhattacharya – "Political Theory: Institutions and Ideas" - The World Press Private Ltd., Calcutta, 1988
2. O.P. Gauba – "An Introduction to Political theory" Macmillan India Ltd., 2008.
3. Robert Dahl – "Modern political Analysis." OUP 2007
4. Prof. A.C Kapoor - "Principles of Political Science", Sterling Publishers PVT. Ltd., New Delhi, 2005

Course Outcomes:

- Understanding of government institutions, electoral processes, and policies in a variety of countries around the world and the ability to compare the effectiveness or impact of various political arrangements across countries.
- Knowledge of some of the philosophical underpinnings of modern politics and government and the legal principles by which political disputes are often settled.
- Understand the changes in patterns of political behaviour, ideas and structures.
- Assess how global, national and regional developments affect polity and society.
- Develop the ability to make logical inferences about social and political issues on the basis of comparative and historical knowledge.
- Knowledge of key theories and concepts, historical developments, organizations, and modern issues in international relations.

Course No	Course Title	L	P	U
HS315	Public Administration	3	0	3

Learning Objectives

The course on Public Administration/Management has following objectives:

1. Understand the concept of public administration/ management/organization
2. Understand the evolution of the concept of public administration and its importance
3. Understand the role of government
4. Understand the role and core functions of public manager
5. Understand the structure of government /organizations
6. Create understanding about the skills required by the public manager in imparting duties
7. Understand the changing role of government and role of public managers.

Course Contents:

UNIT I

Introduction:

Meaning, scope, and significance of Public Administration, Wilson's vision of Public Administration, Evolution of the discipline and its present status, New Public Administration, Public Choice approach, Challenges of liberalization, Privatisation, Globalisation, Good Governance: concept and application, New Public Management

UNIT II

Administrative Thought, Scientific Management and Scientific Management movement, Classical Theory, Weber's bureaucratic model – its critique and post-Weberian Developments, Dynamic Administration, Human Relations School, Functions of the Executive, Simon's decision-making theory, Participative Management.

UNIT III

Administrative Behaviour, Process and techniques of decision-making , Communication; Morale Motivation Theories – content, process and contemporary, Theories of Leadership: Traditional and Modern

Organisations - Theories – systems, contingency, Structure and forms:ministries & departments, corporations, companies, boards, commissions, ad hoc and advisory bodies, headquarters and field relationships, regulatory authorities, public-private partnerships.

UNIT IV

Accountability and control - Concepts of accountability and control; Citizen and Administration, Legislative, Executive and Judicial control over administration, Role of media, interest groups & voluntary organizations, Civil society, Citizen's Charters, Right to Information, Social audit.

Unit V

Administrative Law - Meaning, scope, and significance, Dicey on Administrative law, Delegated legislation, Administrative Tribunals.

Comparative Public Administration - Historical and sociological factors affecting administrative systems, Administration and politics in different countries, Current status of Comparative Public Administration, Ecology and administration, Riggsian models and their critique,

Techniques of Administrative Improvement - Organisation and methods, Work-study and work management, Management aid tools like network analysis, MIS, PERT, CPM, e-governance and information technology.

Text Book:

1. Baker, R.J.S., 1972, Administrative Theory and Public Administration, Hutchinson University Library, London.
2. Bhattacharya, Mohit, 1998, New Horizons of Public Administration, Jawahar Publishers & Distributors, New Delhi.

References:

1. Bertram, M. Gross, 1964, The Managing of Organisations, The Administrative Struggle, The Free Press of Glencoe, CollierMacmillan., London.
2. Denhardt, Robert B. and Joseph W. Grubbs, 2003, Public Administration: An action Orientation, Fourth Edition, Thomson (Wadsworth), Canada.
3. Prasad, D. Ravindra, V.S. Prasad and P. Satyanarayan, 2004, Administrative Thinkers (Ed), Sterling Publishers, New Delhi.
4. Pugh, D.S., 1985, Organisation Theory: Selected Readings (Ed), Penguin Books, Middlesex, England.
5. Sharma, M.P. and B.L. Sardana, 1988, Public Administration in Theory and Practice, Kitab Mahal, New Delhi.
6. Srivastava, Om Prie, 1991, Public Administration and Management, The Broadening Horizons, Volume 1, Himalaya Publishing House, Delhi

COURSE OUTCOMES:

- To understand the nature and scope of Public Administration;
- To appreciate the methodological pluralism and synthesizing nature of knowledge in Public Administration;
- To comprehend the changing paradigms of Public Administration;
- To acquaint with the theories, approaches, concepts and principles of Public Administration;
- To understand the administrative theories and concepts to make sense of administrative practices.
- To Understand public administration theory and concepts from multiple perspectives

Course No:HS316	Course Title:Professional Ethics	L	P	U
		3	0	3

Learning Objectives

- To create an awareness on Ethics as applied in Engineering and Human Values
- Understand what morality is and how it connects to professional ethics
- Determine what characterizes a professional and distinguishes one from a nonprofessional

Course Content

UNIT I

Morals, values and ethics, integrity, work ethic, service learning, civic virtue, respect for others, living peacefully, caring, sharing, honesty, courage, valuing time, co-operation, commitment, empathy, self-confidence, character, spirituality.

UNIT II

Senses of 'Engineering Ethics', variety of moral issued, types of inquiry, moral dilemmas, moral autonomy, Kohlberg's theory, Gilligan's theory, consensus and controversy, models of professional roles, theories about right action, self-interest, customs and religion, uses of ethical theories.

UNIT III

Engineering as experimentation, engineers as responsible experimenters, codes of ethics, a balanced outlook on law, the challenger case study.

UNIT IV

Safety and risk, assessment of safety and risk, risk benefit analysis and reducing risk, the Three Mile Island and Chernobyl case studies. Collegiality and loyalty, respect for authority, collective bargaining, confidentiality, conflicts of interest, occupational crime, professional rights, employee rights, Intellectual Property Rights (IPR), discrimination.

UNIT V

Multinational corporations, environmental ethics, computer ethics, weapons development, engineers as managers, consulting engineers, engineers as expert witnesses and advisors, moral leadership, sample code of Ethics like ASME, ASCE, IEEE, Institution of Engineers(India), Indian Institute of Materials Management, Institution of electronics and telecommunication engineers(IETE), India, etc.

Text Books

1. Martin, M.W. and Schinzinger, R. (2004). *Ethics in engineering*. 4th edn. Boston, MA, USA: McGraw Hill Higher Education.
2. Govindarajan, M., Natarajan, S. and Senthilkumar, V.S. (2004). *Engineering ethics*. New Delhi, India: Prentice-Hall of India Pvt.

Reference Books

1. Fleddermann, C.B. (2011). *Engineering ethics*. 4th edn. Boston, MA, USA: Prentice Hall.
2. Harris, J.C.E., Rabins, M.J., Pritchard, M.S., James, R. and Englehardt, E. (2013). *Engineering ethics: Concepts and cases*. 5th edn. Boston, MA, USA: Wadsworth Cengage Learning.
3. Boatright, J.R. (2011). *Ethics and the conduct of business*. Boston, MA, USA: Pearson College Div.
4. Seebauer, E.G. and Barry, R.L. (2010). *Fundamentals of ethics for scientists and engineers*. New York, NY, USA: Oxford University Press.

Learning Outcomes

Upon successful completion of the course student will be able to:

- Choose their own personal, social, moral and spiritual values and be aware of practical methods for developing and deepening
- Assess their own ethical values and the social context of problems
- Identify an ethical issue and analyze that issue in relationship to the specific topic of study or discipline

Course No	Course Title	L	P	U
IP221	**Internship Program I**	0	0	5

Scope & Objective of the Course:

This course is run during the Summer Term only at various industries and is of about 8 weeks.
This course aims to provide an exposure of the world of professional work to the students.

Textbook(s): Not Applicable
Reference book(s): Not Applicable
Lecture-wise plan: Not Applicable

Evaluation Scheme:

Evaluation Component	Weightage (%)	Duration
Quiz-I	5	2nd week
Group Discussion-I	7	3rd week
Seminar-I	10	6th week
Project Report-I	10	7th week
Observation-I	6	7th week
Diary-I	2	Daily
Mid-Term Grading	40	16th week
Quiz-II	5	9th week
Group Discussion-II	8	12th week
Seminar-II	15	15th week
Project Report-II	20	16th week
Observation-II	9	16th week
Diary-II	3	Daily
Final Grading	100	

Course No	Course Title	L	P	U
IP401	Internship Program II	0	0	20

Scope & Objective of the Course:

The IP II Program is planned to bridge the gap between the professional world and the academic world and is implemented during the final year of graduation in either of the semesters. This Program constitutes working on real life situations, necessary for subsequent problem-solving efforts in the professional world.

Textbook(s): Not Applicable
Reference book(s): Not Applicable
Lecture-wise plan: Not Applicable

Evaluation Scheme:

Evaluation Component	Weightage (%)	Duration
Quiz-I	4	2nd week
Group Discussion-I	5	3rd week
Seminar-I	6	6th week
Project Report-I	5	7th week
Observation-I	3	7th week
Diary-I	3	Daily
Quiz-II	4	9th week
Group Discussion-II	5	12th week
Seminar-II	6	15th week
Project Report-II	5	16th week
Observation-II	3	16th week
Diary-II	3	Daily
Mid-Term Grading	52	16th week
Quiz-III	4	17th week
Group Discussion-III	5	20th week
Seminar-III	12	Last week of IP II
Project Report-III	20	22nd week
Observation-III	4	End of IP II
Diary-III	3	Daily
Final Grading	100	

Course No	Course Title	L	P	U
TS401	Thesis & Seminar	0	0	20

Objective of the course:

This course TS 401 is a must for all students with Thesis option for the eligibility of degree. This course involves research work in an active area to satisfy the creative urge in a student and may involve advanced study learning and experimentation. This work may form the basis for dissertation of a higher degree. Also this requires fulltime work from the student for a complete semester and must co-terminate with thesis report.

Textbook(s) No prescribed text book. Literature Survey to be done with peer reviewed journals.

Reference book(s) - do -

Mid -Semester Grading and Final Grading

TS 401 courses are only awarded non-letter grades Excellent/Good/Fair/ Poor based on the performance of the student as per the evaluation scheme Mid term Grading is to be done announced to the student. All grades are to be submitted to the IC in the format provided to the Supervisors.

Operation Procedure

1. Student has to devote full semester for TS 401 course.
2. Student has to report to Supervisor regularly.
3. Particular of Thesis is to be submitted to IC within two weeks of registration
4. Seminars and Thesis evaluation has to carried out in the presence of two member Committee comprising of experts in the relevant area constituted by the Supervisor.
5. Final Thesis to be submitted has to be in formal hard bound cover bearing the Institute emblem.

Course No	Course Title	L	P	U
CE 491/CS 491 EC 491/EE 491 ME 491	Special Project	0	0	3

- **Scope & objective of the course:**

This is an unstructured open ended where under the overall supervision of a faculty-in-charge, batches of students will be attached to different faculty members. Each batch will work on a specific time bound which is of basic or peripheral concern of student's discipline. Each student must submit a project report as a culmination of his endeavor and investigation. Faculty-in-charge will determine the choice of the project and also whether or not the project report is to be submitted jointly by a group or individually by a student. This course will aim to evaluate the student actual ability to use the fundamentals of knowledge and to meet the new unknown situations as demonstrated by the student's interaction with the faculty member and faculty-in-charge. The faculty-in-charge may assign specific hours of formal brain storming sessions.

4. Evaluation Scheme:

Component	Duration (hr/min)	Weightage (%)	Remarks
Literature Survey	2nd week	**7**	
Project outline	3rd week	**5**	**To be submitted to I/C by the faculty**
Diary -I	**Continuous**	**4**	
Observation-I	**Continuous**	**4**	
MidTerm Project	7th week	**15**	
Report	7th week		
Mid-Semester	8th week	**10**	
Seminar/Viva	8th week		
Mid-Term Grading	8th week	**45**	**To be submitted to I/C by the faculty**
Diary-II	**Continuous**	**5**	
Observation-II	**Continuous**	**5**	**A copy to be submitted to I/C by the faculty**
Final Project Report	14th week	**25**	
Final Seminar	15th week	**20**	
Final Grading	15th week	**100**	**To be submitted to I/C by the faculty**

Textbook(s) & Reference book(s)

Based on literature survey to be done with peer reviewed journals.

General guidelines:

a) This being a three unit course, a student is expected to work for at least 9 hours per week

including the formal contact hours with the instructor.

b) Each student should meet the faculty at least once a week in addition to the formal contact hours at mutually agreed time to apprise the faculty of the progress in the project.

c) Student is supposed to maintain a diary and record the daily progress of the work done. The diary would be periodically checked by the faculty.

d) All the evaluation components are compulsory. If a student misses any component of evaluation, he is likely to get 'NC'.

e) The Mid-term evaluation is to be strict to avoid any laxity on the part of the student.

f) Student should make two copies of the final report in the prescribed format, one his personal copy and the other for submission to the Institute. The faculty may ask for an additional copy if so desired.

g) The final seminar is to be planned only after the submission of the project report.

h) The final seminar is open to all the students and the faculty. The faculty member should involve the local experts in the evaluation of final seminar.

i) If the progress in the project work is not satisfactory, the faculty may advise the student to withdraw from the course in time and the same may be communicated to the instructor-in-charge.

j) The student should submit the withdrawal request to the Convener, Academic Registration Committee. The last day for withdrawal is the same as that for all other courses.

k) If more than one student is working on the same project, the distribution of work among the students is to be made clear to the students and the Instructor-in-charge. The evaluation should be based on individual performances only.

l) The details of components of evaluation should be submitted in the prescribed format only.

m) The student is expected to attend a **conference** on the area of project opted or present a **technical paper** in any of the journal.

Course No	Course Title	L	P	U
TIP 491	Technology Innovation Project	0	0	3

Scope & Objective of the course:

A unique opportunity for the students in the form of a course that facilitate the combination of academics with the industry by involving an in-depth innovation, investigation under the supervision of mentor from Industry and a faculty member for performing the real-life projects with the support from various organizations. Students working in groups will be required to perform research, customer and problem discovery, ideation, concept creation and validation, and technical implementation for a real-world challenge. The specific time-bound based on the students registered for the course will be graded based on the performance feedback from both the industry and the Faculty supervisor. The student will be able to improve the skills and knowledge for improving written and oral communication with indicative content which includes innovation methodology, customer & problem discovery, problem validation, innovation experiments with innovative presentations.

Evaluation:

Student evaluation is based on Literature survey, seminar series conducted, and observations of the supervisor and Thesis report.

Component	Weightage (%)	Date	Remarks
Literature Survey and Project outline	20	3rd week	Supervisor to submit copy to IC
Mid-term Project Report	10	7th week	Supervisor to submit to IC after evaluation
Mid-term Seminar	20	8th Week	Mid-semester grading to be submitted to IC by Supervisor
End-Sem Project Report	25	14th week	Supervisor to submit to IC after evaluation
End-Sem Seminar	25	15th Week	

Textbook T1	There are no specifically prescribed or recommended texts for this subject as student must do literature survey from journals of his field of research.
Reference book(s) R1	Related to Project work

General Guidelines:

a) This being a three-unit course, a student is expected to work for at least 12- 14 hours per week including the formal contact hours with the instructor.

b) Each student should meet the faculty and mentor from Industry at least twice a week in addition to the formal contact hours at mutually agreed time to apprise the faculty of the progress in the project.

c) Student is supposed to maintain a diary and record the daily progress of the work done. The diary would be periodically checked by the faculty.

d) All the evaluation components are compulsory. If a student misses any component of evaluation, he is likely to get "NC".

e) The Mid-term evaluation is to be strict to avoid any laxity on the part of the student.

f) Student should make two copies of the final report in the prescribed format, one his personal copy and the other for submission to eh Institute. The faculty may ask for an additional copy if so desired.

g) The final seminar is to be planned only after the submission of the project report.

h) The final seminar is open to all the student and the faculty. The faculty member should involve the local experts in the evaluation of final seminar.

i) If the progress in the project work is not satisfactory, the faculty may advise the student to withdraw from the course in time and the same may be communicated to the instructor-in-charge.

j) The student should submit the withdrawal request to the Convener, Academic Registration Committee. The last day for withdrawal is the same as that for all other courses.

k) If more than one student is working on the same project, the distribution of work among the students is to be made clear to the students and the Instructor-in-charge. The evaluation should be based on individual performances only.

l) The details of components of evaluation should be submitted in the prescribed format only.

m) The student is expected to attend a conference on the area of project opted or present a **technical paper** in any of the journal.

Learning Outcomes:

After successful completion of the course student will be able to

1. Work independently as part of an interdisciplinary team to complete a technical innovation project
2. Collect and critically analyse a range of data about the project allotted by creating innovation hypotheses from the data
3. Validate innovation hypotheses
4. Conceptualize, design, and implement an innovative and technology-based solution to the identified problem Present technical solutions to various stakeholders in both written and oral forms

Course No: **CE211**	Course Title:**Surveying**	L	P	U
		2	2	3

Course Learning Objectives

The objective of the course is to understand the necessity and importance of surveying in civil engineering, learn in detail various methods of surveying; linear and angular measurements, leveling, electronic distance measurements, etc

Course Content

UNIT I

Introduction, fundamental definitions and concepts, types of surveys, principles of surveying, chain triangulation, obstacles in chaining. Compass- introduction; bearings and angles; local attraction, traversing, adjustments. Plane table surveying- introduction to plane table surveying, methods: radiation, intersection, resection; three point problem; two point problem, advantages and disadvantages in plane tabling.

UNIT II

Definitions, methods in levelling; levelling instruments; levelling staff;; balancing backsights and foresights; differential levelling, longitudinal & cross section levelling, contouring methods, contour intervals, characteristics and uses of contours, plotting, interpolation of contours, contour gradient; calculation of areas and volumes.

UNIT III

Theodolite: transit and non-transit Theodolite; definitions and terms; description and uses, temporary and permanent adjustments, horizontal angles, heights and distances, traversing, closing error and distribution ,total station surveying.

UNIT IV

Tacheometry: general; instruments used; different systems of tacheometric measurements; principle of stadia method; distance and elevation formulae for staff vertical, staff normal and staff inclined; principle of subtense method; horizontal base subtense method; holding the staff; methods of reading the staff; stadia constants, anallactic lens, subtense bar, self reducing tacheometers.

UNIT V

Definitions, designation of curve, elements of simple curve, settings of simple circular curve, transition curve: ideal transition curve, length of transition curve.

Text Books

1. Duggal, S.K. (2013).*Surveying:* Vol. I & II. 4th edn. New Delhi: Tata McGraw-Hill Education.
2. Subramanian, R. (2008).*Surveying and levelling*. 3rd edn. New Delhi: Oxford University Press.

Reference Books

1. Arora, K.R. (2010).*Surveyi*ng.11th edn. New Delhi: Standard Book House.
2. Anderson, J.M. and Mikhail, E.M. (2001).*Introduction to surveying*.3rdedn. New York: McGraw-Hill.
3. Kanetkar, T.P. (2007).*Surveying and leveling*. Pune, India: Pune Vidyarthi Griha Prakashan.

Employability /entrepreneurship/ skill development:

The following List of Experiments and Field activities will be useful for skill development and Employability

Ex. No	Experiment Name	Aim of the Experiment
1	Chain surveying	To measure the distance by ranging and chaining and to measure the area of the given field by chain triangulation
2	Locating given building by using chain and cross staff	To plot the plan of the given building by using chain and cross staff.
3	Measurement of bearings of traverse with prismatic compass.	Measurement of bearings of sides of traverse with prismatic compass and computation of correct included angles
4	Determination of elevation of various points with dumpy level.	To determine the elevation of various given points with Dumpy level by collimation plane method and rise & fall method
5	Fly leveling using Dumpy level	To fix bench mark with respect to temporary bench mark with Dumpy level by fly leveling and check levels.
6	L-Section and cross section of road	To find out the L-section and cross section of the road (one full size drawing sheet each for L- section and cross section) using Dumpy level.
7	Plane table surveying: Radiation	To find out distance between six points given on the ground using Radiation method. Also find the area enclosed by the polygon
8	Plane table surveying: Intersection	To find out distance between different points given on the ground using intersection method. Also to find the area enclosed by the polygon

9	Plane table surveying: Resection –Three point problem	To locate the instrument station with respect to three given points A, B and C and to find the distance AD
10	Plane table surveying: Resection – Two point problem	To locate the instrument station 'P' on the plan, by means of observations to two well defined points A & B whose positions have been previously plotted on the plan and find the distances AV and BV where V is an inaccessible point in the field in line with A & B
11	Determination of horizontal and vertical angles using theodolite.	To determine the horizontal and vertical angles using theodolite
12	Total Station	To determine horizontal angle, slope distance and vertical angle
13	Auto level	To determine the elevation of various points on the ground

Course Outcomes:

Upon completing the course, the students will be able to carry out linear and angular measurements, levelling, measurements to heights and distances, choose appropriate surveying instrument according to the nature of work and analyze the obtained field data and rectify the errors to get accurate measurements.
The knoweldege on Total Station dumpy level and Auto level will enhance employability of students

Course No:**CE221**	Course Title:**Mechanics of Solids**	**L**	**P**	**U**
		2	**2**	**3**

Course Learning Objectives

The objective of the course is to learn the concepts of stress, strain, compound stress, section modulus, shear force diagram, bending moment diagram, theory of simple bending, deflection in beams, torsion of shaft and springs, columns and struts, analysis of thin walled and thick walled cylinders.

Course Content

UNIT I

Stress, strain, lateral strain, longitudinal strain, Poisson's ratio, shear stress and shear strain, rigidity modulus, bulk modulus, relationship between elastic constants, Bars of varying cross-section, stresses due to self weight, compound bars, temperature stresses in bars, principle of complimentary shear stress, principal stresses and strain, determination of stresses on oblique section, Mohr's circle.

UNIT II

Types of beams, shear force and bending moment, sign convention for shear force and bending moment, shear force and bending moment diagrams for cantilever, simply supported and over hanging beams with point load, uniformly distributed load, uniformly varying load.

Theory of simple bending, neutral axis, section modulus, Shearing stresses in beams, deflection of a simply supported beam by various methods.

UNIT III

Torsion of shaft and springs: introduction, pure torsion, relation between twisting moment and shear stress and angle of twist, polar modulus, torsional rigidity, power transmitted by a shaft, composite shafts, torsion of a tapering shaft, warping, close coiled helical spring: axial pull, springs in series and parallel.

UNIT IV

Theory of columns, failure of a column, long column and short column, Euler's formula, Rankin's, formula, effective length of a column with different end conditions, expression for critical load with different end conditions

UNIT V

Thin cylinders and thick cylinders subjected to internal pressure, stresses developed in it, expression for hoop stress and longitudinal stress

Theories of failure: maximum principal stress theory, maximum principal strain theory, maximum shear stress theory, maximum strain energy theory, maximum shear strain energy theory.

Text Books

1. Basavarajaiah, B S, Mahadevappa R (2010). Strength of Materials. , 3rd edition, Taylor & Francis

Reference Books

1. Hibbeler, R.C. (2016). *Mechanics of Materials.* 10th ed. Singapore: Pearson Eduction.
2. Gere, J.M. and Timoshenko (2007). *Mechanics of Materials*, 4thed. New Delhi: PWS Pub Co.
3. Subramanian, R. (2010). *Strength of Materials*, 2nd ed , London: Oxford University Press,
4. Ramamrutham, S & Narayanan, R. (2014). *Strength of Materials*, 8thed. New Delhi: Dhanpat Rai Publishing Company Private Limited.

Employability /entrepreneurship/ skill development:

The following List of Experiments will be useful for skill development

SL NO	NAME OF THE EXPERIMENT	Aim of the Experiment
1	To determine the ultimate compressive strength of wood and concrete blocks	To determine the ultimate compressive strength of wood and concrete blocks
2	Determine the youngs modulus of mild steel specimen by using deflection test on a simply supported beam	To determine the youngs modulus of mild steel specimen by using deflection test on a simply supported
3	Determine the youngs modulus of mild steel specimen by using deflection test on a cantilever beam	To determine the youngs modulus of mild steel specimen by using deflection test on a cantilever beam
4	Determine the toughness of mild steel specimen by using impact test	To determine the toughness of mild steel specimen by using impact test
5	Determine the tensile strength of a mild steel rod by using universal testing machine	To determine the tensile strength of a mild steel rod by using universal testing machine
6	Determine modulus of rigidity of mild steel bar by using torsion testing machine	To determine the modulus of rigidity of mild steel bar by using torsion testing machine

7	Determine modulus of rigidity of spring by using deflection of springs	To determine the modulus of rigidity of spring by using deflection of springs
8	Determine the modulus of rigidity of spring by using deflection of springs	To determine the modulus of rigidity of spring by using deflection of springs
9	Determine the fatigue strength of rod by using fatigue testing machine.	To determine the fatigue strength of rod by using fatigue testing machine.

Course Outcomes

Upon successful completion of the course students will be able to draw SFD, BMD. The student will be thourough with behaviour of coulumns and he will be able to find pressures induced in thin & thick cylinders. Determination of deflection in beams and springs torque developed in the shafts, through experiments enhances the skill development in students.

Course No: **CE311**	Course Title: **Fluid Mechanics**	L	P	U
		2	2	3

Course Learning Objectives

Fluid Mechanics is considered as one of the basic subjects for mechanical & civil engineering students as it develops thinking and imaginative capacity of the students. An engineer who successfully copes with new problems in the field must have a sound understanding of fundamental principles. The present course is designed to prepare the students in this direction. The contents of the syllabus have been developed keeping in this mind, so that the students are exposed to a variety of situations that will test their understanding of the subject both at the conceptual and analytical skills.

Course Content

UNIT I

Concepts & definitions, properties of fluids, fluid pressure and measurement (Manometers & guages), hydrostatic forces, (Centre of pressure and total pressure calculation), buoyancy & flotation, metacentric height, different equilibrium condition.

UNIT II

Fundamental of fluid flow, (different types of flow laminar turbulent 1 2 & 3dimensional flow etc) Kinematics and dynamics equations of motion and energy& related problems (Continuity equation, Bernoulli's equation, Euler's equation), impulse momentum equations.

UNIT III

Applications of Benoulli's equation ; flow through pipes, orifices and mouth pieces, flow over notches & weirs , Equations of discharge through different shapes of notches & weirs and their area of application, Concept of Vena contracta HGL & TEL, Coefficients(C_d C_c C_v).

UNIT IV

Pipe losses (Major & minor) Darcy's weisbech formula, Chezy's constant. Related problems. concept of Boundary layer (Reynold & Prandtl formula). Dimensionalanalysis and model similtude.

UNIT V

Rayleigh's method & Buckinghum й theorem for dimensional analysis, topic related numerical practice.

Text Books

1. "Fluid Mechanics", TMH, 2nd Ed., Yunus Cengel and John Cimbala.
2. "Fluid Mechanics", R K Bansal, Laxmi publications.

Reference Books

1. "Fluid Mechanics", John F Douglas & Swaffield, 5th Ed, Prentice Hall.
2. "Hydraulics & Fluid Mechanics", Modi & Seth, 15th Edition, Standard Book House.
3. "Fundamentals of Fluid Mechanics", Bruce & Donald, 5th Edition. John Wiley Publications.

Employability /entrepreneurship/ skill development:

The following List of Experiments will be useful for skill development

SL NO	NAME OF THE EXPERIMENT	Aim of the Experiment
1	Determination of flow rate with Rotameter (water)	To determine the flow rate with Rotameter
2	Determination of coefficient of discharge through Orifice meter	To determine the coefficient of discharge through Orifice meter
3	Determination of point velocity in Pitot tube	To determine the point velocity in Pitot tube
4	Verification of Bernoulli's Theorem	To verify the Bernoulli's Theorem
5	Determination of flow rate of fluid through Rota meter (Air)	To determine the flow rate of fluid through Rota meter (Air)
6	Determination of type of fluid flow in pipe through Reynolds number	To determine the fluid flow in pipe through Reynolds number
7	Determination of coefficient of discharge through Venturimeter	To determine the coefficient of discharge through Venturimeter
8	Experiment on Losses of head in pipe fittings (Minor losses)	To determine the Losses of head in pipe fittings (Minor losses)
9	Determination of Head, Cd and Flow rate over notches (V , Rectangular notch)	To determine the Head, Cd and Flow rate over notches
10	Determination of Metacentric height (Buoyancy test) of a flat bottomed pontoon experimentally.	To determine the Metacentric height
11	Determination of co-efficient of discharge through Elbow meter	To determine the co-efficient of discharge through Elbow meter

Course Outcomes

- The student will understand stress-strain relationship in fluids, classify their behavior and also establish force balance in static systems. Further they would develop dimensionless groups that help in scale-up and scale-down of fluid flow systems.
- Students will be able to apply Bernouli principle and compute pressure drop in flow systems of different configurations.
- Students will compute power requirement in fixed bed system and determine minimum fluidization velocity in fluidized bed.
- Students will be skilled to perform the functioning of flow metering devices.

Course No: **CE312**	Course Title : **Soil Mechanics**	L	P	U
		3	2	4

Course Learning Objectives

The objective of the course is to teach the fundamentals of soil, its classification and properties and to understand the concepts of seepage, permeability of soils, compaction and consolidation of soils and principles of effective stress in saturated soils, and its application to various soil conditions

Course content

UNIT I

Introduction to soil mechanics-definition of soil and soil mechanics; formation of soil, types of soil; three phase system of soil and their relationships; specific gravity; definition; determination; field density; sand replacement and core cutter method.

Index Properties-classification of soil; grain size analysis; Stoke's law and hydrometer analysis; consistency of soils; Atterberg's limits: liquid limit, plastic limit and shrinkage limit, determination of: plasticity index, liquidity index, consistency index, shrinkage ratio, flow index and toughness index; classification of coarse grained and fine grained soil as per BIS.

UNIT II

Permeability-definition; assumptions; one dimensional flow through soil; Darcy's law: limitations; discharge velocity and seepage velocity; factors affecting the permeability; permeability determination; lab and field methods: constant head permeability test, variable head permeability test; permeability in stratified soil deposits;

Seepage-seepage through porous media; seepage through earthen dams, piping failure of earthen dam; introduction of flow net and its properties - application of flow net.

UNIT III

Compaction-introduction, field and lab methods: standard Proctor test, modified Proctor test; factors affecting the compaction; effect of compaction in soil properties; relative compact, suitability of various methods of compaction.

Consolidation-introduction, initial, primary and secondary consolidation, behavior of saturated soils under pressure, Terzaghi's theory of one dimensional consolidation; consolidation test, determination of coefficient of consolidation, causes of preconsolidation in soils, secondary consolidation; sand drains.

UNIT IV

Stress distribution-introduction: stresses in soil; concept of effective and neutral stresses; stress distribution in soil media; Boussinesq and Westergrads analysis; point load, uniformly distributed load, line load, rectangular load, pressure bulb; Newmark's chart.

Shear strength-introduction, stress system with principal planes, Mohr's circle, Mohr – coulomb theory, direct shear test, triaxial test on cohesive and cohesionless soils, and liquefaction of sand.

UNIT V

Introduction, types of slope failure, stability of an infinite slope of cohesionless soils; stability of an infinite slope of cohesive soils, wedge failure, Culmann's method, friction circle method, failure of finite slopes; Swedish circle method, stability of slopes under steady seepage condition; factor of safety; slope stability of earth dams.

Text Books

1. Kesavulu, C.N. (2009).*Textbook of engineering geology*. 2nd edn. New Delhi, India: Macmillan India.
2. Terzaghi, K., Peck, R.B. and Mesri, G. (1996).*Soil mechanics in engineering practice*. 3rd edn. New York, NY, USA: Wiley, John & Sons.

Reference Books:

1. Gulhati, S.K., Datta, M. and Gulhati, S. (2005).*Geotechnical engineering* 1st edn. New Delhi: India Higher Education.
2. Holtz, R.D., Kovacs, W.D. and Sheahan, T.C. (2010).*An introduction to geotechnical engineering*. 2nd edn. Boston, MA, USA: Prentice Hall.
3. Whitman, R.V. and Robert V. Whitman T. William Lambe (2008).*Soil mechanics SI version*. New Delhi, India: Wiley India Pvt.

Codes:

1. IS 1498:1970: Classification and identification of soils.
2. IS 2720 (Part 1 to Part 41): 1983: Methods of test for soils
3. IS 2131: 1981: Method of standard penetration test for soils
4. IS 11196:1985: Specification for equipment for determination of liquid limit of soils cone penetration method
5. IS 10379: 1982: Code of practice for field control of moisture and compaction of soils of embankment and subgrade

Employability /entrepreneurship/ skill development:

The following List of Experiments and field activities will be useful for skill development

Ex. No	Ex. Name	Aim of the Experiment
1	Water content Determination	To determine the Water content in a given soil sample
2	Insitu-density of Soil by core cutter	To determine natural density of soil
3	Insitu-density by Sand Replacement Method	To determine relative density in field soil
4	Plastic Limit Test	To determine Plastic limit of soil
5	Standard Proctor Test	To determine maximum dry density and optimum moisture content of soil sample
6	Determination of Specific Gravity Test by Density Bottle Method	To determine specific gravity of soil

7	Grain size Distribution(Dry sieve Analysis)	To determine grain size analysis for soil
8	Direct Shear Test	To determine shear strength in soils
9	Unconfined Compression Test	To determine Unconfined compressive strength in soil
10	California Bearing Ratio Test	To determine CBR value of soil

Employability /entrepreneurship/ skill development

- Methods of material testing useful for developing skill
- Employability in the form of Consultancy works

Course Outcomes

Upon successful completion of the course student will be skilled to understand various types of rocks, their mineralogy and structure, identify the properties of a given soil. After undergoing through field activities and laboratory experiments the students will be skilled to classify soil, determine the permeability of soil and predict the shear strength of soil. This will enhance employability in the field of soil testing.

Course No: **CE313**	Course Title: **Analysis of Structures**	L	P	U
		3	0	3

Course Learning Objectives

The objective of the course is to understand the methodology of analyzing structures under various loading conditions, to learn different techniques available for the analysis of structures and to understand rolling loads & influence line diagram concepts for analysis

Course Content

UNIT I

Introduction, definition of indeterminate structures, general methods of analysis of indeterminate structures, Clapeyron's theorem of three moments, statement, application of Clapeyron's theorem of three moments for the following cases, problems on two span, simply supported ends, one end fixed and the other simply supported, simply supported with one end overhanging, propped cantilever, sketching of SFD and BMD for the above cases.

UNIT II

Stain energy, Castigliano's theorem, calculation of deflection in statically determinate beams and trusses, unit load methods, Williot Mohr's diagram, static indeterminacy, strain energy method, analysis of indeterminate structures, beams, pin jointed and rigid jointed structures, temperature effect - bending moment and shear force diagrams.

UNIT III

Introduction, sign convention, kinematic indeterminacy, development of slope deflection equations, analysis of continuous beams, analysis of frames with no lateral translation of joints, analysis of frames with lateral translation of joints, bending moment and shear force diagram.

UNIT IV

Introduction, development of Moment Distribution method, analysis of continuous beams,analysis of frames with no lateral translation of joints, analysis of frames with lateral translation of joints, symmetrical frames, bending moment and shear force diagram.

UNIT V

Influence lines, influence lines for bending moment and shear force, Muller Breaslau's, principle, determinate and indeterminate beams, Maxwell's reciprocal theorem. Rolling loads-single concentrated load, UDL shorter than span, UDL longer than span-two concentrated loads- series of concentrated loads.

Text Books

1. Reddy, C.S. (2001). *Basic structural analysis*. New Delhi, India: McGraw Hill Higher Education.

Reference Books

1. Timoshenko, S.P. and Young, *D.* H. (1983). *Theory of structures.* Columbus, USA: McGraw Hill Higher Education.
2. Negi, L. S. (2003). *Structural analysis*. Columbus, USA: McGraw-Hill.
3. Vazirani, V.N. (2003). *Analysis structure: Theory & design Vol 2*. India: Khanna publishers.

Sskill development activities:

- Analysis of beams(simply supported , cantilever, continuous) and frames using finite element softwares

Course Outcomes

Upon successful completion of the course student will be skilled to apply three moment theorem for structural analysis, perform strain energy concepts in the analysis, and appreciate the importance of the force method and deflection method, make use of rolling loads & influence line diagrams for analysis. The skill development activites exposes the students to the various FEM tools being used in industry and there by enhances employability.

Course No: CE314	Course Title: **Water Resources Engineering**	L	P	U
		3	0	3

Course Learning Objectives

The objective of the course is to develop skills in the ground water flow, type of aquifer and yield from the well, to understand the basic types of irrigation, irrigation standards and crop water assessment, to understand the analysis of seepage and to learn various hydraulic structures such as weirs and barrages, gravity dams, earth dams, spillways and cross drainage works

Course Content

UNIT I

Hydrological cycle, types & forms of precipitation- rainfall measurements, interpretation of rainfall data, missing rainfall data, runoff cycle, infiltration indices, hydrograph analysis, unit hydrograph, applications, reservoir and flood routing.

UNIT II

Ground water-aquifers, permeability & transmissibility, steady flow towards a well in confined & water table aquifer-Dupits&Theims equation, measurement of yield of an open well, tube well & infiltration galleries.

UNIT III

Need for irrigation in India-scope- soil moisture & plant growth - crop water requirements-irrigation scheduling-irrigation efficiencies, duty-delta-base period-relation between them, surface & subsurface irrigation method, irrigation water quality.

UNIT IV

Sediment transport- importance & mechanics of transport, bed load & suspended load estimation, design of channels in India- regime channels- Kennedy and Lacey's theory, water logging- causes- effects- control measures, canal lining, land reclamation.

UNIT V

Theories of seepage, Bligh's creep theory, Lane's weighted creep theory, Khosla's theory, simple design problems on weirs and barrages, gravity dams, earth dams, spillways, factors affecting location and type of dams, forces on a dam, cross drainage works.

Text Books

1. Subramanya, K. (2013). *Engineering hydrology*. 2nd edn. Bronson, USA: McGraw-Hill Professional.
2. Asawa, G.L. (2008). *Irrigation and water resources engineering*. New Delhi: New Age International.

Reference Books

1. Garg, S.K. (2006). *Irrigation engineering and hydraulic structures.* 23rd edn. New Delhi: Khanna Publishers.
2. Sharma, R.K. and Sharma, T.K. (2007). *Irrigation engineering.* 3rd edn. New Delhi: S Chand & Company.

Activities for skill development

- Collection of data from the near by catchment area and develoment of Hydrograph from the colleceted data.

Course Outcomes

Upon successful completion of the course student will be skilled to develop and analyze hydrographs, find the crop water requirement for various crops in the command area and plan and design of water resource systems.

Course No: **CE321**	Course Title: **Construction Materials &Practices**	**L**	**P**	**U**
		3	**2**	**4**

Course Learning Objectives

The objective of the course is to understand the physical and mechanical properties of various construction materials, various construction equipments available in construction industry and sequence of activities and co-ordination to be followed in construction industry

Course Content

UNIT I

Stone as building material, criteria for selection, tests on stones ,deterioration and preservation of stone work, bricks, classification, manufacture of clay bricks, tests on bricks, compressive strength, water absorption, efflorescence, bricks for special use, refractory bricks, cement and concrete hollow blocks ,light weight concrete blocks, code Practices.

UNIT II

Timber ,market forms, industrial timber, plywood, veneer, thermocol, panels of laminates ,steel, aluminium and other metallic materials, composition, uses, market forms, mechanical treatment,paints, varnishes, distempers, code practices.

UNIT III

Glass, ceramics, sealants for joints, fibre glass reinforced plastic, clay products, refractories, composite materials, types, applications of laminar composites, fibre textiles, geosynthetics for Civil Engineering applications, PVC, CPVC.

UNIT IV

Manufacture of Portland cement, wet process, dry process, chemical composition, testing of cement. Classification, source, aggregates from igneous ,sedimentary, metamorphic rocks, , aggregate crushing value, impact value, abrasion value, Deval attrition test, Dorry abrasion test, Los Angeles test. Workability, factors affecting workability- water content, mix proportions, use of admixture, measurement of workability, slump test, compacting factor test, Water/ cement ratio, gel/space ratio, gain of strength with age, relation between compression and tensile strength, centre and third point loading, bond strength. American concrete institute method, Indian standard recommended method of concrete mix design.

UNIT V

Specifications, details and sequence of activities and construction co-ordination, site clearance, marking, earthwork, masonry, stone masonry, bond in masonry, English bond, Flemish bond, random rubble masonry, concrete hollow block masonry, flooring, damp proof courses, construction joints, movement and expansion joints, precast pavements, building foundations, basements ,temporary shed ,centering and shuttering ,slip forms, scaffoldings, de-shuttering forms, fabrication and erection of steel trusses, frames, braced domes, laying brick, weather and water proof, roof finishes ,acoustic and fire protection. Selection of equipment for earth work, earth moving operations

Text Books

1. Varghese, P.C. (2015). *Building materials*. 2nd edn. New Delhi, India: Prentice-Hall.
2. Neville, A.M. (2011).*Properties of concrete.*5th edn. Harlow, England: Prentice-Hall.
3. Peurifoy, R.L., Ledbetter, W.B. and Schexnayder, C.J. (2010). *Construction planning, equipment, and methods*. 7th edn. New York: McGraw-Hill.

Reference Books

1. Kandya, A. (2011). *Elements of civil engineering*. 2nd edn. Gujarat, India: Charotar Publishing House.
2. Duggal, S.K. (2009). *Building materials*. 3rd edn. New Delhi, India: New Age International.

Employability /entrepreneurship/ skill development:
The following List of Experiments will be useful for skill development

Sl. No.	Name of Experiment	Aim of the experiment
1	Water absorption test on different types of bricks.	To determine the Water absorption of bricks
2	Specific Gravity Test On Course Aggregate& Bitumen	To determine the Specific Gravity of Course Aggregate& Bitumen
3	Standard consistency of cement	To determine the normal consistency of cement
4	setting time of cement	To determine the setting times of cement
5	Fineness test on cement	To determine the Fineness of cement
6	soundness test on cement	To determine the expansion of cement
7	Tests for workability of concrete using Slump cone,	To measure the consistency and workability of fresh concrete
8	Tests for workability of concrete using vee bee consistometer	To determine mobility and compactibility of freshly
9	Tests for workability of concrete (compaction factor test)	To determine the compaction factor of concrete with low, medium and high workability
10	Compressive strength of (a) Concrete (b)Bricks (c)Cement cubes	To determine the Compressive strength of concrete, bricks and cement cubes
11	NDT using Rebound hammer	To determine compressive strength of concrete
12	Flexure test on hardened concrete	to determine the flexural strength of concrete beams
13	Shape Test (Flakiness & Elongation Index)	To determine Flakiness & Elongation Index of aggregate particles

14	Hardness and strength tests on aggregate	
15	Aggregate Crushing Strength Test	To determine the Aggregate Crushing Strength
16	Abrasion Test on aggregate	To determine the aggregates resistance to fragmentation
17	Impact Test on aggregate	To determine the aggregate impact value
18	Tests on bitumen Penetration Test Ductility Test Softening Point of Bitumen Viscosity Test	To determine the Penetration value , Ductility value , Softening Point and Viscosity of Bitumen

Employability /entrepreneurship/ skill development

- Construction material testing will enhance employability of civil engineering students
- Employability in the form of Consultancy works

Course Outcomes

Upon completing the course, the students will be skilled to select appropriate construction equipments in construction site, choose the modern construction material appropriate to the climate and functional aspects of the buildings and supervise the construction technique to be followed in brick, stone and hollow block masonry, concreting, flooring, roofing, plastering and painting etc . This will increase the employability of the students.

Course No: **CE322**	Course Title: **Design of Concrete Structures**	L	P	U
		3	0	3

Course Learning Objectives

The objective of the course is to study the stress strain behavior of steel and concrete, to understand the different philosophies available for the design, to understand the usage of IS codes, to understand the behavior of columns subjected to eccentric load and use of interaction diagrams and to understand basic concepts of prestressed concrete design

Course Content

UNIT I

Introduction to different design philosophies, reinforced concrete fundamentals- concept of reinforced concrete, stress strain characteristics of concrete and steel reinforcement –detailed understanding of IS 456 and design philosophy limit state design method, elastic theory, curved stress distribution, compressive stress block, simplified rectangular stress block as per Whitney's approach, ultimate moment of resistance of singly reinforced section, balanced section, over reinforced section, under reinforced sections, design of rectangular beams, singly reinforced section, design and analysis of doubly reinforced section, T& L beams for flexure, shear, and torsion, bond stresses and design for shear and bond.

UNIT II

Limit state design of one way slab, structural analysis of one way slab with UDL using coefficients, design for shear in slabs, use of design aids SP 16, action of two-way slab, moments in two way slabs simply supported on all supports, moments in two way restrained slab with corners held down, arrangement of reinforcements, negative moments at discontinuous edges, choosing thickness of slab, calculation of area of steel, loads on supporting beams, critical section for shear in slab, procedure for design of two way slab with simply supported edges and restrained edges, detailing of reinforcement.

UNIT III

Introduction, short columns, unsupported and effective length of columns, slenderness limits for columns, checking for accidental eccentricity, design of longitudinal steel, design of lateral ties, design of short columns by SP 16, procedure for design of centrally loaded short columns, strength of helically reinforced short columns, calculation of spacing of spirals, placement of steel in circular columns, methods of design of short columns with moments, uniaxial bending (design assumptions), column interaction diagrams, interaction curves in SP 16, use of interaction curves for design and analysis, introduction for slender columns, maximum permitted length for columns, basis of additional moments, reduction factors for additional moments, design moments in braced columns with initial moments, and in unbraced columns, slender columns bent about both axes, design procedure.

UNIT IV

Introduction, design loads in foundation design, basics of design of foundation, soil pressure on foundation, conventional analysis of foundations subjected to vertical load and moments, design of independent footings, checking for development lengths of reinforcements in footing, procedure for design, design of square footing and rectangular footing, detailing of steel, plain concrete footing, design of pedestals, pile caps, design and detailing of combined footing.

UNIT V

Principles of prestressing –development of prestressed concrete, materials of prestressing - systems of prestressing, behavior of prestressed concrete, advantages of prestressed concrete, classification of types of prestressing, post tensioning and pretensioning, methods of prestressing - loss of prestress, immediate losses and time dependent losses, analysis of beam sections at transfer and service loads.

Text Books

1. Varghese, P.C. (2004). *Limit state design of reinforced concrete*. 2nd edn. New Delhi, India: Prentice-Hall.

Reference Books

1. Park, R. and Paulay, T. (1975). *Reinforced concrete structures*. New York, USA: Wiley, John & Sons.
2. Pillai, S.U. and Menon, D. (2009). *Reinforced concrete design.* 3rd edn. New Delhi, India: Tata McGraw-Hill.
3. Krishna, R.N. and Pranesh, R.N. (2009). *Reinforced concrete design: Principles and practice*. New Delhi, India: New Age International.

Codes

1. IS 456: 2000 Plain and reinforced concrete - code of practice
2. SP 24 (S and T): 1983 Explanatory handbook on Indian standard code of practice for plain and reinforced concrete
3. SP 16: 1980 Design aids for reinforced concrete to IS 456 : 1978

Sskill development activities:

- Analysis and design of frames, single and multi-storey RCC buildings by using manual calculation methods finite element softwares

Course Outcomes

Upon successful completion of the course student will be skilled to use IS code of practice for the design of concrete elements, design the beams, slab, column and footing, detail various RCC structural elements and analyze prestressed concrete beams. The skill development activites exposes the students to the various FEM tools being used in industry and there by enhances employability.

Course No: **CE323**	Course Title: **Transportation Engineering**	L	P	U
		3	0	3

Course Learning Objectives

The objective of the course is to understand various transportation modes, various components involved in their respective modes and their basic design concepts.

Course Content

UNIT I

Different modes of transportation, historical development of road construction-highway development in India, classification of roads-road pattern, highway planning in India-highway alignment, engineering surveys for alignment, highway project, the highway cross-sectional elements, sight distance, types of sight distances, design of horizontal alignment, super elevation, widening of pavements on horizontal curves, transition curves, design of vertical alignments, gradients- summit and valley curves.

UNIT II

Material requirement for pavements, soil classification for highway, soil tests, CBR and plate load test, aggregate, materials testing and specification, bitumen, material testing and specification, concrete mix design, construction of bituminous and rigid pavements, highway maintenance, material recycling, importance of highway drainage, clearing and grubbing, slope ditches, excavation, benching, slope protection, compaction.

UNIT III

Characteristics of traffic elements, design of intersections, interchanges, parking layout & road signs, urban traffic management, traffic regulations and control, accidents, causes and preventions, pavement analysis, factors affecting pavement thickness, soil,wheel load, temperature, environmental factors; flexible pavement design, axle load surveys, CBR method of design, rigid pavement design, IRC method.

UNIT IV

Air transport characteristics-airport classification-airport planning: objectives, components, layout characteristics, socio-economic characteristics of the catchment area, criteria for airport site selection and ICAO stipulations, typical airport layouts, case studies, parking and circulation area.

UNIT V

Runway design: orientation, wind rose diagram, runway length, problems on basic and actual length, geometric design of runways, configuration and pavement design principles, elements of taxiway design, airport zones, passenger facilities and services, runway and taxiway markings and lighting.

Text Books

1. Rao, V.G. (2005). *Principles of transportation and highway engineering*. New Delhi: McGraw-Hill.
2. Rao, G.V. (2002). *Airport engineering*. New Delhi, India: Tata McGraw Hill.

Reference Books

1. Robert, M. H., Francis X. M., SproulеW. J, and Young S.(2010). *Planning and design of airports*. 5th edn. New Delhi: Tata McGraw Hill.
2. Khanna, S.K. (2015).*Highway engineering*. 10th edn. Uttarakhand, India: Nem Chand & Bros.

Skill development activities

- Conduct traffic studies on near by junctions /circles /signals.

Course Outcomes

Upon completing the course, the students will be skilled to carry out surveys involved in planning and highway alignment, geometric design and pavement design and identify the requirements of an Airport planning and design.

Course No: **CE324**	Course Title: **Data Structures**	L	P	U
		2	2	3

Course Learning Objectives

- To understand the basics of all data structures.
- To choose the appropriate data structure for specific application.
- To understand and analyze various searching and sorting algorithms.
- To solve the complex problem using hashing, trees and graph.

Course Contents

UNIT-I

Introduction to Data Structures, need and advantages of data structure. Array, Pointers: basics, pointer with function, array of pointers, pointer to array, applications, advantages and disadvantages of pointer. Linear data structures: Stack, Queue, Linked list. Stack: Fundamentals, stack implementation using array and linked list, infix to postfix conversion and vice versa, postfix expression evaluation, recursion, stack operations: Traversing, insertion, deletion, searching (linear search and binary search), sorting (insertion sort, selection sort, bubble sort, quick sort, merge sort).

UNIT-II

Queue: Fundamentals, queue implementation using array and linked list. Queue operations: traversing, insertion and deletion. Double ended queue: Basics, implementation, operations. Circular queue: Basics, implementation, operations. Application of queue.

UNIT-III

Linked list: Fundamentals, difference between array and linked list. Single linked list: basics, representation, operations: insertion, deletion, traversing. Double linked list: basics, representation, operations: insertion, deletion, traversing. Circular linked list: basics, representation, operations: insertion, deletion, traversing.

UNIT-IV

Tree: Fundamentals, representation. Binary tree: Basics, representation, complete binary tree, tree, traversal: Inorder, preorder, postorder traversal, searching, sorting (heap sort, radix sort). Binary search tree: Basic, Inorder, preorder, postorder traversal, searching, sorting (heap sort, radix sort). B+ tree: Basic, traversing, searching, sorting. Red-black tree: Basic, traversing, searching, sorting. AVL tree: traversing, searching, sorting. Threaded binary tree: Basic, traversing, searching, sorting.

UNIT- V

Graph: Basics, Representation: adjacency matrix. Cyclic graph: basics, Acyclic graph: Basics, Traversal: Depth first search, Breadth first search. Minimum spanning tree, shortest path (Dijkstra algorithm), Prim's algorithm. Hashing.

Text Books:

1. Fundamentals of Data structures in C, E. Horowitz, S. Sahni and Susan Anderson-Freed, Universities Press. , 2nd Edition, 2007.
2. Data Structures, S. Lipscutz, Schaum's Outlines, TMH.McGraw Hill Education; 1st edition, July 2017.

Reference Books:

1. Data structures: A Pseudo code Approach with C, R. F. Gilberg and B. A. Forouzan, Cengage Learning, 2nd edition, November 2007.

2. Data structures A Programming Approach with C, D. S. Kushwaha and A.K. Misra, PHI.Phi Learning pvt Ltd, 1st edition, February 10, 2011.

Course Outcomes

Upon successful completion of the course, student will be able to:

- Understand how to use data structure concepts for realistic problems.
- Ability to identify appropriate data structure for solving computing problems in respective language.
- Ability to solve problems independently and think critically.

Course No: **CE401**	Course Title: **Finite Element Methods**	L	P	U
		2	**2**	**3**

Course Learning Objectives

The objective of the course is to learn the basic concepts of Finite element methods, FEA procedure and its applications. Stiffness method. Element and global stiffness matrix for various structural elements. Isoparametric elements, axisymmetric and 3D analysis use of software in FEM analysis.

Course Content

UNIT I

Fundamental Concepts: Introduction to finite element method, Brief history, Role of Computer Introduction to matrix, algebra General steps of the Finite Element Method, Applications and Advantages of Finite Element Method.

UNIT II

Introduction to Stiffness (Displacement) Method: Definition of the stiffness matrix, Derivation of the stiffness matrix for a spring element, Example of a spring assemblage, assembling the total stiffness matrix by superposition, Boundary conditions.

UNIT III

Development of Truss Equation: Derivation of the stiffness matrix for a bar element in local coordinates, Selecting the approximation functions for displacements, Transformation of vectors in 2D.Global Stiffness matrix for bar arbitrarily oriented in the plane, Computation of stress for a bar in the x-y plane, Solution of a plane Truss.Use of Symmetry in structure, Incline or skewed supports

Development of Beam Equations: Beam Stiffness, Assemblage of beam stiffness matrices, Beam analysis using the direct stiffness method, distributed loading.

UNIT IV

Development of the plane stress and plane strain stiffness equations: Basic concepts of plane stress and plane strain, Derivation of the constant strain triangular element stiffness matrix and equations. Treatment of body and surface forces, explicit expression for the CST stiffness matrix, Finite element solution of a plane stress problem, Rectangular plane element.

Development of the Linear strain triangle equations: Derivation of the LST element stiffness matrix and equations, example LST stiffness determination, comparison of elements.

UNIT V

Axisymmetric Elements: Derivation of the stiffness matrix, solution of a axisymmetric pressure vessel, application of asisymmetric elements.

Three Dimensional Stress analysis: Three dimensional stress and strain, tetrahedral element

Text Books

1. Daryl L. Logan. *Finite Element Method.* , 5th edition, Cengage Learning

Reference Books

1. David V. Hutton. *Fundamentals of Finite Elemental analysis.*TMH
2. Singiresu S. RAO. *Finite Element Method in Engineering*, Elsevier
3. JN Reddy.*An Introduction to Finite Element Method*, 3rd ed. TMH.
4. Paleti Srinivas, Sambana Krishna Chaitanya & Datti Rajesh Kumar.Finite Element Analysis Using Ansys 11.0, PHI.

Employability /entrepreneurship/ skill development:

List of Experiments will be useful for skill development.

SINo	Name of the experiment	Aim of the experiment
1	Bars of Constant Cross-section Area	Determine the Nodal Displacement, Stress in each element, Reaction forces.
2	Trusses	For the given truss , find Stress in each element, Reaction forces, Nodal displacement
3	Cantilever Beam	For the given beam , find Stress in each element, Reactions at critical section
4	Simply Supported Beam	For the given beam , find Stress in each element, Reaction
5	Simply Supported Beam with UDL, UVL, Moment	For the given beam , find Stress in each element, Reactions at critical section
6	Stress analysis of a rectangular plate with a circular hole	Analyze the stress distribution around the hole
7	Thermal analysis	Conduct heat transfer analysis for the given structural member
8	Modal Analysis	Modal Analysis of Cantilever beam for natural Frequency determination
9	Frame analysis	For the given frame , find Stress in each element, Reactions , bending moment

Course Outcomes

Upon successful completion of the course students will be skilled to Model of 1-D, 2_D & 3-D structural problems. Analysis of 1-D, 2_D & 3-D structural problems. Validate and interpret the results. The skill development based lab experiments exposes the students to the various FEM tools being used in industry and there by enhances employability.

Course No: **CE402**	Course Title: **Design of Steel Structures**	L	P	U
		3	0	3

Course Learning Objectives

The objective of the course is to understand the concepts of steel design, to learn IS 800-2007 code of practice for the design of compression, tension and flexural members using various cross-sections, to understand the behavior of steel connections and to understand the behavior and design procedure of compression, tension and flexural members.

Course Content

UNIT I

Metallurgy of steel, chemical composition of steel, types of structural steel, residual stresses, types of steel structures, advantages of steel as a structural material, basics of structural design, design consideration and steps involved in construction, role and responsibilities of the designers, structural system and integration, codes and specifications, design philosophies, limit state design, joints- introduction to riveted connection, behavior of bolted connections, design strength of ordinary black bolts, design strength of high strength friction grip bolts, simple connections, lap connection design, single cover connection design and double cover connection design, efficiency of connection.

UNIT II

Design of moment resistant connections, design of beam to beam connections, design of beam and column connections, design of semi rigid connections, beam and column splices. design of bolted and welded connections, axially and eccentrically loaded joints, simple connection of bracket plates to columns, beam to beam and beam to column connections, welded connection introduction, welding process, types of welded joints, design of welds, simple joints, moment resistant connections.

UNIT III

Introduction, types of tension members, behavior of tension members, modes of failures, factors affecting the strength of tension members, design of angle sections under tension, design of tension splices, plastic theory, plastic hinge concept, plastic collapse load, methods of plastic analysis, introduction to compression members, possible modes of failure, classification of cross section, behavior of compression members, elastic buckling of slender compression members, development of multiple column curves, effective length of compression members, flexural torsional buckling.

UNIT IV

Introduction, beam types, section classifications, lateral stability of beams, lateral torsional buckling of symmetric sections, buckling of real beams, behavior of beam in bending, design strength of laterally unsupported beams, shear strength of steel beams, maximum deflection, web buckling and web crippling, design of purlins, design procedure for laterally unsupported and laterally supported beams.

UNIT V

Introduction, general considerations, distribution of stress in plate girder, preliminary design procedure, web panels subjected to shear, web subjected to combined shear and bending, design of plate girder using IS 800-2007, different stiffeners and provisions for their design.

Text Books

1. Subramanian, N. (2008). *Design of steel structures*. New Delhi: Oxford University Press.

Reference Books

1. Salmon, C.G., Johnson, J.E. and Malhas, F.A. (2008). *Steel structures: Design and behavior*. 5th edn. Indianapolis, USA: Prentice Hall.
2. Ramchandra, V.G. and Gehlot, V. (2011). *Design of steel structures I*. 13th edn. Jodhpur: Scientific Publishers Journals Department.
3. Bhavikatti, S.S. (2009). *Design of steel structures*. New Delhi, India: I K International Publishing House.

Codes

1. IS 800: 2007 Code of practice for general construction in steel.
2. IS 808: 1989 Dimensions for hot rolled steel beam, column, channel and angle sections.

Sskill development activities:

- Analysis and design of frames, single and multi-storey steel buildings by using manual calculation methods and finite element softwares

Course Outcomes

Upon successful completion of the course student will be able to apply the IS code of practice for the design of steel structural elements, analyze the behavior of bolted connections, design welded connections for both axial and eccentric loads, design compression and tension members, and design simple beam, built up beam and plate girders . The skill development activites exposes the students to the various FEM tools being used in industry and there by enhances employability.

Course No: **CE403**	Course Title: **Computer Aided Design**	**L**	**P**	**U**
		1	**2**	**2**

Course Learning Objectives

The objective of the course is to learn the software developing skills for structural design, to learn the fundamentals of Computer Aided Drafting and to study the different software packages for analysis and design

UNIT I

Introduction to Basic 2D objects, line, polyline, circle, ellipse, editing objects, trim, break, change, stretch, dimensioning.

UNIT II

Preparation of plan, elevation and section drawings of simple structural objects, printing and plotting drawings, script files and introduction to 3D.

UNIT III

Design and analysis of R.C.C: Slabs, Beams, Columns, and Retaining walls using software package

UNIT IV

Design and analysis of Steel: Trusses, Beams, Columns, Column Bases, Plate girders, Gantry girders, Connections.

UNIT V

Design of multi-storey building using analysis and design packages.

Text Books

1. Dhananjay, A. J. (2010). Engineering Drawing: With An Introduction To Auto Cad. Tata McGraw Hill Education Private Limited.
2. Krishnamoorthy, C., Rajeev, S. and Rajaraman, A. (2007). *Computer aided design*. Harrow: Alpha Science International.

Reference Books

1. Bhatt N.D., Panchal V.M. (2010). Engineering Drawing, 50th edition, Charotar Publishing, Gujarat.

Employability /entrepreneurship/ skill development:
The following List of Experiments will be useful for skill development

Sl. No.	Name of Experiment	Aim of the experiment
1	Study on behaviour of concrete beams	Analysis and design of simple concrete beam
2	Study on behaviour of steel beams	Analysis and design of simple steel beam
3	Study on behaviour of columns	Analysis and design of long and short steel and concrete columns
4	Study on behaviour of slabs	Analysis and design of one-way and two-way slabs, flat slab.
5	Study on behaviour of frames	Analysis and design of steel and concrete frames
6	Study on behaviour of single storey-concrete building	Analysis and design of single storey-concrete building manually and by using software.
7	Multi-storeyed buildings - Planning and analysis	Plan as per Vaastu in Auto CAD and analyse the building using software
8	Multi-storeyed buildings –Design	Identify the critical members and design manually as per IS Code.
9	Multi-storeyed buildings –Estimation	Estimate the cost of Multi-storeyed building.

Course Outcomes

Upon successful completion of the course student will be able to implement Computer Aided Drafting, apply the software skills in the design of infrastructure and run various software packages. After under going the lab activities, the students will be having handson experience with the industry projects and there by increase the employability.

Course No: **CE404**	Course Title: **Design of Industrial Structures**	L	P	U
		3	0	3

Course Learning Objectives

The objective of the course is to understand the concept of plastic analysis, to learn the behavior and design of compression member subjected to eccentric load and design of base plate, to learn the design of gantry girder, welded plate girder, stiffeners and connections and to calculate the wind forces on steel stacks as per IS 875 and design the self-supporting steel stacks including base plate and anchor bolts.

Course Content

UNIT I

Introduction to beam, column, behavior, equivalent moment factor, strength interaction, design of beam column, beam, column subjected to tension and bending, column bases, slab base, gusseted base, moment resistant base plate.

UNIT II

Introduction about different types of stiffeners in plate girders, behavior of longitudinally stiffened plate girders, design of plate girders with stiffeners and splices, introduction, loading consideration, maximum load effect, fatigue effect, selection of gantry girder, design of gantry girder.

UNIT III

Ductility - plastic bending of beams –perfect plastic materials, stages of bending, shape factor, fully plastic moment of a section, elastic plastic bending of a section, plastic hinge, load factor, fundamental conditions for plastic analysis, failure mechanism, upper and lower bound theorems of plastic analysis, collapse load for beams and frames.

UNIT IV

Design of industrial building, roofing, cladding and wall material, structural components and framing, types of roof trusses, components, wind load estimation as per IS 875 part 3 - design of purlins, truss members, joints, cold formed steel purlin.

UNIT V

Analysis and design of steel stacks, functional and structural requirements, self -supporting and guyed stacks - base plate and anchor bolt, design of rectangular water tanks.

Text Books

1. Chandra, R. and Gehlot, V. (2010). *Design of steel structures-2*. 9th edn. Jodhpur, India: Scientific Publishers.
2. Subramanian, N. (2011). *Design of steel structures: theory and practice*. 3rd edn. New Delhi: Oxford University Press.

Reference Books

1. Salmon, C.G., Johnson, J.E. and Malhas, F.A. (2008). *Steel structures: design and behavior*. 5th edn. Indianapolis: Prentice Hall.
2. Bhavikatti, S.S. (2009). *Advance R.C.C. design*. 2nd edn. New Delhi: New Age International.

Codes

1. IS 800: 2007, Code of practice for general construction in steel.
2. IS 808: 1989, Dimensions for hot rolled steel beam, column, channel and angle sections.
3. IS 805:1968, Code of Practice for use of steel in gravity water tanks.
4. IS875 Part (3) - 1987, Code of practice for design loads (other than earthquake) for buildings and structures: wind loads. Bureau of Indian Standards, New Delhi.

Course Outcomes

Upon completing the course, the students will be able to calculate shape factor and plastic moment capacity, design eccentrically loaded compression members (beam-columns) and their base plates, design welded plate girder with stiffeners and gantry girder, Carry out wind load calculations for tall structures and design steel chimneys. After under going prescribed content, the students will be having handson experience with the industry projects and there by increase the employability.

Course No: **CE405**	Course Title: **Stability of Structures**	L	P	U
		3	0	3

Course Learning Objectives

The objective of the course is to understand the behavior of indeterminate structures, to learn the concepts of elastic analysis and plastic analysis, to understand the concepts of matrix analysis of structures, to learn basic principles in finite element analysis

Course Content

UNIT I

Arches as structural forms, examples of arch structures, types of arches, two hinged and three hinged parabolic arches, circular arches, settlement and temperature effects, cables, tension forces in towers, influence line for horizontal thrust and bending moment.

UNIT II

Plastic moment of resistance, shape factor, collapse load, analysis of continuous beams and portals, limiting conditions for applications.

UNIT III

Introduction to FEM: equilibrium and compatibility, determinate vs indeterminate structures, indeterminacy, primary structure, compatibility conditions, analysis of indeterminate pin-jointed plane frames, continuous beams, rigid jointed plane frames (with redundancy restricted to two).

UNIT IV

Element and global stiffness matrices, analysis of continuous beams, co-ordinate transformations, rotation matrix, transformations of stiffness matrices, load vectors and displacements vectors, analysis of pin-jointed plane frames and rigid frames (with redundancy restricted to two).

UNIT V

Introduction, various kinds of frames, sway frames, non – sway frames, analysis of frames with different ends conditions: both ends simply supported, fixed, etc, substitute frame method - portal method - cantilever method and Kani's method.

Text Books

1. Pandit, G. S. and Gupta, S. P. (2001). *Structural analysis: A matrix approach*. London, United Kingdom: McGraw-Hill Education.

Reference Books

1. Timoshenko, S.P. and Young, D.H. (1965). *Theory of structures*. 2nd edn. New York: McGraw Hill Higher Education.
2. Bhavikatti, S.S. (2013). *Structural analysis*. Chennai, India: Vikas Publishing House.
3. Hibbeler, R.C. (2014). *Structural analysis*. 8th edn. Boston: Prentice Hall.

Course Outcomes

Upon successful completion of the course student will be skilled to distinguish determinate and indeterminate structures, analyze indeterminate structures including arches, and apply matrix methods of analysis in FEM and there by increases the employability.

Course No: **CE406**	Course Title:**Building Drawing, Estimation & Costing**	L	P	U
		2	2	3

Course Learning Objectives

The objective of the course is to understand the types of estimates and to learn rate analysis and process of preparation of bills. It also emphasis on the regulations as per national building code and the student will be able to understand line sketches and working drawings of various civil Engineering structures.

Course Content

UNIT I

Rate analysis-purpose, importance and necessity of the same, factors affecting, overhead cost, labours required for different works, materials required for different works, rates of different materials and labours, task work, daily output from different equipments, rate analysis & preparation of bills – data analysis of rates for various items of works – abstract estimates.

UNIT II

Estimates-various types, their relative importance, factors to be considered, complete set of estimate, approximate estimates- importance, purpose, different methods, methods of preparation of estimates for projects such as: building R.C.C., load bearing, road, culvert, irrigation; water supply and sewerage: miscellaneous works like water storage tank, septic tanks; trusses of steel, procedure of estimating, types of estimates, detailed estimate.

UNIT III

Estimation of buildings including sanitary & electrical fittings, specifications-types, requirements and importance, detailed specifications for buildings and industrial steel structures, detailed estimation procedure for different buildings single roomed and multiple.

UNIT IV

Estimate of earthwork by three different methods, estimate of earthwork from L-sections, estimate of earthwork in roads having vertical drop, Road – earthwork fully in banking, cutting, partly cutting & partly filling. Earthwork in canal- different cases, estimation of earthwork in irrigation channels, estimate of permanent land.

UNIT V

R.C.C. work, percentage steel reinforcement, standard hook and cranks of reinforcement bars, estimate of R.C.C and steel works - slab - beam – column, footing and stair case, valuation-gross income, net income, outgoings, scrap value, salvage value, annuity, capitalized value, years purchase, sinking fund, depreciation, valuation of building, determination of depreciation, methods of valuation, life of various items of work, mortgage lease, rent fixation.

Text Books

1. Datta, B.N. (2016). *Estimating and costing.* 28thedn. New Delhi, India: USB Publishers Distributors.

Reference Books

1. Peurifoy R. L. and Garold D. O. (2013). *Estimating construction costs*. 6thedn. New Delhi, India: Mc-Graw Hill Education.
2. Vazirani V.N. andChandola S.P. (2005). *Civil engineering estimating & costing including quantity surveying, contracting & accounts.* New Delhi, India: Khanna Publishers.
3. Padmini, M. (1997). *Civil engineering drawing.* 2ndedn.Kerala, India: Prithiba Publishers and Distributors

Codes

1. *National building code*, Bureau of Indian Standards, New Delhi, 2005.

Employability/entrepreneurship/ skill development

The following List of Experiments will be useful for skill development

Sec. No.	Exercise	Aim
1	Plan, section, elevation of a simple building	To develop detailed Plan, section, elevation of a simple building
	Dimensioning of plan & section	Dimensioning of plan & section
2.	Working drawing of building	To develop Working drawing of building
3	Electrical Service plan	To develop Electrical Service plan
4	Detailed estimation of building using excel	To develop Detailed estimation of building using excel
5	Septic tank and soak pit	To develop drawing of Septic tank and soak pit
6	Detailed estimation of earthwork using excel	To develop Detailed estimation of earthwork using excel
7	Site plan	To develop Site plan
8	Twin semi detached house	To develop detailed plan , elevation and section of Twin semi detached house by using AUTO CAD
9	Twin two storey house	To develop detailed plan , elevation and section of Twin two storey house by using AUTO CAD
10	Flat	To develop detailed plan , elevation and section of Flat by using AUTO CAD
11	Hospital	To develop detailed plan , elevation and section of Hospital by using AUTO CAD
12	Commercial building	To develop detailed plan , elevation and section of Commercial building by using AUTO CAD

Course Outcomes

Upon successful completion of the course students will be skilled to prepare detailed drawings and estimate for different types of structures and valuation reports and cost quality control. Implement the regulations for layout planning. This course there by enhances the employability of the student in construction industry.

Course No: **CE407**	Course Title: **Foundation Engineering**	L	P	U
		3	0	3

Course Learning Objectives

To understand the essential steps involved in a geotechnical site investigation, to learn the principal types of foundations and the factors governing the choice of the most suitable type of foundation for a given situation and the concepts of bearing capacity, earth pressure and slope stability.

Course Content

UNIT I

Site investigation-Introduction, objective of site investigation; stages in sub surface exploration, reconnaissance; detailed site investigation; methods of exploration; depth of exploration; borings for exploration: auger boring, wash boring, rotary drilling, percussion drilling, core drilling, thin walled samplers, split spoon sampler, standard penetration test, cone penetration test; geophysical methods: seismic methods, electrical resistivity method.

Foundations- Functions of foundation, essential requirements of a foundation, factors governing location and depth of foundation; types of foundations; selection of foundation, settlement of foundations, causes of failures of foundation and remedial measures.

UNIT II

Bearing capacity of shallow foundation-Rankine's Analysis, Prandtl's analysis, Terzaghi'stheory of bearing capacity; general and local shear failure; effect of water table; plate load test; standard penetration test; effect of water table on bearing capacity.

Design of shallow foundations- types of shallow foundations: strip footing, strap footing, spread footing, combined footing, rectangular footing, trapezoidal footing, mat or raft foundation, depth of footings, design of footings; settlement of footings; immediate and time dependent settlement; permissible limits; differential settlement.

UNIT III

Definitions: different types of earth pressure, earth pressure at rest, rankine's active and passive earth pressure theory, rankine's earth pressure for horizontal and inclined backfill for both cohesive and cohesionless soils; Coulomb's wedge theory; Coulomb's active earth pressure theory for cohesive soils; Coulomb's passive earth pressure theory for cohesionless soils; Types of retaining walls: cantilever retaining walls, gravity retaining walls, counterfort retaining walls, sheet pile walls.

UNIT IV

Introduction, necessity of pile foundation, classification and selection of piles; cast in-situ piles, concrete piles, timber piles, bored piles, precast concrete piles, static methods for driven piles in sand, pile driving, load carrying capacity of piles, negative skin friction, static and dynamic formulae; group action of piles, pile cap, pile group in sand, pile group in clay, efficiency and capacity of pile groups; design of pile group; settlement of pile groups; load test on piles, tension piles, laterally loaded piles. Drilled piers and caissons, advantages and disadvantages of drilled piers, advantages and disadvantages of caissons, well foundation.

UNIT V

Design criteria; dynamic loads: simple design procedures for foundations ofreciprocating and impact type machines (treated single degree freedom only), vertical, torsional, sliding and rocking modes of oscillation, coupled motion, practical design considerations, vibration control.

Text Books

1. Bowles, J.E., (1997), *Foundation Analysis and Design*, 5th ed., Singapore: McGraw-Hill book Company.
2. Varghese, P.C. (2005) Foundation engineering. New Delhi: Prentice-Hall of India Pvt.

Reference Books

1. Das B.M., (2007), *Principles of Foundation Engineering, Design and Construction*, 7th ed., Stamford, Connecticut, USA: Cengage Learning.
2. Murthy, V.N.S. (2009) *Textbook of soil mechanics and foundation engineering*. Delhi, India: CBS Publishers & Distributors.

Codes:

1. IS 1080:1985: Code of practice for design and construction of shallow foundations in soils (other than raft, ring and shell)
2. IS 1888:1982: Method of load test on soils
3. IS 1892:1979: Code of practice for subsurface investigation for foundations
4. IS 1904:1986: Code of practice for design and construction of foundations in soils: General requirements
5. IS 2132:1986: Code of practice for thin walled tube sampling of soils

Course Outcomes

At the end of the course student will be skilled to know the soil investigation techniques, determine the bearing capacity of soil, safe load carrying capacity of soil and select the suitable type of foundation and understand the concept of earth pressure and earth retaining walls. This course there by enhances the employability of the student in construction industry.

Course No: **CE408**	Course Title: **Ground Improvement Techniques**	L	P	U
		3	0	3

Course Learning Objectives

The aim of this course is to learn about the various ground improvement techniques and to study various methods of dewatering.

Course Contents

UNIT I

Different types of problematic soils and their geological formation principles of treatment-loading.

Ground improvement; role of ground improvement in foundation engineering; methods of ground improvement; geotechnical problems in alluvial, lateritic and black cotton soils; selection of suitable ground improvement techniques basedon soil conditions.

Lime treatment for expansive soils, injection method, lime-columns, chemical analysis.

UNIT II

Ground improvement by drainage, dewatering techniques; well points; vacuum and electro-osmotic methods preloading, vertical drains, vacuum consolidation, electro-kinetic dewatering, design and construction methods of dewatering systems, seepage analysis for two dimensional flow; fully and partially penetrated slots in homogeneous deposits.

UNIT III

In-situ densification of cohesion-less soils and consolidation of cohesive soils: dynamic compaction vibro-flotation, sand compaction piles. consolidation: preloading with sand drains, and fabric drains, stone columns: lime pilesinstallation techniques only; relative merits and limitations ;deep soil mixing, shallow and deep compaction requirements, principles and methods of soil compaction, properties of compacted soil and compaction control, deep compaction and vibratory methods dynamic compaction.

UNIT IV

Grouting; types of grouts, permeation grouting, compaction grouting, jet grouting, different varieties of grout materials, grouting under difficult conditions; suspension grouts; solutions grouts; grouting equipment and method; grouting with soil, bentonite; cement mixes and asphalt; grout monitoring schemes.

UNIT V

Geosynthetics: types, functions of geotextiles, separation, filtration, drainage; reinforcement; geomembranes, containments and barriers; application to ground anchors.

Geotextiles:definition and types; various tests conducted on geotextiles; functions of geotextiles; use of geotextiles in road works, earth dams construction, railway works, erosion control, bearing capacity improvement, storage, handling and placement of geotextiles, vertical drains.

Text Books

1. Gulhati, S.K., Datta, M. (2005).*Geotechnical engineering.* 1st edn. New Delhi, India: India Higher Education.
2. Murthy, V.N.S. (2009).*Textbook of soil mechanics and foundation engineering*. New Delhi, India: CBS Publishers & Distributors.

Reference Books

1. Koerner, R.M. (1984).*Construction and geotechnical methods in foundation engineering*. 2nd edn. New York, NY, USA: McGraw-Hill Inc.

Course Outcomes

Upon successful completion of the course student will be skilled to identify the problems in the soil and select suitable type of ground improvement technique based on the type of problem and soil condition. This course there by enhances the employability of the student in construction industry.

Course No: **CE409**	Course Title: **Soil Dynamics and Machine Foundations**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

The objective of this course is to study the concepts of soil dynamics and wave propagation in soil media, to know the behaviour of the machine foundations and its design and to understand the techniques of foundation isolation.

Course Content

UNIT I

General introduction, earthquake loading, equivalent dynamic load to an actual earthquake load, cause of earthquakes, magnitude, epicentre, p-waves, s-waves, rayleigh waves, richter scale.

Basic definitions, vibration of elementary systems; vibratory motion: single degree freedom system, free and forced vibration, with and without damping. principles of vibration measuring instruments, resonance and its effect, magnification, logarithmic decrement, transmissibility, natural frequency of foundation soil system, barkan's and IS methods, pressure bulb concept, pauw's analogy.

UNIT II

Wave propagation in an elastic homogeneous isotropic medium-rayleigh, shearand compression waves; waves in elastic half space (no theoretical treatment orderivation), field and laboratory methods of determination, uphole, down hole and cross hole methods, response of buried structures to seismic wave propagation and ground displacement.

UNIT III

Elastic properties of soils; coefficient of elastic uniform and non-uniformcompression and shear; effect of vibration dissipative properties of soils;determinationof dynamic properties of soil: stiffness, damping, and plasticity parameters of soils and their determination, correlations; assessment of liquefaction potential. cyclic plate load test, block vibration test, determination of damping factor; codal provisions – IS 5249: 1992.

UNIT IV

Design criteria; dynamic loads: simple design procedures for foundations ofreciprocating and impact type machines (treated single degree freedom only), vertical, torsional, sliding and rocking modes of oscillation, coupled motion, practical design considerations, vibration control.

Pile foundation: One dimensional wave equation for analyzing pile driving, response of single and pile groups under dynamic loading, pile response in liquefied sites.

UNIT V

Types and methods, isolating materials and their properties, vibration isolation technique; foundation isolation; isolation by location; isolation by barriers: active and passive isolation methods

Text Books

1. Saran, S. (1999).*Soil dynamics and machine foundations*. India: Galgotia Publications Pvt.

Reference Books

1. Prakash, S., Puri, V.K. (1988).*Foundations for machines: Analysis and design*. New York, NY, USA: Wiley-Interscience.

Codes:

1. IS 9716:1981: Guide for lateral dynamic load test on piles
2. IS 2974 Code (Part I to IV) of Practice for "*Design and Construction of Machine Foundations*", Bureau of Indian Standards, New Delhi.
3. IS 5249 Code of Practice for "*Method of test for determination of dynamic properties of soil*" Bureau of Indian Standards, New Delhi.

Course Outcomes

Upon successful completion of the course student will be skilled to solve geotechnical earthquake engineering problems, identify the pattern of wave propagation, Attenuation of Seismic waves, study the parameters of the soil under dynamic conditions and design Vibration Isolation.

Course No: **CE410**	Course Title: **Structures on Expansive Soil**	L	P	U
		2	0	2

Course Learning Objectives

The objective of this course is to know the occurrence and distribution of expansive soils, to study the properties of expansive soils, to understand various methods of prediction of heave, to study the design procedure for foundation on expansive soils and to learn various methods of stabilization used in expansive soils.

Course Content

UNIT I

Origin of expansive soils, occurrence and distribution of expansive soils of India, related civil engineering problems; environmental interaction, soil characteristics: active zone, moisture equilibrium; distress symptoms; swelling and shrinkage behaviour, factors influencing swelling & shrinkage of soils.

UNIT II

Identification tests: engineering characteristics, soil structure and clay mineralogy; field exploration: identification of expansivesoils, differential free swell index, cation exchange capacity, potential volume change, California bearing ratio, expansive index test; soil classification methods, classificationusing engineering index properties; comparison of classification schemes.

UNIT III

Methods of prediction of heave: heave prediction based on oedometer tests: consolidation, swell and constant volume tests; heave prediction based on soil suction tests; empirical methods: double oedometer tests; soil moisture, soil suction: osmotic suction, measurement of soil suction: tensiometers, field observations, shrinkage.

UNIT IV

Investigation of structures and foundation soil, remedial procedure alternatives: drilled pier and beam foundation, underpinning, slab on grade foundations, footing foundation, mud jacking and injection, moisture barriers: horizontal and vertical moisture barriers, membranes, moisture stabilization, electrochemical soil treatment, heat treatment, recommendations for type of foundation in expansive soils: design consideration; individual and continuous footings, stiffened mats, under reamedpiles; codal provisions.

UNIT V

Definition, soil stabilization, importance and necessity of soil stabilization; various method: mechanical stabilization, cement stabilization, limestabilization, bituminous stabilization, chemical stabilization, thermalstabilization; mixture design procedure, suitability of type of stabilization technique.

Text Books

1. Chenn .F.H, (2002)*Foundation on Expansive Soils*, Elsevier, 2nd edn., Volume 12 of developments in geotechnical engineering, Netherlands: Elsevier Scientific Pub. Co.
2. Saran, S. (2006) Analysis and design of substructures: Limit state design. 2nd edn. London: Taylor & Francis.

Reference Books

1. Peck, R.B., Hanson, W.E., Thornburn, T.H., Peck, H. and Peck, I.H. (1974) *Foundation engineering*. 2nd edn. New York: Wiley, John & Sons.
2. Nelson, J.D. and Miller, D.J. (1992) Expansive soils: Problems and practice in foundation and pavement engineering. New York: John Wiley & Sons.

Codes:

1. IS 2911(Part 3):1980: Code of practice for design and construction of pile foundation (under reamed piles).
2. IS 15284(Part 1, 2):2003: Design and construction for ground improvement

Course Outcomes

At the end of the course, student will be skilled to understand the problems related to expansive soils, predict the heave and select a suitable type of remedial measure, design suitable foundation on expansive soils and carry out suitable Stabilization Technique.

Course No: **CE411**	Course Title: **Environmental Geotechnology**	L	P	U
		3	0	3

Course Learning Objectives

The objective of the course is to learn about the interaction between waste and soil, and pollutant movement in the ground, to understand the role of geotechnical engineering in waste management systems and to study about the waste disposal and management systemand ground remediation technologies

Course Content

UNIT I

Introduction to environmental geotechnology; scope of geo-environmental engineering, multiphase behavior of soil, role of soil in geo-environmental applications, importance of soil physics, soil chemistry, hydrogeology, biological process, sources and type of ground contamination, impact of ground contamination on geo-environment, case histories on geo-environmental problems,environmental cycles & interaction; soil-water-environment interaction; causes of soil pollution; factors governing soil pollutant interaction,soil and ground water pollutants, their sources, nature, composition and polluting effects, physico-chemical aspects of soils contaminated by various pollutants, effects of environment and wastes on the properties of soils.

UNIT II

Waste characteristics; sources and types of wastes; contaminant transport in subsurface: advection, diffusion, dispersion; contaminant transformation: sorption, biodegradation, ion-exchange, precipitation; ground water pollution:pollution of aquifers by mixing of liquid waste; protecting aquifers.

Soil mineralogy characterization and its significance in determining soil behavior, soil-water interaction and concepts of double layer, forces of interaction between soil particles, concepts of unsaturated soil, importance of unsaturated soil in geo-environmental problems, measurement of soil suction, water retention curves, water flow in saturated and unsaturated zone, soil-water contaminant interactions and its implications, factors effecting retention and transport of contaminants.

UNIT III

Evolution of waste containment facilities and disposal practices, site selection based on environmental impact assessment, different role of soil in waste containment, different components of waste containment system and its stability issues, property evaluation for checking soil suitability for waste containment, design of waste containment facilities, site characterization, risk assessment ofcontaminated site, remediation methods for soil and groundwater, selection andplanning of remediation methods, someexamples of in-situ remediation.

UNIT IV

Objectives of waste disposal facilities; site selection criteria for waste disposal; methods of disposal: surface impoundment systems, sub-surface disposal,passive containment systems, landfills.

Landfill: types, requirements, components; site selection; leachate and gasgeneration; primary and secondary leachate; leachate collection and removalsystem; gas collection and removal system; landfill liners; compacted clayliners, geosynthetic clay liners, geomembrane liners; landfill cover system; enduses of closed landfills.

UNIT V

Soil remediation technologies: soil washing, electro kinetic remediation, soilvapour extraction, bioremediation, stabilization and solidification, ground waterremediation technologies: pump and treat, in-situ flushing, bioremediation, airsparging, reactive well.

Text Books

1. Wentz, C.A. (1995) *Hazardous waste management*. 2nd edn. New York, NY, United States: McGraw-Hill Inc., US.

Reference Books

1. Reddi, L.N., Inyang, H.I. and Reddi/Inyang (2000) *Geoenvironmental engineering: Principles and applications*. New York: Marcel Dekker.
2. Fang, H.-Y. and Daniels, J. (1997)*Introduction to environmental geotechnology*. Boca Raton, NY: CRC Press.

Course Outcomes

At the end of the course, the student will be skilled to identify the sources of waste and contaminant transport, understand the concept of soil and waste interaction and design landfill liners based on the requirement.

Course No: **CE412**	Course Title: **Geo-informatics in Transportation Engineering**	L	P	U
		3	0	3

Course Learning Objectives

The objective of the course is to learn the basic concepts of geo-informatics in brief that includes geographical information system (GIS), remote sensing (RS), and global positioning system (GPS), understand these basic concepts in context of transportation and transportation networks, learn the data needs and database development for doing transportation analysis in GIS environment.

Course Content

UNIT I

Concept of GIS and RS; land use and transportation data spatial and non-spatial data for land use and transportation, traffic analysis zone (TAZ) and screen lines, network and routes, database development, map generation and analysis; concept of map layers, land cover analysis.

UNIT II

Network creation and linear route building, map accuracy and location expression, generation of themes and charts, transportation network development and algorithms; network development and management, network properties, shortest path algorithms, transit network and paths.

UNIT III

Transportation models and their applications in GIS: transportation and land use models, linear and network models.

UNIT IV

GIS-T applications: background and trends of GIS-T application. GIS-T application areas, transportation models and their applications in GIS.

UNIT V

GIS-T applications; intelligent transport systems (ITS), components of ITS, architecture and integration with GIS, analysis and visualizations of traffic data in GIS, Integration of GPS and GIS some case studies.

Text Books

1. Burrough, P.A. and McDonnell, R.A. (1998). *Principles of geographical information systems*. 2nd edn. New York: Oxford University Press.
2. Lillesand, T.M., Kiefer, R.W. and Lilles, T. (1987). *Remote sensing and image interpretation*. 2nd edn. New York: Wiley.

Reference Books

1. Sabins, F.F. (1978). *Remote sensing: Principles and interpretation*. San Francisco: W. H. Freeman & Company.
2. Joseph, G. (2005). *Fundamentals of remote sensing 2nd edition, reprint*. 2nd edn. Hyderabad: University Press.

Course Outcomes

Upon completing the course, the students will be skilled to apply GIS and remote sensing techniques for various urban and transportation problems and apply the GIS-based analytical and problem-solving techniques for sustainable planning and management of urban infrastructure and intelligent transportation system problems.

Course No: **CE413**	Course Title: **Railway, Dock and Harbor Engineering**	L	P	U
		3	0	3

Course Learning Objectives

The objective of the course is to understand the importance of transportation and characteristics of rail transport, dock and harbors.

Course Content

UNIT I

Merits of rail transportation, railway gauges and gauge problems; cross section of permanent way and track components: sleepers-functions and types, sleeper density, ballast functions and different ballast materials, rails: coning of wheels and tilting of rails

UNIT II

Rail cross sections, wear and creep of rails, rail fastenings, geometric design: gradients, transition curves, widening of gauges on curves, cant and cant deficiency, points and crossings: design of turnouts and description of track junctions, yards: details of different types of railway yards and their functions. Signalling and interlocking: classification of signals, interlocking of signals and points, control of train movements.

UNIT III

Construction and maintenance of railway track, methods of construction, material requirements, special measures for high speed track, maintenance of tracks and traffic operations.

UNIT IV

Definition of basic terms: harbor, port, satellite port, waves and tides, planning and design of harbours: requirements, classification, location and design principles, harbour layout and terminal facilities, coastal structures: piers, break waters, wharves, jetties, quays, spring fenders, dolphins and floating landing stage, inland water transport, wave action on coastal structures and coastal protection works, environmental concern of port operations.

UNIT V

Classification of docks, advantages and disadvantages of tidal and enclosed wet docks, different components of docks, design and construction of dock walls, dock entrances, sizes of dock entrances.

Text Books

1. Chandra, S. and Agarwal, M.M. (2013).*Railway engineering*. 2nd edn. New Delhi, India: Oxford University Press.
2. Srinivasan, R.(2015). *Harbour dock and tunnel engineering.*27th edn. Anand, Gujarat: CharotarPublishing House.

Reference Books

1. Hay, W.W. and Hay, C. (1982).*Railroad engineering, Vol. 1.* 2nd edn. New York: Wiley, John & Sons.
2. Quinn, A. D. (1961). *Design and construction of ports and marine structures.* New Delhi, India: McGraw-Hill.

Course Outcomes

Upon completing the course, the students will be skilled to design railway, harbors and its different components. This course there by enhances the employability of the students construction industry.

Course No: **CE414**	Course Title: **Urban Transportation Planning**	**L**	**P**	**U**
		2	**0**	**2**

Course Learning Objectives

The objective of the course is to understand the basic concepts involved in urban transportation ,study about transportation planning in the overall regional system and learn about the travel demands forecasting, trip generation and trip distribution.

Course Content

UNIT I

Fundamentals of transportation planning, components of transportation system and their interaction.

UNIT II

The role of transportation planning in the overall regional system, methodology and models for regional transportation system, planning, implementation framework and case studies.

UNIT III

Travel demands forecasting- trip generation, trip distribution, modal split and trip assignment, urban transport problems.

UNIT IV

Transport behavior of individuals and households, land use/ transportation systems, land value and congestion, access and business migration.

UNIT V

Introduction to urban freight transportation and urban mass transportation systems, characteristics of buses, bicycle, para-transit, rapid transit, traffic restraint techniques and methods.

Text Books

1. Ponnuswamy, S. and Victor, D. J. (2012). *Urban transportation: planning, operation and management*. New Delhi: McGraw Hill Education.
2. Goel .S.L and Urban (2002). *Development and management*. New Delhi: Deep and Deep Publications.

Reference Books

1. Meyer, M. D. and Miller, Eric J. (2001). *Urban transportation planning: a decision-oriented approach*. New York: McGraw-Hill Education.

Course Outcomes

Upon completing the course, the students will be skilled to perform transportation planning in the overall regional system and perform travel demands forecasting.

Course No: **CE415**	Course Title: **Pavement Evaluation, Rehabilitation and Maintenance**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

The objective of the course is to understand the use of non-destructive testing for pavement evaluation and learn maintenance and rehabilitation methods to extend the useful life of pavements

Course Content

UNIT I

Structural and functional requirements of flexible and rigid pavements; pavement distress; different types of failures, causes.

UNIT II

Methods of measurement of skid resistance, unevenness, ruts and cracks, pavement surface condition evaluation by physical measurements, by riding comfort and other methods, their applications.

UNIT III

Evaluation by non-destructive tests such as FWD, Benkelman beam rebound deflection using BBD for flexible overlay design, plate load test, wave propagation and other methods of load tests; evaluation by destructive test methods, and specimen testing.

UNIT IV

Overlay design procedure, recycling of flexible and rigid pavements.

UNIT V

Role of computers in pavement management, applications of expert systems for managing pavements, expert system for pavement evaluation and rehabilitation, knowledge-based expert systems, case studies.

Text Books

1. Khanna, S.K. (2000). *Highway engineering*. 7th edn. Uttarakhand, India: Nem Chand & Brothers.
2. Haas, R. and Hudson, R.W. (1982). *Pavement management systems*. Malabar, USA: Krieger Publishing Company.

Reference Books

1. Yoder, E.J. and Witczak. (1975). *Principles of pavement design*. 2nd edn. Hoboken: John Wiley and Sons.
2. Haas, R., Hudson, R.W. and Hudson, W.R. (1978). *Pavement management systems*. New York: McGraw-Hill.

Course Outcomes

Upon completing the course, the students will be skilled to apply management techniques to improve the life-cycle and reduce the cost of pavements and manage pavements more efficiently with insight into pavement defects, and their causes and solutions

Course No: **CE416**	Course Title: **Hazardous Waste Management**	L	P	U
		3	0	3

Course Learning Objectives

The aim of this course is to teach the students about the various steps involved in the management of hazardous wastes, to identify the sources of hazardous waste, to study the characteristics of hazardous wastes, to learn handling and processing techniques for hazardous wastes and to know about the various disposal methods for hazardous wastes.

Course Content

UNIT I

Types and Sources hazardous wastes; need for hazardous waste management; elements of integrated hazardous waste management and roles of stakeholders and ngos; salient features of indian legislations on management and handling of hazardous wastes, biomedical waste: definition, sources, classification, collection, segregation treatment and disposal. , lead acid batteries, e-waste: waste characteristics, generation, collection, transport and disposal. radioactive waste: definition, sources, low level and high level radioactive wastes and their management, radiation standard by ICRP and AERB.

UNIT II

Hazardous waste generation rates and variation; composition, physical, chemical and biological properties of hazardous wastes; hazardous characteristics; tclp tests; sampling and analysis of hazardous wastes – analytical approach for hazardous waste characterization waste sampling and characterization plan; source reduction of wastes; recycling and reuse.

UNIT III

Handling and segregation of wastes at source: storage and collection of hazardous wastes; need for transfer and transport; transfer stations optimizing waste allocation; compatibility, storage, labeling and handling of hazardous wastes.

UNIT IV

Objectives of waste processing; material separation and processing technologies; biological and chemical conversion technologies; hazardous waste treatment technologies - physical, chemical and thermal treatment of hazardous waste: solidification, chemical fixation, encapsulation, pyrolysis and incineration, solidification and stabilization of hazardous wastes, treatment of biomedical wastes and e-waste.

UNIT V

Waste disposal options; disposal in landfills;site selections, landfill classification; construction and operation of secured landfills; bioreactors; ocean dumping; land disposal; soil remediation. hw reduction, recycling and reuse, regulatory aspects of HWM.

Text Books

1. CPHEEO (2009).*Manual on municipal solid waste management.New Delhi: Central* Public Health and Environmental Engineering Organisation, Government of India.

Reference Books

1. Michael, D., LaGrega, P. L., Buckingham, J. C. (2010).*Environmental Resources Management.*2ndedn. New York, NY, India: McGraw-Hill International.
2. Worrell, W.A. and Vesilind, A.P. (2010) *Solid waste engineering*. 2nd edn. Stamford, CT, USA: Cengage Learning.

Codes:

1. SP 7(Part 9): 2005: National Building Code of India
2. Handbook of Environmental Protection Act 1986.

Course Outcomes

Upon successful completion of the course the student will be skilled to identify various sources of hazardous waste, know the handling and processing techniques of hazardous waste and select the type of disposal technique for a particular type of waste.

Course No: **CE417**	Course Title:**Remote Sensing And GIS**	L	P	U
		3	0	3

Course Learning Objectives

The aim of this course is to understand the basic concepts of remote sensing, to study various types of data, image interpretation, image processing and to know the applications of Geographic information systems in Civil Engineering.

Course Content

UNIT I

Definition of remote sensing and its components , electromagnetic spectrum , wavelengthregions important to remote sensing , wave theory, particle theory, stefan-boltzman and wein's displacement law, atmospheric scattering, absorption, atmospheric windows, spectral signature concepts ,typical spectral reflective characteristics of water, vegetation andsoil.

UNIT II

Types of platforms,orbit types, Sun-synchronous and Geosynchronous,Passive and Activesensors,resolution concept,Pay load description of important Earth Resources andMeteorological satellites,Airborne and spaceborne TIR and microwave sensors.

UNIT III

Types of data products,types of image interpretation ,basic elements of image interpretation , visual interpretation keys, digital image processing, pre-processing, image enhancement techniques, multispectral image classification – supervised and unsupervised.

UNIT IV

Introduction, maps, definitions, map projections, types of map projections, map analysis, gis definition, basic components of gis, standard gissoftwares, data type, spatial and non-spatial (attribute) data, measurement scales, Data Base Management Systems (DBMS).

UNIT V

Data models, vector and raster data, data compression,data input by digitization and scanning, attribute data analysis, integrated data analysis,modelling in GIS Highway alignment studies, Land Information System.

Text Books

1. Lillesand, T.M., Kiefer, R.W. and Lilles, T.M. (1979).*Remote sensing and image interpretation*. New York, NY, USA: John Wiley & Sons.
2. Reddy, A.M. (2006).*Textbook of remote sensing and geographical information systems*. Hyderabad, India: Book Syndicate Publication.

Reference Books

1. Burrough, P.A. (1986).*Principles of geographical information systems for land resources assessment*. Oxford, UK: Oxford University Press.
2. Clarke, K.C., Parks, B.O. and Crane, M.P. (2001).*Geographic information systems and environmental modeling*. Harlow, UK: Upper Saddle River, New Jersey Prentice Hall cop.

Course Outcomes

Upon successful completion of the course student will be skilled to identify the basic remote sensing concepts and its characteristics, implement the photogrammetry concepts and fundamentals of Air photo Interpretation and use various analysis and interpretation of GIS results.

Course No: **CE418**	Course Title:**Environmental Impact Assessment**	L	P	U
		2	0	2

Course Learning Objectives

The aim of this course is to introduce the relevant legal systems and to examine the processes by which normative rules are adopted and enforced, to develop an understanding of the use of EIA procedures and methods within the project and planning cycle to promote more sustainable forms of development and to promote more effective use of Environmental Management Systems and implementation of Environmental requirements.

Course Content

UNIT I

Basic concepts of EIA- introduction- EIA procedure- Systematic Approach for Using EIA as a Planning Tool for Major Project Activities - Preparation of Environmental Base Map- Identification of Study Area- Classification of Environmental Parameters- Formation of EIA Study Team- Preparation of Terms of Reference- Preparation of an EIA Report- Environmental Monitoring and management Plan- Draft and Final Environmental Impact Statements- Impact Analysis- Format and Content of a Draft Environmental Impact Statements (DEIS)- DEIS Processing- Final Environmental Impact Statements (FEIS)- Comparative Evaluation Alternatives from EIA Studies- Selecting a Preferred Alternative- Conceptual Basis for Trade-Off Analysis- Importance Weighting of Decision Factors

UNIT II

Introduction- Criteria for the Selection of EIA Methodology- EIA Methods- Predictive Models for Impact Assessment

UNIT III

Introduction- Soils and Ground water- Methodology for the Prediction and Assessment of Impacts on Soil and Groundwater References- Project Which Create Impact Concerns for the Surface-water Environment- Systematic Methods for Evaluation of Impacts of Various Developmental Activities on Surface Water Environment- General Methodology for the Assessment of Impacts on Biological Environment- Systematic Approach for Evaluating Biological Impacts- Typical Examples for Carrying out EIA- Typical Example Assessment of Impacts of Road Development on Flora and Fauna- A Generalized Approach for Assessment of Air Pollution Impact- Basic Information of Noise- Noise Measurement- Effects of Noise of People- Systematic Methodology for Assessing Environmental Impacts of Noise

UNIT IV

Introduction- Concepts of Environmental Remote Sensing- Basic Principles of Remote Sensing- Electromagnetic Energy- Photography and Optical Data- Airborne Light Detection

and Ranging System (LIDAR)- Thermal Imagery- Radar- Satellite Orbits- Application of Environmental Remote Sensing for EIA- Linear Projects- Coastal Zone Studies- Estuaries- Land Use and Land Cover Studies- Sources of Remote Sensing Applications- Application of GIS for EIA- What is a GIS?- GIS Concepts and Techniques- GIS for Environmental Impact Assessment- Possible Approaches- Resource Implications- GIS in Screening, Scoping and Baseline Studies- Databases for GIS- Major Applications of GIS

Use the mathematical models in EIA – Water quality, air quality and noise; assumptions and limitations. Basic tenets of Global Climate Models

UNIT V

Introduction- Environmental Impact of Industrial Development- Physical Resources- Ecological Resources- Human use values- Quality-of-life values- Project Siting- Factors to be considered in Making Assessment Decisions- Guidelines for Preparations of TORS for Life of Industrial Development Projects for Initial Environmental Examination- Preparation of EIA of Land Clearing Projects- Assessment of Impacts of Traffic and Transportation- Physiography and Drainage- Geology and Structure- Climate- Soil Series- Land use/ Land cover- Preparation of the Secondary Overlays- Slope- Generation of Final Overlays for Decision Making- Hydrogeomorphology and Groundwater- Land-Irrigability- Composite Erosion Intensity Units/Composite Land Development Sites- Land Capability- Sediment Yield Index- Treatment Plans- Development Plan for the command Area

Text Books

1. Canter, L.W. (1995).*Environmental impact assessment*. 2nd edn. New York, NY, USA: McGraw Hill Higher Education.

Reference Books

1. Dalal-Clayton, B. and Sadler, B. (2005).*Strategic environmental assessment a Sourcebook and reference guide to international experience*. London: Earthscan
2. Wood, C. and Thérivel, R. (1999).*Handbook of environmental impact assessment: Impact and limitations*. Vol.2Edited by Judith Petts. Malden, MA, USA: Wiley, John & Sons
3. Anjaneyulu, Y., Manickam, V. and Manikam, V. (2011).*Environmental impact assessment methodologies*. 2nd edn. Hyderabad, India: Taylor & Francis.

Course Outcomes

Upon successful completion of the course student will be skilled to apply the main procedures and methods which are used at different stages in EIA process in Project Appraisal, Decision making and implementation, develop on Environmental Management Systems and develop Environmental law principles in the Regional and International context

Course No: **CE419**	Course Title:**Environmental Systems**	L	P	U
		3	0	3

Course Learning Objectives

The aims of the environmental systems and societies course are to promote understanding of environmental processes, provide knowledge that can be used in the analysis ofenvironmental issues and promote critical awareness among the students.

Course Content

UNIT I

Systems and models: Introduction to the concepts and applications of environmental systems analysis. Application of mathematical programming and modelling to the design.

UNIT II

Planning and management of engineered environmental systems, regional engineered systems and environmental policy.

UNIT III

Economic analysis including benefit - cost analysis and management strategies. Concepts of trade off, non – inferior sets, single and multi-objective optimization. Capacity constrained population growth and decay.

UNIT IV

Practical application to case studies to convey an understanding of the complexity. Introduction to Cyclical Behavior, Cycles in Predator and Prey Populations, coupled hydrology and wildlife systems; species migration

UNIT V

Data collection challenges of actual design practice. Environmental value systems.

Text Books

1. Ford, A., (2010). Modelling the Environment, 2nd Ed, Island Press, Washington, US.
2. Haefner, J.W., (2004). Modelling Biological Systems: Principals and Applications, 2nd Edition, Springer Science + Business Media Inc, New York, US.

Reference Books

1. Wainwright J, and Mulligan, M., (Eds), (2004). Environmental Modelling: Finding Simplicity in Complexity, John Wiley and Sons Ltd, West Sussex, England
2.Clarke, K.C., Parks, B.O. and Crane, M.P. (2001).*Geographic information systems and Environmental modeling*. Harlow, UK: Upper Saddle River, New Jersey Prentice Hall.
3.Seppelt, R., (2003). Computer-Based Environmental Management, Wiley-VCH

Course Outcomes

On successful completion of this course students will be skilled to recognise the complex structure of environmental systems and demonstrate knowledge of the broader field of integrated modelling of human-environmental systems. It will enhance the employability.

Course No: **CE421**	Course Title: **Water supply and Waste water Engineering**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

The objective of the course is to learn various aspects related to supply of pure and safe drinking water to communities and the conservation of water, understand the basics of sewage, types of sewers and sewer material, study the functions of different primary treatment units, the features and function of different secondary treatment units and learn the objectives and methods of sewage disposal and methods of solid waste and sludge management

Course Content

UNIT I

Population forecast and water demand; water treatment objectives; types of demand and their rate of consumption, sources of water, channels and pipes for conveying water; unit operations and processes in surface water treatment; principles, functions and design of flash mixers, flocculators, sedimentation tanks and sand filters; aeration; iron and manganese removal, defluoridation and demineralization; water softening disinfection, water treatment; typical layouts and water distribution.

UNIT II

Characteristics of sewage: Physical, chemical and biological characteristics: biological oxygen demand, chemical oxygen demand, cycles of decomposition, preliminary treatment: racks and screen, comminutors or shredders, grit chambers, disposal of grit, detritus tanks, skimming tanks, vaccum floatation method, primary treatment: principles, types of settling, settling of discrete particles, types of settling tanks, horizontal flow settling tanks, functions and design of primary sedimentation tanks.

UNIT III

Introduction, biological treatment techniques, types of sewage filters: intermittent sand filters, contact beds, activated sludge process and trickling filter; high rate tiltration, process, design and efficiency of trickling filters, aeration units, mechanical aeration systems, aeration tank, advantages and disadvantages; other treatment methods: oxidation ditch, stabilisation ponds, aerobic ponds, anaerobic ponds, imhoff tanks and septic tanks design and construction features; advantages and disadvantages of septic tanks and imhoff tanks, advances in sewage treatment, waste water reuse and recycling.

UNIT IV

Introduction, sewage collection from houses and buildings, sludge treatment processes, amount and characteristics of sludge, sludge thickening or concentration; aerobic and anaerobic digestion of sludge; biogas recovery; drying beds; conditioning and dewatering; sludge disposal, sewage treatment; typical layouts.

UNIT V

Disposal by dilution; self-purification of surface water bodies; oxygen sag curve; disposal to lakes and sea, land disposal; sewage farming; deep well injection; soil dispersion system.

Text Books

1. Metcalf and Eddy, (2005).*Water and Waste water Engineering.*New York, USA: Tata McGraw Hill.
2. Peavy, H.S., Row, D.R. and Tchobanoglous, G. (1985).*Environmental Engineering*.New York, USA: McGraw Hill Book Company.

Reference Books

1. Manual on Water supply and Treatment – CPHEEO (2000).
2. Duggal, .K.N, (2002). *Elements of Environmental Engineering*. New Delhi: S. Chand & Company.
3. Punmia, B.C. and Jain, A.K. (1998). *Wastewater engineering (environmental Engineering-II): Including air pollution*. India: Laxmi Publications.

Course Outcomes

Upon completing the course the students will be able to identify the type of unit operations and processes involved in water and wastewater treatment plants. He/she will be skilled design individual unit operation or process appropriate to the situation by applying physical, chemical, biological and engineering principles and it enhances the imployability of the students.

Course No: **CE422**	Course Title: **Project Planning and Management**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

The objective of the course is to know about the basics and importance of construction management, study about the construction contract document, impart the idea about planning and scheduling of activities and scheduling.

Course Content

UNIT I

Construction as industry and its challenges, role of construction management, methods of construction managements, basic requirements of construction management: learning structures, life cycle of construction projects: conceptual planning, analysis and design, procurement, utilization and maintenance. Examples of real projects and its learning requirements.

UNIT II

Introduction to network based project management techniques: defining activities and their interdependence, drawing of network, time and resource estimations, use of network as scheduling techniques, use of network as control techniques i.e. project monitoring.

UNIT III

Stages of awarding contract, types of contract, contract documents, arbitration and settlement of disputes, contract laws and handling of contracts, commissioning of project.

UNIT IV

Construction technology: construction of superstructure and substructures, quality control, various items of construction: earthwork, excavation. earth- moving, drilling, blasting, dewatering, foundation, finishing items, painting, flooring, brick works, door, windows, examples of construction of structures such as buildings, bridges, roads, tunnels, industrial structures, construction safety.

UNIT V

Basic concepts of resource management-class of labour - labour productivity -material management functions - inventory management -project cost management.

Text Books

1. Jha, K.N. (2011). *Construction project management theory and practice*. New Delhi: Pearson Education.
2. Sengupta, B. and Guha, H. (1995). *Construction management and planning*. New Delhi: Tata McGraw-Hill.

Reference Books

1. Sharma, S.C. (2008). *Construction equipment and its management*. 6th edn. New Delhi: Khanna Publishers.

Course Outcomes

Upon completing the course, the students will be skilled to plan, control and execute the real time projects . It will increase the employment oppurtunities.

Course No: **CE423**	Course Title: **Natural Disaster Mitigation and Management**	**L**	**P**	**U**
		2	**0**	**2**

Course Learning Objectives

The objective of the course is to learn about types of natural and environmental disasters, develop skills in various stages of disaster preparedness, mitigation and management

Course Content

UNIT I

Introduction- natural disasters around the world- natural disaster risk assessment- earth and its characteristics human dimensions of global environment change – disaster mitigation, preparedness, response and recovery comprehensive emergency management early warning systems and disaster preparedness– rehabilitation, vulnerable populations - logistics and services, food, nutrition and shelter -role of UN Red Cross and NGOs.

UNIT II

Introduction and review - natural disasters -principles, elements, and systems - geological-geomorphological aspects- earthquake-geology, seismology, characteristics and dimensions– landslides- human impact on the mountainous terrain and its relationship with rainfall, liquefaction etc- tsunami - nature and characteristics.

UNIT III

Oceanic, atmospheric and hydrologic cycles - severe weather & tornadoes , cyclones, floods and droughts -global patterns - mitigation & preparation – drought – famine-nature and dimensions – drought assessment and monitoring.

UNIT IV

Mapping - modeling, risk analysis and loss estimation – natural disaster risk analysis - prevention and mitigation -applications of space technology (satellite communications, GPS, GIS and remote sensing and information / communication technologies (ICT) in early warning systems, disaster monitoring and support centre–information dissemination, mobile communication – etc.

UNIT V

Community and social organizations – education and training – establishment of capacity building among various stake holders – government - educational institutions – use of multi-media knowledge products for self-education.

Text Books

1. Kovach, R.L. (1995). *Earth's fury: An introduction to natural hazards and disasters*. London: Prentice-Hall.

Reference Books

1. Singh, R.B. (2006). *Natural hazards and disaster management: Vulnerability and mitigation*. Jaipur, India: Rawat Publications.
2. Gupta, H.K., Gupta, H. and Academy, I.N.S. (2004). *Disaster management*. Hyderabad, India: University Press.

Course Outcomes

Upon completing the course, the students will be able to develop organizational and Administrative strategies for managing disasters and perform engineering and non-engineering controls of mitigating various natural disasters.

Course No:**CE424**	Course Title:**Infrastructure Financing**	L	P	U
		3	0	3

Course Learning Objectives

The objective of the course is to understand Infrastructure Development, Financial instruments, Public finance for infrastructure projects, Public-private partnership, PPP Procurement process, and credit rating of infrastructure projects financial institutions in detail.

Course Content

UNIT I

Definition of infrastructure, Multiplier effects of infrastructure development on economic development of the nation, Sources of financing infrastructure project, Traditional and private investments, Limitations of traditional procurement system of infrastructure Legal frameworks and Incentives for private sector participation in infrastructure development, Rationale for investment in infrastructure, The change from public financing to project finance, Definition of project finance, Difference between project finance and corporate finance, Basic features of project finance, The importance of tax issues in project financing, Long-term financing instruments, Mobilising commercial debt, Subordinated debt, Stand-by loans, Debentures, Export credit, Ordinary equity, Cost of equity issue, Issuing of bonds, Other forms of bonds, Privae place of bonds, Preference shares, Warrants, Other financing instruments, Short-term financing instruments.

UNIT II

Typical allocation of government funds, Sources of government funds, Methods of procuring projects, Definition and justification of privatization, Types of privatization, Goals of privatization and deregulations, Prerequisites for privatization, Benefits of privatization, World trends in privatization and economic reform, Case study introduction, Concepts and characteristics of PPP, Features of PPP, Benefits of PPP, Types of PPP Models and their contractual structure.

UNIT III

Stakeholders' perspectives: Granting authority, Funders and Concessionaire, Government's role in successful PPP projects, Financial and Economic Appraisal of BOT Projects, VFM evaluation PPP procurement process, Lifecycle of PPP projects, Contractual package of PPP project, Bankable concession agreement, Case study – Procurement process of Indian PPP projects, Price setting, Price adjustment, Specific performance targets, Penalties and bonuses, Public parties' security rights, Duration, termination and compensation, Force majeure and other unforeseen changes, Dispute settlement

UNIT IV

Competitive bidding, Direct negotiations and unsolicited proposals, Competitive negotiations, Prequalification and short listing, Bid structure and evaluation, Bidding rules and procedures Analysis of project viability, Designing security arrangements

UNIT V

role of credit ratings in financing infrastructure projects, Rating frameworks of various national and international credit rating agencies for infrastructure projects in various sector, World bank guarantees, Export credit agencies, and political risk, insurances, financial institutions, insurance and bonding, appraisal, restructuring projects

Text Books

1. Neil S. Grigg (2010). Infrastructure Finance: The Business of Infrastructure for a Sustainable Future. John Wiley & Sons.

Reference Books

1. Tony Merna and Cyrus Njiru (2002). Financing Infrastructure Projects, ,Thomas Telford,
2. Davis (2008).Infrastructure Finance: Trends and Techniques, ,Euromoney books,
3. Dalip Singh Swamy (2000)Securitisation for infrastructure financing, , Asian Institute of Transport Development (New Delhi, India)

Course Outcomes

Upon successful completion of the course students will be able to prepare the project financing plan.

Course No: **CE425**	Course Title: **Policies, Reforms, Law and Risk Management in Infrastructure Projects**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

The objective of the course is to understand General legal context of infrastructure business, Dispute Resolution, Feasibilities of Infrastructure projects and Risk Analysis in Infrastructure projects

Course Content

UNIT I

Constitutional law, allocation of jurisdiction over different infrastructure sectors between the Centre and State, law making powers, Administrative Law, Role of Centre and State in policy formulation, Central funding of infrastructure projects, central oversight and interference, Investment requirements, non ideological factors leading to commercialization and privatisation of infrastructure, from socialism to market driven economy, legal framework for private sector participation, modes of Public Private Partnership (PPP).

UNIT II

Settlements through the courts and Alternate Dispute, Resolution (ADR), the judiciary, Alternative Dispute Resolution, the Indian Arbitration and Conciliation Act 1996, Contract law, property Law, Company Law, Competition Act 2002, MRTP Act, Competition Act 2002, , General Framework on environmental regulation and guidelines, Coastal Zone Management Regulation, Forest (Conservation) Act , Environmental Impact Assessment, Land Acquisition , Rehabilitation and resettlement.

UNIT III

Theories of regulation, genesis of Independent regulation, evolution of regulation in different jurisdictions, Design and structure of regulators, scope and functions, regulatory process, and regulatory autonomy and accountability, regulatory predictability and certainty, evolution of the power sector reforms, polices, National Electricity policy, new legal framework the state electricity boards, licensing framework, Provisions Relating to and working of Electricity Regulatory Commission- structure, role and functions Reforms, policies and legal framework, New Exploration Licensing Policy (NELP), production sharing contracts, the new Petroleum Regulatory and Natural Gas Board Act – the emerging regulatory reforms Law, policy and reforms relating to Airports, Railways, Road , Port/TAMP and an overview of coastal shipping and Inland Water Transport policy

UNIT IV

Main Features of the infrastructure projects, Infrastructure projects and economic development, Types of Infrastructure projects, Commercial Projects, Basic or Economic Projects, Social Projects Technical Feasibility, Economic Feasibility, Social Feasibility, Environmental Feasibility Political Risk, Sovereign Risk, Operational Risk, Financial Risk, Foreign Exchange Risk, Environmental Risk in case of power projects, Gas power projects.

UNIT V

Credit Guarantee by Financial Institutions, International Financial Institutions and Credit Guarantee, Role of Multilateral Investment Guarantee Agency (MIGA) and areas of risk coverage Forward Contracts, Future Contracts, Valuation of forward and future contract Options, Valuation of options using Black Scholes model Energy Derivatives, Weather Derivatives, Carbon Trading, Need for Real Options in Infrastructure Projects

Text Books

1) Jeffrey Delmon (2011). *Public-Private Partnership Projects in Infrastructure-An essential Guide for policy makers*, Cambridge University Press.

Reference Books

1) Dr Tony Merna and Cyrus Njiru *Financing Infrastucture Projects*, , Thomas Telford Publishing
2) I.P Massey (2008). *Administrative Law,* Lucknow: Eastern Book Company.
3) D D Basu (2009). *The Constitutional Law of India,*New Delhi: Lexis Nexis.

Course Outcomes

Up on successful completion of the project, the student will be able to understand Infrastructure sectoral polices reforms, and laws in the field of Power Sector/Electricity Oil, Petroleum and Natural Gas, Transport, Telecommunications. And he/she will be in a position to understand the features and Need of the Infrastructure Projects

Course No: **CE426**	Course Title:**Materials , Management and Estimation**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

The objective of the course is to understand basic principles of surveying, Construction Management, construction materials and estimation of quantities.

Course Content

UNIT I

Definitions, methods in levelling; levelling instruments; levelling staff; balancing backsights and foresights; differential levelling, longitudinal & cross section levelling, contouring methods, contour intervals, characteristics and uses of contours, plotting, interpolation of contours, contour gradient, total station surveying working principles.

UNIT II

Construction as industry and its challenges, role of construction management, methods of construction managements, basic requirements of construction management: learning structures, life cycle of construction projects: conceptual planning, analysis and design, procurement, utilization and maintenance. Examples of real projects and its learning requirements.

UNIT III

Introduction to network based project management techniques: defining activities and their interdependence, drawing of network, time and resource estimations, use of network as scheduling techniques, use of network as control techniques i.e. project monitoring.

UNIT IV

Stone as building material, criteria for selection, tests on stones ,deterioration and preservation of stone work, bricks, classification, manufacture of clay bricks, tests on bricks, compressive strength, water absorption, efflorescence, bricks for special use, refractory bricks, cement and concrete hollow blocks ,light weight concrete blocks, code Practices.

Timber ,market forms, industrial timber, plywood, veneer, thermocol, panels of laminates ,steel , aluminium and other metallic materials, manufacturing process of cement, sources of aggregate. Use of admixtures.

UNIT V

Introduction to building plans and estimating quantities of items of works involved in buildings.

Text Books

1. Duggal, S.K. (2013).*Surveying:* Vol. I & II. 4th edn. New Delhi: Tata McGraw-Hill Education.

Reference Books

1. Jha, K.N. (2011). *Construction project management theory and practice*. New Delhi: Pearson Education.
2. Varghese, P.C. (2015). *Building materials*. 2nd edn. New Delhi, India: Prentice-Hall.
3. Datta, B.N. (2016). *Estimating and costing.* 28thedn. New Delhi, India: USB Publishers Distributors.

Course Outcomes

Up on successful completion of the project, the student will be able to understand surveying, construction management techniques, construction materials and estimation of a building project.

Course No: **CE427**	Course Title: **Emerging Trends in Structural engineering**	**L**	**P**	**U**
		1	**0**	**1**

Course Learning Objectives

The objective of the course is to learn emerging trends in Structural engineering.

Course Content

The course briefs innovative solutions to various structural related problems in terms of materials, testing, design procedures, applications and case studies.

Course No: **CE428**	Course Title:**Emerging Trends in Geotechnical Engineering**	**L**	**P**	**U**
		1	**0**	**1**

Course Learning Objectives

The objective of the course is to learn emerging trends in geotechnical engineering.

Course Content

The course briefs innovative solutions to various geotechnical problems in terms of materials, testing, design procedures, applications and case studies.

Course No: **CE429**	Course Title: **Emerging Trends in Transportation Engineering**	**L**	**P**	**U**
		1	**0**	**1**

Course Learning Objectives

The objective of the course is to learn emerging trends in transportation engineering.

Course Content

The course briefs innovative solutions to various problems in terms of materials, testing, design procedures, applications and case studies.

Course No: **CE430**	Course Title: **Emerging Trends in Environmental Engineering**	**L**	**P**	**U**
		1	**0**	**1**

Course Learning Objectives

The objective of the course is to learn emerging trends in environmental engineering.

Course Content

The course briefs innovative solutions to various problems in the field of environmental engineering with the aid of case studies.

Course No: **CE431**	Course Title: **Emerging Trends in Construction Management**	L	P	U
		1	0	1

Course Learning Objectives

The objective of the course is to learn emerging trends inConstruction Management.

Course Content

The course briefs latest trends in materials management and construction technology.

Course No:**CE 491**	Course Title: **Special Project**	L	P	U
		0	0	3

Course Learning Objectives

The objective of the course is to understand the civil engineering concepts by doing a project.

Course Content

This course includes projects which are oriented towards reading from published literature or books or internet, about new frontiers of development or analysis of available data base. This course is normally available to students in higher levels. It must terminate with a project report.

5. REGISTRATION

The structuring of the courses in terms of lecture hours, lab hours, etc., is done through the timetable for each semester/term. On the first day of the semester/term, every student, whether newly admitted or already on rolls, is required to make his/her own timetable for all the courses for which he/she is permitted to register. The student next completes a process of registration for each of the courses in his/her timetable. It shall be the responsibility of the student to complete his/her registration in person, failing which he/she shall not be permitted to attend classes or use the facilities of the Institute.

Eligibility Conditions for Registration

Every student on the rolls of the institute is required to register for the courses to be taken in the semester. A student is not permitted to register in a semester/term if

(i) He/she has dues outstanding to the institute, hostel, library or any recognized organ of the institute.

(ii) His/her results of the preceding semester/term are withheld.

(iii) He/she has an Incomplete (I) report in the immediately preceding semester/term.

(iv) He/she has been specifically asked to stay away from that semester.

Original Registration

On the first day of the semester, every student must register for all the courses to be taken in the given semester. The Chairperson, Academic Registration and Counseling Division along with his/her team of registration coordinators, ensures smooth completion of the registration process. After ensuring that there is no default of fee payment, every student is given a randomly generated priority number for registration. The order /queue followed by students for registration are based on the priority number. Every student is provided with a master timetable with the following information: course titles, course codes and units of courses offered in the semester, number of sections for each course, timings and venue, common hour details, tests and examination schedules and faculty names. The student is expected to make his/her own timetable exercising his/her choices while ensuring that the sections of his/her choice are still available and there are no clashes in the timings of different courses. The choices that he/she can exercise will in general be decided by his/her priority number. The

registration process is completed once he/she submits the filled in registration card with details of courses taken and the same is approved by the Chairperson.

Conditions for registration of Backlog courses

If a student has not cleared a named course (other than electives) mentioned in his/her semester-wise chart by the time under consideration, then the said course becomes a backlog course until he/she clears it at the next possible opportunity. During registration, the student should first register for all backlog courses which are offered in that semester before taking other courses.

Provisional Registration

A student may be permitted for a provisional registration even if he/she has some outstanding dues. The student can complete his/her registration with the written permission from the Director. The dues must be cleared within the stipulated time decided by the Institute. The provisional registration is subject to cancellation without notice, if the student is found defaulting after the grace period.

Late Registration

Under exceptional circumstances, a student may be permitted to opt for late registration. The student should apply to the Director through Chairperson-Academic Registration and Counseling Division and obtain prior permission for late registration. Late registration is done on the 8th day of the semester. A student who fails to meet the late registration deadline has lost the last opportunity to register for that semester. Students are advised to avoid late registrations as the choice of sections for various courses can be limited by the delay.

Amendment to Registration

The Chairperson-Registration can amend the registration of a student under the following circumstances:

(i) If the registration of a student in a course is not found to be in accordance with the regulations, like a student not fulfilling prior preparation conditions or pre-requisite conditions for a course his/her registration in that course will be cancelled.

(ii) In case of timetable clashes or clashes in tests/examination schedule, the registration is amended by removing the said course(s) from the students registration card.

Substitution of Courses

Course substitution can be done when

(i) Any time within one week from the beginning of the semester, a student requests for substitution of a course in which he/she has already registered, with another course.

(ii) ACC recommends for substitution of one course with another for a student under its purview.

Withdrawal from Courses

(i) If a student desires to withdraw from a course, he/she may submit a formal application for withdrawal within ten weeks from the beginning of the semester.

(ii) In exceptional circumstances, a student may be permitted to completely withdraw from all the courses and drop the semester/term when the Director is satisfied with the reasons that warrant the withdrawal.

Pre-requisite Courses

Certain courses have pre-requisite conditions attached to them which the student should have fulfilled before registering in such courses. If a course is a pre-requisite,then the student should have a valid grade, not a report, in the pre-requisite course

Prior Preparation

For certain courses or a group of courses, a specified prior preparation is required.These requirements are described in the following table.

For first degree students:	
IP I for single/dual degree	Normally all courses in the semesters preceding IP I for his/her program/composite program.
IPII/TS for single/dual degree	All named courses of his/her program/composite program, other than TS/IP-II.
For any other prescribed semester of single / dual degree	All named courses in semesters and terms preceding this set of courses in his/her program / composite program

* If IP-I is delayed by one year for a student with the permission of the appropriate authority, he/she would be permitted to register for CDC's with prior preparation package not including IP I.

6. TEACHING AND EVALUATION

Teaching

The objective of classroom education is to awaken curiosity, generate habits of rational thinking and train students to be independent and face unfamiliar situations. Classroom instructions help a student to organize and correlate facts, comprehend ideas and to use knowledge creatively.

Multi-Section Operations

A number of courses offered in the first two years at IcfaiTech are multi-section in operation and many of these are interdisciplinary in nature. Some of the salient features of multi-section operation are enumerated below:

• Every course, is conducted by a member of the faculty called an Instructor-in-Charge (IC), with the assistance of required number of Instructors - who will partner in meeting the full academic responsibilities and organizational needs of teaching and evaluation.

• The IC with the team of instructors makes a comprehensive plan with respect to the conduct of the course. The team remains in continuous interaction throughout the semester, to ensure smooth operation of the course.

• While the style of teaching may vary from instructor to instructor, the team makes all effort to ensure that the pace of delivery of the content is uniform.

• The question papers, its solutions and detailed break-up of marks for tests/quizzes and other examinations are prepared by the entire team.

To ensure uniformity in marking, a given question is marked by the same instructor for all the students registered in the course. All this ensures that the operational aspects including grading are free from arbitrariness.

Course Handout

For a smooth conduct of a course, the instructors share all the important details of the course, including assessment scheme with students at the beginning of the semester. This is done through a 'Course Handout' that provides information like the

• scope& objectives of the course

• text books, reference books, and other digital resources like NPTEL, SWAYAM

• content and operational aspects (pace, coverage and level of treatment)

• frequency/duration of classes, credits

• components of evaluation like quizzes/tests (announced or unannounced, open-book or closed-book), laboratory exercises, list of experiments, home assignments and their relative weights

• course outcomes

• attendance policy

• policy on make-up tests

• chamber consultation hours

Evaluation Components

Teaching and evaluation form a coherent function and operate on the basis of mutual understanding and trust at IcfaiTech. All components of evaluation are internal; conducted and evaluated by the Instructors/team of instructors handling the course. The evaluation components are evenly spread out in the semester. Various attributes like spontaneous recall, practical application of concepts, ability to work on their own, competence in conceptualized arguments, aptitude to face unfamiliar situations are put to test. The various components of evaluation that the instructor may employ to evaluate a student are tests, quizzes, seminars, presentations, assignments, projects, laboratory-based experiments etc. The evaluation methods, components and their weights depend on the nature of the course. The suggested components normally include two or three written tests, quizzes, and assignments. The quizzes and assignments are interspersed between the tests. All tests and quizzes are conducted during the common hours without disturbing the normal academic schedule. All test and end semester examinations are conducted as per the schedules announced to the students through Course Handouts. One of the components of evaluation (End-Semester examination) is comprehensive enough to include the entire course and is held at the end of the semester. The written examination normally consists of objective questions, short-answer questions, descriptive-answer questions, problems etc. The pattern and type of questions may vary depending on the nature of the course.

Component	Weights	Duration
Test-I	15%	50 minutes
Test-II	15%	50 minutes
Test-III	15%	50 minutes
Assignments/quizzes/presentations/projects	15%	
End Semester Examination	40%	3 hours

Evaluation components and their weights for a typical theory course.

Evaluation and Feedback on performance

Just as evaluation is done in a continuous and transparent manner, feedback on performance in the evaluation components is also made available at regular intervals. The answer scripts are promptly evaluated and shown to the students. The performance of the students with reference to the highest, lowest and average marks is discussed in the class. Solutions with the marking scheme are displayed immediately on the department notice board after every test and examination.

In case of any subjectivity in the evaluation, or discrepancy from the discussed/displayed evaluation scheme, or any totaling errors in the answer script, the student reserves the right to request for a rechecking or retotalling.

Mid-semester grading for each course, based on the evaluation components conducted until the middle of the semester, is made available to the students. This grade alert will help the students to improve their performance in the remaining evaluation components.

Attendance Policy

Every student is normally expected to maintain a minimum of 75% attendance in every course for which he/she is registered. In courses with both theory and laboratory components, the student must maintain a minimum of 75% attendance in both the components.

The IC/instructor in consultation with the Chairperson Academics can recommend to the Director, IcfaiTech for condonation up to a maximum of 10% for those students who face genuine difficulty in maintaining 75% attendance.

Condoning process has the following steps:

• Instructor-in-Charge/instructors make a list of students with attendance between 65 and 75%.

• The data of these students on performance indicators like marks in tests, quizzes and assignments is examined.

• Assignments and tasks are designed for each student to make up for deficiency in academic performance and the shortage of attendance.

• who complete the task to the satisfaction of the Instructor are permitted to appear for the examination.

If a student does not write the end-semester examination or is not permitted to take the end-semester examination in any course, he/she will be given RRA report. He/she will be required to Register Again (RRA) for the course when it is next offered.

Periodic alerts given by the instructors regarding attendance must be taken seriously and every effort made to reach the required attendance.

Make-up Policy

If a student anticipates a genuine difficulty in meeting the date of component of evaluation, he/she should take the IC/Instructor into confidence prior to the event and request for a makeup. Whenever a student misses a component of evaluation for genuine and unanticipated reasons and has therefore not taken prior permission, the student must immediately after the test approach the IC/Instructor with a request for make-up.

If the IC is satisfied with the request, a make-up test/examination would be conducted one week after the date of the missed component of evaluation.

The students must note that there will be no makeup for laboratory experiments, lab exams, quizzes and presentations.

Unfair Practices in Examinations/Academics

Students must not resort to unfair means during any evaluation component. Any of the following events will be considered as unfair practice(s) during examinations/evaluation.

a) Possessing unauthorized materials like notes or slips in pockets, vanity bags and purses.

b) Having notes and formulas written on the body.

c) Using cell phones or programmable calculators.

d) Copying from other students.

e) Allowing/enabling other students to copy from one's paper/computer screen.

f) Taking or giving any kind of assistance from/to other students.

g) Communicating with the students in or outside the exam hall.

h) Going out of the examination hall other than to the rest room.

i) Plagiarism in project work/assignments.

In the judgement of the Invigilator, if a student has indulged in unfair means in the examination hall, the following steps are taken by the invigilator:

• The student is asked to surrender the answer book and any possible material evidence and leave the exam hall.

• A report is filed with the Director, IcfaiTech after handing over the answer book with material evidence. The examination committee conducts an enquiry where the student is given opportunity to defend himself.

Use of unfair means if established, would result in one of the two punishments:

a. Cancellation of registration (RC) for the course in which use of unfair means was established.

b. Cancellation of registration for the course along with suspension for a full semester. Suspension for a full semester implies that the student cannot register for any course offered in that semester.

7. GRADING

The IcfaiTech system emphasizes on continuous and regular evaluation, which includes numerical marking in grading the student. At the end of a semester, letter grades are awarded to the students based on their overall performance in the course. These grades are relative to the performance of all the students evaluated for that course.

Letter Grades

The list of letter grades, the grade points associated with them and their qualitative meanings are given below:

Letter	Qualitative Grade	Points attached
A	Excellent	10
B	Good	8
C	Fair	6
D	Poor	4
E	Exposed	2

In order to arrive at letter grades, the histogram based on the total marks in a particular course for all the students pursuing the course is made. The histogram normally shows clusters, gaps between clusters or dips between clusters. The grading in the course is guided with reference to the highest, lowest, average marks, and the gaps and dips between clusters of students. In courses where the registered number of students runs into hundreds, the range of C grade usually covers the average marks. This may however not be case when the histogram is skewed, and the average marks of the class is unusually high or low.

In case of absence of clear gap between clusters, the grade border may be drawn in a dip in the cluster. The decision on whether the students appearing on the borderline are pushed to the higher grade or to the lower grade is taken on a case by case basis. Some of the factors that guide the instructor in grading the borderline students are attendance, participation in the class and overall attitude.

In courses with a small number of registered students, the instructor opts for absolute grading. In such cases, the instructor announces to the students at the beginning of the semester, the anticipated mark ranges for various grades.

Reports

At the time of final grading, in certain cases, the Instructor-in-Charge can report certain events/facts in place of letter grades. These reports are not to be construed as grades. The various reports listed below are elaborated in the subsequent paragraphs.

1. Incomplete (I)

2. Grade Awaited (GA)

3. Withdrawn (W)

4. Registration Cancelled (RC), Required to Register Again (RRA) and Discontinued from the Program (DP)

5. Not Cleared (NC).

Incomplete (I)

An Instructor-in-Charge who finds that a student has not fulfilled some requirement of a course before the deadline for transmitting the grades, is satisfied that the student is able to transmit a grade or a report without this fulfillment; can use his/her discretion to give the student an opportunity.

The Instructor-in-Charge can within the deadline, send a report 'I' (Incomplete) for the student and also inform the student of the same. It shall be the responsibility of the student to contact the Instructor-in-Charge and fulfill the requirement for replacement of the 'I' report within two weeks after the end of the semester; failing which the Instructor-in-Charge will communicate whatever grade/report is possible for that situation.

Grade Awaited (GA)

'GA' is given in situations where operational and practical difficulties may cause a delay in transmitting of a grade or a report. Some instances when GA is given are as follows:

(i) pending case of unfair means

(ii) pending case of indiscipline

(iii) for IP courses where the student is at an off campus center and the dissemination of information between the Institute and the IP center is delayed

(iv) if due to genuine reasons a student is unable to appear for end-semester examination on the scheduled date and his/her request for make-up has been granted After the case has been decided, or the IP grade getting transmitted or the makeup taken and evaluated, the GA report is converted into a valid grade or report.

Whenever the report GA appears in the grade sheet, it must be converted into a letter grade or a report before the next semester registration.

Withdrawn (W)

A student may seek withdrawal from course(s) in a semester for any of the following reasons:
(i) The student is unable to attend classes for the course(s) for a genuine reason.

(ii) The student is unable to cope up with the normal load and withdraws from the course(s) to reduce his/her academic load for the semester.

Request for withdrawal should be made to Chairperson-Academics, within ten weeks of commencement of the semester. In case of withdrawal within the stipulated time, the grade sheet/transcript of the student will indicate 'W' (withdrawn) against the course(s) from which the student has withdrawn his/her registration. If the withdrawal is made after the due date, the event will be reported as 'RC'. In either of the situations, the student will have to register for the course(s) at the next offer and obtain a valid letter grade.

Registration Cancelled (RC), Required to Register Again (RRA), Discontinued from Program (DP)

If a student's registration for a course has been cancelled, it will be reported in the grade sheet as 'RC'. The following are the situations when an RC report is issued:

(i) Cancellation is recommended as a part of disciplinary action against the student for resorting to unfair means during examination or other unprofessional behavior

(ii) Cancellation is recommended due to less than the minimum required percentage of attendance.

(iii) Cancellation is recommended if a provisionally admitted student fails to submit the proof of necessary documents required for registration and/or does not satisfy the minimum eligibility requirements for the admission within the prescribed time limit.

(iv) Cancellation is recommended when a student persistently and/or deliberately does not pay his/her dues.

RC itself has many contextual meanings:

(i) When it is clearly known that the student is required to register again in the same course, the event will be reported as RRA (Required to Register Again).

(ii) If RC amounts to discontinuation from the program, it will be reported as DP (Discontinued from the Program).

(iii) If the cancellation of registration is not reported either as RRA or as DP but as RC, it does not necessarily mean that it is free from any constraint but that the meaning of the constraint must be construed from the context in which the RC is reported.

Not Cleared (NC)

If a student continued to remain registered in a course (with or without lab component) but gave the instructor inadequate opportunity to evaluate him by not attending the quizzes/ tests/examinations/lab sessions and other components of evaluation, or by appearing in the same for the sake of appearing, without applying himself to the task at hand, the student will be given NC (Not Cleared). It is to be noted that a NC cannot be ignored, except under the situations described in (ii) and (iii) below:

(i) Whenever a student gets a NC report in a course which is in the compulsory package of his/her program, he/she is required to register again in the same course and get a valid grade.

(ii) If a student has a NC report in an elective course, he/she can either repeat the course to get a valid grade or ignore it to choose another course. However, a student must get valid grades in at least the prescribed number of electives in his/ her program.

(iii) If a student record has a NC report in a course which remains unaccounted for, after a process of transfer has been completed, although it will not be possible for him/her to wipe out the NC report from his/her transcript, he/she can still graduate. (iv) If a student gets a NC in IP/Thesis, he/she will be required to register in the same for one more semester.

Cumulative Grade Point Average (CGPA)

The Cumulative Grade Point Average (CGPA) is used to describe the overall performance of a student in all courses in which he/she is awarded letter grades since his/her entry into the Institute. It is also used for the declaration of division when the program is completed.

CGPA is the weighted average of the grade points of all the letter grades received by the student from his/her entry into IcfaiTech and is computed as follows:

$$CGPA = \frac{\Sigma u_i g_i}{\Sigma u_i} = \frac{(u_1 g_1 + u_2 g_2 + u_3 g_3 + \ldots)}{(u_1 + u_2 + u_3 + \ldots.)}$$

Where u1 , u2 , u3 , ... denote units associated with the courses taken by the student and g1 , g2 , g3 ..... denote grade points of the letter grades awarded in the respective courses. Reports will not alter the CGPA, since the same are not accounted for in the CGPA calculations.

When a student repeats a course in which he/she has already received a grade, as soon as a new grade is obtained, it will replace the earlier one in the calculation of CGPA. It is to be noted that only the latter grade in a course would be considered for the calculation of CGPA and not the better of the two grades.

Grade Sheet

A student's grades, reports, CGPA, etc., at the end of every semester/term will be recorded on a grade sheet, a copy of which will be issued to him/her. The grade sheet will be withheld when a student has not paid his/her dues or when there is a case of breach of discipline or unfair means pending against him/her.

While registration with approval of the appropriate authority is a token of permission to pursue studies, the grade sheet is a complete record of the outcome of what was intended in the registration. The various grades and reports discussed in the handbook will be appropriately used to tally the grade sheet with the registration data. It would be evident that this tally between what was registered for and what was obtained in terms of grades and reports will apply to all courses except for any course which was originally registered for, but subsequently replaced by another course through substitution.

The tally is made on a course by course basis at the end of the term to determine which of the courses have been cleared. A course is deemed to have been cleared if the student obtains a grade in the course. However, mere clearing of the prescribed courses does not tantamount to fulfilling the requirements of graduation.

While all grades secured, reports and other pertinent information for a semester are given in a grade sheet, the chronologically organized information from the grade sheets of a student with necessary explanation constitutes his/her transcript, which is issued at the time he/she leaves the institute or on request at an intermediate point.

Minimum Academic Requirements

The education philosophy of IcfaiTech interlinks and at the same time distinguishes between the performance of a student in a single course and his/her cumulative performance. Accordingly, the student of the first-degree program has to maintain the expected minimum academic requirement at the end of each semester.

They are as follows:

(i) A student should not have secured more than one 'E' grade in the semester.

(ii) A student should have CGPA of at least 4.50.

(iii) A student should have at least cleared with his/her latest performance, such courses (counted from the point of his/her entry into the Institute) as are prescribed for a period that corresponds to two-thirds of the number of semesters spent by him/ her since his/her entry into the Institute with reference to his/her current program. This means that at any stage of reckoning, the student should not have spent more than 50% extra time than what is prescribed for him/her up to that stage.

Academic Counseling Committee (ACC)

The minimum academic requirements that every first-degree student should meet at the end of every semester are mentioned above. Failure to meet even one of these requirements will automatically bring the student under the purview of the ACC or the designated authority.

The ACC will take immediate charge of the student and ask him/her to follow a specific path so that he/she can be rehabilitated at the earliest. The student under ACC will not undergo

normal registration process but will be guided by the ACC in selection of the courses for the semester registration.

Once a student has been placed under the purview of the ACC, he/she should continue to be under its direct guidance until,ACC after being satisfied with his/her overall progress and performance, declares him/her to be outside its purview. All decisions of the ACC shall be final.

Students under the purview of ACC are cautioned from time to time if they fail to improve in the following stages.

Warning: A student, who comes under the purview of the ACC for the first time due to a CGPA between 4.2 and 4.5 is warned to take studies seriously and improve the performance in order come out of ACC list by the next semester.

Severe Warning and Reduction in Course Load: If a student has CGPA between 3.0 and 4.2 or continues to remain under the purview of the ACC in the subsequent semester, he/ she would be severely warned. The ACC, based on its evaluation of the student, decides that the student would not be able to cope up with the normal load of courses for the semester. The ACC will work out a package of courses with reduced load for the ensuing semester, so that the student gets a chance to improve and come out of the purview of the ACC.

The implication of a reduced load is that the period of study gets extended.

Probation: If the advice and guidance of the ACC is not taken seriously by the student,and he/she continues to give deteriorating performance, he/she might be given a last chance and kept on probation during the next semester. During this semester his/her progress will be closely monitored.

Discontinued from Program: If a student on probation during a semester fails to improve his/her performance to the satisfaction of the ACC and his/her CGPA falls to below 3.0, he/ she would be Discontinued from the Program (DP) and would be asked to leave IcfaiTech.

It must be noted that any student under the purview of the ACC found to be involved in any act of indiscipline or unfair means in examination at any time would be immediately asked to discontinue from the program. It should therefore be the single-minded objective of the student to fulfill the minimum academic requirements stipulated,thus enabling himself/herself to be declared outside the purview of the ACC at the earliest.

Graduation Requirements

A student is deemed to have fulfilled the requirement of graduation for the first-degree program when he/she satisfies the following conditions-

(i) Has cleared all the courses prescribed for him/her in his/her program.

(ii) Has obtained a minimum CGPA of 4.5.

(iii) Has remained outside the purview of the ACC or has been declared outside its purview.

(iv) Has overcome all the consequential stipulations of an NC report; except where there is NC report in an elective course over and above the prescribed number of elective courses or in a course which has ceased to be a part of his/her current program because of transfer of program.

A student is deemed to have become eligible for the Bachelors degree if, in addition to the above requirements he/she has no case of indiscipline or unfair means pending against him/ her. If a student has outstanding dues against him/her to be paid to IcfaiTech, the student hostel or any other recognized affiliate/ associate organization of IFHE, his/her degree will be withheld until the said dues are cleared.

Certification

The following classification based on CGPA will be made and mentioned in the graduation certificate of the first Degree program student.

Distinction	CGPA 9.00 or above
I Division	CGPA 7.00 or more but less than 9.00
II Division	CGPA 4.50 or more but less than 7.00

Every student is expected to familiarize himself with the following documents associated with academic progress and program completion: Grade Sheet: Grade sheet is a complete record of courses done, grades obtained by the student, showing GPA and CGPA and other information for a semester. Students can obtain duplicate copies of grade sheet on payment of nominal fee.

Transcript: Transcript is chronologically organized information of courses, grades,GPA, CGPA obtained in various semesters during the Program which is issued on successful

completion of the Program. Students can obtain additional transcript on payment of ` nominal fee. Provisional Certificate: Students who fulfill the graduation criteria will be given a provisional certificate before the convocation.

Degree Certificate:

Students who fulfill the graduation criteria will be awarded the Degree certificate at the formal convocation.

Awards

All students who successfully complete the prescribed course work and examinations will receive their degree from IFHE.

Gold and Silver medals will be awarded to the students scoring the first rank and second rank respectively on completion of the program. A student against whom disciplinary action has been taken or has any backlog of course(s) will not be eligible to get merit scholarship/medals.

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(Deemed-to-be-University establishes under section 3 of UGC Act 1956.)