Mahindra École Centrale

Bahadurpally, Hyderabad 500043

ACADEMIC REGULATIONS FOR FOUR-YEAR UNDERGRADUATE DEGREE PROGRAMS

(Applicable to students from the Academic Year 2018-19 and onwards)

1) COURSES OF STUDY AND AWARD OF B. TECH. DEGREE

The Institute awards B-Tech degree in the following four four-year undergraduate (UG) programs:

S. No.	**B. Tech. Degree Program**
1	**Civil Engineering**
2	Computer Science and Engineering
3	Electrical Engineering
4	Mechanical Engineering

a) A student who has passed all the individual courses in the corresponding curriculum is entitled to be awarded the Bachelor of Technology (B. Tech.) degree provided he complies with the subsequent rules.

b) A student cannot be awarded the Bachelor of Technology (B. Tech.) degree with a Cumulative Performance Index (CPI) strictly less than 4.0.

c) A student must not earn not less than 165 credits (see b)) for the award of the B-Tech. degree.

d) A student after securing admission into one of the four B. Tech. degree programs must pursue the course of study for a duration of 8 semesters (or 4 years). Each semester shall have a minimum of 90 days of instruction including Examinations, as per AICTE norms. The B. Tech. degree program has to be completed within at most 8 consecutive years from the date of admission to the program.

e) The first two years of the B. Tech. degree program are termed as the Core Program and the last two as the Professional Program. The maximum duration to complete all academic requirements of either the Core or the Professional Program is four consecutive years from the year of the registration into the corresponding program; students who fail to do so shall forfeit their seats in the B. Tech. course.

f) Elective courses are available in the professional program. Students in consultation with faculty members may propose their choices from among the offered elective courses; the proposal needs approval by a departmental committee nominated by the Dean of Academics.

g) Cancellation of Admission: All students admitted provisionally or otherwise to any program shall submit copies of their mark sheets, provisional certificates, etc. of the

qualifying examination and other documents by the last date specified for the purpose in the Academic Calendar. MEC reserves the right to cancel the admission at any later time if it is found that the student had supplied false information or suppressed relevant information while seeking admission.

h) Any matter relating to the award of the B. Tech. degree that is not covered in the existing regulations is to be decided upon by a standing committee (nominated by the Director) composed of faculty members and chaired by the Dean Academics.

2) CREDITS AND ACADEMIC PERFORMANCE

a) Credit representation: Each lecture hour contributes to *one credit*, while one hour of tutorial or practical contributes toward *half a credit*.

No. of lecture hours per week	No. of tutorial hours per week	No. of practical hours per week	Total credits
2	1	2	2*1 + 1*0.5 + 2*0.5 = 3.5

b) Grades and Grade Points: At the end of the semester, a student is awarded a letter grade (based on a prescribed process) in each of his courses by the concerned Instructor-in-Charge taking into account his performance in the various examinations, quizzes, assignments, laboratory work (if any), etc., besides regularity of attendance in classes. The grades are submitted in the undergraduate office within the prescribed time limit of 72 hours after the end semester examination. There are eight letter grades: A, B^+, B, C^+, C, D, E and F. The letter grades and their numerical equivalents on a 10-point scale (called Grade Points) are as follows. The letter grades: A, B^+, B, C^+, C and D are considered as passing grades; students who are awarded any of these grades in a course, acquire the corresponding number of credits allotted to the course. The letter grades: E and F are considered as failing grades; students who are awarded any of these grades in a course, do not acquire the corresponding number of credits allotted to the course; such students have to take up a supplementary examination to get a passing grade.

Letter Grades	A	B^+	B	C^+	C	D	E	F
Grade Points	10	9	8	7	6	4	2	0

In addition to the letter grades mentioned above, there is an additional letter grade, viz., 'I' which stands for Incomplete. A student may be awarded the grade 'I' (Incomplete) in a course if he has missed, for a genuine reason such as a medical reason, as decided by the instructor in charge or the Dean Academics, , a part of the course requirement but has done satisfactorily in all other parts.. An 'I' grade must, however, be converted by the Instructor-in Charge into an appropriate letter grade and communicated to the

undergraduate office by the last date specified in the academic calendar. Any outstanding 'I' grade after this date shall be automatically converted into the 'F' grade.

c) Project Grades: Project grades shall be submitted by the last date specified for the submission of grades. An 'I' grade may be given only on medical grounds or by recommendation of the project evaluation committee to the Dean Academics.

d) Change of Grade: A letter grade once awarded shall not be changed unless the request made by either the Instructor-in-Charge of the course is approved by the Dean Academics. However, any such request for change of grade must be made within six weeks of the start of the next semester in the prescribed form with all relevant records and justification.

e) Semester Performance Index (SPI): The Semester Performance Index (SPI) is a weighted average of the grade points earned by a student in all the courses credited and describes his/her academic performance in a semester. If the grade points associated with the letter grades awarded to a student are g1, g2, g3, g4, and g5 in five courses and the corresponding credits are c1, c2, c3, c4, and c5, the SPI is given by:

$$\text{SPI} = \frac{c1g1+c2g2+c3g3+c4g4+c5g5}{c1+c2+c3+c4+c5}$$

f) Cumulative Performance Index (CPI): The Cumulative Performance Index (CPI) indicates the overall academic performance of a student and is computed in the same manner as SPI by considering the grades in all the courses registered up to and including the most recently completed semester/summer term. When a student is permitted to repeat or substitute a course/examination, the new letter grade replaces the old letter grade in the computation of CPI; however, the previous grades remain in the Grade Report.

g) Grade Report: A copy of the Grade Report is issued to each student at the end of the semester. A duplicate copy, if required, may be obtained on payment of a prescribed fee.

CPI, SPI condition ?

3) DISTRIBUTION AND WEIGHTAGE OF MARKS

a) The performance of a student in each course of a semester shall be evaluated out of a possible maximum of 100 marks. The resulting marks will then be converted to appropriate letter grade.

b) Specifics of breakup of marks shall be defined at course level. This breakup of marks will be communicated by the instructor in charge at the beginning of the semester. The below-mentioned guidelines shall be followed:

   i. The distribution of marks for all courses shall follow the principles of continuous evaluation. Continuous evaluation during the semester – through mid-term examinations, quizzes, assignments, team projects, term papers, seminars, presentations, etc., (whichever of them applicable for a particular course) – typically constitute between 40-50% of the total marks, whereas,

the end-semester examination including lab will constitute 50-60% of the marks.

ii. For courses without a laboratory, there shall be at least one mid-semester examination along with any other forms of continuous evaluation methods described above (i.). The first mid-semester examinations shall cover units taught during the first spell of instructions i.e. from the beginning of the semester until the first mid-semester examination. A second mid-semester examination if any shall cover the units taught during the second spell of instructions i.e. the intervening period between first mid-semester examinations and the second mid-semester examinations. The end-semester examination will cover all the units taught during the entire semester. All end-semester examinations shall be for a total of 100 marks.

iii. For courses consisting of both theoretical and laboratory components or design or drawing or project (such as but not limited to Engineering Graphics, Engineering Drawing, Machine Drawing) as a part of the course, the evaluation process for the theory part shall follow the same procedure as described above, with typically a total marks for theory between 60-70 (out of the maximum of 100) and the rest of 30-40 marks being awarded to the laboratory part. The evaluation of the laboratory/practical part of the course shall also follow the principle of continuous evaluation. The instructor-in-charge shall inform the students whether an independent minimum passing mark in the theory part of the course as well as an independent minimum passing mark in the laboratory part of the course is required.

b) There shall be an industry-internship, in collaboration with industry/academia, to be taken up before the beginning of the 4^{th} year. The evaluation of the internship shall be based on the performance evaluation report from the industrial/academic partner and may be a viva. There shall be no credits awarded for the internship.

c) Project beginning during the first semester of academic year III may extend over the second semester. Provisional grade will be awarded at the end of the first phase of the project and upon successful completion of the project this grade is subject to revision at the end of the second phase. For each semester it shall be evaluated for a total of 100 marks. The evaluation shall be based on the report submitted at the end of the project and the presentation of the project to a committee. The committee shall consist of the supervisor of the team project and another faculty member of relevant experience.

d) B. Tech project shall begin in IV year I semester (phase-I) and will continue during IV year II semester (phase-II). Out of the total 100 marks for the project work, 25 marks shall be allotted for internal evaluation and 75 marks for final project report and end semester examination (viva voce). The end semester examination of the project work shall be conducted by an expert committee consisting of at least two faculty members with relevant subject specialization. In addition, the project supervisor shall

also be a member of the committee. Evaluation of the progress of the project shall be done one at the end of the first phase (semester) and a provisional grade is awarded. Upon successful completion of the project evaluation process a revised grade for both first and second phase shall be awarded.

4) ATTENDANCE REQUIREMENTS

a) A student shall be eligible to receive a passing grade in a course offered in a specific semester, if he acquires a minimum of 75 % attendance in lectures, tutorials and lab individually in that course during the same semester.

b) A student with up to 10% of shortage of attendance in a course (an attendance of at least 65%) in a semester may apply to the Dean of Academics; such exceptions shall be granted only on genuine and valid reasons on representation by the candidate with supporting evidence, and on payment of a stipulated fee.

c) A student with attendance below 65% in a course in a semester could be condoned on a case by case basis at the discretion of the Director; such exceptions shall be granted only on genuine and valid reasons on representation by the candidate with supporting evidence, and on payment of a stipulated fee.

d) A student with attendance below 75% in a course during a semester, who has not been exempted by the Dean of Academics, will receive an F grade by default in the corresponding course.

5) ACADEMIC PROGRESSION REQUIREMENTS

a) The Student Performance Committee, chaired by the Dean of Academic Affairs informs and advises students on their academic performance.

b) The Student Performance Committee, gives their recommendation to the director on the academic progression of all admitted students.

c) A student completing an academic year (N) may be promoted to the next academic year (N+1) when he has acquired at least:

   a. 60% of the credits in the current academic year (N)
   b. 90% of the credits in all previous academic years (<N)

d) Students who receive failing grades in courses are permitted to avail supplementary examinations for those courses. With the permission of the SPC students may also be allowed to take up these courses with extra-load during a regular semester.

e) When a student in any given semester acquires at least 60% of the credits prescribed during that semester, he may be permitted to take up the full course load during the next semester; otherwise, the student may be advised to take up a reduced course load.

f) Marks obtained in a supplementary examination will be used to re-compute the grade in the corresponding course. However, the supplementary examination may replace either the end-semester or both the end-semester and mid-semester examination-components (whichever is more beneficial to the student) of the total marks and no other evaluations like the laboratory component or projects, assignments, etc.

6) WITHHOLDING OF RESULTS

If the student has not paid dues, if any, to the Institute or if any case of indiscipline is pending against him, the result of the student will be withheld and he will not be allowed into the next semester and/or his degree will be withheld.

7) TRANSITORY REGULATIONS

1. Students of previous batches may be given equivalent subjects as per the revised regulations, which they have to pass in order to obtain the required number of credits.

8) GENERAL

1. Wherever the words "he", "him", "his", occur in the regulations, they include "she", "her", "hers".
2. The academic regulations should be read as a whole for the purpose of any interpretation.
3. In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Director is final.
4. The Institute may change or amend the academic regulations or syllabi from time to time and the changes or amendments made shall be applicable to all the students with effect from the corresponding notification date.

COURSE CATEGORIES

S. No.	Category	Description
1	CH – Chemistry	Courses in Chemistry.
2	PH - Physics	Courses in Physics
3	ES – Engineering Science	Courses in Engineering Sciences
4	CE – Civil Engineering	Courses related to Civil Engineering
5	CS – Computer Science	Courses in Computer Science and Technology
6	EE – Electrical Engineering	Courses of Electrical Engineering
7	ME – Mechanical Engineering	Courses in Mechanical Engineering
8	HS – Humanities and Social Sciences	Courses in Language, Culture, Philosophy, etc.
9	SE – Society & Enterprise	Includes projects and courses in Media, Industrial Engineering, Management, Finance, etc.
10	PR – Projects	Includes third year and final year projects

CURRICULUM

Semester 1						
	Code	**Course**	**L**	**T**	**P**	**Credits**
1	MA 101	Mathematics - I	4	1	0	5
2	CH 101	Chemistry - I	2	1	0	3
3	ES 101	Introduction to Electrical Engineering	2	1	2	4
4	ES 102	Engineering Drawing	0	0	3	1.5
5	ES 103	Earth and Environmental Sciences	2	0	0	2
6	ES 104	Thermodynamics	2	1	0	3
7	SE 101	Media Project	0	0	3	1.5
8	HS 101	English and Humanities - I	1	2	2	4
9	FL 101	French language & Culture - I	0	2	0	0
		Total Credits	13	8	10	**24**
		Total contact hours	31			

Semester 2						
	Code	**Course**	**L**	**T**	**P**	**Credits**
1	MA 102	Mathematics - II	3	1	0	4
2	PH 101	Physics - I	2	1	2	4
3	CH 102	Chemistry - II	2	0	2	3
4	ES 105	Electronics	2	1	2	4
5	ES 106	Introduction to Computer Science	2	1	2	4
6	ES 107	Workshop Practice	0	0	2	0
7	SE 102	Introduction to Enterprise & Economy	2	1	0	3
8	HS 102	Professional Ethics	0	1	0	1
9	FL 102	French language & Culture - II	0	2	0	0
		Total Credits				**23**
		Total contact hours	31			

Semester 3						
	Code	**Course**	**L**	**T**	**P**	**Credits**
1	MA 203	Mathematics - III	3	1	0	4
2	PH 202	Physics - II	3	1	2	5
3	ES 208	Mechanics	2	1	0	3
4	ES 209	Signals & Systems	2	1	2	4
5	ES 210	Data Structures	2	2	2	5
6	CE 201	Building Materials	2	0	0	2
7	FL 203	French language & Culture - III	0	2	0	0
		Total Credits	14	8	6	**23**
		Total contact hours	29			

Semester 4						
	Code	**Course**	**L**	**T**	**P**	**Credits**
1	ES 211	Numerical Methods	3	0	2	4
2	CE 202	Mechanics of Materials	3	1	0	4
3	CE 203	Engineering Surveying	2	0	2	3
4	CE 204	Fluid Mechanics	3	0	2	4
5	CE 205	Concrete Technology	2	0	2	3
6	CE 206	Construction Technology and Drawing	2	0	2	3
7	SE 203	Design Thinking	1	0	2	2
8	FL 204	French Language & Culture - IV	0	2	0	0
		Total Credits				**23**
		Total contact hours	30			

Semester 5						
	Code	**Course**	**L**	**T**	**P**	**Credits**
1	MA 304	Mathematics - IV	3	1	0	4
2	ES 312	Introduction to Materials Sciences	2	0	2	3
3	CE 307	Computing Lab	1	0	4	3
4	CE 308	Structural Analysis	3	1	0	4
5	CE 309	Soil Mechanics	3	0	2	4
6	CE 310	Water Resources Engineering	3	0	0	3
7	HS-E1	HSS + Mgmt. - Elective – I	2	0	0	2
8	FL 305	French Language & Culture - V	0	2	0	0
		Total Credits				**23**
		Total contact hours	29			
Semester 6						
	Code	**Course**	**L**	**T**	**P**	**Credits**
1	CE311	Reinforced Concrete Design	3	1	0	4
2	CE 312	Environmental Engineering	2	0	2	3
3	CE 313	Transportation Engineering	3	0	2	4
4	CE 314	Foundation Engineering	3	0	0	3
5	PR 301	Third Year Team Project	0	0	6	3
6	E1	Elective - I	3	0	0	3
7	HS-E2	HSS + Mgmt. - Elective – II	2	0	0	2
8	FL 306	French Language & Culture - VI	0	2	0	0
		Total Credits				**22**
		Total contact hours	30			

Semester 7						
	Code	**Course**	**L**	**T**	**P**	**Credits**
1	CE 415	Design of Steel Structures	3	1	0	4
2	CE 416	Construction Planning and Management	2	0	0	2
3	HS-E3	HSS + Mgmt. - Elective - III	2	0	0	2
4	E2	Elective – II	3	0	0	3
5	E3	Elective – III	3	0	0	3
6	PR 402	Year-4 Project I	0	1	4	3
7	FL 407	French Language & Culture - VII	0	2	0	0
		Total Credits				**17**
		Total contact hours	26			
Semester 8						
	Code	**Course**	**L**	**T**	**P**	**Credits**
1	E4	Elective – IV	3	0	0	3
2	E5	Elective – V	3	0	0	3
3	PR 403	Year-4 Project II	0	5	8	9
4	FL 408	French Language & Culture -VIII	0	2	0	0
		Total Credits				**15**
		Total contact hours	19			

List of Electives (semesters 6, 7, and 8)

S.No.	Code	Course	L	T	P	Credits
1	CE 450	TE - II (Railways, Airports & Harbour Engg.)	3	0	0	3
2	CE 451	Traffic Engineering and Management	3	0	0	3
3	CE 452	Intelligent Transportation Systems	3	0	0	3
4	CE 453	Pavement Analysis and Design	3	0	0	3
5	CE 454	Transport and Environment	3	0	0	3
6	CE 455	Urban Transportation Planning	3	0	0	3
7	CE 456	Pavement Material Characterization and construction	3	0	0	3
8	CE 457	Airport Planning and Design	3	0	0	3
9	CE 460	Advanced Foundation Engineering	3	0	0	3
10	CE461	Advanced Soil Mechanics	3	0	0	3
11	CE462	Environmental Geotechnics	3	0	0	3
12	CE463	Geosynthetics and Reinforced Soil Structures	3	0	0	3
13	CE464	Geotechnical Earthquake Engineering	3	0	0	3
14	CE465	Ground Improvement Techniques	3	0	0	3
15	CE466	Risk assessment and Management in Geotech. Engg.	3	0	0	3
16	CE467	Rock Mechanics	3	0	0	3
17	CE468	Soil Dynamics and Machine Foundations	3	0	0	3
18	CE 469	Soil-Structure Interaction	3	0	0	3
19	CE 470	Introduction to Continnum Mechanics	3	0	0	3
20	CE 471	Introduction to Finite Element Analysis	3	0	0	3
21	CE 472	Introduction to Fracture Mechanics	3	0	0	3
22	CE 473	Introduction to Structural Health Monitoring	3	0	0	3
23	CE 474	Earthquake Engineering	3	0	0	3

24	CE 475	Dynamics of Structures	3	0	0	3
25	CE 480	Sanitary Engineering and Design	3	0	0	3
26	CE 481	Advanced Waste Water Treatment and Design	3	0	0	3
27	CE 482	Environmental Impact Assessment	3	0	0	3
28	CE 483	Industrial Waste Management	3	0	0	3
29	CE 484	Design of Environmental Engineering Structures	3	0	0	3
30	CE 485	RS and GIS for Environmental Engineering	3	0	0	3
31	CS 313	Machine learning	2	0	2	3
32	CS 457	Deep Learning	3	0	0	3
33	CS 460	Object oriented Programing	3	0	0	3
34	ME 452	Introduction to Operation Research	3	0	0	3
35	ME 460	Alternative Energy Sources	3	0	0	3
36	ME 469	Computational Fluid Dynamics	3	0	0	3
37	ME 470	Robotics: Dynamics and Control	3	0	0	3
38	MA 450	Numerical Linear Algebra	3	0	0	3
39	MA 451	Meshfree Methods	3	0	0	3
40	MA 452	Boundary Element Method and Boundary Integral Equations	3	0	0	3
41	MA 453	PDE Based Image Processing	3	0	0	3
42	MA 454	Topology and Operator Theory	3	0	0	3
43	MA 455	Infinite dimensional Control Theory	3	0	0	3
44	MA 456	Bayesian Statistics	3	0	0	3
45	MA 457	Financial Mathematics	3	0	0	3

List of HS Electives (for semesters 5,6, and 7):

S.No.	Code	Course	L	T	P	Credits
1	HS 500	Selections from World Literature	2	0	0	2
2	HS 501	Business Communication	2	0	0	2
3	HS 502	Visual Story Telling	2	0	0	2
4	HS 503	Introduction to Culture Studies	2	0	0	2
5	HS 504	Literature and Visual Arts	2	0	0	2
6	HS 505	Cinema and Philosophy	2	0	0	2
7	HS 506	The Humanities for a Critical Understanding of the World	2	0	0	2
8	HS 507	Academic Writing	2	0	0	2
9	HS 508	Urban Studies: Reading the City	2	0	0	2
10	HS 509	Contemporary Shakespeare: Readings and Adaptations	2	0	0	2
11	HS 510	Philosophical Arguments	2	0	0	2

Semester-wise Course Descriptions

Course Code: **MA 101**
Course Name: **Mathematics - I**
Credits:5 **(4-1-0)**
Course Position: **Semester 1**

Course Content:

Module 1. Single variable calculus
Limit, Continuity, Integration and its Applications, Polar Coordinates, Differentiability, Applications of Differentiation, Mean value theorem and its Applications, Curve Sketching, Indeterminate Forms, Taylor's and Maclaurin's theorems, Fundamental Theorem of Calculus.

Module 2. Functions of Several Variables

Limit, Continuity, Total Differential, Extrema of functions, Lagrange multiplier method, Double and Triple integrals, Change of Order of Integration.

Module 3. Vector Calculus

Gradient, Divergence and Curl, Line, Surface and Volume Integrals, Theorems of Green, Stokes and Gauss and their applications.

Module 4. Infinite Series

Sequences, Convergence and Divergence of a series, Tests for Convergence, Conditional and Absolute Convergence, uniform convergence of sequence of functions.

Module 5. Ordinary Differential Equations

The existence and uniqueness theorem on the general first order differential equations (statement, without proof, with some simple examples). Variable separable method, reducible to variable separable. Exact differentiable equations, integrating factors. Linear differential equations, Bernoulli’s equation. The general solution of the second order linear homogeneous equations with constant coefficients. Undetermined coefficients, Variation of parameters. Cauchy problem for differential equation systems. Existence theorem (without proof), differential linear systems with constant coefficients. Geometric study in phase plane of simple equations, orthogonal polynomials.

Textbooks:

1. Tom M. Apostol, One Variable Calculus, with an Introduction to Linear Algebra (Text Book for First, Second and Fifth Modules)
2. Tom M. Apostol, Multi-Variable Calculus and Linear Algebra, with Applications to Differential Equations and Probability (Text Book for Third and Fourth Modules)
3. R.K. Jain and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publications (Reference Book)
4. E. Kreyszig, Advanced engineering mathematics, John Wiley (1999). * George B. Thomas, Jr., Maurice D. Weir, Joel Hass, Thomas' Calculus
5. W. E. Boyce and R. DiPrima, Elementary Differential Equations (8th Edition), John Wiley (2005).

Course Code: **CH 101**
Course Name: **Chemistry – I (Physicsal and Analytical Chemistry)**
Credits: **3 (2-1-0)**
Course Position: **Semester 1**

Course Content:

Module 1: Atomic structure and periodic properties (6 lectures): Wave-particle duality. Schrodinger equation. Principles of quantum mechanics. Particle in a one-dimensional box solutions and its applications. Hydrogen atom wave functions. Shape and size of atomic orbitals. Multi-electron atoms – shielding – effective nuclear charge – orbital penetration. Periodic table and periodic properties of elements: electronic configuration, ionization energy and electron affinity.

Module 2: Chemical bonding and intermolecular interactions (8 lectures): Molecular orbitals as linear combinations of atomic orbitals. Molecular orbital energy level diagrams of homonuclear and heteronuclear diatomic molecules - electronegativity. Multi-atomic molecules, molecular geometry and symmetry. Crystal field theory of transition metal ions. Band theory of solids. Molecular properties: Dipole moment and Polarizability. Intermolecular interactions: dipolar and van der Waal's interactions.

Module 3: Analytical methods (10 lectures): Theoretical background of UV-Visible Spectroscopy, Infrared and Raman spectroscopy, Microwave spectroscopy, NMR spectroscopy and magnetic resonance imaging. Introduction to surface analytical techniques: X-ray photoelectron Spectroscopy, Atomic force microscopy.

Module 4: Structure determination using spectroscopic methods (6 lectures): Introduction to chemical analysis of organic molecules. Elemental analysis and Mass spectrometry. Structural elucidation of simple organic molecules using combination of different spectroscopic data.

Textbooks:

1. Atkin's Physical Chemistry; 10th edition; Peter Atkins and Julio De Paula; ISBN 978-0-19-954337-3
2. Organic Chemistry; Jonathan Clayden, Nick Greeves and Stuart Warren; ISBN: 978-0-19-927029-3
3. Fundamentals of Molecular Spectroscopy; 4th edition; Colin N. Banwell and Elaine M. McCash; ISBN-13: 978-9352601738
4. Organic Spectroscopy; 3rd Edition; William Kemp; ISBN 978-1-4039-0684-7

Course Code: **ES 101**
Course Name: **Introduction to Electrical Engineering**
Credits: **4 (2-1-2)**
Course Position: **Semester 1**

Course Content:

Module 1: Electrical Quantities and Circuit Elements; Circuit Analysis: nodal and mesh analyses, superposition and linearity, network simplification;

Module 2: Network Graphs: nodal analysis using reduced incidence matrix, mesh analysis using fundamental circuit matrix, Tellegen's theorem;

Module 3: Sinusoidal Steady-State Analysis: nodal and mesh analyses using phasor method, Thevenin's theorem, maximum-power conditions; Response to Simple Networks: forced, natural and total responses in RLC networks;

Module 4: State Equations: zero-state, zero-input and total responses in RLC networks; Network Functions: poles, zeros and their properties;

Module 5: Resonant Circuits; Two-Port Networks: impedance, admittance and hybrid parameters; Magnetic Circuits and Transformers.

Textbooks:

1. E. Fitzgerald, D. E. Higginbotham, A. Grabel; Basic Electrical Engineering; Fifth Edition, McGraw-Hill, 2009.
2. A. Desoer, E. S. Kuh; Basic Circuit Theory; Tata McGraw-Hill, 2009.
3. M. E. Van Valkenburg; Network Analysis; Third Edition, PHI Learning, 1980.

Course Code: ES 102
Course Name: Engineering Drawing
Credits: 1.5 (0-0-3)
Course Position: Semester 1

Course Contents:

Module 1: General principles, projection systems and multiview drawing: Sizes of drawing sheets, layouts, scales, lines, and lettering. The multiview projection method: orthographic representations including first and third angle projections. Projection symbols.

Module 2: Pictorial drawing: Isometric projection. Isometric drawing / isometric view. Oblique projections: cavalier view, and cabinet view.

Module 3: Sectioning: The cutting plane and its line type. The viewing direction. Naming the sectional view. Hatching of internal surfaces contacting the cutting plane. Convention for hidden features below the cutting plane. Half sections. Offset sections. Revolved sections, removed sections, local sections, and successive sections. Conventions on not hatching shafts, ribs, keys, fasteners, and spokes of wheels.

Module 4: Computer aided drafting: Practical training on the basics of computer aided drafting using commercial software.

Module 5: Dimensioning, tolerancing, annotations, and conventions: Distinction between functional, non-functional, and auxiliary dimensions. Elements of dimensioning: projection lines (extension lines), dimension lines, and leader lines. Types of termination of dimension lines, and origin indication. Placing of dimensions: the aligned and the unidirectional systems. Shape indication, e.g., diameters, radii, etc. Special indications: chords, arcs, and angles. Arrangement of dimensions: Chain dimensioning, and dimensioning from a common feature. Tolerance stack-up in chain dimensioning. Simplified representations of intersections. Representations of square ends. Views of symmetrical parts. Simplified views of repetitive features.

Textbooks:

- Engineering Drawing by N. D. Bhatt, Charotar Publishing House Pvt. Ltd., Anand, 2012 Reprint.

Course Name: **Earth and Environmental Sciences**
Course Code: **ES 103**
Credits: **2 (2-0-0)**
Course Position: **Semester 1**

Course Content:

Module 1: The earth system: Earth in the solar system. Atmosphere and oceans: Origin and evolution; Atmosphere-ocean interaction; Air pollution, Greenhouse effect, Ozone layer; Ocean currents and waves. Lithosphere, Hydrosphere, Cryosphere and atmosphere and their Interactions.

Module 2: Environment and Environmental Studies: Definition and Components of Environment, Relationship between the different components of Environment, Man and Environment relationship, Impact of technology on Environment, Environmental Degradation, Multidisciplinary nature of the Environment studies, its scope and importance in the present day Education System

Module 3: Ecology and Ecosystems: Introduction: Ecology- Objectives and Classification, Concept of an ecosystem- structure and functions of ecosystem, Components of ecosystem- Producers, Consumers, Decomposers. Bio-Geo- Chemical Cycles- Hydrologic Cycle, Ocean currents and waves. Lithosphere, Hydrosphere, Cryosphere and atmosphere and their Interactions, Carbon cycle, Energy Flow in Ecosystem, Food Chains, Food webs, Ecological Pyramids Major Ecosystems: Forest Ecosystem, Grassland Ecosystem, Desert Ecosystem, Aquatic Ecosystem, Estuarine Ecosystem.

Module 4: Population and Economic Growth: The nature of human population growth, population parameters, industrialisation, urbanisation, sustainable development, sustainable consumption, health and the environmental impacts. Environmental pollution: Types of Environmental Pollution: Water Pollution: Introduction – Water Quality Standards, Sources of Water Pollution: Industrial Agricultural, Municipal; Classification of water pollutants, Effects of water pollutants, Eutrophication Marine pollution- Air Pollution: Composition of air, Structure of atmosphere, Ambient Air Quality Standards, Classification of air pollutants, Sources of common air pollutants like PM, SO_2, NO_X, Natural & Anthropogenic Sources, Effects of common air pollutants Land Pollution: Land uses Land degradation: causes, effects and control, soil erosion. Noise Pollution: Introduction, Sound and Noise, Noise measurements, Causes and Effects Thermal Pollution: Causes and effects, Role of individual in the prevention of pollution

Module 5: Social Issues and the Environment: From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization. Environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, and ozone layer depletion, nuclear accidents and holocaust, case studies. Wasteland reclamation – consumerism and waste products. Environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

Textbooks:

1. The Good Earth: Introduction to Earth Science. 2nd Edition, McConnell, Steer, Knight, Owens & Park (2010), McGraw-Hill, New York, USA.
2. Geology for Geotechnical Engineers, J.C. Harvey, Cambridge University Press
3. Basics of Environmental Studies, Varandani, LAP -Lambert Academic Publishing , Germany.
4. Basics of Environmental Studies U K Khare, 2011 ,Tata McGraw Hill
5. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.
6. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India Pvt Ltd, New Delhi, 2007.
7. Erach Bharucha, "Textbook of Environmental Studies", Universities Press(I) Pvt, Ltd, Hydrabad, 2015.
8. G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India PVT, LTD, Delhi, 2014.
9. The Good Earth: Introduction to Earth Science. 2nd Edition, McConnell, Steer, Knight, Owens & Park (2010), McGraw-Hill, New York, USA.

Course Code: **ES 104**
Course Name: **Thermodynamics**
Credits: **3 (2-1-0)**
Course position: **Semester 2**

Course Content:

Module 1: Introductory Concepts and Definitions

System and Surroundings, Macroscopic and Microscopic approaches, Intensive and Extensive Properties, Path and Process, Thermodynamic Equilibrium, Zeroth Law.

Module 2: First Law of Thermodynamics

Closed and Open Systems, Energy, Heat and Work, First law for closed system and flow process, Applications of First law.

Module 3: Properties of Pure Substances

Properties of gases Pure substance, Liquid, Solid, and Vapour Phase Properties, Triple Point, Critical Point, Dryness Fraction, use of Vapour Tables, Mollier Chart.

Module 4: Second Law of Thermodynamics

Clausius and Kelvin-Planck Statements, Heat Engines and Heat Pumps, Reversibility, Carnot Efficiency, Entropy, Availability and Irreversibility

Module 5: Basics of Energy Conversion Cycles

Carnot Cycle, Air-Standard Cycles, Mean Effective Pressure, Vapour Power Cycles, Refrigeration Cycle, Vapour Compression Cycle

Textbooks:

1. P.K. Nag, "Engineering Thermodynamics", McGraw Hill, New Delhi
2. Van Wylen, "Engineering Thermodynamics", Wiley
3. Cengel, "Thermodynamics - An Engineering Approach", Tata McGraw Hill, New Delhi

Moran and Shapiro, Principles of Engineering Thermodynamics", John Wiley & Sons

Course code: **SE 101**
Course Name: **Media Project**
Credits: **1.5 (0-0-3)**
Course Position: **Semester 1**

Course Contents

Module 1: Introduction to Image: Properties, elements, technology of imaging. LAB: sketching images, 5 hand drawn images leading to a comic strip, uses of color for the images, INSTAGRAM usage for capturing images.

Module 2: Visual Design, Visual and Aural Story telling. LAB: Introduction to Camera, Microphones, Report writing, editing software.

Module 3: Introduction to moving images, building up a narrative. LAB: Advance training in camera handling, sound recording, dealing with real life situations, editing to form a narrative with actual footage and writing scripts.

Module 4: Production of a 30 to 45 second narrative, using various images set to a pre-recorded audio track in real life situations, dealing with challenges, start of postproduction of documentaries.

Module 5: Post Production: Editing of the raw footage to form a structured narrative, dealing with sound and music to enhance the narrative and finalizing the project. Discussing the learning outcomes from the project.

Course Code: HS 101
Course Name: English and Humanities – I
Credits: 4 (1-2-2)
Course Position: Semester 1

Course Content:

Module 1:

- The Bet- Anton Chekhov
- Seven Ages of Man/ To be or not to be/ Mark Antony's Speech in Julius Caesar- William Shakespeare
- *London*- William Wordsworth; *Ode on a Grecian Urn*- John Keats

Skills: Paragraph Writing: types, structure, features; Topic, supporting and concluding sentences; Definition, Description, Illustration; Concord.

Module 2:

- *Ulysses*- Tennyson
- *The Second Coming*- W. B. Yeats
- Destructors- Graham Greene

Skills: Expository and Argumentative writing, Fact versus Opinion, Connectors, Noun and Adverbial clauses

Module 3:

9) A Homemade Education: Malcom X
10) I have a Dream: Martin Luther King OR "The Meaning of July Fourth for the Negro" by Frederick Douglas
11) The Danger of a Single Story- Chimamanda Adichie

Skills: Essay – Structure, organisation, unity, coherence, cohesion; Developing the thesis; Narrative essay; Active/Passive voice

Module 4:

- Wife's Letter- Rabindranath Tagore
- Toba Tek Singh- Sadat Hassan Manto
- Imaginary Homelands- Salman Rushdie

Skills: Close reading and Comprehension; Compare/Contrast and Cause and Effect Essays; Conditionals

Module 5:

- *Where I live*- Arundhathi Subramaniam
- Dance Like a Man- Mahesh Dattani

Skills: Process Analysis Essay; Summarizing; Translation (from Indian language to English)

Lab Component: Phonetics & Communication Skills practice cycles (14 weeks):

I. Introduction to Phonetics: Phonetics- a branch of Linguistics, International Phonetic Alphabet (IPA), Phonetic Symbols, English as an international language.

Introduction: Introduction to effective communication, verbal/non-verbal aspects of communication, components of communication, introducing oneself and others

II. Sounds of English: Classification of English phonic sounds into Vowels and Consonants, Description and Characteristic features

Situational Dialogues: Role plays, greeting, making requests, seeking permissions, asking for and giving instructions/directions, turn taking, telephone etiquette.

III. Vowels: Classification, Description, Articulation, Acoustics, Prosody and Transcription·

Debates: Stating points of view, agreeing/disagreeing, asking for and giving information, negotiation and persuasion, making suggestions.

IV. Consonants: Classification, Description, Articulation, Acoustics, Prosody and Transcription

Presentation Skills: Individual/group presentations, poster presentations, PowerPoint presentations, describing and interpreting non-verbal data, project reports/proposals.

V. Stress Patterns: Syllable, Word Stress, Stress Patterns

Group Discussion: Team dynamics, techniques for group discussions, intervention, turn taking, summarizing, body language, tone, relevance, fluency and coherence.

VI. Intonation: Rising intonation, Falling intonation and Rise- Fall intonation

Panel Discussion: Initiating and coordinating discussion, asking for and expressing opinions, providing clarification, coordinating, conducting and participating in meetings.

VII. Rhythm: Stressed-time language, Connected speech, Pitch

Public Speaking: Structure, organizing thoughts/ideas, effective transitions, summarizing and concluding, body language, tone, JAM sessions.

Course code: **FL 101**
Course Name: **French Language and Culture I**
Credits: **0 (0-2-0)**
Course Position: **Semester 1**

Objectives:

To develop basic LSRW skills in French Language, from learning how to pronounce and write French alphabet to picking up phrases and words in written, spoken communication through listening and reading exercises.

Course Content:

i) **Topics**

- Alphabet
- Numbers
- Nationality
- Profession
- Country and Cities
- Self-introduction and introducing others

j) **Grammar**

c) Present tense only with 1st group regular and irregular verbs
d) Negations
e) Prepositions in front of countries and cities
f) Likes and dislikes with simple notions

k) **Types of writing**

g) Very short essay on introduce oneself

Course Code: **MA 102**
Course Name: **Mathematics - II**
Credits: **4 (3-1-0)**
Course Position: **Semester 2**

Course Content:

Module 1. Linear Algebra: Real and complex vector spaces, Linear dependence, Matrix of a vector system, change of coordinates, Linear transformation, addition and composition; kernel and image, rank; one to one and onto maps, matrix of a linear map, Inner product, Cauchy-Schwarz, Norm, triangle inequality. Euclidean spaces, Orthogonal and orthonormal family and basis, Gram-Schmidt orthonormalization and Fourier Series.

Module 2. Matrices: Matrix addition and multiplication, singular matrix, determinant, rank, inverse, adjoint, Linear system: abstract study, Gaussian Elimination, Transpose and conjugate matrix; similar matrix, Eigenvalues and eigenvectors of a linear map. Characteristic polynomial of a matrix, diagonalizability, Symmetric and orthogonal matrices, diagonalization of a symmetric matrix.

Module 3. Complex Analysis: Complex numbers, Polar form, De Moivre's formula, complex differentiation. Cauchy- Riemann equations. Analytic functions, Elementary functions, Contour and contour integral. Cauchy's theorem and integral formula. Taylor's theorem, zeros of analytic functions. Maximum modulus principle, Laurent series, Cauchy residue theorem, poles and residue.

Module 4. Integral Transform: Laplace Transform: Functions of exponential order and examples. Transforms of elementary, transcendental and special functions. Transforms of derivatives and integrals and periodic function, unit step function and impulse function. The inverse transform, Convolution theorem, solution of ordinary differential equations (IVP and BVP). Z-Transform, Fourier Transform.

Text and Reference Books

1. H. Anton, Elementary linear algebra with applications (8th Edition), John Wiley (1995).
2. S. Kumaresan, Linear algebra - A Geometric approach, Prentice Hall of India (2000).
3. E. Kreyszig, Advanced engineering mathematics, John Wiley (1999).
4. J. W. Brown and R. V. Churchill, Complex Variables and Applications, McGraw Hill, 2008.
5. D.G. Zill, P.D. Shanahan, A first course in complex analysis with applications.
6. J. W. Brown and R. V. Churchill, Complex Variables and Applications, McGraw Hill, 2008.
7. JL Schiff, The Laplace transform, Springer
8. G. Strang, Linear Algebra and its Applications, Fourth Edition, Books/Cole.

Course Number: PH 101
Course Name: Physics I
Credits: 4 (2-1-2)
Course Position: Semester 2

Course Content

Classical mechanics

Module 1 (Coordinate systems and Vector Calculus)

Vectors, Algebra of Vectors, Multiplying Vectors , Components of a Vector, Base Vectors, The Position Vector r and Displacement, Velocity and Acceleration, Formal Solution of Kinematical Equations, More about the Time Derivative of a Vector, Motion in Plane Polar Coordinates.

Module 2 (Newton's laws, Types of Forces and Application of Newton's laws)

Newton's Laws and Inertial Systems, Base Units and Physical Standards, Algebra of Dimensions, Applying Newton's Laws, Dynamics Using Polar Coordinates.

Fundamental Forces of Physics, Gravity, Some Phenomenological Forces, A Digression on Differential Equations, Viscosity, Hooke's Law and Simple Harmonic Motion.

Dynamics of a System of Particles, Center of Mass Coordinates, Conservation of Momentum, Impulse and a Restatement of the Momentum Relation, Momentum and the Flow of Mass, Rocket Motion.

Module 3 (Work-energy theorems, conservative forces and angular momentum)

Integrating Equations of Motion in One Dimension, Work and Energy, Conservation of Mechanical Energy, Potential Energy, What Potential Energy Tells Us about Force, Energy Diagrams, Non-conservative Forces, Conservation Laws and World Energy Usage.

Small Oscillations in a Bound System, Stability Normal Modes Collisions and Conservation Laws.

Angular Momentum of a Particle, Fixed Axis Rotation, Torque and Angular Momentum, Dynamics of Fixed Axis Rotation, Motion Involving Translation and Rotation, Work–Energy Theorem and Rotational Motion, Vector Nature of Angular Velocity and Angular Momentum, Gyroscope.

Module 4 (Central forces, gravitation, Kepler's law dynamics of rigid bodies (2D))

Central Force Motion as a One-body Problem, Universal Features of Central Force Motion, Energy Equation and Energy Diagrams, Planetary Motion, Some Concluding Comments on Planetary motion, Integrating the Orbit Integral and Properties of the Ellipse.

Module 5 (Harmonic oscillators and waves)

Simple Harmonic Motion: Review, Damped Harmonic Oscillator, Driven Harmonic Oscillator, Transient Behavior, Response in Time and Response in Frequency.

Types of waves, Energy and Power of a Wave travelling along String, Wave Equation, Standing waves and Resonance, Travelling Sound waves, Doppler Effect and Supersonic speed and Shock waves.

Textbooks:

1. An Introduction to Mechanics by Daniel Kleppner and Robert Kolenkow, Cambridge University Press
2. Berkely Physics Mechanics Vol. 1 by Charles Kittel, Walter D. Knight, Malvin A. Ruderman
3. Physics for Scientists and Engineers, Fishbane, Gasiorowicz, Thornton, Prentice Hall

LABORATORY WORK

Objectives:

The objective of the course is to let the students understand practically what basic laws and their effects are. They will practice mechanical, thermodynamical, optical and electromagnetical experiments and will be able to develop their intuitive understanding of natural effects. In parallel with the theoretical lectures they will face reality and will be in position to make links with its mathematical expressions.

Course Content:

Mechanics (Semester 1)

- Maxwell's wheel: free fall, inertia momentum
- Pendulum: Eigen frequency of an oscillator, momentum, gravity force
- Collisions of projectiles: 1D motion, elastic and inelastic collisions
- Vibrating string: standing waves, eigenmodes, influence of boundary conditions
- Acoustic Doppler effect: analogic mixing of electric signal to detect a change in the frequency
- Kundt's tube: to determine velocity of sound in air
- Lee's disk method: to measure thermal conductivity of various insulators
- Force and momentum: to validate Newton's laws of motion

Course Code: **CH 102**
Course Name: **Chemistry – II (Organic, Polymer, and Applied Chemistry)**
Credits: **3 (2-0-2)**
Course Position: **Semester 2**

Module – 1: Chemical Kinetics: Rate Law and order of reactions; extent of reaction, Determination of reaction rates; Effect of temperature; Theories of chemical kinetics; Introduction to Catalysis (air pollution, catalytic converter).

Module – 2: Organic chemistry: Structural isomers and stereoisomers, optical activity, absolute configurations and conformational analysis. Introduction to organic reactions involving substitution, addition, elimination, oxidation and reduction. Reaction mechanisms and reactive intermediates. Chromatographic techniques. Synthesis of some commonly used drug molecules.

Module – 3: Polymers: Synthetic and natural polymers. Methods of polymerization, Molecular weight and determination, Glass transition temperature. Structure-property correlations. Examples of some specific polymers.

Module – 4: Electrochemistry: Electrochemical Cell, Half-cell reactions and electrodes, Standard electrode potential, Electrochemical Series, Nernst equation. Electrochemistry of corrosion and preventive methods. Batteries: different types of batteries and applications.

Module – 5: Nanoscience: Basics of nanomaterials, Synthesis- Bottom-up and Top-down approach, Characterization- Electron microscopy techniques, Applications- electronics, medicinal.

List of laboratory experiments:

1. Determination of total hardness of water by complexometric titration.

2. Determination of surface tension of a liquid by drop count method and the effect of additives.

3. Study of kinetics of hydrolysis of ester.

4. Determination of equilibrium constant of KI + I2 = KI3 by solubility method.

5. Simultaneous determination of concentrations of strong and weak acid in a mixture using conductometric titrations.

6. Preparation of phosphate/citrate buffers and evaluating their pH resistance.

7. Estimation of amount of Cu2+ or Ni2+ present in a solution using UV-Visible spectrophotometer and Beer-Lambert's law.

8. Synthesis of silver nanoparticles by reduction of AgNO3 and the evaluation of the optical properties by UV-Vis spectrophotometry.

9. Synthesis of benzillic acid from benzil using solid phase synthesis (Green chemistry).

10. Synthesis and FT-IR spectroscopic characterization of dibenzalacetone.

11. Determination of critical micellar concentration (CMC) of a surfactant.

12. Synthesis of an organometallic complex and spectroscopic characterization.

13. Synthesis of a polymer such as Bakelite.

14. Paper chromatography and separation of natural pigments.

15. Synthesis of Aspirin.

Textbooks:

1. Atkin's Physical Chemistry; 10th edition; Peter Atkins and Julio De Paula; ISBN 978-0-19-954337-3

2. Organic Chemistry; Jonathan Clayden, Nick Greeves and Stuart Warren; ISBN: 978-0-19-927029-3

Course Code: **ES 105**
Course Name: **Electronics**
Credits: **4 (2-1-2)**
Course Position: **Semester 2**

Course Content:

Module 1: Signals and signal processing: Analog, Discrete and Digital signals and their characterization; Electronic circuits for implementing mathematical operations; Need for active devices; Transistors: characteristic, load line and biasing techniques; Small signal transistor amplifiers and its incremental equivalent circuit;

Module 2: Differential amplifier: its characteristics and operation; Mathematical operations performed using Operational Amplifier (OPAMP); CMRR, slew rate and gain-bandwidth product; OPAMP based amplifiers and applications: spectral analysis and active filters;

Module 3: Feedback: various topologies of feedback network; Nonlinear applications of OPAMP, sinusoidal oscillators and negative resistance circuits;

Module 4: Power amplifiers: Class A, AB, B, C, D: their operations and efficiency; Rectifier circuits, voltage regulators and power supplies;

Module 5: Introduction to digital circuits: ADC/DAC and their implementations; Digital Logic Gates, representing boolean functions: expression, truth table, circuit; boolean minimization using Karnaugh maps; Adders; Comparators; Multiplexers; Encoders / Decoders; Latches – SR Latch, D Latch; Flip Flops – D, JK, T Flip-flops; Synthesizing sequential state machines.

Textbooks:

1. A. Malvino, D. J. Bates; Electronics Principles; Seventh Edition, McGraw-Hill, 2007.
2. R. A. Gayakwad; Op-amps and Linear Integrated Circuits; Fourth Edition, Prentice Hall, 2000.
3. M. M. Mano; Digital Logic and Computer Design; First Edition, Pearson Education, 2004.

Course Code: **ES 106**
Course Name: **Introduction to Computer Science**
Credits: **4 (2-1-2)**
Course Position: **Semester 2**

Course Contents

Module 1: Representation of data: Number systems; Conversion from one base to the other; Binary number system; Representation of Binary numbers using Physical devices; Basic logic gates and binary logic; Short, Int, Long types; Integer arithmetic using logic gates; Float point representation; Float, Double, long Double data types; Characters - ascii codes; Boolean variables; IEEE standards and history.

Module 2: Von Neumann architecture of modern computing system; Low level languages vs High level Languages; Compilation and byte code; Introduction to C programming language; Variables, type declaration and operations. Control structures and manipulation of data: Conditional Constructs if, ifelse, while, for, do-while, switch, break, continue. Functions: Implementation of functions in C, recursion, Iteration vs recursion.

Module 3: Pointers and Arrays: The pointer datatype; Declaring pointer variables; Passing a reference using pointers; Null pointers. Arrays; Declaring and using arrays; Arrays as parameters; Strings in C; Relation between arrays and pointers; N-dimensional arrays; What is an algorithm?;
Algorithms: Sorting examples - Insertion sort, Bubble sort, mergesort. Searching examples - linear search, Binary search. Structures; Dynamic Memory Allocation; Malloc - Free functions; Dynamically Sized arrays; Implementation of Linked lists. File handling: Reading and writing files; Writing header files; Make and Installation Packages.

Module 4: Introduction to interpreted languages; Introduction to Python3; Dynamic typing; inbuilt data types - Strings, Lists, Tuples, Sets, Dictionaries, and methods. Subcriptables and Iterables; the while and for loops; Functions – Polymorphism in Python functions; Introduction to Python classes; Brief introduction to Object Oriented Programming.

Module 5: Standard modules in Python for scientific computing and plotting; Handling files; Implementation of various algorithms (search, sort etc) in Python; Speed comparison with C; Integration of C programs into Python scripts.

Textbooks:

1. Introduction to Computing Systems: From Bits & Gates to C & Beyond; Yale Patt & Sanjay Patel
2. C: How to Program; Paul Deitel, Harvey Deitel
3. Dive into Python; Mark Pilgrim
4. Beginning Python: Novice to Professional; Magnus Lie Heitland
5. Python Algorithms; Magnus Lie Heitland

Course Code: **ES 107**
Course Name: **Workshop Practice**
Credits: **0 (0-0-2)**
Course Position: **Semester 1**

List of Typical Experiments:

- Introduction to Workshop: Overview and Safety Practices (1 week)
- Hand Tools & Machining Demonstration (1 week)
- Benchwork and Fitting (2 weeks)
- Woodwork and Carpentry (2 weeks)
- Welding Demonstration (1 week)
- Introduction to Machine Tools (1 week)
- Lathe and Milling: Basic Operations (2 weeks)

Textbooks:

- Workshop Practice by B. L. Juneja, 2016, Cengage Learning.

Course code: **SE 102**
Course Name: **Introduction to Enterprise and Economy**
Credits: **3 (2-1-0)**
Course Position: **Semester 2**

Objectives:

The course provides students with a structured understanding of how companies operate and can be managed. After the class, students should be familiar with concepts such as governance, strategy, partnering, organizing, etc.

Course Content:

- Introduction: objectives, stakeholders, operations and product life cycles
- Marketing of products and services
- Corporate strategy
- Growth process and strategic plan
- Structure and processes, informal organization
- Performance driving and operations management
- Management of innovation and technology

Textbooks:

1. Course reader in English + copy of the slides presented in class
2. The structuring of organizations, H. Mintzberg
3. Principles of ecomomy, N. Gregory Mankiw
4. Economics, Organization and Management, Paul Milgrom and John Roberts

Course Code: **HS 102**

Course Name: **Professional Ethics**

Credits: **1 (0-1-0)**

Course Position: **Semester 2**

Course Content:

Module 1: Why be moral? Introduction to ethical theories. Is and Ought. What is and what ought to be? Fact-value distinction

Module 2: End and Means. Classical dilemma, Debates and theories. Gandhian Ethics. The concept of shreyas and preyas.

Module 3: Justice. Classical theories of justice. Crime and punishment. Malpractices.

Module 3: Rights, Duties and Responsibilities. Natural rights, Fundamental rights and Human dignity. Freedom and autonomy. Duties and responsibilities. Legal rights. Patents and intellectual rights

Module 4: Good Life. Happiness. Harmony. Care and Compassion

Module 5: Case studies of professionals, institutions and organizations

Textbooks / References:

1. Handouts of classical texts by various philosophers will be provided to students. (Socrates, Kant, Hume, Locke, Mills, Bentham, Rawls, Gandhi, etc.)
2. Practical Ethics by Peter Singer
3. Applied Ethics by Peter Singer
4. What We Owe Each Other by T. M Scanlon Fundamental Ethics – for Scientists and Engineers by Edmund Seebauer and Robert Barry

Course Code: **FL 102**
Course Name: **French Language and Culture II**
Credits: **0 (0-2-0)**
Course Position: **Semester 2**

Objectives:

To develop basic LSRW skills in French Language, from learning how to pronounce and write French alphabet to picking up phrases and words in written, spoken communication through listening and reading exercises.

Contents:

- **Topics**
  - Family
  - Hobbies and pastimes
  - Leisure activities
  - Describing habit and routines
  - Weather description

- **Grammar**
  - Possessive adjective
  - Near future
  - Past tense
  - Negation
  - Spatial location : - venir de / aller à + ville ou pays
  - Adverb of time: now, this week, tomorrow, last month etc…
  - Fixed preposition with some verbs(aller, venir, faire, jouer)

- **Types of writing**
  - Post card writing
  - Family tree
  - Likes and dislikes with advanced notions

Course Code: **MA 203**
Course Name: **Mathematics - III**
Credits: **4 (3-1-0)**
Course Position: **Semester 3**

Course Content:

Module 1: Probability and Random Variables Axiomatic definition of probability, Sample Space, Events, Conditional Probability, Independence of Events, Theorem of Total Probability, Baye's Theorem, Discrete and Continuous Random Variables, Probability Mass Function, Probability Density Function, Cumulative Distribution Function, Moments, Mathematical Expectation, Variance, Standard Deviation, Moment Generating Function.

Module 2: Discrete and Continuous Distributions Binomial Distribution, Poisson Distribution, Uniform Distribution, Exponential Distribution, Normal (Gaussian) Distribution, Markov's Inequality, Chebyshev's Inequality.

Module 3: Random Vectors: Joint Probability Distribution of Functions of Random Variables, Independence of Random Variables, Covariance, Variance, Expectation, Correlation, Multinomial

Distribution, Transformations of Random Variables, The Law of Large Numbers,The Central Limit Theorem.

Module 4: Random Processes: Continuous and Discrete Random Processes, Autocorrelation Function, Auto covariance Function, Correlation Coefficient, The Bernoulli Process, The Poisson Process, The Wiener Process, The Markov Chain, Stationarity: Strict-Sense Stationary (SSS) and Wide-Sense Stationary (WSS) Processes.

Module 5: Statistics: Descriptive Statistics: Sample Mean, Sample Variance, Sample Standard Deviation and Sample Correlation Coefficient; Confidence Intervals, Parameter Estimation: Unbiasedness, Consistency, Point Estimator, Maximum Likelihood Estimators.

Textbooks:

1. Sheldon M. Ross, Introduction to Probability and Statistics for Engineers and Scientists, Elsevier, Fifth Edition 2016.
2. Sheldon M. Ross, Introduction to Probability Models: 11th Edition, Academic
3. Press Elsevier, 2015.□ Jean Jacod and Philip Protter, Probability Essentials, Springer, 2004.
4. Hogg, Tanis and Rao, Probability and Statistical Inference: 7th Edition, Pearson, 2006.
5. Alberto Leon-Garcia, Probability, Statistics, and Random Processes for Electrical Engineering, Pearson, 2008.

Course No: **PH 202**
Course Name: **Physics II**
Credits: **5 (3-1-2)**
Course Position: **Semester 3**

Objectives

The objective of this course is to introduce and present the basics of Fields and Waves in the context of Electromagnetism and Optics

Course Contents

Electrostatics

Physical definitions of Gradient, divergence and curl operators, curvilinear coordinates, Dirac Delta function, Theory of vector fields, Coulomb's law and principle of superposition, Gauss's law and its applications, Electric potential and electrostatic energy, Poisson's and Laplace's equations with simple examples, uniqueness theorem, boundary value problems, Properties of conductors, Multipole expansion, Electric fields in matter, Dielectrics and polarization

Magnetostatics

Biot & Savart's law, Amperes law, Divergence and curl of magnetic field, Vector potential, Vector potential, Magnetic field in matter, Bound currents, Field H, Classification of magnetic materials, Faraday's law in integral and differential forms, Motional EMF, Displacement current

Electromagnetism

Maxwell's equations, Electromagnetic waves, wave equation, e.m. waves in vacuum and media, refractive index, Energy and momentum of e.m.w., Poynting vector, Polarization of e.m. waves, Reflection and refraction, skin depth, standing electromagnetic waves, Electric dipole radiation, Waveguides with rectangular metallic boundaries, TE, TM and TEM mode.

Optics

Some discussions on geometrical optics, Wave optics: Interference between two coherent waves, Fresnel and Fraunhoffer diffraction, Diffraction grating, polarization, Fiber Optics

Labs

1. Geometrical optics with lenses
2. Newton's rings
3. Single-and double-slit diffraction
4. Spectrometry of a glass prism
5. Polarization study with half and quarter wave plates
6. Helmholtz coils
7. Faraday's law
8. B-H loop
9. Hall effect

Course No: **ES 208**
Course Name: **Mechanics**
Credits: **3 (2-1-0)**
Course Position: **Semester 3**

Course Content:

Module 1. Moment of inertia: basic concepts and definitions – Moments of inertia of areas – Parallel-axis theorem and moments of inertia of composite areas.

Module 2. Analysis of cables – Cables with concentrated loads - Cables with distributed loads - Parabolic cables.

Module 3. Method of virtual work: Introduction - Work of a force - Work of a couple - Principle of virtual work - Applications of the principle of virtual work - Work, potential energy and stability of equilibrium.

Module 4. Kinematics and kinetics of particles: Rectilinear motion of particles – Relative motion – Curvilinear motion of particles – Newton's laws of motion – Newton's second law of motion and linear momentum – Angular momentum – Orbital motion – Work and energy – Conservation of energy – Impulse and momentum – Impacts – Systems of particles – Analysis of systems of particles using Newton's second law – Energy and momentum methods for systems of particles.

Module 5. Kinematics and kinetics of rigid bodies: Translation and fixed-axis rotation – General plane motion – Instantaneous centre of rotation –Equations of motion for a rigid body – Angular momentum of a rigid body in plane motion – Systems of rigid bodies – Constrained plane motion –Energy methods for rigid bodies – Momentum methods for rigid bodies.

Textbooks:

1. F. Beer, E. Johnston, D. Mazurek, P. Cornwell, B. Self, S. Sanghi, Vector Mechanics for Engineers: Statics and Dynamics, McGraw Hill India, 2017.

References:

1. R.C. Hibbeler, Engineering Mechanics: Statics and Dynamics, 11th edition, Pearson, 2009.

2. A.P. Boresi, R.J. Schmidt, Engineering Mechanics: Statics and Dynamics, 1st edition, Cengage Learning, 2008.

Course Code: **ES 209**
Course Name: **Signals and Systems**
Credits: **4 (2-1-2)**
Course Position: **Semester 3**

Course Content:

Module 1: Characterization and classes of signals; Representation of signals: orthonormal expansion; Analytic signal; Hilbert Transform; Transforms on signals: Fourier Transform; Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT);

Module 2: Analytic signals, Hilbert Transform, Real part sufficiency; Laplace transform; Random signals: Characterization and representation of discrete and continuous random processes, Orthogonal expansion and Kahrunen Loeve series; Discrete signals: Sampling, sampling function and error in sampling; Z-transform, Properties of z-transform, inverse z transform;

Module 3: Discrete LTI systems: Linear Difference Equations and z-transform; State variable representation of discrete systems; Continuous LTI systems - impulse response, Transfer Function, pole zero concepts; state variable representation of continuous systems; Eigen value and Eigen functions of LTI systems, their significance;

Module 4: Stability, controllability, Observability and their significance, state estimation and state control; Feedback: stability, RH criterion, root locus, Nyquist criterion; Output feedback Control: P.PI.PD.PID;

Module 5: Transmission of random processes through LTI systems; Generation of WSS signals, spectral factorization; Estimation of random signals in noise; Linear Time Varying Systems: Time varying impulse response; Digital Filters: FIR and IIR filters, and their synthesis.

Textbooks:

1. Oppenheim, Wilsky, Nawab; Signals and Systems; Second Edition, PHI.
2. J. G. Proakis and Manolakis; Digital Signal Processing; Fourth Edition, PHI.
3. K. Ogata; Modern Control Systems; Fifth Edition, PHI.

Course Code: ES 210
Course Name: Data Structures
Credits: 5 (2-2-2)
Course Position: Semester 3

Course Contents

Module 1: Introduction to Data Structures: Single and Multi-dimensional Arrays, Sparse Matrices (Array and Linked Representation) . Introduction to Algorithms: Algorithm Development, Complexity analysis, Recursion. Growth of Functions & Asymptotic Notations. Rates of Growth: O(n), Ω(n), Θ(n), o(n), ω(n), Run-Time Complexity, Space Complexity, NP-Completeness (Time Permitting). Complexity Class - P, NP, NP Complete, NP Hard, Is P=NP? and Reductions.

Module 2: Linear Data Structures- Stacks: Operations and Applications, Implementing single / multiple stack/s in an Array; Prefix, Infix and Postfix expressions, Applications of stack; Limitations of Array representation of stack. Links Lists: Operation – Creations, insertion, Deletion, Circular Lists, Doubly Linked List. (Approaches, Implementation Issues, Complexity & Efficiency), Amortized Analysis.

Module 3: Array and Linked representation of Queue, De-queue, Priority Queues, Circular Queues: Operations and Applications
Sorting Algorithms & Searching: Bubble sort, Quick Sort, Insertion Sort, Merge Sort, Selection sort, Heap Sort, Radix sort and Bucket sort. Lower bound for comparison based sorting algorithms. Linear Search, Binary Search.

Module 4: Introduction to Hashing, Deleting from Hash Table, Efficiency of Rehash Methods, Hash Table Reordering, Resolving collusion by Open Addressing, Coalesced Hashing, Separate Chaining, Dynamic and Extendible Hashing, Choosing a Hash Function, Perfect Hashing Function
Introduction to Tree as a data structure; Binary Trees (Insertion, Deletion , Recursive and Iterative Traversals on Binary Search Trees); Threaded Binary Trees (Insertion, Deletion, Traversals); Height-Balanced Trees (Various operations on AVL Trees).

Module 5: Graphs I: Representation and Traversal (Preorder, Inorder, Postorder) - • Representation: Matrix, Adjacency list; Traversal: Depth First Search, Breadth First Search; Graphs II: Basic Algorithms - Minimum Spanning Tree, Shortest Path, All pairs Shortest Path, Transitive Closure

Textbooks:

1. Aaron M. Tenenbaum, Moshe J. Augenstein, YedidyahLangsam, "Data Structures Using C and C++:, Second edition, PHI, 2009.
2. Micheal T. Goodrich and Roberto Tamassia: Algorithm Design: Foundations, Analysis and Internet examples (John Wiley &Sons, Inc., 2002)
3. Cormen T.H., Leiserson, C.E., Rivest, R.L., and C. Stein. Introduction to Algorithms, MIT Press, Second Edition (Indian reprint: Prentice-Hall).
4. Sanjoy Das Gupta, Christos Papadimitriou, Umesh Vazirani, Algorithms; Tata McGraw-Hill Publishers
5. Alfred V. Aho, John E. Hopcroft, Jeffery D.Ulman. Data Structures and Algorithms
6. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran. Computer Algorithms
7. Robert L. Kruse, "Data Structures and Program Design in C++", Pearson, 1999.

Course Code: **CE 201**
Course Name: **Building Materials**
Credits: **2 (2-0-0)**
Course Position: **Semester 3**

Course Content:

Module 1: Sources of Aggregates & Properties: Physical and Mechanical properties of construction materials, commonly used types of stones, Tests for stones, road aggregates and concrete aggregates, properties of sand, BIS specification for testing of aggregates, Bricks, Properties and testing methods for Bricks.

Module 2: Modern Construction Materials: Structural Steel and Aluminium, Roofing Material, Physical descriptions of asbestos sheets, GI sheets, tubes and light weight roofing materials, Timber,Types, Seasoning and various products, Modern materials, Neoprene, thermocole, decorative panels and laminates, architectural glass and ceramics, ferrocement, PVC, polymer base materials, fibre reinforced plastics.

Module 3: Flooring & Roofing Materials: Principles of construction, Bonding, Reinforced brick work, Stone masonry, Hollow block masonry, Pointing, Plastering, DPC Floor and Roof Construction: Floors, General Principles, Types of floors, Floor coverings ,Types of roofs.

Module 4: Prefabricated buildings: Sound insulations – Ventilations–Fire resisting construction– Prefabricated panels and structures–production, transportation and erection of structures.

Module 5: Building Drawing: Planning of Residential Building: Develop concept plan of buildings, Prepare detail drawings for single and two storied residential building and public building. Draw details of parts of building Using AutoCAD

Textbooks:

- S.C.Rangwala, K.S. Rangwala, P.S. Rangwala. Engineering Materials (Materials Science), Charotar Publishing House (2011)
- Fundamental building materials by Ken Ward-Harvey.
- Building Construction by Arora.S.P & Bindra.S.P

Course Code: **FL 203**
Course Name: **French Language and Culture III**
Credits: **0 (0-2-0)**
Course Position: **Semester 3**

Objectives:

The aim of this course is to understand very short, simple information in the spoken and written language and to express oneself simply and briefly in speech and in writing for practical purposes in everyday situations requiring a direct exchange of information. It is expected that productive skills will be limited and fragmented and that language will be mostly or completely formulaic at this level; receptive skills will be more developed than productive skills.

Course Content:

General themes

- People: Family, Physical description
- Places: Cafe, Restaurant, Shops, Bank, Post office, Hotel, Road
- Hobbies: Sports, Going out, Shows, Holiday trips
- Daily Life: Work, Shopping,
- Daily activities

Grammar topics

- Pronominal verbs: verbes reflechis and pronominal verbs
  Past Simple - events in the past
- Past participles
  Imperfect tense - descriptions in the past (it was, there was)
  Imperative - Affirmative and Negative - for instructions and commands
- Near Future Tense
  Future simple tense
- Conditional tense

Course Code: **ES 211**

Course Name: **Numerical Methods**

Credits: **4 (3-1-2)**

Course Position: **Semester 4**

Course Content:

Module 1: Algebraic and Transcendental equations: Computation of floating point numbers and round-off errors and machine representation of numbers. Solutions of non-linear and transcendental equations: order and convergence analysis.

Module 2: Interpolation, numerical differentiation and Integration: interpolation; Numerical differentiation, Richardson's extrapolation; Numerical integration: Newton-Cotes formulae, Romberg integration, quadrature formulae.

Module 3: System of Algebraic Equations: Norms of vectors and matrices, Linear systems: direct and iterative schemes, ill conditioning, convergence analysis and finding dominant eigenvalues; Numerical schemes for nonlinear systems (Newton's method); Regression.

Module 4: Ordinary differential equations: Difference equations; Numerical solution of differential equations: Single step and multi-step methods, order consistency, stability and convergence analysis, stiff equations; Solving two-point boundary value problems by shooting methods and finite difference methods.

Textbooks:

1. David Kincaid and Ward Cheney, Numerical Analysis and mathematics of scientific computing, Books/Cole, 1999.
2. Samuel D. Conte and Boor, Elementary Numerical Analysis: Algorithmic Approach, Tata McGraw-Hill, 1980.□ K. Atkinson, Elementary Numerical Analysis, John Wiley, 1978.
3. Richard L Burden and J Douglas Faires, Numerical Analysis, Thomson Books Cole, Seventh edition 2009.

Course Code: **CE 202**
Course Name: **Mechanics of Materials**

Credits: **4 (3-1-0)**

Course Position: **Semester 4**

Course Content:

Module 1:
Stress-Strain behaviour for uniaxial loading, Generalized Hooke's law, Elastic constants for isotropic materials, Notion of equilibrium, Free body diagrams, Deformation of axial members, Statically determinate and indeterminate problems, Truss structures – Stiffness methods.

Module 2:
Definition of stress, Different states of stress – uniaxial, biaxial, plane stress, Transformation of plane stress, Principal stresses and maximum shear stress, Mohr's circle.
Definition of strain – shear and normal strains, Transformation of plane strain, Principal strains.

Module 3:
Bending of beams: Relation between transverse loads, shear and bending moments, Shear and bending moment diagrams, Shear stresses in beams, Deflections in beams.

Module 4:
Torsion: Torsional moment diagrams, Torsion formula for circular cross-sections, Maximum normal and shear stresses, Angle of twist, Power transmission through shafts.

Module 5:
Elastic stability: Notion of stability of equilibrium, Euler buckling.

Textbooks:
1. An Introduction to the Mechanics of Solids, Crandall S.H, Dahl N.C, McGraw-Hill.
2. Strength of Materials Vol. I by S P Timonshenko.
3. Engineering Mechanics of Solids by Egor P Popov

Course Code: **CE 203**
Course Name: **Engineering Surveying**

Credits: **3 (2-0-2)**

Course Position: **Semester 4**

Course Content:

Module 1: Introduction- Various types of surveying- based on methods and instruments, classifications, uses and necessity of geodetic surveying, photographic, astronomy and hydrographic surveying. Diagonal scale, various types of venires, micrometers on surveying instruments, principles of surveying.

Module 2: Leveling and contouring-Definitions, technical terms. Different methods of leveling, reduction of level problems.

Module 3: Plane table surveying-Definitions, uses and advantages, temporary adjustments.

Module 4: Traverse Surveying-Types of Compass, Bearing of lines, fore bearing and back bearing.

Module 5: Curves-Definitions of different terms, necessity of curves and types of curves. Modern surveying instruments-Electronics in surveying, Global Positioning System (G.P.S)-G.P.S. and remote sensing. Geographical Information System-Information systems, spatial and non- spatial information, geographical concept and terminology, advantages of GIS, Basic component of GIS.

Practical Work:

1. Chain and Compass surveying
2. Use of optical theodolite / Electronic theodolite for measurement of horizontal and
3. vertical angles.
4. Simple and compound leveling by using Dumpy / Auto Level, booking methods.
5. Methods of plane tabling:- Radiation . Intersection and Traversing.
6. Setting out a simple foundation plan in the field Practical Work.
7. Study of satellite images and its interpretation
8. Determination of horizontal, sloping and vertical distance between any two points by
9. using Total Station
10. Geo-registration of map and its digitization

Textbooks:

1. Surveying (Vol. I and II). S. K. Duggal, 4th Edition ,Tata McGraw Hill

Reference:

1. Surveying and Leveling, Vol I & II, Kanetkar and Kulkarni, 24th edition, Pune Vidyarthi Griha, Pune.
2. Surveying, R Agor, Khanna Publishers
3. Surveying and Leveling, Vol I & II, III, B.C.Punmiya , Laxmi Publication
4. Concepts and Techniques of GIS, Lo C.P.Yeung A K W, Prentice Hall, India
5. Remote sensing and GIS, K. Anjali Rao , BS Publications
6. Surveying and Leveling. N.N.Basak,1st Edition ,Tata McGraw Hill37
7. Introduction to GIS, Kang-tsung Chang, Tata McGraw Hill

Course Code: **CE 204**
Course Name: **Fluid Mechanics**
Credits: **4 (3-0-2)**
Course Position: **Semester 4**

Course Content:

Module 1: Fluid properties and fluid statics: Definition of a fluid; Differences between fluids and solids; Fluid properties: mass density, specific weight, specific volume, specific gravity, viscosity, compressibility and bulk modulus (including ideal gas law), surface tension, capillarity, vapor pressure; Pascal's law; Hydrostatic pressure and pressure variation in fluids at rest; Absolute pressure and gauge pressure (measurement of pressure); Manometers; Hydrostatic forces on plane and curved surfaces; Buoyancy, flotation and stability; Metacenter and metacentric height

Module 2: Fundamentals of fluid flow and fluid kinematics: Lagrangian and Eulerian descriptions; Streamlines, streaklines and pathlines; Types of flow: compressible, incompressible, viscid, inviscid, rotational, irrotational, laminar, turbulent, internal and external; Equation of continuity; Material derivative; Velocity field and acceleration field (including temporal and convective components of acceleration); Stream function and velocity potential; equations of streamlines.

Module 3: Introduction to fluid dynamics: Forces acting on a fluid in motion; Euler's equations of motion; Bernoulli's equation and its derivation; Applications of Bernoulli's equation (Venturi meter, Pitot tube, free liquid jet, etc.); Impulse-momentum equation and its applications: force exerted by a flowing fluid on a pipe bend, force exerted by a jet on a plate, etc.; Navier-Stokes equations (significance and derivation); flow through pipes (including losses, branching pipe problems and simple pipe networks).

Module 4: Orifices, mouthpieces, notches and weirs: Types and uses of orifices and mouthpieces; Hydraulic coefficients of an orifice; Flow through a large rectangular orifice; Types of mouthpieces; Flow through mouthpieces; Time required to empty a tank through an orifice or a mouthpiece with no inflow; Types of notches and weirs; Applications of notches and weirs; Flow over a rectangular sharp-crested weir or notch; Flow over a triangular weir or notch; Flow over a trapezoidal weir or notch.

Module 5: 5: Dimensional analysis and flow around immersed bodies: Introduction to dimensional analysis; Dimensions of physical quantities; Dimensional homogeneity; Rayleigh's indicial method; The Buckingham pi theorem; Types of similarity / similitude (geometric, kinematic and dynamic); Model investigations in fluid mechanics; Common dimensionless groups in fluid mechanics: Reynolds number, Froude number, Mach number, etc.; Introduction to the concepts of boundary layer, drag and lift.

Textbooks:

1. Munson, B.R., Young, D.F., Okiishi, T.H. and Huebsch, W.W., Fundamentals of Fluid Mechanics, 6th edition, Wiley, 2010.
2. Douglas, J.F., Gasiorek, J.M., Swaffield, J.A. and Jack, L.B., Fluid Mechanics, 5^{th} edition, Pearson Education, 2005.
3. Modi, P.N. and Seth, S.M., Hydraulics and Fluid Mechanics including Hydraulic machines, 21st edition, Standard Book House, 2017

Reference:

1. Fox, R.W., McDonald, A.T. and Pritchard, P.J., Fluid Mechanics, 8th edition, Wiley, 2015.
2. Som, S.K., Biswas, G. and Chakraborty, S., Introduction to Fluid Mechanics and Fluid Machines, 3rd edition, McGraw Hill Education, 2012.
3. Cengel, Y.A. and Cimbala, J.M., Fluid Mechanics, 3rd edition, McGraw Hill Education, 2014

Course Code: **CE 205**
Course Name: **Concrete Technology**
Credits: **3 (2-0-2)**
Course Position: **Semester 4**

Course Content:

Module 1: Cement & Hydration
Production, composition, and properties, cement chemistry, bogue's compounds, hydration process, types of cements, special cements.

Module 2: Aggregates & Admixtures
Aggregates: Mineralogy, properties, tests and standards, Alkali silica reaction
Admixtures: Water reducers, air entrainers, set controllers, specialty admixtures - structure properties, and effects on concrete properties, Introduction to supplementary cementing materials and pozzolans, their production, properties, and effects on concrete properties.

Module 3: Mix design & concrete manufacturing
Basic principles; IS method; ACI method; new approaches based on rheology and particle packing, Batching of ingredients, mixing, transport, and placement, Consolidation, finishing, and curing of concrete.

Module 4: Concrete properties
Fresh concrete: workability tests on concrete, setting times of fresh concrete, segregation and bleeding.
Hardened concrete: Compressive strength and parameters affecting it, Tensile strength - direct and indirect, Modulus of elasticity and Poisson's ratio, Stress strain response of concrete, Chemical attack of concrete; corrosion of steel rebars; other durability issues.

Module 5: Special concretes
High strength - high performance concrete, reactive powder concrete, Lightweight, heavyweight, and mass concrete; fibre reinforced concrete; self-compacting concrete; shotcrete; other special concretes

Textbooks:

1. Concrete technology by A.M. Neville & J J Brooks, Low price edition 2004, Pearson Education
2. Concrete Technology by M.S. Shetty,S. Chand& Co

References:

1. Concrete Technology by M.L. Gambhir, McGraw Hill Education (India) Pvt. Ltd,5th edition 2.
2. Concrete –Microstructure, properties and materials by P. Kumar Mehta & Paulo J.M.
3. Monteiro- 3 rd edition published by Tata Mc Graw Hill Education Pvt. Ltd. 3.
4. Properties of concrete by A.M. Neville, Pearson publishers.

Course Name: Construction Technology and Drawing
Course Code: CE 206
Course Credits: 3 (2-0-2)
Course Position: Semester 4

Course Content

Module 1: Construction Equipment-Standard types of equipment, special equipment, factors affecting selection of construction equipment, Earthmoving Equipment, Drilling and blasting equipment, Pile driving equipment, Stone crushing equipment, Concrete manufacture, transport, placing and compacting equipment, Equipment cost, Operating cost, Buy rent and lease options.

Module 2: Tunneling- Geo-technical investigations, selection of alignment, methods of tunneling, drilling and blasting method, mechanical moles, boomers, tunnel boring machines, mucking, ventilation of tunnels, dust control, types of tunnel supports, Lining operation.

Module 3: Bridge Construction- Geo-technical investigation, Site selection, Launching of bridges by incremental launching, using false work, balanced cantilever construction method.

Module 4: Steel & Concrete Construction- Erection tools and method of welding, tools and methods of cutting and joining, safety measures during fabrication and erection, Concreting under water, concreting in different weather conditions, mass concreting, vacuum concreting, Self-Compacted Concrete, Roller Compacted Concrete.

Module 5: Ground Improvement Techniques- Need for ground improvement, Dewatering, Ground modification, Sand drains, stone column, grouting, Reinforced earth technology Emerging and innovative topics.

Text Books:

- R.L. Purifoy & Ledbetter - Construction Equipment and its Planning , McGraw hill

Reference Books:

Thomas baron, Erection of Steel Structures
Stubbs, Handbook of Heavy Construction
Dr. P. Purushothama Raj, Ground Improvement Techniques, Laxmi Publications
Jagdish Lal, Construction Equipment
Varma Mahesh, Construction Equipment and its Planning & Applications

Course code: **SE 203**
Course Name: **Design Thinking**
Credits: **2 (1-0-2)**
Course Position: **Semester 4**

1st week:

Exercise 1**:** Drawing practice using subconscious mind with the help of music…. Al Di Meola (Race with Devil on Spanish Highway), Beethoven Symphony No.9, Hans Zimmer - Kings of the Past, Pink Floyd - Terminal Frost etc. Another exercise was to create a story from subconscious mind.

Exercise 2: 2D drawing from conscious mind and create a story.

Exercise 3: 2D Story making following story board & comic strips type.

2nd week:

Introduction 3D, where 'D' stands for dimension, which means an object has three dimensions. X-axis, Y-axis and extra dimension are the Z-axis which gives height/width/depth to an object.

Exercise 1**:** Composition exercise 3D, Create a new 3d compound structure using any one symmetrical and asymmetrical pattern with the help of colour paper

3rd week:

3d exploratory prototyping/ connection of variety objects….Bangles, Rubber band, Scooby sticks, Marbles, Paper cups. This is a brain storming activity. Where they will learn how to build a product with the help of very limited object and also they need to calculate the mathematical way to function this game.

4th week: 2D form exploration Tangram

5th & 6th weeks:

Screening short films.

Exercise 1: First write down the basic theme.

Exercise 2: To identify and write down the visual and audio components of this design/narrative and also to state alongside as to what could be its motivation.

7th week:

Context-Concept- We are providing some objects (Syringe, Nail Cutter, and Stapler). Brain storms the following using object which is given them. Note the idea, possibilities and connection as possible.

- In what contexts do you see a use for this product?
- How did this product evolve? What are the alternatives before the product for the same need? What the problem did this product solve?

- Think of 5 important “WHAT IF CONTEXTS” for this product?
- Describe a PERSONA of the product.
- Sketch your 10 new concepts based on this product.
- What can be made it simpler, pleasurable and more meaningful?

(8th week)

Typography & Photo montage (collage) – History of typography/ Calligraphy and Photomontage. Typography plays a *critical* role in strengthening the brand, creating interest to the product, and highlighting a central message. The core purpose of a design is communication. Whether we're talking about an online ecommerce store or a corporate brochure, typography is a vital component. Typography is the art and technique of selecting and arranging type styles/fonts for texts.

Exercise 1: To write their name in two different styles (Serif and Calligraphy).

Exercise 2: Making a collage art using magazine and newspaper.

9th week

Book Cover Design: History and evolution of book. History of book covers designing.

Exercise 1: Create a book cover by using typography or any kind of creative image which can describe the book visually.

10th week

Ideating objects & Mechanical transformation-

Problem review

- Identify the object.
- User profile of the product.
- Function of the product.
- How many parts is the product made of?
- How is each part manufactured?
- What manufacturing processes are applied?
- What are the alternatives uses the product?
- What are the irritants present in this product?
- If the product had to be redesigned, what would be your approach? Sketch the design.

11th t to 15th weeks

‘Final Project and Prototype.

Course Code: **FL 204**

Course Name: **French Language and Culture IV**

Credits: **0 (0-2-0)**

Course Position: **Semester 4**

Objectives:

The aim of this course is to understand very short, simple information in the spoken and written language and to express oneself simply and briefly in speech and in writing for practical purposes in everyday situations requiring a direct exchange of information. It is expected that productive skills will be limited and fragmented and that language will be mostly or completely formulaic at this level; receptive skills will be more developed than productive skills.

Course Content:

General themes

- Accommodation: Units in the house, interior decor
- Everyday objects
- Countries & Cities
- Actions in daily life
- Events: Meetings, Evening out, Family events, Visits, Excursions, Accidents, TV news
- Money and payments

Grammar topics

- Transitive and Intransitive verbs - Direct and Indirect object
- Relative pronoun 'there' - place
- Relative pronouns - who, that/which
- Prepositions of place: go to, be at,come from + a place
- Connectors: but, because

Course code: **MA 304**
Course Name: **Mathematics - IV**
Credits: **4 (3-1-0)**
Course Position: **Semester 5**

Course Content

Module 1. Series solutions of ordinary differential equations and Special functions.

Module 2. Partial Differential Equations: Formation and solutions of partial differential equations. Method of separation of variables, Solution of wave equation, Heat equation, Laplace's equation. Fourier transform method for solving PDEs.

Module 3. Finite Difference methods for second order linear PDEs.

Module 4. Variational principles and introduction to Finite Element method Galerkin method.

Text and Reference Books:

1. LC Evans, Partial differential equations.
2. W. E. Boyce and R. DiPrima, Elementary Differential Equations (8th Edition), John Wiley (2005).
3. Ronald N. Bracewell, The Fourier Transform and its Applications, Mc-Graw Hill, 1965
4. T. Amaranath, An Elementary Course in Partial Differential Equations, Jones & Bartlett Publishers.
5. L. Elsgolts, Differential equations and Calculus of variations.
6. G. D. Smith, Numerical solution of partial differential equations: Finite Difference methods, Oxford University press.
7. Cook, Robert D; Malkus, David S; Plesha, Michael E; Witt, Robert J. Concepts and Applications of Finite Element Analysis, Wiley, 2001.
8. K. Shankara Rao, Introduction to Partial Differential Equations, PHI Learning Private Limited.
9. J. N. Reddy, An Introduction to Finite Element Method.
10. J. N. Reddy, Applied Functional Analysis and Variational Methods in Engineering
11. E. Kreyszig, Introductory functional analysis with applications, Wiley, New-York.

Course code: **ES 312**
Course Name: **Introduction to Materials Sciences**
Credits: **3 (2-0-2)**
Course Position: **Semester 5**

Course Content

Module 1: Classification of Materials: Crystal and atomic structure/property correlation. Criteria for selection of materials for engineering applications. Structure-Property-Performance correlations. Lennard- Jones potential and understanding intrinsic behavior of materials.

Module 2: Short-range/long-range order, Amorphous Materials, Glasses. Basic Crystallography, Bravais lattices, packing fraction, crystal structures of metallic elements. Crystal directions and planes, Miller indices, inter-planar spacings. Crystal structure determination, Polymorphism or Allotropy.

Module 3: Imperfections in crystals and their importance. Types of imperfections: point, line, surface, volume. Deformation by slip, Mechanism of slip, Slip systems. Dislocations and Stacking faults. Applications of diffusion, Mechanisms of Diffusion, Fick's first law, Factors affecting Diffusion, Fick's second Law. Diffusion and Materials Processing-Case studies: Applications

Module 4: Alloy formation and Hume-Rothery rules. Gibb's free energy for thermodynamic stability of phases and Gibb's phase rule. Cooling curves and Equilibrium diagrams: Unary/Binary Phase diagram, Lever rule; Invariant reactions: Eutectic, Eutectoid, Peritectic and, Peritectoid; Non-equilibrium cooling, Avrami kinetics, Phase transformation, Time-Temperature-Transformation and Continuous Cooling Transformation Diagrams. Analysis of specific alloy systems.

Module 5: Steel: Fundamentals and applications. Mechanical Behaviour of Ferrous/Non-ferrous alloys: Fatigue, Creep and Failure.

Module 6: Functional/ Adaptive materials: Smart Metals/Engineered alloys, sensors and actuators, Ceramic Materials, properties, processing and applications. Dielectrics, Ferroelectrics, Piezoelectrics, Multiferroics, Semiconductors and advanced functional materials.

Module 7: Composite materials: Types of composites, Properties and applications.

Textbooks:

1. *Callister's Materials Science and Engineering*, (2ed) R. Balasubramaniam, Wiley, ISBN: 9788126541607
2. *Materials Engineering: Bonding, Structure, and Structure-Property Relationships* (1st Ed) by Susan Trolier-McKinstry, Robert E. Newnham; Cambridge University Press, ISBN-13: 978-1107103788ISBN-10: 1107103789.
3. *Introduction To Solids* by Leonid Azaroff (2017) McGraw Hill Education, ISBN-10: 0070992193ISBN-13: 978-0070992191

Course Code: **CE 307**
Course Name: **Computing Lab**

Credits: **3 (1-0-4)**

Course Position: **Semester 5**

Course Content:

Module 1: : Introduction to CAD and BIM: Introduction to basic principles of Computer-Aided Design (CAD).
Introduction to Building Information Modelling (BIM), both as a virtual prototype and a working method, as well as the theoretical differences between the working methods of CAD and BIM designs.

Module 2: Linear Programming (MATLAB): DBMS concepts, Civil Engineering Databases, Manipulation, Spreadsheet concepts, Worksheet calculations in Civil Engineering, Regression, Matrix Inversion, etc.,

Module 3: CAD Basic Modeling and Analysis: STAAD Pro / ETABS / SAP2000: Modeling and analysis of 2D and 3D buildings using IS Codes. Two and three dimensional beams with various loads and comparison with classical solution, two and three dimensional frames. Analysis for various load combinations.

Module 4: CAD Modeling and Analysis of Special Structures
STAAD Pro / ETABS / SAP2000: Modeling and analysis of special structures like Stadium, Cable-stayed bridges.

Module 5: CAD Analysis using ANSYS
ANSYS: Modeling and analysis of 2D and 3D beams for different loads including temperature.

Textbooks:

1. Chapra, S.C., and Canale R.P., Numerical Methods for Engineers, McGraw - Hill, 2004
2. Rudra Pratap, Getting Started with MATLAB: A Quick Introduction for Scientists & Engineers, Oxford, 2010

References:

1. Krishnamoorthy, C.S. and Rajeev, S., Computer Aided Design and Analytical Tools, Narosa, 1993
2. Li Quan Bian Zhu, ANSYS in Civil Engineering, People Post, 1991

Course Code: **CE 308**
Course Name: **Structural Analysis**
Credits: **4 (3-1-0)**
Course Position: **Semester 5**
Course Content:

Module 1: Deflections – Geometric methods: Concept of determinate and indeterminate structures – Moment-curvature relation – Slope and deflection of beams by successive integration – Macaulay's method – Principle of superposition – Moment area method – Conjugate beam method – Deflection and slope of beams with non-uniform flexural rigidity.

Module 2: Introduction to energy methods: Strain energy and complementary energy - Castigliano's theorems and its application to statically determinate beams, rigid-jointed frames and trusses – Principle of virtual work and its application to statically determinate beams, rigid jointed frames and trusses – Maxwell's reciprocal theorem – Principle of minimum potential energy.

Module 3: Moving loads and influence lines: Influence lines for reactions, shear forces and bending moments in simply supported, cantilever, overhanging beams – Maximum effect of moving load for simply supported beams – Absolute maximum shear force and bending moment.

Module 4: Indeterminate structures – force and displacement methods: Determination of static and kinematic indeterminacy in beams, rigid jointed frames and trusses – Introduction to force method of analysis – Method of consistent displacements and its application to indeterminate beams, rigid-jointed frames and trusses – Effect of temperature and lack of fit in trusses – Introduction to displacement method of analysis – Slope deflection method for beams and rigid-jointed frames – Moment distribution method for beams and rigid-jointed plane frames.

Module 5: Matrix analysis of structures: Concept of flexibility and stiffness influence coefficients – Development of element flexibility matrices for beams, rigid-jointed frames and trusses – Analysis of statically indeterminate beams, rigid-jointed frames and trusses using flexibility matrix method – Development of element stiffness matrices for beams, rigid-jointed frames and trusses – Analysis of statically indeterminate beams, rigid-jointed frames and trusses using stiffness matrix method.

Textbooks:

1. Hibbeler, R.C., *Structural Analysis*, 6th edition, Pearson Education, 2015.
2. Reddy, C.S., *Basic Structural Analysis*, 3rd edition, McGraw Hill Education, 2011.
3. Roy, S.K. and Chakrabarty, S., *Fundamentals of Structural Analysis*, Revised edition, S. Chand, 2009.

References:

1. Kassimali, A., *Structural Analysis*, 5th edition, Cengage Learning, 2015.
2. Leet, K.M., Uang, C.-M. and Gilbert, A.M., *Fundamentals of Structural Analysis*, 3rd edition, McGraw Hill Education, 2008.
3. Ghali, A., Neville, A.M. and Brown, T.G., *Structural Analysis: A Unified Classical and Matrix Approach*, 6th edition, CRC Press, 2009.
4. Weaver, W. and Gere, J.M., *Matrix Analysis of Framed Structures*, 2nd edition, CBS, 2004.

Course Code: CE 309
Course Name: Soil Mechanics
Credits: 4 (3-0-2)
Course Position: Semester 5
Course Content:

Module 1: Introduction-Definitions: soils, soil mechanics, soil engineering, rock mechanics, geotechnical engineering. Scope of soil engineering. Comparison between soil and rock. Three phase system, Definitions, Relationship and Interrelationship. Determination of various parameters such as: Moisture content by oven dry method etc. Plasticity Characteristics of Soil-Introduction, Definitions, Determination of: liquid limit, plastic limit and shrinkage limit. Use of consistency limits. Classification of Soils, Indian standard soil classification system. field identification of soils, general characteristics of soil in different groups, clay mineralogy, capillary water.

Module 2: Permeability of Soil-Introduction to hydraulic head, Darcy's law, validity of Darcy's law. Determination of coefficient of permeability: Laboratory method and field method. Permeability aspects: stratified soils and factors affecting permeability. Seepage Analysis Introduction, stream and potential functions, characteristics of flow nets, graphical method to plot flow nets.

Module 3: Effective Stress Principle-Introduction, effective stress principle, nature of effective stress, effect of water table. Fluctuations of effective stress, effective stress in soils saturated by capillary action, seepage pressure, quick sand condition. Compaction of Soil- Introduction, theory of compaction, laboratory determination of optimum moisture content and maximum dry density. Compaction in field, compaction specifications and field control. Stress Distribution.

Module 4: Consolidation of Soil-Introduction, comparison between compaction and consolidation, initial, primary & secondary consolidation, spring analogy for primary consolidation, consolidation test results, basic definitions, Terzaghi's theory of consolidation, final settlement of soil deposits, consolidation settlement: one- dimensional method, secondary consolidation.

Module 5: Shear Strength-Principle planes parallel to the coordinate axes, Mohr's circle, important characteristics of Mohr's circle, Mohr-Coloumb theory, types of shear test: direct shear test, merits of direct shear test, triaxial compression tests, test behaviour of UU, CU and CD tests, relation between major and minor principal stresses, unconfined compression test, vane shear test.

Text Books:

Geotechnical Engineering by C. Venkatramaiah, 5th Edition, New Age International Publishers

Reference Books:

- Soil Mechanics and Foundation Engineering by K.R. Arora, Standard Publishers
- Basic and Applied Soil Mechanics by Gopal Ranjan and A.S.R. Rao, New Age International Publishers
- Soil Mechanics and Foundations by Muniram Budhu, John Wiley and Sons
- Principles of Geotechnical Engineering by B.M. Das and K. Sobhan, Cengage Learning
- Soil Mechanics by Craig R.F., Chapman & Hall

Course Code: CE 310
Course Name: Water Resources Engineering
Credits: 3 (3-0-0)
Course Position: Semester 5
Course Content:

Module 1: Introduction- irrigation, water resources in India, need of irrigation in India, development of irrigation in India, impact of irrigation on human environment, irrigation systems: minor and major, command area development. Water requirement of crops-Crops and crop seasons in India, cropping pattern, duty and delta; Quality of irrigation water; Soil-water relationships- soil characteristics significant from irrigation considerations, root zone soil water, infiltration, consumptive use, irrigation requirement, frequency of irrigation; Methods of applying water to the fields: surface, sub-surface, sprinkler and trickle / drip irrigation.

Module 2: Hydrology- hydrologic cycle, rainfall – runoff process, factors affecting runoff, runoff hydrograph, runoff computations, flood discharge calculations, unit hydrograph method, Shydrograph.

Module 3: Ground water and well hydrology- Ground water resources, occurrence of ground water, methods of ground water exploration, well irrigation; Well hydraulics: steady state flow in wells, equilibrium equations for confined and unconfined aquifers, aquifer tests, design of water wells.

Module 4: Distribution system-Canal systems, alignment of canals, canal losses, estimation of design discharge. Design of channels- rigid boundary channels carrying clear and sediment laden water, alluvial channels carrying clear and sediment laden water, Kennedy's and Lacey's theory of regime channels. Canal outlets: non-modular, semi-modular and modular outlets. Water logging: causes, effects and remedial measures. Lining of canals economics of lining, types of lining. Drainage of irrigated lands: necessity, methods. Canal structures- Surface and sub-surface flow considerations for design of canal structures: hydraulic jump, seepage forces, uplift forces. Canal falls, cross regulator, distributory head regulator, canal escapes: types, components and design considerations. Canal head works-Weir and barrage, different units of head works, types of weirs, sediment control in canals, river training for canal head works.Theories of seepage for design of weirs: Bligh's creep theory, Lane's weighted creep theory, Khosala's method of independent variables.

Module 5: Dams and spillways-Embankment dams: Classification, selection of site for dam, design considerations, estimation and control of seepage, slope protection. Gravity dams: forces on gravity dams, causes of failure, stress analysis, elementary and practical profile, structural joints, keys and water seals, galleries, outlets. Arch and buttress damstypes. Spillways: components of spillways, types, terminal structures, types of gates for spillway crests; Reservoirs- Types, capacity of reservoirs, yield of reservoir, reservoir regulation, sedimentation, economic height of dam, selection of suitable site, flood routing.

Text Books:

G L Asawa, Irrigation Engineering, Wiley Eastern
S K Garg, Irrigation Engineering & Hydraulic Structures, Khanna Publishers
P N Modi, Irrigation Engineering & Hydraulic Structures

Reference Books:

J D Zimmerman, Irrigation, John Wiley & Sons
Varshney, Gupta & Gupta, Theory and Design of Irrigation Structures, Nem Chand & Bros.
Punmia B C & Pande B B Lal, Irrigation Engineering and Water Power Engineering, Laxmi Publications

Course Code: FL 305
Course Name: French Language and Culture V
Credits: 0 (0-2-0)
Course Position: Semester 5

Objectives:

At this level the students work in class on understanding and expressing feelings, intentions, opinions and routine tasks in order to interact with relative facility in their specific field of activities. Students are able to discuss ideas with frequently used language and can ask for information about familiar subjects concerning everyday subjects and the news. They also work on comprehension skills and writing notes. They work on improving their grasp of everyday syntax and grammar and build a lexical base corresponding to immediate needs. They also work on targeted pronunciation to improve clarity of expression.

Course Content:

- **Topics**

1. To accept or to refuse any invitation
2. Showing possession
3. Description of an object
4. Expressing comparison
5. To express an idea
6. Description of a landscape

- **Grammar**

1. Revision of l'imparfait (Past Continuous), le Futur simple (Simple future) et le passé composée (Simple Past)
2. Possessive Pronouns
3. Place of Adjectives
4. Recent Past
5. Forms of negation

- **Types of writing**

1. Informal letter or email
2. A short passage

Course Code: **CE 311**
Course Name: **Reinforced Concrete Design**

Credits: **4 (3-1-0)**

Course Position: **Semester 6**

Course Content:

Module 1: Concepts of RC. Design – Working Stress Method – Limit State method – Material Stress Strain Curves – Safety factors – Characteristic values. Stress Block parameters – IS – 456 – 2000. Beams: Limit state analysis and design of singly reinforced, doubly reinforced, T and L beam sections.

Module 2: Limit state analysis and design of section for shear and torsion – concept of bond, anchorage and development length, I.S. code provisions. Design examples in simply supported and continuous beams, detailing; Design of canopy.

Module 3: Short and Long columns – under axial loads, uniaxial bending and biaxial bending – I S Code provisions.

Module 4: Footings: Different types of footings – Design of isolated, square, rectangular, circular footings and combined footings.

Module 5: Design of one way slab, Two-way slabs and continuous slab Using I S Coefficients Limitstate design for serviceability for deflection, cracking and codal provision. Design of doglegged staircase.

Textbooks:

1. Reinforced concrete design by S. Unnikrishna Pillai & Devdas Menon, Tata McGraw Hill, New Delhi.
2. Reinforced concrete design by N. Subrahmanian Oxford University Press.
3. Limit state designed of reinforced concrete – P. C. Varghese, Prentice Hall of India, New Delhi

Standards:
IS 456:2000 Indian Standard PLAIN AND REINFORCED CONCRETE – CODE OF PRACTICE, BIS, New Delhi.
IS 875 (Part 1-5) Code of practice for design loads (other than earthquake) for buildings and structures

References:

1. Design of Reinforced Concrete Structures by I. C. Syal and A. K. Goel, S. Chand & company.
2. Fundamentals of reinforced concrete by N.C. Sinha and S.K Roy, S. Chand publishers
3. Design of concrete structures – Arthus H. Nilson, David Darwin, and Chorles W. Dolar, Tata McGraw-Hill, 3rd Edition, 2005
4. Park, R., and Paulay, T. Reinforced Concrete Structures, John Wiley and Sons, 1975
5. Dayaratnam, P. Design of Reinforced Concrete Structure 4th Ed., Oxford and IBH, 2011

Course Code: CE 312
Course Name: Environmental Engineering
Course Credits: 3 (2-0-2)
Course Position: Semester 6
Course Contents

Module 1: Water:- Water Supply systems, Need for planned water supply schemes, Sources of Water, Water demand and Potable, industrial and agricultural water requirements, Components of water supply system; Transmission of water, Distribution system, Various valves used in W/S systems, service reservoirs and design.

Module 2: Sewage- Domestic and Storm water, Quantity of Sewage, Sewage flow variations. Conveyance of sewage,; Sewerage, Sewer appurtenances, Design of sewerage systems. Storm Water- Quantification and design of Storm water; Sewage and Sullage, Pollution due to improper disposal of sewage, National River cleaning plans, recycling of sewage – quality requirements for various purposes.

Module 3: Air - Composition and properties of air, Quantification of air pollutants, Monitoring of air pollutants, Air pollution- Occupational hazards, Urban air pollution, automobile pollution, Chemistry of combustion, Automobile engines, quality of fuel, operating conditions and interrelationship. Air quality standards, Control measures for Air pollution, construction and limitations.
Noise- Basic concept, measurement and various control methods.

Module 4: Solid waste management-Municipal solid waste (MSW), MSW management, Special MSW, Effects of solid waste on environment. Disposal of solid waste, Disposal methods-Integrated solid waste management. Hazardous waste.

Module 5: Building Plumbing- home plumbing systems for water supply and waste water disposal and high rise building plumbing. Government authorities and their roles in water supply, sewerage disposal. Solid waste management and monitoring/control of environmental pollution.

Text Books:
Introduction to Environmental Engineering by P. Aarne Vesilind, Susan M. Morgan, Thompson /Brooks/Cole; Second Edition 2008
Introduction to Environmental Engineering, Vesilind, PWS Publishing Company 2000

Reference Books:
Water Supply and Sewerage, E.W. Steel
CPHEEO Manual on Water Supply & Treatment
Manual on Water Supply and Treatment, (latest Ed.), Ministry of Works & Housing, New Delhi.
Plumbing Engineering. Theory, design and Practice, S.M. Patil, 1999
Integrated Solid Waste Management, Tchobanoglous, Theissen & Vigil. McGraw Hill Publication
Environmental Engineering by H.S.Peavy, D.R. Rowe, G.Tchobanoglous; 1991, Tata Mcgraw Hill

Course Code: CE 313
Course Name: Transportation Engineering
Course Credits: 4 (3-0-2)
Course Position: Semester 6

Course contents

Module 1: Introduction to transportation modes – History of highway development - classification of roads - road patterns - planning surveys - saturation system – Highway planning in India – Highway alignment – requirements for an ideal alignment - factors controlling – engineering surveys – Highway economics

Module 2: Highway Geometric design - cross-section elements – camber - sight distance - design of horizontal alignment – super-elevation - transition curves – widening of pavement – setback distance - curve resistance - vertical alignment – grade compensation

Module 3: Traffic characteristics- Road user and vehicular characteristics - traffic studies and surveys – speed studies, volume studies, parking studies, accident studies – traffic signs and markings - intersections & rotaries – design of rotary intersection

Module 4: Material requirement for pavements – soil, aggregates, bitumen – properties - material testing and specification – Marshall's mix design – pavement construction and maintenance

Module 5: Highway pavement design - Design factors - design of flexible pavement: CBR method – stresses in rigid pavements - design of rigid pavements: IRC method – joints in rigid pavements

Text Books:
1. S K Khanna and C E G Justo, Highway Engineering

References
2. S K Sharma, Principles, Practice, and Design of Highway Engineering
3. Kadiyali, L.R. Principles and Practice of Highway Engineering
4. Vazirani and Chandola, Transportation Engineering Vol.1 and Vol. 2
5. Fred L. Mannering, Scott S. Washburn and Principles of Highway Engineering and Traffic Analysis

Course Code: CE 314
Course Name: Foundation Engineering
Course Credits: 3 (3-0-0)
Course position: Semester 6
Course Content

Module 1: Site Investigations: Planning a Sub-Surface Exploration programs, Reconnaissance, Depth and Lateral Extent of Exploration, Borings for Exploration, Common Sampling Methods, Sample Disturbance, In-Situ Tests. Stability of Earth Slopes: Different Factors of Safety, Types of Slope Failures, Stability of Finite and Infinite Slopes, Determination of Factor of Safety by Various Methods, Improving Stability of Slopes

Module 2: Earth Pressure Theories: Different Types of Earth Pressures, States of Plastic Equilibrium Rankine's Theory and Coulomb's Theory, Application of Rankine's and Coulomb's Theory to Cohesionless and Cohesive Soils, Cullman's Graphical Method, Stability Considerations For Retaining Walls, Effect of Earthquakes. Design of Retaining Walls and Bulkheads: Types of Retaining Walls, Principles of The Design of Retaining Walls, Analysis and Design of Different Types of Sheet Pile Walls. Braced Cuts and Coffer Dams: Introduction, Lateral Earth Pressures on Sheeting, Design of Various Components of Bracing, Design of Cellular Cofferdams on Soil

Module 3: Bearing Capacity and Settlement Analysis: Introduction and Definitions, Bearing Capacity, Methods of Determining Bearing Capacity, Bearing Capacity from Building Codes, Analytical Methods of Determining Bearing Capacity, Effect of Water Table on Bearing Capacity, Safe Bearing Capacity, Foundation Settlements, Plate Load Tests, Bearing Capacity from Penetration Tests, Bearing Capacity from Model Tests-Housel's Approach, Data for Settlement Analysis, Settlement, Corrections to Computed Settlement, Further Factors Affecting Settlement, Other Factors Pertinent to Settlement, Settlement Records, Contact Pressure and Active Zone From Pressure Bulb Concept

Module 4: Shallow Foundations: Introductory Concepts on Foundations, General Types of Foundations, Choice of Foundation Type and Preliminary Selection, Spread Footings, Strap Footings, Combined Footings, Raft Foundations on Non-uniform Soils

Module 5: Pile Foundations: Introduction, Classification of Piles, Use of Piles, Pile Driving, Pile Capacity, Pile Groups, Settlement of Piles and Pile Groups, Laterally Loaded Piles, Batter Piles, Design of Pile Foundations, Construction of Pile Foundation Caissons and Well Foundations: Introduction

Text Books:
Geotechnical Engineering by C. Venkatramaiah, 5th Edition, New Age International Publishers

Reference Books:

1. Soil Mechanics and Foundation Engineering by K.R. Arora, Standard Publishers
   Basic and Applied Soil Mechanics by Gopal Ranjan and A.S.R. Rao, New Age International Publishers
2. The Engineering of Foundations by Rodrigo Salgado, McGraw Hill
3. Theory and Practice of Foundation Design by N.N. Som and S.C. Das, Prentice Hall
4. Principles of Geotechnical Engineering by B.M. Das and K. Sobhan, Cengage Learning

Course Code: **PR 301**
Course Name: **Year-3 Team Project**

Credits: **3 (0-0-6)**

Course Position: **Semester 6**

Course Content:

The Year-3 team project can focus on any topic or problem of relevance to civil engineering and its allied fields. Students are expected to make use of the knowledge gained in their coursework over the first 5 semesters, as well as knowledge from other relevant subjects, in order to conduct a detailed theoretical / analytical, experimental, or computational study of a problem of their own interest. Alternatively, the topic of the project may be suggested by the faculty advisor supervising the project. Project topics involving knowledge from multiple disciplines are especially encouraged, as these will broaden the students' view of the engineering profession and its interfaces with other disciplines.

The Year-3 team project is intended to help the students develop a set of key skills to become innovative engineers. It encompasses:

Teamwork: Development of organization skills, decision-making skills, and managerial skills within the framework of a team-based task; Roles and performance of team members; Written and oral communication: Structure and synthesis; Enhancement of written and oral impact; Interpersonal communication and public communication; Development of skills for solving complex problems: Framing the issue; Inductive, experimental and recursive approaches; Handling doubts and complexity.

Creativity: Enhancement of creative skills through group creativity methods; Skills needed to build one's academic and career plans; Exposure to the work of practicing engineers / researchers.

Textbooks:

1. Case studies based teaching and problem based learning
2. A Guide to the Project Management Body of Knowledge: PMBOK Guide (Fifth Edition), PMI Project Management Institute.
3. Project Management: A Systems Approach to Planning, Scheduling, and Controlling (11th Edition), Harold Kerzner.
4. Managing Complex Projects (The IIL/Wiley Series in Project Management) International Institute for Learning, Harold R. Kerzner, Carl Belack.
5. Project Management: from Simple to Complex, v. 1.0; Russell Darnall and John M. Preston.

Course Code: **FL 306**

Course Name: **French Language and Culture VI**

Credits: **0 (0-2-0)**

Course Position: **Semester 6**

Objectives:

At this level the students work in class on understanding and expressing feelings, intentions, opinions and routine tasks in order to interact with relative facility in their specific field of activities. Students are able to discuss ideas with frequently used language and can ask for information about familiar subjects concerning everyday subjects and the news. They also work on comprehension skills and writing notes. They work on improving their grasp of everyday syntax and grammar and build a lexical base corresponding to immediate needs. They also work on targeted pronunciation to improve clarity of expression.

Course content:

e) **Topics**

1. To Propose or to invite for a program, a party etc.
2. Writing a personal letter
3. Expressing obligation and interdiction
4. To ask for the touristic information
5. To present one's point of view and argue about it
6. To understand the difference between written and spoken language

f) **Grammar**

1. Adverb
2. To know how to change verbs into noun and vice-versa
3. The Subjunctive
4. Relative pronouns
5. Expression of duration
6. Direct and Indirect speech in present
7. Basic logical connective

g) **Types of writing**

1. A short essay
2. Informal letter or email
3. Film review

Course Code: CE 415
Course Name : Design of Steel Structures
Course Credits: 4 (3-1-0)
Course Position: Semester 7

Course contents

Module 1

Materials, types of structural steel, mechanical properties of steel, yield strength, Loads and combinations, Concept of limit State, working stress and ultimate load Design, Introduction to riveted connection, design of bolted and welded connections, simple connections, Unstiffened and stiffened seat connections, design of axially and eccentrically loaded connections.

Module 2

Design of tension members, lug angle, splices. Design of compression in members, laced, battened, splice, built up compression members, Design of column base, Design of simple slab base and gusseted base.

Module 3

Introduction to Plastic theory, Plastic hinge concept, Plastic collapse load, conditions of plastic analysis, Theorem of Plastic collapse, Methods of Plastic analysis, Plastic analysis of continuous beams.

Module 4

Introduction, Beam types, Lateral stability of beams, factors affecting lateral stability, Behavior of simple and built-up beams in bending (without vertical stiffeners), Design strength of laterally supported beams in Bending, Design strength of laterally unsupported beams, Shear strength of steel beams, Maximum deflection, Design of beams and purlins.

Text books:

1. Subramanian, N., 2010. ***Design of steel structures***. Oxford University Press.
2. Duggal, S.K., 2010. ***Limit State Design of Steel Structures****, 2e*. Tata McGraw-Hill Education.

Reference books:

1. Salmon, C.G., Johnson, J.E. and Malhas, F.A., 2009. ***Steel structures design and behavior***, Pearson.
2. Owens, G.W. and Cheal, B., 1989. ***Structural steelwork connections***. Butterworth Heinemann.

Relevant IS Codes: IS:800-2007, IS-808-1989, SP:6(1)-1964.

Course Name: Construction Planning and Management
Course Code: CE 416
Course Credits: 2 (2-0-0)
Course Position: Semester 7

Course Content
Module 1: Management process- Roles. management theories . Social responsibilities. planning and strategic management strategy implementation . Decision making: tools and techniques — Organizational structure . Human resource management- motivation performance- leadership.

Module 2: 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- Cost & Time optimization.

Module 3: Resource planning – planning for manpower, materials, costs, equipment. Labour, - Scheduling .Forms of scheduling – Resource allocation . budget and budgetary control methods

Module 4: Contract – types of contract, contract document, specification, important conditions of contract — tender and tender document – Deposits by the contractor – Arbitration . negotiation – M.Book – Muster roll -stores.

Module 5: Management Information System – Labour Regulations: Social Security – welfare Legislation – Laws relating to Wages, Bonus and Industrial disputes, Labour Administration – Insurance and Safety Regulations – Workmen's Compensation Act -other labour Laws – Safety in construction : legal and financial aspects of accidents in construction . occupational and safety hazard assessment. Human factors in safety. legal and financial aspects of accidents in construction . occupational and safety hazard assessment

Text Books:

Ghalot, P.S., Dhir,D.M., Construction Planning and Management, Wiley Eastern Limited,1992.

Chitkara,K.K., Construction Project Management, Tata McGraw Hill Publishing Co, Ltd., New Delhi, 1998.

Reference Books:
Construction Management And Planning by: sengupta, b. /guha, h. tata mcgraw-hill publications.

Course Code: **PR 402**
Course Name: **Year-4 Project**

Credits: **9 (0-5-8)**

Course Position: **Semester 7**

Course Content:

The object of Year-4 Project Work & Dissertation is to enable the student to extend further the investigative study taken up under, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from a School at MEC or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include:

1. Review and finalization of the Approach to the Problem relating to the assigned topic;
2. Preparing an Action Plan for conducting the investigation, including team work;
3. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed;
4. Final development of product/process, testing, results, conclusions and future directions;
5. Preparing a paper for Conference presentation/Publication in Journals, if possible;
6. Preparing a Dissertation in the standard format for evaluation;
7. Final Seminar presentation before a Committee.

Course Code: **FL 407**
Course Name: **French Language and Culture VII**
Credits: **0 (0-2-0)**
Course Position: **Semester 7**

Objectives:

The aim is to place the students in various communication situations in French that correspond to social and professional contexts. They learn to express their ideas simply and coherently and are able to understand selective authentic French texts written in everyday language. These texts usually discuss subjects of cultural nature. Radio and television documentaries about the news or subjects linked to the students' specific area of interest are used to practice extracting key information. Students acquire sufficient vocabulary and control of the main grammatical structures to be able to express most of what they want to say relatively easy.

Course Content:

1. **Topics**
   - **h)** Intergeneration accommodation
   - **i)** Internet and cellphone
   - **j)** Pollution
   - **k)** Love, marriage, divorce
   - **l)** Carpool (Covoiturage)

The topics were studied through written articles, audio listening and television coverage. Students were also asked to do oral presentations on the above mentioned topics.

2. **Grammar**
   - g) Subjunctive
   - h) Reported speech
   - i) Connectors

3. **Types of writing**
   - **h)** Official letter
   - **i)** Argumentative essay

Course Code: **PR 403**
Course Name: **Year-4 Project**
Credits: **9 (0-5-8)**
Course Position: **Semester 8**

Course Content:

The object of Year-4 Project Work & Dissertation is to enable the student to extend further the investigative study taken up under, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from a School at MEC or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include:

8. Review and finalization of the Approach to the Problem relating to the assigned topic;
9. Preparing an Action Plan for conducting the investigation, including team work;
10. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed;
11. Final development of product/process, testing, results, conclusions and future directions;
12. Preparing a paper for Conference presentation/Publication in Journals, if possible;
13. Preparing a Dissertation in the standard format for evaluation;

Final Seminar presentation before a Committee.

Course Code: **FL 408**

Course Name: **French Language and Culture VIII**

Credits: **0 (0-2-0)**

Course Positon: **Semester 8**

Objectives:

The aim is to place the students in various communication situations in French that correspond to social and professional contexts. They learn to express their ideas simply and coherently and are able to understand selective authentic French texts written in everyday language. These texts usually discuss subjects of cultural nature. Radio and television documentaries about the news or subjects linked to the students' specific area of interest are used to practice extracting key information. Students acquire sufficient vocabulary and control of the main grammatical structures to be able to express most of what they want to say relatively easy.

Course Content:

1. **Topics**
    - French education system
    - Employment/Unemployment
    - House exchange

The topics were studied through written articles, audio listening and television coverage. Students were also asked to do oral presentations on the above mentioned topics.

2. **Grammar**
    - Future perfect
    - Nominalization

3. **Types of writing**
    - Article for magazine
    - Writing/ Responding to queries on forum discussion platforms

Course Code: CE450
Course Name: TE - II (Railways, Airports & Harbour Engineering)
Credits: 3 (3-0-0)
Course Position: Semester 6, 7 or 8

Course Content:

Module 1: History and general features of Indian railways – Gauges - Elements of permanent way – Rails, sleepers, ballast, rail fixtures and fastenings – types and functions - Resistances to traction and stresses in track – coning of wheels – creep, wear and defects in rails – track alignment

Module 2: Geometric design of railway track – Horizontal curves and superelevation – equilibrium cant and cant deficiency – vertical curves – gradients and grade compensation – widening of gauge on curves - Points and crossings – Turn out - Railway stations and yards - Signaling and interlocking

Module 3: History of Aviation – Air transportation in India – Regional planning - Aircraft characteristics – Airport classifications - Location and planning of airport elements – terminal area, obstructions, zoning law, approach zone, turning zone, airport capacity – Airport size and site selection.

Module 4: Runway configurations – wind rose and orientation of runway - runway length- Corrections to runway length - runway geometric design – elements of taxiway, apron and hangar – aircraft parking configuration and parking system - Air traffic control – Objectives - Airport markings and lighting – airport drainage

Module 5: Water transportation- Harbours - Classification - Site selection- Harbour layout - Ports - Classification of ports - Coastal structures: Piers, Breakwaters, Wharves, Jetties, Quays, Fenders - Docks – classification – working principle – Repair docks - Port amenities: Ferry, transit sheds, ware houses - Navigational facilities – buoys, beacons, light house – Harbour maintenance: dredging.

Text Books:

1. Transportation Engineering Vol. 1 and 2 by Vazirani and Chandola,
2. Planning & Design of Airports by Robrt Horonjeff, Francis McKelvey; TataMcGrawhill
3. Harbour, Dock & Tunnel Engineering- R.Srinivasan; Charotar Publishers, Ahmedabad.

References

1. Railway Engineering (2012) - Rangwala
2. Airport Planning and Design- S.K.Khanna, M.G.Arora & S.S.Jain; NemChand & Bros, Roorkee, India
3. Dock & Harbour Engineering- H.P.Oza & G.H.Oza; Charotar Publishers, Ahmedabad.
4. Harbour, Dock & Tunnel Engineering- R.Srinivasan; Charotar Publishers, Ahmedabad.

Course Code: CE451
Course Name: Traffic Engineering & Management
Credits: 3 (3-0-0)
Course Position: Semester 6, 7 or 8

Course Content:

Module 1 - Traffic stream characteristics
Introduction to traffic engineering, Road user & Vehicle characteristics, Fundamental parameters and relations of traffic flow, Traffic stream models, Moving observer method, Traffic measurement procedures

Module 2 - Traffic intersection control:
Principles of traffic control, Traffic signs and road markings, Uncontrolled intersection, Channelization, Traffic rotary, Grade separated intersection.

Module 3 - Traffic signal design:
Elements of traffic signal, Design principles of a traffic signal, Evaluation of a traffic signal, Coordinated traffic signal, Vehicle actuated signals and area traffic control.

Module 4 - Specialised traffic studies:
Parking Studies, Accident Studies, Congestion studies, Toll operation, Pedestrian studies, Fuel consumption and emission studies.

Module 5 – Intelligent transportation systems:
Introduction, ITS user services, ITS Architecture, ITS planning and evaluation.

Text Books:

- Roess, RP., McShane, WR. and Prassas, ES. (1998), Traffic Engineering, Prentice Hall.

Reference Books:

- Kadiyali, L.R. (1987), Traffic Engineering and Transportation Planning, Khanna.
- May, A. D. (1990), Fundamentals of Traffic Flow, Prentice Hall.
- Papacostas, C. S. (1987), Fundamentals of Transportation Engineering, Prentice Hall.
- Khanna, S. K. and Justo, C. E. G. (1991), Highway Engineering, Nemchand.
- Pingnataro, G. J. (1970), Principles of Traffic Engineering, Mc Graw - Hill.

Course Code: CE452
Course Name: Intelligent Transportation Systems
Credits: 3 (3-0-0)
Course Position: Semester 6, 7 or 8

Course Content:

UNIT I: Fundamentals of ITS
Introduction to Intelligent transportation systems – Definition – objectives – historical background – benefits of ITS

UNIT II: Telecommunications and data requirements of ITS
Importance of telecommunications in the ITS – Information management – Traffic Management Centres (TMC) – Application of sensors to traffic management – Traffic flow sensor technologies – ITS data collection techniques: Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), GIS, Video data collection

UNIT III: ITS user services
Introduction – Travel and traffic management – Public transportation operations – Electronic payment – Commercial vehicle operations – Advanced vehicle control and safety systems – Emergency management – Information management – Maintenance and construction management

UNIT IV: ITS architecture
National and Regional ITS architecture – ITS models and evaluation methods – Planning and human factor issues for ITS – ITS and safety – ITS and security - ITS planning – ITS standards and evaluation

UNIT V: ITS applications
Automated highway systems – Vehicles in platoons – Integration of automated highway systems – ITS programs in the world – Overview of ITS implementations in developed countries – ITS in developing countries – Case studies

Text Books:
Fundamentals of intelligent transportation systems planning By Mashrur A. Chowdhury, Adel Wadid Sadek.

Lawrence A. Klein, Sensor technologies and Data requirements of ITS.

ITS Hand Book 2000: *Recommendations for World Road Association (PIARC)* by Kan Paul Chen, John Miles.

Sussman, J. M., *Perspective on ITS*, Artech House Publishers, 2005.

National ITS Architecture Documentation, US Department of Transportation, 2007.

Course Code: CE453
Course Name: Pavement Analysis & Design
Credits: 3 (3-0-0)
Course Position: Semester 6, 7 or 8

Course Content:

Module 1: Introduction to pavement design
Types of pavement – Flexible, rigid, composite; Factors affecting design of pavements – Wheel loads, Material properties, Environmental and other factors; Different types of pavement performance criteria; Different pavement design approaches; Traffic Considerations in Pavement Design - Axle configurations, Contact shapes and contact stress distributions, Concept of standard axle load, Vehicle damage factor, Axle load surveys.

Module 2: Analysis & design of flexible pavement
Stresses in flexible pavement- layered systems concept, one layer system, two layer system, Design of flexible pavements- IRC: 37, AASHTO methods.

Module 3: Analysis & design of rigid pavement
Analysis of wheel load stresses, curling/warping stresses due to temperature differential, critical stress combinations. Methods of design of concrete pavements- IRC: 58, AASHTO, PCA methods.

Module 4: Pavement evaluation techniques
Functional and structural evaluation of pavements, concept of roughness, international roughness index, measurement of roughness using different types of equipment, structural evaluation of in-service pavements using Benkelman beam and falling weight deflectometer methods.

Module 5: Pavement overlay design methods:
Overlay design as per Indian Roads Congress guidelines (IRC:81), Overlay design as per AASHTO-1993 guidelines.

Text Books:

1. Yang H Huang "Pavement Analysis and Design", Prentice Hall.
2. EJ Yoder and MW Witczak, "Principles of Pavement Design", John Wiley & Sons.

Standard codes:

1. AASHTO Guide for Design of Pavement Structures", American Association of State Highway and Transport Officials.
2. IRC:37-2001 "Guidelines for the Design of Flexible Pavements", Indian Roads Congress, New Delhi.
3. IRC:58-2002, "Guidelines for the Design of Plain Jointed Rigid Pavements for Highways", Indian Roads Congress, New Delhi.
4. IRC:81-1997, "Guidelines for Strengthening of Flexible Road Pavements using Benkelman beam deflection techniques", Indian Roads Congress, New Delhi.

Course Code: **CE454**
Course Name: **Transport & Environment**
Credits: **3 (3-0-0)**
Course Position: **Semester 6, 7 or 8**

Course Content:

Module I: Introduction
Importance of transportation-related environmental problems in the global, national, regional and local context, Global warming & climate change

Module II: Air Pollution
Pollutants: Gases, Particles; Pollutant Sources: Motor Vehicles Emissions, Train Emissions, Shipping Emissions, Aircraft Emissions; Measurement and Data Analysis: Concentration Measurement of Gases, Concentration Measurement of Particles, Analysis of an Air-quality Data Set; Mitigation and Effects of Air Pollution: The Role of Vegetation, Effects on Humans and Animals, Effects on Plants, Soil and Groundwater, Effects on Materials; Control of Emission: EU legislation, UK legislation, US legislation, Legislation in Asian Regions

Module III: Measures to mitigate traffic emissions
The relative cost-effectiveness of emissions technology vs. non-technological strategies; the potential for changing travel behavior to promote environmental quality; parking, road congestion pricing, and transit options; the congestion-air quality nexus; energy consumption implications; and what we mean by sustainable transportation.

Module IV: Noise Pollution
Noise: Introduction to Acoustics, The nature of environmental noise; Noise Sources: Motor Vehicles Emissions, Train Emissions, Aircraft Emissions; Measurement, Prediction, Propagation and Control of Noise (Considering German, British and American Guides): Noise Measurement; Prediction, Propagation and Control of Railway Noise; Prediction, Propagation and Control of Airport Noise; Effects of Noise on Humans and Animals

Module V: Environmental Impact assesment
Impacts of transportation projects; Case studies

Text Books:

Environmental Science and Engineering, by J. Glynn and Gary W. Hein Ke – Prentice Hall

Publishers

Course Code: CE455
Course Name: Urban Transportation Planning
Credits: 3 (3-0-0)
Course Position: Semester 6, 7 or 8

Course Content:

UNIT I: Transport Planning Process
Scope – interdependence of land use and traffic – systems approach to transport planning – Transport surveys – definition of study area – zoning survey - types and methods – inventory on transport facilities - inventory of land use and economic activities.

UNIT II: Trip Generation
Factors governing trip generation and attraction rates – multiple linear regression analysis – category analysis – critical appraisal of techniques.

UNIT III: Trip Distribution Methods
Presentation of trip distribution data - PA matrix to OD matrix – Growth factor methods - gravity model and its calibration – opportunity model

UNIT IV: Modal split analysis
Influencing factors – Earlier modal split models: Trip end type and trip interchange type – limitations – Disaggregate mode choice model – Logit model - binary choice situations – multinomial logit model – model calibration

UNIT V: Route assignment
Description of highway network – route choice behaviour – shortest path algorithm - assignment techniques – all nothing assignment – multi path assignment – capacity restrained assignment – diversion curves

Text Books:
Hutchinson, B.G. (1974). Principles of Urban Transport Systems Planning. McGraw Hill Book Company, New York.

Reference Books:
Kadiyali, LR (1987), Traffic Engineering and Transportation Planning, Khanna Publishers, New Delhi.
NPTEL videos on Urban Transportation Planning, Dr. V. Tamizh Arasan, IIT Madras
Paul.H.Wright (1995), Transportation Engineering – Planning & Design, John Wiley & Sons, New york.
John W Dickey (1995), Metropolitan Transportation Planning, Tata McGraw-Hill publishing company Ltd, New Delhi.
Papacostas, C.S., and Prevedouros, P.D. (2002). Transportation Engineering and Planning. 3rd Edition, Prentice - Hall of India Pvt Ltd.

Course Code: **CE456**
Course Name: **Pavement Material Characterization & Construction**
Credits: **3 (3-0-0)**
Course Position: **Semester 6, 7 or 8**

Course Content

Module 1: Sub- grade Soil Characterization
Properties of sub-grade layers, different types of soils, soil classification, Index and other basic properties of soil; A critical look at the different laboratory and in-situ procedures for evaluating the mechanical properties of soils viz. SPT, DCPT, CPT, CBR, Plate Load test & resilient modulus; Suitability of different type of soil for the construction of highway embankments and pavement layers; Field compaction and control. Dynamic properties of soil: FWD test.

Module 2: Aggregate Characterization
Origin, Classification, Types of aggregates; Sampling of aggregates; Mechanical and shape properties of aggregates, Aggregate texture and skid resistance, polishing of aggregates; Proportioning and Blending of aggregates: Super pave gradation, Fuller and Thompson's Equation, 0.45 power maximum density graph; Use of locally available materials in lieu of aggregates.

Module 3: Bitumen and Bituminous Concrete Mix Characterization
Bitumen sources and manufacturing, Chemistry of bitumen, bitumen structure, Rheology of bitumen, Elastic modulus, Dynamic modulus, visco-elastic and fatigue properties, creep test, Modified bitumen: Crumb Rubber Modified bitumen, Natural rubber modified bitumen, polymer modified bitumen; Introduction to emulsified bitumen and its characterization; Modified Marshall's specifications.

Module 4: Pavement construction equipment
Different types of excavators, graders, soil compactors / rollers, pavers and other equipment for construction of different pavement layers – their uses and choice, Problem on equipment usage charges; Pre-construction surveys and marking on ground - Specifications and steps for the construction of road formation in embankment and cut, construction steps for granular sub-base, quality control tests.

Module 5: Pavement construction
WMM, CRM, WBM; specifications, construction method and quality control tests. Different types of bituminous layers for binder and surface courses; their specifications (as per IRC and MORTH); construction method and quality control tests. Different types of sub-base and base course for cement concrete (CC) pavement and construction method. Construction of cement concrete (PQC) pavements joints quality control during construction. Construction details of interlocking concrete block pavements.

Text Books:

Standard codes:

MoRTH Manual for Construction and Supervision of Bituminous Works- 2013, Indian Roads Congress

MoRTH Manual for Maintenance of Roads- 1989,

Indian Roads Congress IRC: 42-1994, IRC:15-2002, IRC SP :11-1988, , 55-2001, 57-2001,58-2001, IRC 19-1977, 27-1967, 29-1988, 34-1970, 36-1970,48-1972,61-1976, 63-1976, 68-1976, 81-1997,82-1982, 84-1983,93-1985, 94-1986, 95-1987, 98-1997, 105-1988.

Course Code:	**CE 457**
Course Name:	**Airport Planning and Design**
Credits:	**3 (3-0-0)**
Course Position:	**Semester 6, 7 or 8**

Course Contents

Module 1

Airport Planning: General- Regional Planning- Development of New Airport- Data Required Before Site Selection- Airport Site Selection- Surveys for Site Selection- Drawings to be prepared- Estimation of Future Air Traffic Needs.

Module II

Runway Design: Runway Orientation- Basic Runway Length- Corrections for Elevation, Temperature and Gradient- Airport Classification- Runway Geometric Design- Airport Capacity- Runway Configurations- Runway Intersection Design.

Module III:

Structural Design Of Airport Pavements: Introduction- Various Design Factors- Design Methods for Flexible Pavement- Design Methods for Rigid Pavement- LCN System of Pavement Design- Joints in Cement Concrete Pavement- Airport Pavement Overlays- Design of an Overlay.

Module- IV:

Visual Aids: General- Airport Marking- Airport Lighting.

Module- V:

Airport Grading And Drainage: General- Computation of Earthwork- Airport Drainage- Special Characteristics and Requirements of Airport Drainage- Design Data- Surface Drainage Design- Subsurface Drainage Design.

REFERENCES:

1. Airport Planning and Designing by S.K. Khanna, M. G. Arora.
2. Highway Engineering including Expressways and Airport Engineering by Dr. L. R. Kadyali, Dr. N. B. Lal.
3. Highway Engineering including Airport Pavements by Dr. S. K. Sharma.
4. Transportation Engineering by S. P. Chandola.

Course Code: **CE 460**
Course Name: **Advanced Foundation Engineering**
Credits: **3 (3-0-0)**
Course Position: **Semester 6, 7 or 8**

Course Content:

- Subsurface Exploration, Shallow Foundations - Ultimate bearing capacity, Safe bearing pressure, settlement analysis.
- Design of Combined and Raft foundations, Design of Retaining walls, Sheet pile walls, Braced cuts, Pile foundations, Drilled piers and Caissons.
- Machine Foundations, Concept of reinforced earth

Text/Reference Books:

1. Joseph Bowles, "Foundation Analysis and Design", McGraw-Hill Book Company.
2. Braja M. Das, "Principles of Foundation engineering", PWS Publishing Company.
3. V.N.S. Murthy, "Advanced Foundation Engineering", CBS Publishers and Distributors

Course Code: CE 461
Course Name: Advanced Soil Mechanics
Credits: 3 (3-0-0)
Course Position: Semester 6, 7 or 8

Course Content:

1. Introduction: Origin of soil and its types, mineralogy and structure of clay minerals, consolidation: Steady State flow, 2D and 3D seepage, transient flow;
2. Compressibility and rate of consolidation, one, two, and three dimensional consolidation theories; Sand drains;
3. Mohr's circles;
4. Critical state soil mechanics: Critical State Line, Hvorslev Surface, Yield Surfaces: Modified Cam-clay and Original Cam-clay;
5. Elastic and plastic analysis of soil: Constitutive relationships of soil; failure theories. Limit analysis-Upper bound theorems, lower bound theorems, limit equilibrium methods;
6. Soil Stabilization: Classification of stabilizing agents and stabilization processes. Strength improvement characteristic of soft and sensitive clays, Marine clay and waste material.

Text/Reference Books:

1. Das B. M. *Advanced Soil Mechanics*, Taylor and Francis.
2. Scott R. F. *Principles of Soil Mechanics*, Addison & Wesley.
3. Davis R. O. and Selvadurai A. P. S. *Elasticity and Geomechanics*, Cambridge University Press.
4. Mitchell J. K. *Fundamentals of Soil Behaviour*, Wiley.
5. Wood D. M. *Soil Behaviour and Critical State Soil Mechanics*, University of Glasgow.
6. Schofield A. N. and Wroth C. P. *Critical State Soil Mechanics*, McGraw-Hill.

Course Code: CE462
Course Name: Environmental Geotechnics
Credits: 3 (3-0-0)
Course Position: Semester 6, 7 or 8

Course Content:

Fundamentals of geoenvironmental engineering, multiphase behavior of soil, case histories on geoenvironmental engineering problems, Soil-water-contaminant interaction studies, concepts of unsaturated soil in geoenvironmental engineering, Waste containment system, property evaluation of soil, design practices, Vertical barriers, Contaminant site remediation, some examples of in-situ remediation, Advanced soil characterization for geoenvironmental applications.

Text/Reference Books:

1. Rowe R.K., "Geotechnical and Geoenvironmental Engineering Handbook" Kluwer Academic Publications, London, 2000.
2. Reddi L.N. and Inyang, H. I., "Geoenvironmental Engineering, Principles and Applications" Marcel Dekker Inc. New York, 2000.
3. Yong, R. N., "Geoenvironmental Engineering, Contaminated Soils, Pollutant Fate, and Mitigation" CRC Press, New York, 2001.
4. Sharma H.D. and Reddy K.R., "Geoenvironmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Technologies" John Wiley & Sons, Inc., USA, 2004.
5. Fredlund D.G. and Rahardjo, H., "Soil Mechanics for Unsaturated Soils" Wiley-Interscience, USA, 1993.
6. Mitchell, J. K., "Fundamentals of Soil Behavior" Wiley, 2005.
7. Hillel D., "Introduction to Environmental Soil Physics" Academic Press, New York, 2003.

Course Code: CE463

Course Name: **Geosynthetics and Reinforced Soil structures**

Credits: **3 (3-0-0)**

Course Position: **Semester 6, 7 or 8**

Course Content:

Introduction: Historical background of reinforced soil, Principles of reinforced soil through Mohr circle analysis.

Different types of geosynthetics: Types of geosynthetics like geotextiles, geogrids, geonets, geocells, geo-composites, their manufacturing methods. Testing methods for geosynthetics: Techniques for testing of different index properties, strength properties, Apparent Opening Size, In-plane and cross-plane permeability tests, assessment of construction induced damage, extrapolation of long term strength properties from short term tests.

Reinforced Soil retaining walls: Different types of walls like wrap-around walls, full-height panel walls, discrete-facing panel walls, modular block walls Design methods as per BS-8006 and FHWA methods Construction methods for reinforced soil retaining walls.

Reinforced soil slopes: Basal reinforcement for construction on soft clay soils, construction of steep slopes with reinforcement layers on comptenet soils, Different slope stability analysis methods like planar wedge method, bi-linear wedge method, circular slip methods.Erosion control on slopes using geosynthetics.

Applications in foundations: Binquet and Lee's approach for analysis of foundations with reinforcement layers. Drainage and filtration applications of geosynthetics: Different filtration requirements, filtration in different types of soils and criteria for selection of geotextiles, estimation of flow of water in retaining walls, pavements, etc. and selection of geosynthetics.

Pavement application: Geosynthetics for separation and reinforcement in flexible pavements, design by Giroud-Noiray approach, reflection cracking and control using geosynthetics. Use of geosynthetics for construction of heavy container yards and raiway lines.

Construction of landfills using geosynthetics: Different components of modern landfills, collection techniques for leachate, application of different geosynthetics like geonets, geotextiles for drainage in landfills, use of geomembranes and Geosynthetic Clay Liner (GCL) as barriers.

REFERENCES

1. Koerner, R.M. "Designing with Geosynthetics", Prentice Hall, New Jersey, USA, 4th edition, 1999.
2. Jewell, R.A., "Soil Reinforcement with Geotextiles", Special Publication No. 123, CIRIA, Thomas Telford. London, UK, 1996.
3. Geosynthetics - New Horizons, Eds. G.V. Rao, PK Banerjee, J.T. Shahu, G.V. Ramana, Asian Books Private Ltd., New Delhi, 2004.
4. Design guidelines from FHWA, BS and other codal organizations.

Course Code: CE464
Course Name: Geotechnical Earthquake Engineering
Credits: 3 (3-0-0)
Course Position: Semester 6, 7 or 8

Course Content:

UNIT I : SEISMOLOGY AND EARTHQUAKES
Internal Structure of the Earth – Continental Drift and Plate Tectonics – Faults – Elastic rebound theory – Different sources of Seismic Activity – Geometric Notation – Location of Earthquakes – Size of Earthquakes.

UNIT II : DYNAMIC PROPERTIES OF SOILS
Measurement of Dynamic Properties of soils – Field Tests – Low strain – Seismic Reflection – Seismic Refraction – Horizontal layering – Steady State Vibration – Spectral analysis of surface wave – Seismic cross hole – Down Hole – Up hole – tests – Laboratory tests – Resonance Column Test – Bender Element – Cyclic Tri-axial test.

UNIT III : SEISMIC HAZARD ANALYSIS
Identification and Evaluation of Earthquake Sources – Geologic Evidence – Tectonic Evidence – Historical Seismicity – Instrumental Seismicity – Deterministic Seismic Hazard Analysis – Probabilistic Seismic Hazard Analysis.

UNIT IV : GROUND RESPONSE ANALYSIS
Ground Response Analysis – One Dimensional Linear – Evaluation of Transfer Function – Uniform undamped soil on rigid rock – Uniform damped soil on Rigid Rock – Uniform damped soil on elastic rock – layered damped soil on elastic rock – Equivalent linear Approximation – Deconvolution.

UNIT V : LIQUEFACTION ANALYSIS
Liquefaction – Flow liquefaction – Cyclic Mobility – Evaluation of liquefaction Hazards – Liquefaction Susceptibility – Criteria – Historical Geologic – Compositional – State – Evaluation of Initiation of Liquefaction – Cyclic stress approach – Characterization of Liquefaction Resistance – SPT Test – Various correction factor – Factor of Safety.

Text/Reference Books:

1. Kramer S. L. *Geotechnical Earthquake Engineering*, Pearson.
2. Day R. W. *Geotechnical Earthquake Engineering Handbook*, McGraw-Hill.

Course Code: **CE 465**

Course Name: **Ground Improvement Techniques**

Credits: **3 (3-0-0)**

Course Position: **Semester 6, 7 or 8**

Course Content

UNIT I : PROBLEMATIC SOIL AND IMPROVEMENT TECHNIQUES
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 based on soil conditions.

UNIT II : DEWATEREING
Dewatering Techniques – Well points – Vacuum and electroosmotic methods – Seepage analysis for two – dimensional flow for fully and partially penetrated slots in homogeneous deposits – Simple cases – Design.

UNIT III : INSITU TREATMENT OF COHESIONLESS AND COHESIVE SOILS
Insitu densification of cohesion-less soils and consolidation of cohesive soils: Dynamic compaction Vibroflotation, Sand compaction piles and deep compaction. Consolidation: Preloading with sand drains, and fabric drains, Stone columns and Lime piles-installation techniques – simple design – relative merits of above methods and their limitations.

UNIT IV : EARTH REINFORCEMENT
Concept of reinforcement – Types of reinforcement material – Reinforced earth wall – Mechanism – simple design – applications of reinforced earth. Role of Geotextiles in filtration, drainage, separation, road works and containment.

UNIT V : GROUT TECHNIQUES
Types of grouts – Grouting equipments and machinery – injection methods – Grout monitoring – stabilization with cement, lime and chemicals – stabilization of expansive soil.

Text/Reference Books:

1. Raju P. P. *Ground Improvement Techniques*, Laxmi Publications.
2. Moseley M. P. and Kirsch K. *Ground Improvement*, Spon Press.
3. Das B. M. *Principles of Foundation Engineering*, Cengage Learning.
4. Indraratna B. and Chu J. J. *Ground Improvement: Case Histories*, Elsevier.
5. Raison C. A. *Ground and Soil Improvement*, Thomas Telford.
6. Koerner R. M. *Designing with Geosynthetics*, Pearson.

Course Code: **CE 466**
Course Name: **Risk Assessment and Management in Geotechnical Engineering**
Credits: **3 (3-0-0)**
Course Position: **Semester 6, 7 or 8**

Course content

Introduction to probabilistic geotechnical engineering, variability measures, random variables, probability mass and density functions, moments of distribution, modelling of uncertainty, engineering judgment, spatial variability of soil, autocovariance functions, functions of random fields, levels of reliability, loads and resistances, reliability methods, first order second moment (FOSM) method, Hasofer-Lind approach, Response Surface Method, Monte Carlo simulations.

1 Introduction

2 Models

3 Geological risks

4 An engineer's assessment of risk of slope stability

5 Probabilistic slope instability analyses

6 Probabilistic dam safety evaluations

7 The importance of engineering judgement

Text/Reference Books:

1. Haldar A. and Mahadevan S. *Probability, Reliability, and Statistical Methods in Engineering Design*, John Wiley.
2. Baecher G. and Christian J. *Reliability and Statistics in Geotechnical Engineering*, John Wiley.
3. Ang A. H. S. and Tang W. H. *Probability Concepts in Engineering Planning and Design: Basic Principles (Vol. I)*, John Wiley.
4. Ang A. H. S. and Tang W. H. *Probability Concepts in Engineering Planning and Design: Decision, Risk, and Reliability (Vol. II)*, John Wiley.
5. Ang A. H. S. and Tang W. H. *Probability Concepts In Engineering: Emphasis On Applications In Civil & Environmental Engineering*, Wiley.
6. Melchers R. E. *Structural Reliability Analysis and Prediction*, John Wiley.
7. Nowak A. S. and Collins K. R. *Reliability of Structures*, CRC Press.
8. Vanmarcke E. *Random Fields: Analysis and Synthesis*, MIT Press.

Course Code: CE 467
Course Name: Rock Mechanics
Credits: 3 (3-0-0)
Course Position: Semester 6, 7 or 8

Course Content:

Classification of Rocks and Rock masses, Laboratory and in-situ testing of rock, insitu stresses and their measurement, Analysis and design of underground openings, Failure criteria for rock and rock masses.

Strength and deformability of jointed rock mass, Stability of rock slopes, Foundation on rocks. Methods to improve rock mass responses, numerical modeling of rock and rock masses.

Text/Reference Books:

1. Introduction to Rock Mechanics by R.E.Goodman, John Wiley & Sons.
2. Engineering in Rocks for Slopes, Foundation and Tunnels, Editor T.Ramamurthy, Prentice Hall India Pvt. Ltd.
3. Fundamentals of Rock Mechanics, Fourth Edition, by Jaeger, Cook and Zimmerman, Blackwell Publishing.
4. Rock mechanics and the design of structures in rock, L. Obert and Wilbur I. Duvall, John Wiley & Sons, Inc.

Course Code: **CE 468**
Course Name: **Soil Dynamics and Machine Foundations**
Credits: **3 (3-0-0)**
Course Position: **Semester 6, 7 or 8**

Course Content:

Introduction, vibration theories, analysis of free and forced vibrations using spring dashpot model, single degree of freedom system, multi-degrees of freedom system, application of single and multi-degree of freedom systems, wave propagation in elastic media, laboratory and field evaluation of dynamic soil properties, Design of Machine Foundations.

Text/Reference Books:

1. Saran S. *Soil Dynamics and Machine Foundations*, Galgotia.
2. Das B. M. and Ramana G. V. *Principles of Soil Dynamics*, CL-Engineering.
3. Richart F. E., Woods R. D. and Hall J. R. *Vibrations of soils and foundations*, Prentice.
4. Kramer S. L. *Geotechnical Earthquake Engineering*, Prentice.

Course Code: **CE 469**
Course Name: **Soil – Structure Interaction**
Credits: **3 (3-0-0)**
Course Position: **Semester 6, 7 or 8**

Course content

Introduction to soil foundation interaction problems, soil behaviour, foundation behaviour, interface behaviour, concept of subgrade modulus, effects/parameters influencing subgrade modulus soil foundation interaction analysis, Winkler, elastic continuum, two parameter elastic model, Elastic Plastic behaviour, time dependent behaviour, elastic analysis of single pile, theoretical solutions for settlement and load distributions, analysis of pile group, interaction analysis, Load deflection prediction for laterally loaded piles, other applications.

Text/Reference Books:

1. Selvadurai A. P. S. *Elastic analysis of soil foundation interaction*, Elsevier Science.
2. Davis R. O. and Selvadurai A. P. S. *Plasticity and Geomechanics*, Cambridge University Press.
3. Davis R. O. and Selvadurai A. P. S. *Elasticity and Geomechanics*, Cambridge University Press.
4. Poulos H. G. and Davis E. H. *Pile Foundation Analysis and Design*, Wiley
5. Bull J. W. *Soil structure interaction: numerical analysis and modelling*, Spon.

Course Code: **CE 470**
Course Name: **Introduction to Continnum Mechanics**
Credits: **3 (3-0-0)**
Course Position: **Semester 6, 7 or 8**

Course Content:

Module 1: Introduction: The continuum concept: definition and significance – Vectors and tensors: a brief introduction – Review of vector algebra – Indicial notation and the summation convention – Kronecker delta and permutation symbol – Theory of matrices – Review of vector calculus – Tensors: an introduction – Dyads and dyadics – Nonion form of a second-order tensor – Transformation of components of a tensor – Tensor calculus: an introduction – Eigenvalues and eigenvectors.

Module 2: Kinematics of continua: Descriptions of motion – Analysis of deformation – Strain measures – Infinitesimal strain tensor and rotation tensor – Velocity gradient and vorticity tensors – Compatibility equations – Rigid-body motions – Polar decomposition theorem.

Module 3: Stress measures: Cauchy stress tensor – Transformation of stress components – Principal stresses – First and second Piola-Kirchhoff stress tensors – Equilibrium equations for small deformations – Objectivity of stress tensors: a brief introduction.

Module 4: Conservation and balance laws: Conservation of mass – Material time derivative – Vector and integral identities – Continuity equation in spatial description – Continuity equation in material description – Reynolds transport theorem – Balance of linear and angular momentum – Balance of energy – Entropy inequality.

Module 5: Constitutive equations: Introduction – General principles of constitutive theory – Material frame indifference – Restrictions placed by entropy inequality – Elastic materials – Cauchy-elastic materials – Green-elastic or hyperelastic materials – Hookean solids – Generalized Hooke's law – Material symmetry planes – Monoclinic, orthotropic and isotropic materials.

Recommended textbooks / references:

1. J.N. Reddy, *An Introduction to Continuum Mechanics*, 2nd edition, Cambridge University Press, 2013.
2. W.M. Lai, D. Rubin, E. Krempl, Introduction to Continuum Mechanics, 4th edition, Butterworth Heinemann, 2009.
3. A.J.M. Spencer, *Continuum Mechanics*, Dover Publications, 2004.

Course Code: **CE 471**
Course Name: **Introduction to Finite Element Analysis**
Credits: **3 (3-0-0)**
Course Position: **Semester 6, 7 or 8**

Course Content:

Module 1: Introduction: Brief history of the finite element method (FEM) – Overview of finite element (FE) modeling: Representation of system as assemblage of elements; discretization; calculation of element properties; assembly of elements; formulation of system equations from element equations; solution of system equations using basic matrix algebra – Examples of applications in industry and research.

Module 2: Mathematical preliminaries for finite element analysis: Coordinate systems – Initial value, boundary value and eigenvalue problems – Integral identities – Linear and bilinear functionals – Introduction to calculus of variations – Integral formulations – Variational methods.

Module 3: One-dimensional elements: Introduction – Spring element – Derivation of stiffness matrix for spring element – Spring assemblage – Assembly of total stiffness matrix by superposition – Boundary conditions – Derivation of spring element equations using potential energy approach – Bar element – Derivation of stiffness matrix for bar element in local coordinates – Selection of approximation functions for displacements – Transformation of vectors in two dimensions – Global stiffness matrix for bar element – Derivation of bar element equations using potential energy approach.

Module 4: Basic two-dimensional elements: Introduction – Interpolation – Shape functions – Element matrices – Linear triangle: interpolation functions, element matrices and element defects – Quadratic triangle: interpolation functions – Bilinear rectangle: interpolation functions, element matrices and element defects – Quadratic rectangle: interpolation functions.

Module 5: Weighted residual methods and isoparametric elements: Galerkin method – Introduction and one-dimensional bar example – Other weighted residual methods – One-dimensional finite element form of the Galerkin method – Introduction to the concept of isoparametric elements.

Recommended textbooks / references:

1. R.D. Cook, D.S. Malkus, M.E. Plesha, R.J. Witt, *Concepts and Applications of Finite Element Analysis*, 4th edition, Wiley, 2003.
2. J.N. Reddy, *An Introduction to the Finite Element Method*, 3rd edition, McGraw Hill Education, 2006.
3. D.L. Logan, A First Course in the Finite Element Method, 4th edition, Cengage Learning, 2007.
4. P. Seshu, *Textbook of Finite Element Analysis*, PHI Learning, 2003.

Course Code: **CE 472**
Course Name: **Introduction to Fracture Mechanics**
Credits: **3 (3-0-0)**
Course Position: **Semester 6, 7 or 8**

Course Content:

Module 1: Introduction: Overview of structural failure – Brief history of fracture research – The fracture mechanics approach to design – Energy criterion – Stress intensity approach – Time-dependent crack growth – Damage tolerance – Effect of material properties on fracture – Brief review of dimensional analysis – Buckingham Π- theorem – Dimensional analysis in fracture mechanics.

Module 2: Linear elastic fracture mechanics: Introduction – Stress concentration effect of flaws – Griffith energy balance – Energy release rate – Instability – The R curve – Stress analysis of cracks – Stress intensity factor – Relation between stress intensity factor and energy release rate – Crack tip plasticity – K-controlled fracture – Plane strain fracture – Mixed-mode fracture.

Module 3: Elastic-plastic fracture mechanics: Introduction – Crack tip opening displacement (CTOD) – The J contour integral concept – Nonlinear energy release rate – J as a path-independent line integral – J as a stress intensity factor – Relationships between J and CTOD – Crack growth resistance curves – Stable and unstable crack growth.

Module 4: Fracture mechanisms: Fracture mechanisms in metals – Ductile fracture: void nucleation, void growth and coalescence, ductile crack growth – Cleavage fracture – Ductile-to-brittle transition – Intergranular fracture – Brief introduction to fracture mechanisms in concrete.

Module 5: Fatigue of metals: Introduction – Stress cycles – The *S-N* curve – Statistical nature of fatigue – Theories of fatigue – Effect of stress concentration on fatigue – Size effect – Effect of mean stress on fatigue.

Recommended textbooks / references:

1. T.L. Anderson, *Fracture Mechanics: Fundamentals and Applications*, 3rd edition, CRC Press, Taylor and Francis Group, 2005.
2. T. Kundu, *Fundamentals of Fracture Mechanics*, CRC Press, Taylor and Francis Group, 2008.
3. P. Kumar, *Elements of Fracture Mechanics*, Tata McGraw-Hill, 2009.
4. G.E. Dieter, *Mechanical Metallurgy*, 3rd edition, McGraw Hill Education, 2017.

Course Code: **CE 473**
Course Name: **Introduction to Structural Health Monitoring**
Credits: **3 (3-0-0)**
Course Position: **Semester 6, 7 or 8**

Course Content:

Module 1.

An Overview of Structural Health Monitoring, Need for Structural and Performance Health Monitoring, Structural Health Monitoring versus Non Destructive Evaluation, Passive and active SHM, Type of sensors for SHM, An Overview of Smart Materials.

Module 2.

Piezoelectricity and Piezoelectric Materials, Electromechanical Coupling in Piezoelectric Devices, Physical Basis for Electromechanical Coupling in Piezoelectric Materials, Constitutive Equations for Linear Piezoelectric Material. Common Operating Modes of a Piezoelectric Transducer.

Module 3.

Non Destructive Testing of Concrete Structures, SHM in civil engineering, Different types of SHM techniques, Vibration based techniques, Electro-Mechanical Impedance Technique for civil engineering applications, Impedance Models for Structural Health Monitoring Using Piezo-Impedance Transducers. Data Acquisition and processing.

Module 4.

Capacitive Methods for SHM in civil engineering, Data Acquisition and processing, Case studies in civil engineering.

Reference:

Adams Douglas E., 2007, Health Monitoring of Structural Materials and Components: Methods with Applications, John Wiley & Sons Inc.

Zhongqing Su, Lin Ye, Ye Lu, Guided Lamb waves for identification of damage in composite structures: A review, Journal of Sound and Vibration, 2006.

Course Code: **CE 474**
Course Name: **Earthquake Engineering**
Credits: **3 (3-0-0)**
Course position: **Semester 6,7 or 8**

Unit-I

Introduction to Earthquake Engineering: Engineering Seismology, Earthquake phenomenon, Causes and effects of earthquakes, Failures of structures in past earthquakes and lessons learnt, Faults Structure of earth, Plate Tectonics, Elastic Rebound Theory, Earthquake Terminology, Source, Focus, Epicenter, Earthquake size. Magnitude and intensity of earthquakes, Classification of earthquakes, Seismic waves, Seismic zones, Seismic Zoning Map of India, Seismograms and Accelerograms.

Unit-II

Codal Design Provisions: Review of the latest Indian seismic code IS:1893 –2002 (Part-I) provisions for buildings, Earthquake design philosophy, Assumptions, Analysis of multi storied building by seismic coefficient and response spectrum methods, Displacements and drift requirements, Provisions for torsion.
Codal Detailing Provisions: Review of the latest Indian codes IS: 4326 and IS: 13920 Provisions for ductile detailing of R.C buildings, Beam, column and joints.

Unit-III

Aseismic Planning: Plan Configurations, Torsion Irregularities, Re-entrant corners, Non parallel systems, Diaphragm Discontinuity, Vertical Discontinuities in load path, Irregularity in strength and stiffness, Mass Irregularities, Vertical Geometric Irregularity, Proximity of Adjacent Buildings.

Unit-IV

Earthquake Resistant design of masonry building: Identification of damages and no-damages in masonry building from past earthquakes, lesson learnt, Elastic properties of structural masonry, lateral load analysis of masonry building, Design of masonry building.

Unit-V

Innovative Strategies in Earthquake Engineering: Introduction to P-BSD, Energy Equations, concepts of damage control structures

References:

1. Elements of earthquake engineering Jaikrishna and Chandrasekaran.
2. Earthquake Resistant Design of Structures - Pankaj Agarwal and Manish Shrikhande
3. Earthquake Engineering: From Engineering Seismology to Performance-Based Engineering - Yousef Bozorgnia, Vitelmo V. Bertero

Course Code: **CE 475**
Course Name: **Dynamics of structures**
Credits: **3 (3-0-0)**
Course position: **Semester 6, 7 or 8**

UNIT I : Theory of vibrations: Introduction - Elements of vibratory system, Degrees of Freedom, Continuous System - Lumped mass idealization - Oscillatory motion, Simple Harmonic motion, Vectorial representation of S.H.M, Free vibrations of single degree of freedom system - undamped and damped vibrations, critical damping, Logarithmic decrement, Forced vibration of SDOF systems, Harmonic excitation, Vibration Isolation, Dynamic magnification factor, Phase angle.

UNIT II : Introduction to Structural Dynamics : Fundamental objectives of dynamic analysis, Types of prescribed loading - Methods of discretization - Formulation of equations of motion by different methods, Direct equilibration using Newton's law of motion / D'Alembert's principle, Principle of virtual work and Hamilton principle.
Single Degree of Freedom Systems : Formulation and solution of the equation of motion, Free vibration response, Response to Harmonic, Periodic, Impulsive and general dynamic loadings - Duhamel integral.

UNIT III : Multi Degree of Freedom Systems : Selection of the degrees of Freedom, Evaluation of structural property matrices, Formulation of the MDOF equations of motion, Undamped free vibrations, Solutions of Eigen value problem for natural frequencies and mode shapes, Analysis of Dynamic response, Normal co-ordinates, Uncoupled equations of motion, Orthogonal properties of normal modes, Mode superposition procedure.

UNIT IV : Practical Vibration Analysis: Introduction to Stodola method, Fundamental mode analysis, Analysis of second and higher modes, Holzer method, Basic procedure.
Continuous Systems: Introduction, Flexural vibrations of beams - Elementary case – Derivation of governing differential equation of motion - Analysis of undamped free vibrations of beams in flexure - Natural frequencies and mode-shapes of simple beams with different end conditions - Principles of application to continuous beams.

UNIT V: Introduction to Earthquake Analysis: Excitation by rigid base translation, Lumped mass approach, SDOF and MDOF systems, Theory of Response Spectrum Method, analysis for obtaining response of multi storeyed buildings.

References:
1. "Dynamics of structures" by Anil K Chopra
2. "Structural Dynamics" by Clough & Penzin
3. "Theory of Vibrations" by Thompson
4. "Elements of vibration analysis" by Leonard Mirovitch
5. "Structural dynamics" by Madhujit Mukhopadyay

Course Code:	**CE 480**
Course Name:	**Sanitary Engineering and Design**
Credits:	**3 (3-0-0)**
Course position:	**Semester 6, 7 or 8**

Unit -I: Sanitation

Sewage Characteristics - sewer sewage and sewerage -methods of collection - conservancy system, water carriage system - classification of sewerage systems - quantity of sanitary sewage - fluctuation in sewage flow - design of flow of sewage for separate, storm and combined sewers – full flow and partial flow conditions - design of separate sewers using Manning's formula.

Unit -II: Sewer Materials, Construction and Appurtenances

Materials for pipe sewers - construction - laying ,jointing, dewatering and testing - sewer appurtenances - traps - plumbing system of drainage – one pipe system and two pipe system of plumbing - sanitary fittings.

Unit-III –Sewage Treatment

Primary treatment - objectives - screening - grit chamber and primary sedimentation tanks design. **Secondary Treatment** Principles, functions and design - activated sludge unit and trickling filter - septic tank - sludge digestion tank - oxidation pond- aerobic reactor- anaerobic reactor.

Unit IV- Tertiary Treatment

Disinfection Systems: Chemicals- Chlorination and other Disinfection methods, UV, Ozonation, Aeration and Gas transfer; Precipitation;

Softening; Adsorption and Ion exchange; Reverse Osmosis Technologies Membrane processes, Ultra Filtration,

Unit V- SEWAGE DISPOSAL, SLUDGE MANAGEMENT AND SOLID WASTE MANAGEMENT

Sewage Disposal – Dilution - self-purification of running streams - oxygen sag curve land disposal - sewage farming - deep well injection - soil dispersion system. Objectives of sludge treatment - properties and characteristics of sludge - sludge digestion - thickening - dewatering - conditioning - drying beds - biogas recovery. solid waste -generation-collection-conveyance-disposal.

Text Books

1. Wastewater Engineering Treatment and Reuse, Metcalf and Eddy
2. Duggal .K.N, "Elements of Environmental Engineering", S. Chand & Company Ltd., New Delhi, 2002.

References

1. Garg .S.K "Sewage Disposal & Air Pollution," Khanna Publishers, New Delhi, 2004.
2. "Manual on Sewerage & Sewage Treatment", CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2009.
3. Paneerselvam .R "Environmental Engineering", Vol. II, SPGS Publishers Chennai, 2006.

Course Code: **CE 481**
Course Name: **Advanced Waste Water Treatment and Design**
Credits: **3 (3-0-0)**
Course position: **Semester 6, 7 or 8**

Unit-1 Advance Wastewater treatment design:

Need for advanced waste water treatment-technologies used for advanced treatment-goals of advanced treatment-combination of unit operations and processes with treatment flow sheets-Effluent polishing.

Unit -2 Nutrient Removal

Nitrogen – sources, forms, nitrification and denitrification processes-phosphorous –sources, forms, chemical and biological methods of treatment-air stripping.

Unit-3 Adsorption

Adsorption processes – Adsorption equilibria – Adsorption isotherm – Adsorption kinetics – Influencing factors – Design of adsorption units.

Unit 4 - Filtration and Membrane Process

Filtration processes – membrane filtration processes – reverse osmosis – membrane properties – ultra filtration – Electrodialysis – process design and applications.

Unit 5 - Ion Exchange and Chemical Oxidation

Exchange processes – exchange materials – exchange reactions – column design procedure – Application of ion–exchange in water and waste water treatments. Chemical oxidation – principles and theories of chemical oxidation – properties, generation and applications of oxygen, permanganate, chlorine dioxide, etc.

Text Book:

1. Weber .W.J, “Physiochemical processes for water quality control”, Wiley Interscience, 2002.
2. Metcalf & Eddy., “Wastewater engineering Treatment and Reuse”, Tata McGraw Hill publications, 2003.

References:

1. Rich .L.G, “Unit operations of sanitary engineers”, Wiley Topan, 2001.
2. Fair .G.M., “Water and Waste water engineering Vol.I & II .John Wiley and Sons”, Newyork, 2005.

Course Code: **CE 482**
Course Name: **Environmental Impact Assessment**
Credits: **3 (3-0-0)**
Course position: **Semester 6, 7 or 8**

Unit I: Introduction Impact of development projects – Sustainable development- Need for Environmental Impact Assessment (EIA) – Environmental Impact Statement (EIS) – EIA capability and limitations – Legal provisions on EIA-Stages of EIA, Types of EIA

Unit II: Methodologies: Methods of EIA – Check lists – Matrices – Networks – Cost-benefit analysis Analysis of alternatives.

Unit III: Prediction And Assessment: Assessment of Impact on land, water, air, social & cultural activities and on flora & fauna- Mathematical models- Public participation

Unit IV: Environmental Management Plan: Plan for mitigation of adverse impact on environment – Options for mitigation of impact on water, air, land and on flora & fauna – Addressing the issues related to the Project Affected People. Post project monitoring

Unit V: Case Studies: EIA for infrastructure projects – Dams – Highways – Multi-storey Buildings, Metros rail, Water Supply and Drainage Projects – Waste water treatment plants, STP.

Textbooks:

Canter, R.L., "Environmental Impact Assessment", McGraw Hill Inc., New Delhi, 1996.

Shukla, S.K. and Srivastava, P.R., "Concepts in Environmental Impact Analysis", Common Wealth Publishers, New Delhi, 1992.

REFERENCES:

John G. Rau and David C Hooten "Environmental Impact Analysis Handbook", McGraw Hill Book Company, 1990.

"Environmental Assessment Source book", Vol. I, II & III. The World Bank, Washington, D.C., 1991.

Judith Petts, "Handbook of Environmental Impact Assessment Vol. I & II", Blackwell Science, 1999.

Course Code: **CE 483**
Course Name: **Industrial Waste Management**
Credits: **3 (3-0-0)**
Course position: **Semester 6, 7 or 8**

Unit I - Industrialization:

Industrial activity and environment-industrialization and sustainable development indicators of sustainability-sustainability strategies-Barriers to sustainability- Pollution prevention in achieving sustainability-Prevention Vs control of industrial pollution-Environment policies and Regulations to encourage pollution prevention- Types of industries and industrial pollution - Characteristics of industrial wastes - Population equivalent

Unit II - Waste Water Treatment

Sources, Characteristics, waste treatment flow sheets for selected industries such as Textiles, Tanneries, Dairy, Sugar, distilleries, Refineries, thermal power plants, Chemical Industry, Electroplating Industry - Wastewater reclamation concepts.

Unit III - Regulatory Boards

Environment friendly chemical processes-Properties of environmental contaminants - Regulations for clean environment and implications for industries- International environmental standards-Environmental technology assessment.

Unit IV - Source Reduction Techniques

Waste management Approach - Waste Audit - Volume and strength reduction - Material and process modifications - Recycle, reuse and byproduct recovery - Applications-residuals management-Economic recovery and recycling of wastes.

Unit V - Hazardous Waste Management

Hazardous wastes - Physico chemical treatment - solidification - incineration - Secured land fills-Industrial applications of pollution prevention, Life cycle assessment, and technology assessments.

Books

1. James G. Mann and Y.A.Liu, "Industrial Water Reuse and Waste Water Minimization", McGraw Hill, 2009.
2. Eckenfelder .W.W, "Industrial Water Pollution Control", McGraw-Hill, 2009.
Reference
1. Freeman H.M., "Industrial Pollution Prevention Hand Book", McGraw Hill, 2005.
2. Arceivala ,S.J., "Wastewater Treatment for Pollution Control", Tata McGraw- Hill, 2008.
3. Frank Woodard., “Industrial waste treatment Handbook”, Butterworth Heinemann, New Delhi, 2010.
4. World Bank Group "Pollution Prevention and Abatement Handbook - Towards Cleaner Production”, World Bank and UNEP, Washington D.C.2008.
5. Paul L. Bishop "Pollution Prevention: - Fundamentals and Practice", McGraw-Hill International, 2010.

Course Code: **CE 484**
Course Name: **Design of Environmental Engineering Structures**
Credits: **3 (3-0-0)**
Course position: **Semester 6, 7 or 8**

Unit-1- Design of Pipes

Structural design of - Concrete - Prestressed Concrete - Steel - Castiron piping mains- sewerage tanks design – anchorage for pipes – massive outfalls – structural design and laying – hydrodynamic considerations-Advances in the manufacture of pipes.

Unit –II Analysis and Design of Water Tanks

Design of concrete roofing systems - Cylindrical - Spherical - Conical shapes using membrane theory and design of various types of folded plates for roofing with concrete- IS Codes for the design of water retaining structures- Design of circular- rectangular- spherical and Intze type of tanks using concrete- Design of prestressed concrete cylindrical tanks – Economic analysis – introduction to computer aided design and packages.

Unit –III Design of Special Purpose Structures

Underground reservoirs and swimming pools- Intake towers- Structural design including foundation of water retaining structures such as settling tanks clarifloculators- aeration tanks etc – effect of earth pressure and uplift considerations – selection of materials of construction.

Unit –IV Repair and Rehabilitation of Structures

Diagonising the cause and damage- identification of different types of structural and nonstructural cracks – repair and rehabilitation methods for Masonry- Concrete and Steel Structures.

Unit –V Environmental Engineering Steel Structures

Exposure on Steel- Lattice Structures used in water and sewerage works.

Text Books

1. Dayaratnam, P., “Reinforced Concrete”, Khanna Publishers, 2005.

2. Krishna Raju, “Prestressed Concrete”, 2nd Edn,Tata McGraw-ill Publishing Co. 2008.

References

1. Sinha .N.C and Roy .S.K, “Reinforced Concrete”, S.Chand and Co. 2005.

2. Hulse .R and Mosley .W.H, “Reinforced Concrete Design by Computer”, Macmillan Education Ltd., 2006.

3. Ramaswamy .G.S, “Design and Construction of Concrete Shell Roofs”, CBS Publishers, 2006.

4. Green .J.K and Perkins .P.H, “Concrete liquid retaining structures”, Applied Science Publishers, 2001.

Course Code: **CE 485**
Course Name: **RS and GIS for Environmental Engineering**
Credits: **3 (3-0-0)**
Course position: **Semester 6, 7 or 8**

Unit-1- Remote Sensing Application in Environmental Engg.

Introduction – Environmental Satellites: GOES, NOAA, AVHRR, CZCR –Monitoring land, water, atmosphere and ocean using Remote Sensing data – Case studies.

Unit –II - Soil Degradation Study Using GIS and Remote Sensing

Taxonomical classification of soils – soil survey Interpretation and mapping – Impact ofagricultural and Industrial activity on soil properties – Soil salinity / alkalinity, erosion studies –Application of GIS in assessing soil salinity, erosion productivity etc.,

Unit –III - GIS in water quality management

Classification of water quality-Conceptualization of Hydrogeology- Aspects of Water Budget-Database creation and Water quality modeling using GIS. Database creation and maintaining water supply network – Case studies.

Unit –IV - GIS Application in Pollution Monitoring and Modeling

Aquifer – Vulnerability Intrinsic & Specific Vulnerability, DRASTIC, SINTACS MODELS, MODFLOW, MT3D, contaminant transport model

Unit –V- GIS Applications in Air Quality Monitoring and Modeling

Atmosphere: chemicals, Particulate matters present in the atmosphere, allowable limits –Remote Sensing technique to monitor atmosphere constituents, air pollution due to industrialactivity – monitoring & modeling using GIS.

Text Book

1. Sabins .F, "Remote Sensing Principles and Interpretation", W. H. Freeman and Company, 2007.

Reference

1. "World in transition: The threat to Soils" Annual Report of the Germon Advisory Council on Global change, Economical Verlag, 2004.

2. "Ground Water vulnerability assessment: Predicting Relative Contamination PotentialUnder Conditions of Uncertainty", National Academic Press, 2003.

3. Savigny. D. and Wijeyaratne .P., "GIS for Health and Environment", Stylus Publication, 2005.

4. Allaric Sample .V.,"Remote Sensing and GIS for Eco System Management". Island Press, 2006.

MALPRACTICES RULES

DISCIPLINARY ACTION FOR IMPROPER CONDUCT IN EXAMINATIONS
As guidelines for the disciplinary committee to recommend actions to the Director.

	Nature of Improper conduct	Punishment
	If the candidate:	
1.(a)	Possesses or keeps accessible in examination hall, any paper, book, programmable calculator, Cell phone, pager, palm computer or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculator, palm computer or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The Hall Ticket of the candidate will be cancelled.

3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the subjects of the examination (including practical and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all the corresponding examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.
4.	Smuggles in the answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all the corresponding examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to	Cancellation of performance in that subject.

	award pass marks.	
6.	Refuses to obey the orders of the Chief Superintendent or Assistant Superintendent or any officer on duty, or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in-charge or any person on duty in or outside the examination hall or causes any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge or any person on duty in or outside the examination hall or any of his relations or indulges in any other act of misconduct or mischief which results in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all the corresponding examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture

		of seat.
8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9.	If a student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clauses 6, 7 or 8.	Punishment for students of the college: Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. A person who does not belong to the College will be handed over to police and, a police case will be registered against them.
10.	Comes in an intoxicated condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year.

12.	If any malpractice is detected, which is not covered in the above clauses 1 through 11, the same shall be reported for further action to award suitable punishment.	