Department: Civil Engineering

Curriculum Structure & Syllabus

(Effective from 2018-19 admission batch)

Under Autonomy (**GR A:** ECE, EE, EIE, BME; **GR B:** CSE, IT, ME, CE, FT)

1st Semester								
Sl No	**Course Type**	**Course Code**	**Theory**	**Contact Hours /Week**				**Credit Points**
				L	**T**	**P**	**Total**	
A. THEORY								
1	BS	M 101	Mathematics -I	3	1	0	4	4
2	BS	CH 101/ PH 101	Chemistry (Gr. A) / Physics- I (Gr. B)	3	0	0	3	3
3	ES	EE 101/ EC 101	Basic Electrical Engineering (Gr. A) / Basic Electronics Engineering (Gr. B)	3	0	0	3	3
4	HS	HU 101	English	2	0	0	2	2
Total of Theory							**12**	**12**
B. PRACTICAL								
5	BS	CH 191/ PH191	Chemistry Lab (Gr. A) / Physics- I Lab (Gr. B)	0	0	3	3	1.5
6	ES	EE 191/ EC 191	Basic Electrical Engineering Lab (Gr. A) / Basic Electronics Engineering Lab (Gr. B)	0	0	3	3	1.5
7	ES	ME 191/ ME 192	Engineering Graphics & Design (Gr A) / Workshop/Manufacturing Practices (Gr-B)	0	0	3	3	1.5
8	PROJ	PR 191	PROJECT-IA	0	0	1	1	0.5
9	PROJ	PR 192	PROJECT-IB	0	0	1	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
10	MC	MC 181	Induction Program	0	0	0	0	
Total of Theory, Practical & Mandatory Activities/Courses							**23**	**17.5**

Syllabus- 1st Semester

Course Name: Mathematics-I

Course Code: M 101

Contact: 3:1:0

Total Contact Hours: 48

Credits: 4

Prerequisites:

The students to whom this course will be offered must have the concept of (10+2) standard matrix algebra and calculus.

Course Objectives:

The objective of this course is to disseminate the prospective engineers with techniques in matrix algebra and calculus. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Course Outcomes:

COs	DESCRIPTIONS
CO1	Recall the distinctive characteristics of matrix algebra and calculus.
CO2	Understand the theoretical working of matrix algebra and calculus.
CO3	Apply the principles of matrix algebra and calculus to address problems in their disciplines.
CO4	Examine the nature of system using the concept of matrix algebra and calculus.

Course Content:

Module I: Matrix Algebra (11)

Echelon form and Normal (Canonical) form of a matrix; Inverse and rank of a matrix; Consistency and inconsistency of system of linear equations, Solution of system of linear equations; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton theorem.

Module II: Differential Calculus and Infinite Series (10)

Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Concept of sequence and series, Tests for convergence of infinite series: Comparison test, D'Alembert's ratio test, Raabe's test, Cauchy's root test, Power series; Taylor's series, Series for exponential, trigonometric and logarithm functions.

Module III: Multivariable Calculus (Differentiation) - I (9)

Function of several variables, Concept of limit, continuity and differentiability; Partial derivatives, Total derivative and its application; Chain rules, Derivatives of implicit functions Euler's theorem on homogeneous function, Jacobian.

Module IV: Multivariable Calculus (Differentiation) - II (7)

Maxima and minima of functions of two variables, Method of Lagrange multipliers; Directional derivatives, Gradient, Divergence, Curl.

Module V: Integral Calculus (11)

Evolutes and involutes; Evaluation of definite integrals and its applications to evaluate surface areas and volumes of revolutions; Improper integrals; Beta and Gamma functions and their properties.

Text Books:

1. Kreyszig, E., Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Ramana, B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. Veerarajan, T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
5. Bali, N.P. and Goyal, M., A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

Reference Books:

1. Thomas, G.B. and Finney, R.L., Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. Apostol, M., Calculus, Volumes 1 and 2 (2nd Edition), Wiley Eastern, 1980.
3. Kumaresan, S., Linear Algebra - A Geometric approach, Prentice Hall of India, 2000.
4. Poole, D., Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
5. Bronson, R., Schaum's Outline of Matrix Operations. 1988.
6. Piskunov, N., Differential and Integral Calculus, Vol. I & Vol. II, Mir Publishers, 1969

CO-PO Mapping:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	3	2	-	-	-	-	-	-	-	-	-	1
CO2	3	2	-	-	-	-	-	-	-	-	-	1
CO3	3	2	2	-	-	-	-	-	-	-	-	1
CO4	2	3	1	-	-	-	-	-	-	-	-	1

Course Name: Physics –I

Course Code: PH 101

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Pre requisites: Knowledge of Physics up to 12^{th} standard.

Course Objective:

The aim of courses in Physics is to provide an adequate exposure and develop insight about the basic physics principles along with the possible applications. The acquaintance of basic principles of physics would help engineers to understand the tools and techniques used in the industry and provide the necessary foundations for inculcating innovative approaches. It can also create awareness of the vital role played by science and engineering in the development of new technologies. It also gives necessary exposure to the practical aspects, which is an essential component for learning sciences.

Course Outcomes:

CO1: Describe various types mechanical resonance and its electrical equivalence

CO2: Explain basic principles of Laser, Optical fibers and various types of semiconductors

CO3: Apply superposition to explain interference and diffraction as well as apply wave mechanics to attainment of Heisenberg's uncertainty principle

CO4: Analyze importance of light as a carrier of information and examine different crystallographic structures according to their co-ordination number and packing factors

CO5: Justify the need of a quantum mechanics as remedy to overcome limitations imposed by classical physics

Course Content:

Module 1 (6L):
Waves & Oscillations:
Simple Harmonic Motion (only preliminary idea), damped harmonic motion-over damped, critically damped and under damped motion, energy decay, logarithmic decrement, force vibration and resonance (amplitude, velocity resonance), sharpness of resonance, quality factor, related numerical problems.

Module 2 (8L):
Classical Optics:
2.01- Interference of light: Huygens's principle, superposition of waves, conditions of sustained interference, Newton's ring (qualitative descriptions of working principles and procedures-no deduction required). Engineering applications, Numerical Problems.

2.02- Diffraction of light: Fresnel and Fraunhofer class, Fraunhoffer diffraction of a single slit, multiple slits, intensity distributions, missing order, Rayleigh criterion (no deduction) and resolving power of grating and microscope (no deduction), related numerical problems.

Module 3 (8L):
Quantum Mechanics-I:
3.01 Quantum Theory: Inadequacy of classical physics and its modifications by Planck's quantum hypothesis-qualitative (no deductions), particle concept of electromagnetic wave (example: photoelectric and Compton Effect; no derivation required, origin of modified and unmodified lines), wave particle duality; phase velocity and group velocity; de Broglie hypothesis; Davisson and Germer experiment.
3.02 Quantum Mechanics 1: Concept of wave function, physical significance of wave function, probability interpretation; normalization of wave functions; uncertainty principle, relevant numerical problems.

Module 4 (7L):
Solid State Physics-I:
4.01 Crystal Structure: Structure of solids, amorphous and crystalline solids (definition and examples), lattice, basis, unit cell, Fundamental types of lattices –Bravais lattice, simple cubic, fcc and bcc lattices, Miller indices and miller planes, co-ordination number and atomic packing factor, Bragg's equation, applications, numerical problems.

4.02 Semiconductor: Physics of semiconductors, electrons and holes, metal, insulator and semiconductor, intrinsic and extrinsic semiconductor, p-n junction.

Module 5 (7L):
Modern Optics-I:
5.01- Laser: Concepts of various emission and absorption process, Einstein A and B coefficients and equations, working principle of laser, metastable state, population inversion, condition necessary for active laser action, optical resonator, illustrations of Ruby laser, He-Ne laser, Semiconductor laser, applications of laser.

5.02-Fibre optics: Principle and propagation of light in optical fibres- Numerical aperture and Acceptance angle, Numerical problems.

Text Books:

Waves & Oscillations:
1. Sound-N. K. Bajaj (TMH)
2. Advanced Acoustics-D. P. Roy Chowdhury (Chayan Publisher)
3. Principles of Acoustics-B.Ghosh (Sridhar Publisher)
4. A text book of sound-M. Ghosh (S. Chand publishers)
5. A text book of Light- K.G. Mazumder & B.Ghoshs, (Book & Allied Publisher)
6. Physics of Oscillations and Waves- R.P. Singh
7. College Physics Vol. II - A.B. Gupta
8. Vibration, Waves and Acoustics- Chattopadhyay and Rakshit

Classical & Modern Optics:
1. A text book of Light- K.G. Mazumder & B.Ghoshs (Book & Allied Publisher)
2. A text book of Light-Brijlal & Subhramanium, (S. Chand publishers)

3. Modern Optics-A. B. Gupta (Book & Allied Publisher)
4. Optics-Ajay Ghatak (TMH)
5. Optics-Hecht
6. Optics-R. Kar, Books Applied Publishers
7. Physical Optics Möler
8. Optics -F.A. Jenkins and H.E White

Quantum Mechanics-I

1. Introduction to Quantum Mechanics-S. N. Ghoshal (Calcutta Book House)
2. Quantum Mechanics-Bagde and Singh (S. Chand Publishers)
3. Perspective of Quantum Mechanics-S. P. Kuilla (New Central Book Agency)
4. Quantum Mechanics-Binayak Datta Roy (S. Chand Publishers)
5. Quantum Mechanics-Bransden (Pearson Education Ltd.)
6. Perspective of Modern Physics-A. Beiser (TMH)
7. Quantum mechanics -A.K. Ghatak and S Lokenathan
8. Modern Physics -E.E. Anderson
9. Physics Volume 2 -Haliday, Resnick & Krane, Published by Wiley India

Solid State Physics-I:

1. Solid state physics-Puri & Babbar (S. Chand publishers)
2. Materials Science & Engineering-Kakani Kakani
3. Solid state physics- S. O. Pillai
4. Introduction to solid state physics-Kittel (TMH)
5. Solid State Physics and Electronics-A. B. Gupta and Nurul Islam (Book & Allied Publisher)
6. Problem in Solid state physics -S.O. Pillai (a. b.)

Reference Books:

1. Refresher courses in physics (Vol. 1, Vol. 2 & Vol. 3)-C. L. Arora (S. Chand Publishers)
2. Basic Engineering Physics-Amal Chakraborty (Chaya Prakashani Pvt. Ltd.)
3. Perspective & Concept of Modern Physics -Arthur Baiser
4. Principles of engineering physics – Md. N Khan and S Panigrahi.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	-	-	-	-	-	-	-	-	-	-	2
CO2	**3**	**-**	-	-	-	-	-	-	-	-	-	2
CO3	**3**	2	-	-	-	-	-	-	-	-	-	1
CO4	2	**3**	**-**	-	-	-	-	-	-	-	-	1
CO5	1	**3**	-	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**

Course Name: Basic Electronics Engineering

Course Code: EC101

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Prerequisites:

Electric current and voltage-D.C and A.C., Complex impedance, conductivity, resistivity, transformer charging and discharging of capacitor, active and passive elements.

Course Objective:

1. To understand the behavior of Conductors, Insulators, and Semiconductors based on energy-band theory and relevant problems.
2. To instill the knowledge of working principles of P-N Junction Diode, Zener diode and analyze their applications in the rectifier, clipper, clamper, regulator etc.
3. To familiarize with the characteristics of Bipolar junction transistor(BJT) under CE, CE, CC mode of operation and its biasing mechanisms.
4. To understand working principles of JFET, MOSFET and perform operations under CG, CS, CD configurations for parametric observation.
5. To determine the parameters due to the effect of feedback in amplifier to ,adder circuit , integrator and differentiator circuit using Operational Amplifier

Course Outcomes:

CO1	Students able to describe the fundamentals of Semiconductors
CO2	Students able to explain V-I characteristics of P-N Junction Diode, zener diode , working of diode rectifier, clipper, clamper, and regulator circuit
CO3	Students able to analyze characteristics of Bipolar junction transistor(BJT) under CE, CB, CC mode of operation and its biasing therein
CO4	Students able to illustrate the operations of JFET, MOSFET and the CS,CD , CG configuration using JFET
CO5	Students able to determine parameters due to effect of feedback in amplifier
CO6	Students able to construct inverting amplifier circuit , non-inverting amplifier circuit ,adder circuit , integrator and differentiator circuit using Operational Amplifier IC

Course Content:

Module-I: Basics of semiconductor (6L)

Conductors, Insulators, and Semiconductors- crystal structure, Fermi Dirac function, Fermi level, Energy band diagrams, valence band, conduction band, and band gap; intrinsic, and extrinsic (p-type and n-type) semiconductors, position of Fermi level in intrinsic and extrinsic semiconductor, drift and diffusion current – expression only (no derivation) , mass action law , charge neutrality in semiconductor, Einstein relationship in semiconductor , Numerical problems.

Module-II: P-N Junction Diode and its applications (8L)

p-n junction formation and depletion region, energy band diagram of p-n junction at equilibrium and barrier energy, built in potential at p-n junction, energy band diagram and current through p-n junction at forward and reverse bias, Static and Dynamic resistance of Diode, Transition capacitance and diffusion capacitance, V-I characteristics and current expression of diode, temperature dependencies of V-I characteristics of diode, p-n junction breakdown – conditions, avalanche and Zener breakdown, Concept of Junction capacitance, Zener diode and characteristics.

Diode half wave and full wave rectifiers (centre tapped and bridge) circuits and operation ($I_{DC,}$ I_{rms}, $V_{Dc,}$ $V_{rms)}$, ripple factor without filter, efficiency, PIV, TUF; Reduction of ac ripples using filter circuit (Qualitative analysis); Design of diode clipper and clamper circuit - explanation with example, application of Zener diode in regulator circuit. Numerical problems.

Module-III: Bipolar junction transistor (6L)

Concept of "Transistor", Formation of PNP/NPN Transistors, energy band diagram, current conduction mechanism, CE, CB, CC configurations, transistor static characteristics in CE, CB and CC mode, junction biasing condition for active, saturation and cut-off modes, current gain α, β and γ, early effect.

Biasing and bias stability; biasing circuits - fixed bias; voltage divider bias; collector to base bias, D.C. load line and Quiescent point, calculation of stability factors for different biasing circuits.

BJT as an amplifier and as a switch – Graphical analysis; Numerical Problems.

Module-IV: Field effect transistor (6L)

Concept of "field effect", Classification of FETs-JFET, MOSFET, operating principle of JFET. Drain and transfer characteristics of JFET (n-channel and p-channel), CS, CG, CD configurations, Relation between JFET parameters. FET as an amplifier and as a switch– graphical analysis. E-MOSFET (n-channel and p-channel), D-MOSFET (n-channel and p-channel), Numerical Problems.

Module-V: Feedback and Operational Amplifier (8L)

Concept of feedback with block diagram, positive and negative feedback, gain with feedback. Feedback topologies, effect of feedback on input and output impedance, distortion, concept of oscillation and Barkhausen criterion.

Operational amplifier – electrical equivalent circuit, ideal characteristics, non-ideal characteristics of op-amp – offset voltages; bias current; offset current; Slew rate; CMRR and bandwidth, Configuration of inverting and non-inverting amplifier using Op-amp, closed loop voltage gain of inverting and non-inverting amplifier, Concept of virtual ground, Applications op-amp – summing amplifier; differential amplifier; voltage follower; basic differentiator and integrator, Numerical Problems.

Module-VI: Cathode Ray Oscilloscope (2L)
Operating principle of CRO with block diagram, measurement of voltage, frequency and phase.

Text Books :
1.D. Chattopadhyay, P. C. Rakshit, Electronics Fundamentals and Applications, New Age International
2.Millman & Halkias, Integrated Electronics, Tata McGraw Hill.
3.Sedra & Smith, Microelectronics Engineering

Reference Books :
1.John D. Ryder, Electronic Fundamentals and Applications, PHI
2.J.B.Gupta, Basic Electronics, S.K. Kataria.
3.Malvino: Electronic Principle.
4.Boyelstad & Nashelsky: Electronic Devices & Circuit Theory, McGraw Hill, 1976.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	-	-	-	-	-	2	-	1
CO2	3	3	3	1	-	-	-	-	1	1	1	2
CO3	3	1	1	1	-	-	-	-	1	1	1	1
CO4	3	2	1	1	-	-	-	-	1	1	2	2
CO5	3	2	3	1	-	-	-	-	1	1	1	2
CO6	3	3	3	1	-	-	-	-	2	1	2	3

Course Name: English
Course Code: HU101
Contact: 2:0:0
Total Contact Hours: 24

Credits: 2

Prerequisites: The course presupposes a high school level knowledge of English grammar, punctuation, and elementary to intermediate reading and writing skills.

Course Objectives: The basic objectives of this course are to impart professional communication skills in the globalized workplace context, to enable functional competence in reading and writing so as to create industry-ready personnel.

Course Outcomes:

CO1: Know about and employ communication in a globalized workplace scenario.
CO2: Understand and apply functional grammar, reading skills and sub-skills.
CO3: Acquire a working knowledge of writing strategies, formats and templates of professional writing.
CO4: Apply and make use of the modalities of intercultural communication.

Course Content:

Module 1: Communication in a Globalized World **4L**
1.1 Definition, Process, Types of Communication
1.2 Verbal and Non-Verbal Communication
1.3 Barriers to Communication
1.4 Workplace Communication

Module 2: Functional Grammar **4L**
2.1Articles, Prepositions and Verbs
2.2 Verb-Subject Agreement
2.3 Voice, Modality and Modifiers
2.4 Direct and Indirect Speech
2.5 Common Errors in English

Module 3: Vocabulary and Reading **6L**
3.1 Word Roots, Prefixes and Suffixes
3.2 Antonyms, Synonyms and one word Substitution
3.3 Reading—Purposes and Skills (Skimming, Scanning & Intensive Reading)
3.4 Reading Comprehension (Fictional and Non-fictional prose)

Module 4: Professional Writing **10L**
4.1Writing Functions: Describing, Defining, Classifying
4.2 Structuring—coherence and clarity
4.3 Business Writing—Letters (Enquiry, Order, Sales, Complaint, Adjustment, Job Application letters), Memos, Notices, Circulars, Agendas and Minutes of Meetings).
4.4 E-mails—types, conventions, jargons and modalities.
4.5 Reports and Proposals
4.6 Précis writing
4.7 Essay writing
4.8 Punctuation and its importance in writing
4.9 Writing for an Audience

Text Books:

1. Ruskin Bond: The Night Train at Deoli OR Khushwant Singh: The Portrait of a Lady
2. Roald Dahl: Lamb to the Slaughter OR Somerset Maugham: The Man with the Scar
3. Anne Frank: The Diary of a Young Girl (Letters of 3rd February 1944, 12th February 1944 and 13th February 1944) OR Jawaharlal Nehru: "How Britain Ruled India" (Glimpses of World History, Chap 112)

Reference Books:

1. Raymond Murphy. English Grammar in Use. 3rd Edn. CUP, 2001.
2. A. J Thomson and A. V. Martinet. A Practical English Grammar Oxford: OUP, 1980.
3. Michael Swan. Practical English Usage. Oxford: OUP, 1980.
4. Simeon Potter. Our Language. Oxford: OUP, 1950.
5. Pickett, Laster and Staples. Technical English: Writing, Reading & Speaking. 8th ed. London: Longman, 2001.
6. Ben Heasley and Liz Hamp-Lyons. Study Writing. Cambridge: CUP, 2006.

CO-PO Mapping:

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**P10**	**P11**	**P12**
CO1	**3**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**3**	**-**	**2**
CO2	**2**	**3**	**2**	**-**	**-**	**2**	**2**	**-**	**-**	**3**	**-**	**3**
CO3	**1**	**3**	**-**	**-**	**-**	**3**	**3**	**-**	**-**	**3**	**-**	**3**
CO4	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**-**	**-**	**3**	**-**	**3**

Course Name: Physics I Lab

Course Code: PH 191

Contact: 0:0:3

Credits: 1.5

Pre requisites: Knowledge of Physics upto 12^{th} standard.

Course Outcomes:

CO1 : Demonstrate experiments allied to their theoretical concepts

CO2 : Conduct experiments using LASER, Optical fiber, Torsional pendulum, Spctrometer

CO3 : Participate as an individual, and as a member or leader in groups in laboratory sessions actively

CO4 : Analyze experimental data from graphical representations , and to communicate effectively them in Laboratory reports including innovative experiments

List of Experiments:

General idea about Measurements and Errors (One Mandatory):

i) Error estimation using Slide calipers/ Screw-gauge/travelling microscope for one experiment.
ii) Proportional error calculation using Carrey Foster Bridge.

<u>Any 6 to be performed from the following experiments</u>

Experiments on Waves & Oscillations:
1. Study of Torsional oscillation of Torsional pendulum & determination of time period using various load of the oscillator.
2. Determination of elastic moduli of different materials (Young's modulus /Rigidity modulus)

Experiments on Classical Optics:
3. Determination of wavelength of light by Newton's ring method.
4. Determination of wavelength of light by Laser diffraction method.

Experiments on Quantum Physics-I:
5. Determination of Planck's constant using photoelectric cell.
6. Verification of Bohr's atomic orbital theory through Frank-Hertz experiment.
7. Determination of Stefan's Constant

Experiments on Solid State Physics-I:
8. Determination of Band gap of a semiconductor

In addition it is **recommended that each student should carry out at least one experiment beyond the syllabus/one experiment as Innovative experiment.

Probable experiments beyond the syllabus:

1. Determination of wavelength of light by Fresnel's bi-prism method (beyond the syllabus).
3. Study of dispersive power of material of a prism.
4. Study of viscosity using Poiseullie's capillary flow method/using Stoke's law.
5. Measurement of nodal and antinodal points along transmission wire and measurement of wave length.
6. Any other experiment related to the theory**.**

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	1
CO2	1	2	-	3	-	-	-	-	-	-	-	1
CO3	1	2	-	-	-	-	-	-	3	-	-	1
CO4	1	2	-	-	-	-	-	-	-	3	-	1

Course Name: Basic Electronics Engineering Lab

Course Code: EC 191

Contact: 0:0:3

Credit: 1.5

Prerequisites: A basic course in electronics and Communication engineering Progresses from the fundamentals of electricity, active and passive components, basic electronics laws like Ohm's law, Ampere's law.

Course Objective:

The objectives of this course are

1. To prepare the students to have a basic knowledge of active and passive components.
2. To build knowledge to distinguish pure and impure DC signals.
3. To grow measuring ability of signals through multi meter and CRO
4. To understand characteristics of proper biasing for BJT and FET.
5. To encourage in developing circuits using diodes, transistors, FETs and OPAMPs.

Course Outcomes:

CO1	Knowledge of Electronic components such as Resistors, Capacitors, Diodes, Transistors measuring equipment like DC power supply, Multimeter, CRO, Signal generator, DC power supply.
CO2	Analyse the characteristics of Junction Diode, Zener Diode, BJT & FET and different types of Rectifier Circuits.
CO3	Determination of input-offset voltage, input bias current and Slew rate, Common- mode Rejection ratio, Bandwidth and Off-set null of OPAMPs.
CO4	Able to know the application of Diode, BJT & OPAMP.

List of Experiments:

1. Familiarization with passive and active electronic components such as Resistors, Inductors, Capacitors, Diodes, Transistors (BJT) and electronic equipment like DC power supplies, millimeters etc.
2. Familiarization with measuring and testing equipment like CRO, Signal generators etc.
3. Study of I-V characteristics of Junction diodes.
4. Study of I-V characteristics of Zener diodes.
5. Study of Half and Full wave rectifiers with Regulation and Ripple factors.
6. Study of I-V characteristics of BJTs.
7. Study of I-V characteristics of Field Effect Transistors.
8. Determination of input-offset voltage, input bias current and Slew rate of OPAMPs.
9. Determination of Common-mode Rejection ratio, Bandwidth and Off-set null of OPAMPs.
10. Study of OPAMP circuits: Inverting and Non-inverting amplifiers, Adders, Integrators and

Differentiators.
11. Study of Logic Gates and realization of Boolean functions using Logic Gates.
12. Study of Characteristic curves for CB, CE and CC mode transistors.
13. Innovative Experiment

Text Books:

1.D. Chattopadhyay, P. C. Rakshit, Electronics Fundamentals and Applications, New Age International
2.Millman & Halkias, Integrated Electronics, Tata McGraw Hill.
3.Sedra & Smith, Microelectronics Engineering

Reference Books:

1.John D. Ryder, Electronic Fundamentals and Applications, PHI
2.J.B. Gupta, Basic Electronics, S.K. Kataria.
3.Malvino: Electronic Principle.
4.Boyelstad & Nashelsky: Electronic Devices & Circuit Theory, McGraw Hill, 1976.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	2	-	-	-	-	-	-	2
CO2	3	3	3	2	2	-	-	-	-	-	-	2
CO3	3	3	3	2	1	-	-	-	-	-	-	3
CO4	3	3	2	3	2	-	-	-	-	-	-	3

Course Name: Workshop/Manufacturing Practices

Course Code: ME 192

Contact: 0:0:3

Credit: 1.5

Prerequisite: Higher Secondary with Mathematics, Physics and Chemistry

Course Objectives:

To understand the basic knowledge of Workshop Practice and Safety. To identify and use of different hand tools and other instruments like Hack Saw, Jack Plane, Chisels etc. and operations like Marking, Cutting etc. To expose students to different types of manufacturing/fabrication processes

Course Outcomes:

CO1: Fabricate components with their own hands.

CO2: Get practical knowledge of the dimensional accuracies and tolerances applicable for different manufacturing processes.

CO3: Produce small devices of their interest for project or research purpose.

Course Content:

(i) Theoretical discussion & videos: (3P)

Detailed contents:

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods
2. Fitting operations & power tools
3. Carpentry
4. Welding (arc welding & gas welding), brazing
5. Electrical & Electronics
6. Metal casting
7. CNC machining, Additive manufacturing
8. Plastic moulding& Glass Cutting.

(ii) Workshop Practice:

Module 1 - Machine shop (6P)

Typical jobs that may be made in this practice module:

i. To make a pin from a mild steel rod in a lathe.

ii. To make rectangular and vee slot in a block of cast iron or mild steel in a shaping and / or milling machine.

Module 2 - Fitting shop (6P)

Typical jobs that may be made in this practice module:

i. To make a Gauge from MS plate.

Module 3 - Carpentry (6P)

Typical jobs that may be made in this practice module:

i. To make wooden joints and/or a pattern or like.

Module 4 - Welding shop (Arc welding 3P + gas welding 3P) (3P)

Typical jobs that may be made in this practice module:

i. ARC WELDING (3P): To join two thick (approx 5mm) MS plates by manual metal arcwelding.

ii. GAS WELDING (3P): To join two thin mild steel plates or sheets by gas welding.

Module 5 - Electrical & Electronics (3P)

House wiring, soft Soldering

Module 6 – Smithy (3P)

Typical jobs that may be made in this practice module:

i. A simple job of making a square rod from a round bar or like.

For further study (Optional)

Module 7 - Casting

Typical jobs that may be made in this practice module:

i. One/ two green sand moulds to prepare, and a casting be demonstrated.

Module 8 - Plastic moulding & Glass Cutting (3P)

Typical jobs that may be made in this practice module:

i. For plastic moulding, making at least one simple plastic component should be made.

ii. At least one sample shape on glass should be made using laser cutting machine.

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

Text Books:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of WorkshopTechnology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.

Reference Books:

1. Gowri P., Hariharan and A. Suresh Babu, Manufacturing Technology – I, Pearson Education, 2008.

2. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.

3. Kalpakjian S. and Steven S. Schmid, Manufacturing Engineering and Technology, 4th edition, Pearson Education India Edition, 2002.

4. Manufacturing Science by A.Ghosh and A.K.Mallick, Wiley Eastern.

5. Principles of Metal Cutting/Principles of Machine Tools by G.C.Sen and A.Bhattacharya, New Central Book Agency, Kolkata.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	1	1	-	-	-	2	1	-	2
CO2	3	3	2	2	1	-	-	-	2	1	-	2
CO3	3	2	2	2	1	1	-	1	2	2	3	2

Curriculum for B.Tech 2nd Semester

Under Autonomy (GR A: ECE, EE, EIE, BME; **GR B:** CSE, IT, ME, CE, FT)

2nd Semester								
Sl No	**Course Type**	**Course Code**	**Theory**	**Credit Hours /Week**				**Credit Points**
				L	**T**	**P**	**Total**	
A. THEORY								
1	BS	M 201	Mathematics -II	3	1	0	4	4
2	BS	CH 201/ PH 201	Chemistry - (Gr. B) / Physics – I (Gr. A)	3	0	0	3	3
3	ES	EE 201/ EC 201	Basic Electrical Engineering (Gr. B) / Basic Electronics Engineering (Gr. A)	3	0	0	3	3
4	ES	CS 201	Programming for Problem Solving	3	0	0	3	3
5	ES	ME 201	Engineering Mechanics	3	0	0	3	3
Total of Theory							**16**	**16**
B. PRACTICAL								
6	ES	CS291	Programming for Problem Solving Lab	0	0	3	3	1.5
7	BS	CH 291/	Chemistry Lab (Gr. B) / Physics - I Lab (Gr. A)	0	0	3	3	1.5
8	ES	EE 291/	Basic Electrical Engineering Lab (Gr. B) /	0	0	3	3	1.5
9	ES	ME 291/	Engineering Graphics & Design (Gr B) / Workshop/Manufacturing	0	0	3	3	1.5
10	HS	HU 291	Language Lab	0	0	2	2	1
11	PROJ	PR 291	Project-II	0	0	1	1	0.5
12	PROJ*	PR 292	Innovative activities-I	0	0	0	0	0.5
C. MANDATORY ACTIVITIES / COURSES								
13	MC	MC 281	NSS/ Physical Activities/Meditation & Yoga/Photography/ Nature Club	0	0	0	3	
Total of Theory, Practical & Mandatory Activities/Courses							**34**	**24**

* Inter/ Intra Institutional Activities viz; Training with higher Institutions; Soft skill training organized by Training and Placement Cell of the respective institutions; contribution at incubation/ innovation /entrepreneurship cell of the institute; participation in conferences/ workshops/ competitions etc.; Learning at Departmental Lab/ Tinkering Lab/ Institutional workshop; Working in all the activities of Institute's Innovation Council for eg: IPR workshop/Leadership Talks/ Idea/ Design/ Innovation/ Business Completion/ Technical Expos etc. (evaluation by Programme Head through certification)

Innovative activities to be evaluated by the Programme Head/ Event coordinator based on the viva voce and submission of necessary certificates as evidence of activities.

Syllabus- 2nd Semester

Course Name: Mathematics - II

Course Code: M 201

Contact: 3:1:0

Total Contact Hours: 48

Credit: 4

Prerequisites: The students to whom this course will be offered must have the concept of (10+2) standard calculus.

Course Objectives: The objective of this course is to disseminate the prospective engineers with techniques in multivariable calculus, ordinary differential equations and Laplace transform. It aims to equip the students with concepts and tools at an intermediate to advanced level of mathematics and applications that they would find useful in their disciplines.

Course Outcomes:

CO1	Use mathematical tools to evaluate multiple integrals and vector integrals
CO2	Apply effective mathematical tools for the solutions of ordinary differential equations that model physical processes.
CO3	Recall the properties of Laplace Transform to evaluate multiple integrals and their usage
CO4	Understand the concept of Laplace transform to solve ordinary differential equations.

Course Content:

Module I: Multivariable Calculus (Integration): (12 L)

Double integration, Change of order of integration in double integrals, Triple integrals, vector line integrals, scalar surface integrals, vector surface integrals, Green's theorem, Gauss divergence theorem and Stokes' theorem.

Module II: First Order Ordinary Differential Equations: (10 L)

Solution of first order and first degree ODE: Exact ODE, Rules for finding Integrating factors, Linear ODE, Bernoulli's equation, Solution of first order and higher degree ODE: solvable for p, solvable for y solvable for x and Clairaut's equation.

Module III: Second Order Ordinary Differential Equations: (12 L)

Solution of second order ODE with constant coefficients: C.F. & P.I., Method of variation of parameters, Cauchy-Euler equations, Reduction of 2^{nd} order ODE to a pair of first order ODEs, Solution of simultaneous linear ODEs.

Module IV: Laplace Transform: (14L)

Definition and existence of LT, LT of elementary functions, First and second shifting properties, Change of scale property, LT of $t\,f\,(t)$, LT of $\frac{f\,(t)}{t}$, LT of derivatives of f (t), LT of $\int f(t)dt$, Evaluation of improper integrals using LT, LT of periodic and step functions, Inverse LT: Definition and its properties, Convolution theorem (statement only) and its application to the evaluation of inverse LT, Solution of linear ODE with constant coefficients (initial value problem) using LT.

Text Books:

1. Kreyszig, E., Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Ramana, B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. Veerarajan, T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
5. Bali, N.P. and Goyal, M., A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

Reference Books:

1. Thomas, G.B. and Finney, R.L., Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. Boyce, W. E. and DiPrima, R. C., Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India, 2009.
3. Ross, S. L., Differential Equations, 3rd Ed., Wiley India, 1984.
4. Piskunov, N., Differential and Integral Calculus, Vol. I & Vol. II, Mir Publishers, 1969.
5. Coddington, E. A., An Introduction to Ordinary Differential Equations, Prentice Hall, India, 1995.

CO-PO Mapping:

PO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**P10**	**P11**	**P12**
CO1	3	2	2	-	-	-	-	-	-	-	-	1
CO2	3	2	2	-	-	-	-	-	-	-	-	1
CO3	2	2	-	-	-	-	-	-	-	-	-	1
CO4	3	3	2	-	-	-	-	-	-	-	-	1

Course Name: Chemistry
Course Code: CH201
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Pre requisites: Knowledge of Chemistry up to 12th standard.

Course Objective:

The concepts developed in this course will aid in quantification of several concepts in chemistry that have been introduced at the 10+2 levels in schools. Technology is being increasingly based on the electronic, atomic and molecular level modifications.

Course Outcomes:

CO1: **Able to describe the fundamental properties of atoms & molecules, atomic structure and the periodicity of elements in the periodic table**

CO2: **Able to apply fundamental concepts of thermodynamics in different engineering applications.**

CO3: **Able to apply the knowledge of water quality parameters, corrosion control & polymers to different industries.**

CO4: **Able to determine the structure of organic molecules using different spectroscopic techniques.**

CO5: **Capable to evaluate theoretical and practical aspects relating to the transfer of the production of chemical products from laboratories to the industrial scale, in accordance with environmental considerations.**

Course Content:

Module I: Inorganic Chemistry (9 L)

(i) Atomic structure (5 L)

Bohr's theory to hydrogen-like atoms and ions; spectrum of hydrogen atom. Quantum numbers, Introduction to the concept of atomic orbitals, diagrams of s, p and d orbitals, Pauli's exclusion principle, Hund's rule, exchange energy, Aufbau principle and its limitation, introduction to Schrodinger equation.

(ii) Periodic properties (4 L)

Modern Periodic table, group trends and periodic trends in physical properties: electron affinity, electronegativity, polarizability, oxidation states, effective nuclear charges, penetration of orbitals, variations of s, p and d orbital energies of atoms.

Module II: Physical Chemistry (8 L)

(i) Use of free energy in chemical equilibria (6 L)

Thermodynamic functions: internal energy, enthalpy, entropy and free energy. 2nd Law of Thermodynamics, Estimations of entropy and free energies, Free energy and emf, Cell potentials, the Nernst equation and applications.

(ii) **Real Gases (2 L)**

Reason for deviation of real gases from ideal behavior, Equations of state of real gases, Vander Waals' equation, pressure & volume correction, validity, critical state of gas.

Module III: Organic Chemistry (8 L)

(i) Stereochemistry (4 L)

Representations of 3 dimensional structures, Chirality, optical activity, isomerism, structural isomerism, stereoisomers, enantiomers, diastereomers, configurations (D,L & cis trans), racemisation.

(ii) Organic reactions (4L)

Concepts of inductive effect, resonance, hyperconjugation, introduction to reactions involving substitution, addition, elimination, oxidation (Baeyer villiger oxidation), reduction (Clemmensen reduction, Wolff-Kishner reduction)

Module IV: Industrial Chemistry 8L

(i) Water (2 L): **Hardness, alkalinity, numerical**

(ii) Corrosion. (2 L): **Types of corrosion: wet & dry, preventive measures**

(iii) Polymers (3 L): **Classification of polymers, conducting polymers, biodegradable polymers**

(iv) Synthesis of a commonly used drug molecule. (1 L): **Paracetamol, Aspirin**

Module V: Spectroscopic techniques in Chemistry (3L)

Electromagnetic radiation, Principles of spectroscopy, spectrophotometer, infrared spectroscopy, fingerprint region, functional group region, UV-VIS spectroscopy, ^{1}H Nuclear magnetic resonance spectroscopy, chemical shift

Text Books

(i) A Text Book of Organic Chemistry, Arun Bahl & Arun Bahl
(ii) General & Inorganic Chemistry, P.K. Dutt
(iii) General & Inorganic Chemistry, Vol I, R.P. Sarkar
(iv) Physical Chemistry, P.C. Rakshit

Reference Books

(v) Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane (iii)Fundamentals of Molecular Spectroscopy, by C. N. Banwell
(iv) Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
(v) Physical Chemistry, by P. W. Atkins
(vi) Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	-	-	-	-	1	2	2	2
CO2	3	3	3	3	-	-	-	-	1	1	2	3
CO3	3	3	2	1	-	2	1	-	1	-	3	3
CO4	3	2	3	2	-	-	1	-	1	2	3	3
CO5	3	3	3	3	1	1	1	-	1	-	2	3

Course Name: Basic Electrical Engineering

Course Code: EE201

Contact: 3:0:0

Total Contact hours: 36

Credits: 3

Prerequisites:

- Basic 12th standard Physics and Mathematics.
- Concept of components of electric circuit.

Course Objective:

To introduce the students to basic principles of DC and AC circuits, Electrical Machines and Electrical Systems.

Course Outcomes:

CO1: To understand Basic Electrical circuits, Power distribution and Safety measures.

CO2: To analyze an apply DC network theorems.

CO3: To analyze and apply concept of AC circuits of single-phase and three-phase.

CO4: To analyze and apply concepts of AC fundamentals in solving AC network problems.

CO5: To understand basic principles of Transformers and Rotating Machines.

Course contents:

Module I: DC Circuits (9L)

Definition of electric circuit, linear circuit, non-linear circuit, bilateral circuit, unilateral circuit, Dependent source, node, branch, active and passive elements, Kirchhoff's laws, Source equivalence and conversion, Network Theorems - Superposition Theorem, Thevenin's Theorem, Norton Theorem, Maximum Power Transfer Theorem, Star-Delta Conversions.

Module II: AC Fundamentals (9L)

Sinusoidal quantities, Average and RMS values, peak factor, Form factor, Phase and Phase difference, concept of phasor diagram, V-I Relationship in R, L, C circuit, Combination R-L-C in series and parallel circuits with phasor diagrams, impedance and admittance, impedance triangle and power triangle, Power factor, concept of resonance, Power in AC circuit, simple problems (series and parallel circuit only), Three-phase balanced circuits, Concept of three-phase power measurement.

Module III: Single-Phase Transformer (5L)

Brief idea on constructional parts, classifications, working principle. Problems on EMF equation. Phasor diagram, Equivalent circuit.

Module IV: Electrical Rotating Machines (8L)

a)DC Machines (4L)

Brief idea on constructional features, classifications, working principle of both motor and generator. Simple problems on Voltage equation.

b) Three-Phase Induction Motor (4L)

Basic concept of three phase circuit and production of rotating magnetic field. Working principle of three-phase induction motor and torque-speed characteristics (concept only). No numerical problem.

Module V: General Structure of Electrical Power System (1L)

Power generation to distribution through overhead lines and underground cables with single line diagram.

Module VI: Electrical Installations (4L)

Earthing of Electrical Equipment, ideas of basic components- MCB, MCCB, ELCB, SFU, Megger.

Text books:

1. D. P. Kothari & I. J. Nagrath, Basic Electrical Engineering, TMH.
2. V. Mittle & Arvind Mittal, Basic Electrical Engineering, TMH.
3. Ashfaq Hussain, Basic Electrical Engineering, S. Chand Publication.
4. Chakrabarti,Nath & Chanda, Basic Electrical Engineering, TMH.
5. C.L. Wadhwa, Basic Electrical Engineering, Pearson Education.

Reference books:

1. E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.
2. V. D. Toro, “Electrical Engineering Fundamentals”, Printice Hall India, 1989.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	3	1	-	-	-	2	-	-	-	2	2	1
CO2	2	3	-	-	-	-	-	-	-	-	1	1
CO3	2	3	1	-	-	-	-	-	-	-	1	1
CO4	1	2	3	1	-	-	-	-	-	-	-	1
CO5	3	-	-	-	-	-	-	-	-	-	-	1

Course Name: Programming for Problem Solving
Course Code: CS 201
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites: Number system, Boolean Algebra

Course Outcomes:

CO1	Understand and differentiate among different programming languages for problem solving.
CO2	Describe the way of execution and debug programs in C language.
CO3	Define, select, and compare data types, loops, functions to solve mathematical and scientific problem.
CO4	Understand the dynamic behavior of memory by the use of pointers.
CO5	Design and develop modular programs using control structure, selection structure and file.

Course Content:

Fundamentals of Computer: (8 L)

History of Computer, Generation of Computer, Classification of Computers, Basic structure of Computer System, Primary & Secondary Memory, Processing Unit, Input & Output devices. 2L

Binary and Allied number systems representation of signed & unsigned numbers, BCD, ASCII, Binary number. Arithmetic – Addition and Subtraction (using 1's complement and 2's complement). 2L

Overview of Procedural vs Structural language, compiler and assembler (basic concepts) 1L

Problem solving- Algorithm & flow chart. 2L

C Fundamentals: (28 L)

Variable and Data Types:

The C character set identifiers and keywords, data type & sizes, variable names, declaration, statements. 2L

C Operators & Expressions:

Arithmetic operators, relational operators, logical operators, increment and decrement operators, bitwise operators, assignment operators, conditional operators, special operators - type conversion, C expressions, precedence and associativity.

Input and Output: Standard input and output, formatted output - printf, formatted input scanf, bit fields.

4L

Branching and Loop Statements:
Statement and blocks, if - else, switch, goto and labels, Loops - while, for, do while, break and continue.

4L

Fundamentals and Program Structures:

auto, external, static and register variables Functions, function types, function prototypes, functions returning values, functions not returning values, scope rules, recursion, C preprocessor and macro.

5L

Arrays, Strings and Pointers:

One dimensional arrays, Two-dimensional arrays, Multidimensional arrays. Passing an array to a function Character array and string, array of strings, Passing a string to a function, String related functions, Pointers, Pointer and Array, Pointer and String, Pointer and functions, Dynamic memory allocation. 7L

Structures and Unions:

Basic of structures, arrays of structures, structures and pointers, structures and functions. 3L

Files handling with C:

formatted and unformatted files, Command line arguments, fopen, fclose, fgetc, fputc, fprintf, fscanf function. 3L

Text book:

Kerninghan B.W. & Ritchie D.M. - The C Programming Language ,PHI, 2nd Edition

Kanetkar Y. - Let us C, BPB Publication, 15th Edition

Reference Books:

E Balagurusamy – Programming in ANSI C, TMH, 3rd Edition

K R Venugopal & S R Prasad – MASTERING C, TMH, 2nd Edition

Reema Thareja – INTRODUCTION TO C PROGRAMMING, OXFORD UNIVERSITY PRESS, 2nd Edition

CO – PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	-	-	1	-	3	3	1	1
CO2	2	2	3	3	2	2	-	-	3	3	3	3
CO3	2	2	2	2	2	1	-	-	3	3	1	3
CO4	3	2	2	2	2	3	-	-	3	3	2	3
CO5	3	3	3	3	2	3	-	-	3	3	3	3

Course Name: Engineering Mechanics

Course Code: ME 201

Contacts: 3:0:0

Total Contact Hours: 36

Credits: 3

Prerequisites: Basic Concept of Physics

Course Objective:

This course teaches students how to apply Newtonian physics to relatively simple real life applications. This course covers statics, dynamics and elementary part of strength of materials.

Course Outcomes:

CO1: To understand representation of force, moments for drawing free-body diagrams and analyze friction based systems in static condition

CO2: To locate the centroid of an area and calculate the moment of inertia of a section.

CO3: Apply of conservation of momentum & energy principle for particle dynamics and rigid body kinetics

CO4: Understand and apply the concept of virtual work, rigid body dynamics and systems under vibration.

Course Content:

Module 1: Introduction to Engineering Mechanics: Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy. 6L

Module 2: Friction: Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack. 2L

Module 3: Basic Structural Analysis: Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines. 3L

Module 4: Centroid and Centre of Gravity: Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of

inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook. 5L

Module 5: Virtual Work and Energy Method: Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium. 5L

Module 6: Review of particle dynamics: Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2^{nd} law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy.Impulse-momentum (linear, angular); Impact (Direct and oblique). 5L

Module 7: Introduction to Kinetics of Rigid Bodies: Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation. 5L

Module8: Mechanical Vibrations: Basic terminology, free and forced vibrations, resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of free vibrations without damping and single degree of freedom system, simple problems, types of pendulum, use of simple, compound and torsion pendulums. 5L

Text books:

1. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall

2. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill

3. R.C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.

4. Andy Ruina and Rudra Pratap (2011), Introduction to Statics and Dynamics, Oxford University Press

5. Shanes and Rao (2006), Engineering Mechanics, Pearson Education,

6. Hibler and Gupta (2010),Engineering Mechanics (Statics, Dynamics) by Pearson Education

Reference books:

1. Reddy Vijaykumar K. and K. Suresh Kumar(2010), Singer's Engineering Mechanics

2. Bansal R.K.(2010), A Text Book of Engineering Mechanics, Laxmi Publications

3. Khurmi R.S. (2010), Engineering Mechanics, S. Chand & Co.

4. Tayal A.K. (2010), Engineering Mechanics, Umesh Publications

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	-	-	-	1	-	-	-
CO2	3	3	2	2	-	-	-	-	1	-	-	1
CO3	3	2	3	2	1	-	-	-	1	-	-	1
CO4	3	3	3	3	-	-	-	-	1	-	1	-

Course Name: Programming for Problem Solving Lab

Course Code: CS291

Contacts: 0:0:3

Credits: 1.5

Prerequisites: Number system, Boolean Algebra.

Course Outcomes:

CO1	Learn the concept of DOS system commands and editor.
CO2	To formulate the algorithms for simple problems and to translate given algorithms to a working and correct program.
CO3	To be able to identify and correct syntax errors / logical errors as reported during compilation time and run time.
CO4	To be able to write iterative as well as recursive programs.
CO5	Learn the concept of programs with Arrays, Pointers, Structures, Union and Files.

List of Experiment:

- Some basic commands of DOS, Windows and Linux Operating System, File handling and Directory structures, file permissions, creating and editing simple C program, compilation and execution of C program.
- Writing C Programs on variable, expression, operator and type-casting.
- Writing C Programs using different structures of if-else statement and switch-case statement.
- Writing C Programs demonstrating use of loop (for loop, while loop and do-while loop) concept and use of break and continue statement.
- Writing C Programs demonstrating concept of Single & Multidimensional arrays.
- Writing C Programs demonstrating concept of Function and Recursion.
- Writing C Programs demonstrating concept of Pointers, address of operator, declaring pointers and operations on pointers.
- Writing C Programs demonstrating concept of structures, union and pointer to structure.
- Writing C Programs demonstrating concept of String and command line arguments.
- Writing C Programs demonstrating concept of dynamic memory allocation.
- Writing C Programs demonstrating concept of File Programming.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	2	2	-	1	-	1	2	3
CO2	3	3	3	-	-	-	-	-	-	-	-	2
CO3	2	2	2	2	2	-	-	-	-	-	-	3
CO4	1	2	2	2	2	-	-	-	-	-	-	2
CO5	2	3	3	3	2	2	3	1	3	3	3	3

Course Name: Chemistry Lab
Course Code: CH 291
Contact: 0:0:3
Credits: 1.5

Prerequisites: Knowledge of Physics up to 12^{th} standard.

Course Objective:

- Study the basic principles of pH meter and conductivity meter for different applications.
- Analysis of water for its various parameters & its significance in industries.
- Learn to synthesis Polymeric materials and drugs.
- Study the various reactions in homogeneous and heterogeneous medium.
-

Course Outcomes:

CO1: Able to operate different types of instruments for estimation of small quantities chemicals used in industries and scientific and technical fields.

CO2: Able to analyse and determine the composition of liquid and solid samples working as an individual and also as an team member

CO3: Able to analyse different parameters of water considering environmental issues

CO4: Able to synthesize drug and polymer materials.

CO5: Capable to design innovative experiments applying the fundamentals of chemistry

List of Experiment:

Choice of 10-12 experiments from the following:

- Determination of surface tension and viscosity
- Thin layer chromatography
- Determination of hardness of water
- Determination of chloride content of water
- Determination of the rate constant of a reaction
- Determination of cell constant and conductometric tritration
- pH metric titrations
- Synthesis of a polymer/drug
- Saponification/acid value of an oil
- Chemical analysis of a salt
- Chemical oscillations- Iodine clock reaction
- Determination of the partition coefficient of a substance between two immiscible liquids
- Adsorption of acetic acid by charcoal

Innovative experiments (any one)

- Synthesis of silver nano particles
- Green synthesis

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	3	1	-	2	3	-	-	-	-	1
CO2	2	2	1	1	-	1	-	-	-	1	-	1
CO3	-	-	-	-	-	-	-	-	3	3	2	2
CO4	2	1	2	2	-	-	1	-	-	-	-	2
CO5	3	3	3	3	1	1	1	1	-	-	2	2

Course Name: Basic Electrical Engineering Laboratory
Course Code: EE291
Contact: 0:0:3
Credits: 1.5

Prerequisites:

- Basic Physics and applied physics.
- Basic Mathematics.
- Basic concept of Electric Circuit

Course Objective:

To impart and apply knowledge about the Basic Electrical Components, Machineries, Instruments and Safety measures.

Course Outcomes:

CO1: Identify and use common electrical components.
CO2: To develop electrical networks by physical connection of various components and analyze the circuit behavior.
CO3: Apply and analyze the basic characteristics of transformers and electrical machines.

List of Experiments:

1. Basic safety precautions – earthing, introduction to measuring instruments – Voltmeter, Ammeter, Multimeter, Wattmeter, Real life Resistor, Capacitor, Inductor.
2. Verification of Thevenin's and Norton's Theorem.
3. Verification of Superposition and Maximum Power Transfer Theorem.
4. Characteristics of Fluorescent, Tungsten and Carbon filament lamps.
5. Study of R-L-C series circuit.
6. Three-phase Power measurement with two wattmeter method.
7. Demonstration of cut-out sections of machines: DC Machine (commutator-brush arrangement), Induction Machine (squirrel cage rotor).
8. Measurement of primary and secondary voltage and current of single-phase transformer – Open Circuit and Short Circuit Test.
9. Starting, Reversing and speed control of DC shunt motor.
10. Torque-Speed characteristics of DC Machine.
11. Torque-Speed characteristics of Three-phase Induction Motor.
12. Test on single-phase Energy Meter.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	3	-	-	-	-	2	-	-	-	-	-	1
CO2	2	3	-	-	-	-	-	-	-	-	1	1
CO3	3	-	-	-	-	-	-	-	-	-	-	1

Course Name: Engineering Graphics & Design

Course Code: ME 291

Contact: 0:0:3

Credits: 1.5

Prerequisites: Basic knowledge of geometry

Course Objectives:

To learn detailed drawing and modeling of a system, component, or process which meets desired needs within realistic constraints. It will help students to use the techniques, skills, and modern engineering tools and communicate effectively.

Course Outcomes:

CO1: Get introduced with Engineering Graphics and visual aspects of design.

CO2: Know and use common drafting tools with the knowledge of drafting standards.

CO3: Apply computer aided drafting techniques to represent line, surface or solid models in different Engineering viewpoints.

CO4: Produce part models; carry out assembly operation and show working procedure of a designed project work using animation.

List of Drawing:

Traditional Engineering Graphics:

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Module 1: Introduction to Engineering Drawing

Principles of Engineering Graphics and their significance, Usage of Drawing instruments, lettering, Conic sections including Rectangular Hyperbola (General method only); Cycloid, Epicycloid and Involute; Scales – Plain, Diagonal and Vernier Scales.

Module 2: Orthographic & Isometric Projections

Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes; Projection of Solids inclined to both the Planes- Auxiliary Views; Isometric Scale, Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa.

Module 3: Sections and Sectional Views of Right Angular Solids

Drawing sectional views of solids for Prism, Cylinder, Pyramid, Cone and project the true shape of the sectioned surface, Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw sectional orthographic views of objects from industry and dwellings (foundation to slab only)

Computer Graphics:

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modeling; Solid Modeling.

Module 4: Overview of Computer Graphics

Demonstration of CAD software [The Menu System, Toolbars (Standard, Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), Zooming methods, Select and erase objects].

Module 5: CAD Drawing, Customization, Annotations, layering

Set up of drawing page including scale settings, ISO and ANSI standards for dimensioning and tolerancing; Using various methods to draw straight lines, circles, applying dimensions and annotations to drawings; Setting up and use of Layers, Changing line lengths (extend/lengthen); Printing documents; Drawing sectional views of solids and project the true shape of the sectioned surface; Drawing annotation, CAD modeling of parts and assemblies with animation, Parametric and non parametric solid, surface and wireframe modeling, Part editing and two dimensional documentation of models.

Module 6:

Demonstration of a simple team design project

Illustrating Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; Meshed topologies for engineering analysis and tool-path generation for component manufacture, Use of solid-modeling software for creating associative models at the component and assembly levels.

Text Books:

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House

2. (Corresponding set of) CAD Software Theory and User Manuals

Reference Books:

1. K. Venugopal, Engineering Drawing + AutoCAD, New Age International publishers

2. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication.

3. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education

4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	1	-	1	1	-	1	2	1	-	-
CO2	2	1	2	-	1	1	-	2	1	2	1	1
CO3	2	1	3	2	3	-	-	2	2	2	1	1
CO4	2	1	3	3	3	1	1	2	2	2	2	2

Course Name: Lang. Lab. and Seminar Presentation
Course Code: HU 291
Contact: 0:0:2
Credit: 1

Pre requisites: Basic knowledge of LSRW skills.

Course Objective: To train the students in acquiring interpersonal communication skills by focussing on language skill acquisition techniques and error feedback.

Course Outcomes:

CO1: Able to understand advanced skills of Technical Communication in English through Language Laboratory.
CO2: Able to apply listening, speaking, reading and writing skills in societal and professional life.
CO3: Able to demonstrate the skills necessary to be a competent Interpersonal communicator.
CO4: Able to analyze communication behaviours.
CO5: Able to adapt to multifarious socio-economical and professional arenas with the help of effective communication and interpersonal skills.

Course Content:

Module 1: Introduction to the Language Lab
a. The Need for a Language Laboratory
b. Tasks in the Lab
c. Writing a Laboratory Note Book

Module 2: Active Listening
a. What is Active Listening?
b. Listening Sub-Skills—Predicting, Clarifying, Inferencing, Evaluating, Note-taking
c. Academic Listening vs Business Listening
d. Listening in Business Telephony
e. Study of Contextualized Examples based on Lab Recordings

Module 3: Speaking
a. Speaking—Accuracy and Fluency Parameters
b. Pronunciation Guide—Basics of Sound Scripting, Stress and Intonation
c. Fluency-focussed activities—JAM, Conversational Role Plays, Speaking using Picture/Audio Visual inputs
d. Accuracy-focussed activities—Identifying Minimal Pairs, Sound Mazes, Open and Closed Pair Drilling, Student Recordings (using software)
e. Group Discussion: Principles and Practice

Module 4: Lab Project Work
a. Making a brief Animation film with voice over (5 minutes)OR
b. Making a brief Documentary film (10 minutes)

Reference Books:

1.IIT Mumbai**, Preparatory Course in English** syllabus
2. IIT Mumbai, **Introduction to Linguistics** syllabus
3. Sasikumar et al. *A Course in Listening and Speaking*. New Delhi: Foundation Books, 2005.
4. Tony Lynch, *Study Listening*. Cambridge: Cambridge UP, 2004.

CO – PO Mapping :

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**P10**	**P11**	**P12**
CO1	2	-	-	3	**-**	**3**	**2**	**2**	**3**	**3**	**-**	**3**
CO2	2	3	3	3	**-**	**3**	**3**	**3**	**2**	**3**	**-**	3
CO3	1	3	3	3	**-**	**2**	**2**	**2**	**2**	**3**	**-**	2
CO4	1	2	3	3	**-**	**2**	**1**	**1**	**2**	**3**	**-**	2
CO5	3	3	2	3	**-**	**2**	**3**	**2**	**2**	**3**	**-**	2

Course Name: NSS/Physical Activities/ Meditation & Yoga/ Photography/Nature Club

Course Code: MC 281

Contact: 0:0:3

Course Objectives:

- To increase student awareness about the weaker and unprivileged sections of society
- To expose students to environmental issues and ecological concerns
- To make students self aware about their participatory role in sustaining society and the environment

List of Activities:

a) Creating awareness in social issues

b) Participating in mass education programmes

c) Proposal for local slum area development

d) Waste disposal

e) Environmental awareness ``

f) Production Oriented Programmes

g) Relief & Rehabilitation work during Natural calamities

Creating awareness in social issues:

1. Women's development – includes health, income-generation, rights awareness.

2. Hospital activities – Eg. writing letters for patients, guiding visitors

3. Old age home – visiting the aging in-mates, arranging for their entertainment.

4. Children's Homes - visiting the young in-mates, arranging for their entertainment

5. Linking with NGOs to work on other social issues. (Eg. Children of sex-workers)

6. Gender issues- Developing an awareness, to link it with Women's Cell of college

Participating in mass education programmes: 1.Adult education 2. Children's education

Proposal for local slum area development : One or two slums to be identified and according to the needs, activities to be developed and proposals and reports are to be submitted.

Environmental awareness

• Resource conservation – Awareness to be developed on water, energy,soil.

• Preservation of heritage monuments- Marches, poster campaigns

• Alternative energy consciousness amongst younger school-children.

• Plantation and beautification- Plantation of trees, their preservation and upkeep, developing NSS parks.

• Waste disposal- Proper methods of domestic waste disposal.

Production Oriented Programmes

5. Working with people and explaining and teaching improved agricultural practices

6. Rodent control land pest control practices;

7. Soil-testing, soil health care and soil conservation;

8. Assistance in repair of agriculture machinery;

9. Work for the promotion and strengthening of cooperative societies in villages;

10. Assistance and guidance in poultry farming, animal husbandry, care of animal health etc.;

11. Popularization of small savings and

12. Assistance in procuring bank loans

Relief & Rehabilitation work during Natural calamities

g) Assisting the authorities in distribution of rations, medicine, clothes etc.;

h) Assisting the health authorities in inoculation and immunization, supply of medicine etc.;

i) Working with the local people in reconstruction of their huts, cleaning of wells, building roads etc.;

j) Assisting and working with local authorities in relief and rescue operation; Collection of clothes and other materials, and sending the same to the affected areas;

3rd								
Sl No	**Course Code**	**Paper Code**	**Theory**	**Contact Hours /Week**				**Credit Points**
				L	**T**	**P**	**Total**	
A. THEORY								
1	ES	M(CS)301	Numerical Methods	3	0	0	3	3
2	BS	PH(CE)301	Physics - II	3	0	0	3	3
3	PC	CE301	Surveying	2	1	0	3	3
4	PC	CE302	Strength of Material	2	1	0	3	3
5	PC	CE303	Building Material and Construction	2	1	0	3	3
6	PC	CE304	Engineering Geology	2	1	0	3	3
Total of Theory							**18**	**18**
B. PRACTICAL								
7	ES	M(CS)391	Numerical Methods Lab	0	0	3	3	1.5
8	PC	CE391	Engineering Geology Lab	0	0	2	2	1
9	PC	CE392	Surveying Practice	0	0	3	3	1.5
10	BS	PH (CE)391	Physics-II Lab	0	0	3	3	1.5
11	PROJ	PR 391	Project-III	0	0	2	2	1
12	PROJ*	PR 392	Innovative activities-II	0	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
13	MC	MC 381	Behavioural & Interpersonal skills	0	0	3	3	
Total of Theory, Practical & Mandatory Activities/Courses							**35**	**25.0**

*Students may choose either to work on participation in all the activities of Institute's Innovation Council for eg: IPR workshop/ Leadership Talks/ Idea/ Design/ Innovation/ Business Completion/ Technical Expos etc.

Innovative activities to be evaluated by the Programme Head/ Event coordinator based on the viva voce and submission of necessary certificates as evidence of activities.

COURSE NAME: NUMERICAL METHODS
COURSE CODE: M(CS) 301
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36 HRS
CREDITS : 3

Prerequisite:

The students to whom this course will be offered must have the concept of (10+2) standard number system, algebra and calculus.

Course Objectives:

The purpose of this course is to provide basic understanding of the derivation and the use of the numerical methods along with the knowledge of finite precision arithmetic.

Course Outcome (COs):
On successful completion of the learning sessions of the course, the learner will be able to:

COS	DESCRIPTIONS
CO1	Recall the distinctive principles of numerical analysis and the associated error measures.
CO2	Understand the theoretical workings of numerical techniques.
CO3	Apply numerical methods used to obtain approximate solutions to intractable mathematical problems such as interpolation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
CO4	Select appropriate numerical methods to apply to various types of problems in engineering and science in consideration of the mathematical operations involved, accuracy requirements, and available computational resources.

Course Content

MODULE I: ***Error Analysis and Interpolation (10 Lectures)***

Approximation in Numerical Computation: Truncation and rounding errors, Propagation of errors, Fixed and floating-point arithmetic.
Interpolation: Difference Operator: Forward and Backward, Shift Operator, Newton forward interpolation, Newton backward interpolation, Lagrange's Interpolation.

MODULE II: ***Numerical Solution of Linear and Non-linear Equations (12 Lectures)***

Numerical Solution of a System of Linear Equations: Gauss elimination method, Tridiagonal matrix algorithm, LU Factorization method, Gauss-Seidel iterative method, Successive over Relaxation (SOR) method.
Solution of Polynomial and Transcendental Equations: Bisection method, Regula-Falsi, Secant Method, Newton-Raphson method.

MODULE III: ***Numerical Integration and Numerical Solution of Differential Equation (14 Lectures)***

Numerical Integration: Trapezoidal rule, Simpson's 1/3 rule, Weddle's Rule, Expression for corresponding error terms.
Numerical Solution of Ordinary Differential Equation: Taylor series method, Euler's method, Euler's modified method, fourth order Runge-Kutta method and Milne's Predictor-Corrector methods.
Numerical solution of partial differential equation: Finite Difference method, Crank–Nicolson method.

Project Domains:

1) Application of PDE and ODE in Engineering Field.
2) Application of numerical methods for the relevant field.
3) Mathematical modelling.

Text Books:

1. Shishir Gupta &S.Dey, Numerical Methods, Mc. Grawhill Education Pvt. Ltd.
2. C.Xavier: C Language and Numerical Methods, New age International Publisher.
3. Dutta& Jana: Introductory Numerical Analysis. PHI Learning
4. J.B.Scarborough: Numerical Mathematical Analysis.Oxford and IBH Publishing
5. Jain, M. K., Iyengar, S. R. K. and Jain, R. K. *Numerical Methods (Problems and Solution)*. New age International Publisher.
6. Prasun Nayek: Numerical Analysis, Asian Books

Reference Books:

1. Balagurusamy, E. *Numerical Methods*, Scitech. TMH.
2. Dutta, N. *Computer Programming & Numerical Analysis*, Universities Press.
3. Guha, S. and Srivastava, R. *Numerical Methods*, Oxford Universities Press.
4. Shastri, S. S. *Numerical Analysis*, PHI.
5. Mollah, S. A. *Numerical Analysis*, New Central Book Agency.
6. Numerical Methods for Mathematics ,Science&Engg., Mathews, PHI.
7. Rao, G. S. *Numerical Analysis*, New Age International.

CO-PO Mapping:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	3	1	1	-	-	-	-	-	-	-	-	1
CO2	3	2	1	-	-	-	-	-	-	-	-	1
CO3	3	2	2	-	-	-	-	-	-	-	-	1
CO4	3	3	2	3	-	-	-	-	-	-	-	1

COURSE NAME: PHYSICS -II
COURSE CODE: PH(CE) 301
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36 HRS
CREDITS : 3

Pre-Requisites: 1st year Basic Physics knowledge

Course Outcome (COs):
On successful completion of the learning sessions of the course, the learner will be able to:

COS	DESCRIPTIONS
CO1	explain electromagnetic wave propagation using fundamentals of electrostatics, magnetostatics and electromagnetic theory.
CO2	apply Schrödinger equation in variety of atomic scale problems including nanomaterials.
CO3	analyze the importance of superposition principle of quantum mechanics in conceptualization of Quantum bits.
CO4	justify the importance of Fermi energy level in turning electronic properties of various semiconductors

COURSE CONTENTS:

Module 1: Electric and Magnetic properties of materials (8L)

Module 1.01: Insulating materials:

Dielectric Material: Concept of Polarization, the relation between **D, E** and **P**, Polarizability, Electronic (derivation of polarizability), Ionic, Orientation & Space charge polarization (no derivation), internal field, ferroelctric and piezoelectrics (Qualitative study). **3L**

Module 1.02: Magnetic materials and storage devices:

Magnetic Field & Magnetization M, relation between **B, H, M**. Bohr magneton, susceptibility, Diamagnetism- & Paramagnetism - Curie law (qualitative discussion), Ferromagnetism– Curie Temperature, Weiss molecular field theory (qualitative) & Curie-Weiss law, concept of θ_p , Hysteresis, Hard ferromagnets, Comparison and applications of permanent magnets (storage devices) and Soft ferromagnets (Permalloys, Ferrites etc.) **5L**

Module 2: Building Acoustics, Ultrasound and infrasound (6L)

2.01: Building Acoustics: Introduction, bel, decibel-their physical significance, Reverberation, reverberation time, Sabine's formula (statement only), remedies over reverberation; Absorption of sound, absorbent materials; Conditions for good acoustics of a building; Noise, its effects and remedies. **2L**

2.02: Ultrasound-Introduction, definition and properties –Production of ultrasonics by Piezo-electric crystal and magnetostriction method; Detection of ultrasonics; Engineering applications of Ultrasonics (Non-destructive testing, cavitations, measurement of gauge). **Infrasound** – Introduction and definition, production, application: Seismography (concept only). **4L**

Module 3: Quantum Mechanics-II (8L)

Formulation of quantum mechanics and Basic postulates- superposition principle, orthogonality of wave function, expectation value; operator correspondence, Commutator. Measurements in Quantum Mechanics-Eigen value, Eigen function, Schrödinger's equation as energy eigen value equation. **4L**

Application of Schrödinger equation – Particle in an infinite square well potential (1-D and 3-D potential well; Discussion on degenerate levels), 1D finite barrier problem and concept of quantum tunnelling (solve only $E<V_0$).

4L

Module 4: Statistical Mechanics (4L)

Concept of energy levels and energy states. Microstates, Macrostates and thermodynamic probability, MB, BE, FD, statistics (Qualitative discussions)- physical significance, conception of bosons, fermions, classical limits of quantum statistics, Fermi distribution at zero & non-zero temperature, Concept of Fermi level. **4L**

Module 5: Solid state physics (6L)

5.01: Defects: Point defects; line defects; Dislocations, Types of dislocations, Planar defects, stacking faults, twins, grain boundaries, defect propagation (qualitative). **3L**

5.02: Vibration in solids: Lattice vibrations – Mono and diatomic lattice, concept of phonon, specific heat of solids-Dulong-Pettit law, Einstein, Debye theory (qualitative discussion).

3L

Module 6: Physics of Nanomaterials (4L)

Reduction of dimensionality, properties of nanomaterials, Quantum wells (two dimensional), Quantum wires (one dimensional), Quantum dots (zero dimensional); Quantum size effect and Quantum confinement. Carbon allotropes. Application of nanomaterials (CNT, graphene, electronic, environment, medical). **4L**

List of recommended Books:

Module1:

1. Electromagnetics-B.B. Laud (TMH)
2. Electricity Magnetism-B.Ghosh (Book & Allied Publisher)
3. Electricity Magnetism-Chattopadhyay & Rakshit (New Central Book Agency)
4. Electricity Magnetism-Fewkes and Yardwood (Oxford University Press)
5. Solid State Physics- Ali Omar (Pearson Eduction)
6. Solid state physics- S. O. Pillai
7. Solid State Physics-A. J. Dekker (Prentice-Hall India)

Module 2:

1. Acoustics by D. P. Chattopadhyay

Module 3:

1. Advanced Quantum Mechanics-J. J. Sakurai (TMH)
2. Quantum Mechanics-Schiff (Addison-Wesley)

3. Quantum Computation and Quantum Information(10th Anniversary Edition)-Nielsen & Chuang (Cambridge University Press)
4. The physics of quantum information-Dirk Bouwmeester, Artur K. Ekert, Anton Zeilinger (Springer)
5. Quantum Mechanics-Cohen Tanuje.
6. Advanced Quantum Mechanics-P.A.M. Dirac

Module 4.
Statistical Mechanics by B.B. Laud
Statistical Mechanics by Singh and Singh
Statistical Mechanics by Satyaprakash
Module 5
1 Introduction to solid state physics-Kittel (TMH)
2. Solid State Physics- Ali Omar (Pearson Eduction)
3. Solid state physics- S. O. Pillai
4. Solid State Physics-A. J. Dekker (Prentice-Hall India)
5. Materials Science-Raghavan

Module 6
6. Nanotechnology-Rakesh Rathi (S. Chand Publishers)
7. Integrated Electronics-Millman Halkias (TMH)
8. Nanotechnology-Rakesh Rathi (S. Chand Publishers)
9. Nanoscience-H. E. Schaefer (Springer)

Genarl Book:
1. Engineering Physics by **Khan** and Panigrahi Publisher: Oxford.

* How staff works website

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	-	-	-	-	-	-	-	-	1
CO2	3	2	-	-	-	-	-	-	-	-	-	2
CO3	2	3	-	-	-	-	-	-	-	-	-	1
CO4	1	2	2	3	-	-	-	-	-	-	-	1

COURSE NAME: SURVEYING
COURSE CODE: CE301
CONTACT: 2:1:0
TOTAL CONTACT HOURS: 36 HRS
CREDITS : 3

Pre requisites: Student should have knowledge about measurement and mathematical knowledge

Course Objective: The objective of this course is appreciate of the need for lifelong learning through the discussion of recent changes in survey procedures and equipment and also have the ability to apply knowledge of mathematics, science, and engineering to understand the measurement techniques and equipment used in surveying.

Course Outcome:

CO1	Students will summarize surveying techniques that will remain correct for long period of time.
CO2	Students will experiment about different methods using instrument such as Chain, Compass, Leveling, minor instruments like planimeter, etc.
CO3	Students will learn about Area & Volume calculation.
CO4	Students will evaluate about Trigonometrically leveling.
CO5	Students will analyze about simple & complex problems of different instrument methods of Survey.

COURSE CONTENTS:

Module-1: [1L]

Introduction: Definition, classification of surveying, objectives, principles of surveying.

Module-2: [6L+3T]

Chain surveying: Chain and its types, Optical square, Cross staff, Reconnaissance and site Location, Locating ground features by offsets – Field book. Chaining for obtaining the outline of structures, Methods for overcoming obstacles, Conventional symbols, Plotting chain survey and Computation of areas, Errors in chain surveying and their elimination: Problems.

Compass Surveying: Details of prismatic compass, Use and adjustments, Bearings, Local attraction and its adjustments. Chain and compass surveying of an area, Booking and plotting, Adjustments of traverse, Errors in compass surveying and precautions: Problems.

Module-3: [2L+1T]

Plane Table Surveying: Equipment, Orientation, Methods of Plane Tabling, Three Point Problems.

Module-4: [6L+3T]

Leveling: Introduction, Basic definitions, Detail of dumpy Level, Temporary adjustment of Levels, Sensitiveness of bubble tube; Methods of leveling – Differential, Profile & fly Leveling, Effect of curvature and refraction, Automatic levels, Plotting longitudinal sections and Cross sections; Measurement of area and volume.

Contouring: Topographic Map, Characteristics of Contour, Contour Interval. Methods of Locating Contours, Interpolation of Contours.

Module-5: [6L+3T]

Theodolite Surveying: Components of a Transit Theodolite, Measurement of horizontal and vertical Angles, Co-ordinates and traverse Table.

Tacheometry: Definition, Details of stadia System, Determination of horizontal and vertical distance with Tacheometer- Staff held vertically and normal to the line of sight.

Module-6: [2L+1T]

Simple & Transition Curves: Definition, Degree of Curve, Elements of Simple Curve, Setting out by Linear method and Rankine's tangential method, Transition Curves.

Module-7: [1L+1T]

Introduction to Total Station with Field applications.

Text / Reference Books:

Sl No	Title	Author
1	Surveying:- Vol - I & II	B.C. Punmia
2	Surveying & Leveling	R. Subramanian (OXFORD)
3	Surveying& Leveling Vol - I [Part I & II]	T.P.Kanetkar & Kulkarni
4	Surveying:- Vol - I & II	S.K. Duggal
5	Fundamental of Engineering Survey	J.K. Ghosh (Studium Press, Roorkee)
6	Higher Surveying	Dr. A. M. Chandra
7	Surveying	R.B. Gupta & B.K. Gupta
9	Plane and Geodetic Surveying (Vol - I & II)	David Clark
10	Fundamental of Surveying	S. K. Roy
11	Surveying	Saikia & Das (PHI)

CO-PO mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	3	1	1	1	3	3	3	3
CO2	3	3	3	2	2	2	1	1	3	2	3	2
CO3	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	3	2	2	1	1	3	2	2	2
CO5	3	3	3	3	2	1	1	1	3	2	1	2

COURSE NAME: STRNGTH OF MATERIALS
COURSE CODE: CE 302
CONTACT: 2:1:0
TOTAL CONTACT HOURS: 36 HRS
CREDITS : 3

Pre requisites: Student should have the knowledge about Elements of Civil Engineering & Mechanics.

Course Objective: The objective of this course is elaborate on the knowledge of engineering mechanics (statics) and to teach the students the purpose of studying strength of materials with respect to civil engineering design and analysis. The course introduces the students to the concepts of engineering mechanics of materials and the behavior of the materials and structures under applied loads.

Course Outcome:

CO1	Interpret the concepts of stress and strain at a point as well as the stress-strain relationships for homogenous, isotropic materials.
CO2	Analyze the stresses and strains associated with thin-wall spherical and cylindrical pressure vessels.
CO3	Demonstrate the capability to conduct experiments, as well as to analyze and interpret data
CO4	Ability to classify a component to meet desired needs within realistic constraints of safety.

COURSE CONTENTS:

Module-1: [4L+2T]

Review of Basic Concepts of Stress and Strain: Normal stress, Shear stress, Bearing stress, Normal strain, Shearing strain; Hooke's law; Poisson's ratio; Stress-strain diagram of ductile and brittle materials; Elastic limit; Ultimate stress; Yielding; Modulus of elasticity; Bulk Modulus: Factor of safety. Beam Statics: Support reactions, concepts of redundancy, axial force, shear force and bending moment diagrams for concentrated, uniformly distributed, linearly varying load, concentrated moments in simply supported beams, cantilever and overhanging beams

Module-2: [6L+3T]

Symmetric Beam Bending: Basic kinematic assumption, moment of inertia, elastic flexure formulae and its application, Bending and shear stress for regular sections, shear centre, centre of gravity [3L+2T]

Deflection of statically determinate beams: Fundamental concepts: Elastic curve, moment Curvature relationship, governing differential equation, boundary conditions: Direct integration solution [3L+1T]

Module-3: [7L+3T]

Analysis of determinate plane trusses: Concepts of redundancy, Analysis by method of joints, Method of sections. [3L+1T]

Two Dimensional Stress Problems: Principal stresses, maximum shear stresses, Mohr's circle of stresses, construction of Mohr's circle, applications. [4L+2T]

Module-4: [7L+4T]

Introduction to thin cylindrical & spherical shells: Hoop stress and meridonial - stress and volumetric changes. [2L+2T]

Torsion: Pure torsion, torsion of circular solid shaft and hollow shafts, torsional equation, torsional rigidity, closed coil helical; springs [2L+1T]

Columns: Fundamentals, criteria for stability in equilibrium, column buckling theory, Euler's load for columns with different end conditions, limitations of Euler's theory – problems, eccentric load and secant formulae. [3L+1T]

Text / Reference Books:

Sl No	Name	Author	Publisher
1	Elements of Strength of Material	S. P. Timoshenko & D.H.	EWP Pvt. Ltd
2	Engineering Mechanics of Solids	E. P. Popov	Pearson Education
3	Strength of Materials	R. Subramanian	OXFORD University Press
4	Strength of Material	S S Bhavikatti	Vikas Publishing House Pvt. Ltd
5	Engineering Mechanics I by	J. L. Mariam	John Willey
6	Engineering Mechanics	I. H. Shames	PHI
7	Fundamentals of Strength of Material	Nag & Chandra	WIE

CO-PO mapping

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	-	-	-	-	-	1	-	2
CO2	3	3	3	2	1	-	-	-	-	1	-	3
CO3	2	3	3	3	1	1	-	-	1	1	1	2
CO4	3	2	3	3	1	-	2	-	-	-	-	1

COURSE NAME: BUILDING MATERIAL AND CONSTRUCTION
COURSE CODE: CE303
CONTACT: 2:1:0
TOTAL CONTACT HOURS: 36 HRS
CREDITS : 3

Pre requisites: No Pre Requisite required (NPR)

Course Objective: The objective of this course is know the student about the basic building materials, properties and their applications., to know the smart building materials, external paints and their uses to understand different types of masonries and their applications

Course Outcome:

CO1	Students will summaries basic knowledge about various kind of materials used in construction work.
CO2	Students will differentiate about different types of building foundation i.e. shallow and deep foundation, their mechanisms and uses.
CO3	summaries knowledge about various structural members of a building like-walls, door, window, stair, flooring, roof etc.
CO4	Extend to apply their knowledge at the time of decision making for application of structural member including material used.

COURSE CONTENTS:

Module-1: [6L+3T]

Bricks: Classification, Characteristics of good bricks, Ingredients of good brick earth, Harmful substance in brick Earth, Different forms of bricks, testing of bricks as per BIS. Defects of bricks. Fly ash bricks [2L+1T]

Aggregates: Classification, Characteristics, Deleterious substances, Soundness, Alkali – aggregates reaction, Fine aggregates, coarse aggregates, testing of aggregates [2L+1T]

Lime: Impurities in limestone, Classification, Slaking and hydration, Hardening, Testing, Storage, Handling, **Cement:** OPC: Composition, PPC, Slag cement, Hydration, setting time **Concrete**: Types, ingredients, W/C ratio, Workability, Different grades in cement concrete, Tests on cement concrete [2L+1T]

Module -2: [6L+3T]

Mortars: Classification, Uses, Characteristics of good mortar, Ingredients. Cement mortar, Lime mortar, Lime cement mortar, special mortars [2L+1T]

Wood and Wood Products: Classification of Timber, Structure, Characteristics of good timber, Seasoning of timber, Defects in Timber, Diseases of timber, Decay of Timber, Preservation of Timber Testing of Timber, Veneers , Plywood, Fibre Boards, Particle Boards, Chip Boards , Black Boards, Button Board and Laminated Boards, Applications of wood and wood products [2L+1T]

Paints, Enamels and Varnishes: Composition of oil paint, characteristic of an ideal paint, preparation of paint, covering power of paints, Painting: Plastered surfaces, painting wood, surfaces, painting metal Surfaces. Defects, Effect of weather, enamels, distemper, water wash and colour wash, Varnish, French Polish, Wax Polish. **Miscellaneous Materials**: Gypsum: Classification, Plaster of Paris, Heat and sound insulating materials, Geo-synthetics [2L+1T]

Module -3: [6L+3T]

Foundations: Function of Foundations, Essential requirement of good foundation, Different types of shallow and deep Foundations. Uses of Spread foundation, pile and well foundation [2L+1T]

Brick masonry: Definitions, Rules for bonding, Type of bonds – stretcher bond, Header bond, English bond, Flemish Bond, Comparison of English Bond and Flemish Bond (one and one and half brick thick wall). Cavity wall [2L+1T]

Wall, Doors and Windows: Load bearing wall, Partition wall, Reinforced brick wall Common types of doors and windows of timber and metal [2L+1T]

Module -4 [6L+3T]

Stairs: Technical Terms, Requirements of good stair, Dimension of steps, Classification, Geometric design of a dog legged stair case, Elevation and cross section of different type of stair cases. [2L+1T]

Flooring: Components of a floor, selection of flooring materials, Brick flooring, Cement concrete flooring, mosaic, marble, Terrazzo flooring, Tiled roofing [2L+1T]

Plastering and Pointing: Plastering with cement mortar, Defects in plastering, pointing, white washing, colour washing, Distempering, **Roofs:** Types, Pitched roofs and their sketches, Lean – to roof, coupled and collared roofs, King Post – Truss, Queen post truss and Simple steel Truss , Roof Covering materials: AC sheets GI sheet [2L+1T]

Text / Reference Books:

Sl no	Name	Author	Publisher
1	Building Materials	S.K. Duggal	
2	Building Materials	P.C. Varghese	PHI
3	Engineering Materials	S.C. Rangwala	
4	Concrete Technology	M. S. Shetty	
5	Concrete Technology[	A.M. Nevile & J.J. Brooks	Pearson Education
6	Building Construction	B.C. PUNMIA	

CO-PO mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	1	-	-	-	-	-	-
CO2	2	3	1	-	-	-	-	-	-	-	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-	-
CO4	2	3	1	-	-	-	-	-	-	-	-	-

COURSE NAME: ENGINEERING GEOLOGY
COURSE CODE: CE 304
CONTACT: 2:1:0
TOTAL CONTACT HOURS: 36 HRS
CREDITS : 3

Pre requisites: Basic knowledge of Geography & Earth Science

Course Objective:
To make the students knowledgeable to understand, apply and explore Geological parameters, Rock and other materials and activity related to earth science.

Course Outcome:

CO1	Students will have knowledge about Engineering properties of Rocks and their Minerals.
CO2	Student will be appraised about Dam, reservoir, tunnel
CO3	Student will understand about Earthquake phenomena.
CO4	Student will able to carry out Physical exploration
CO5	Student will able to estimate various geological parameters by use of modern tools & techniques

COURSE CONTENTS:

Module-1: [2L+1T]

Geology and its importance in Civil Engineering

Module-2: [2L+1T]

Mineralogy: Definition, internal and external structure of minerals, Classification and physical properties of minerals.

Module-3: [2L+1T]

Classification of rocks:

a) Igneous rocks: Origin, mode of occurrence, forms & texture, classification and engineering importance.

b) Sedimentary rocks: Process of sedimentation, classification and engineering importance.

c) Metamorphic rocks: Agents and types of metamorphism, classification and engineering importance.

Module-4: [2L+1T]

Weathering of rocks: Agents and kinds of weathering, soil formation & classification based on origin.

Module-5: [2L+1T]

Geological work of rivers: Origin and stages in the system, erosion, transportation and deposition.

Module-6: [2L+1T]

Structural geology: Introduction to structural elements of rocks, dip & strike, definition, description, classification of folds, faults and joints, importance of geological structures in Civil Engineering.

Module-7: [2L+1T]

Earthquakes and seismic hazards: Causes and effects, seismic waves and seismographs, Mercelli's intensity scale and Richter's scale of magnitude

Module-8: [2L+1T]

Engineering properties of rocks: Porosity, permeability, compressive strength, tensile strength and abrasive resistance

Module-9: [2L+1T]

Rocks as construction materials: Qualities required for building and ornamental stones, foundations, concrete aggregate, railway ballast, road metal, pavement, flooring and roofing

Module-10: [2L+1T]

Geophysical exploration: Methods of Geophysical Exploration, electrical resistivity method field procedure –sounding and profiling, electrode configuration, interpretation of resistivity data. Geophysical surveys in ground water and other Civil Engg. Projects.

Module-11: [2L+1T]

Applied Geology: Surface and subsurface geological and geophysical investigations in major Civil Engg. Projects. Geological studies of Dams and reservoir sites, Geological studies for selection of tunnels and underground excavations.

Module-12: [2L+1T]

Landslides: Types of landslides, causes, effects and prevention of landslides

Text / Reference Books:

Sl no	Name	Author	Publisher
1	Engineering and General Geology	Parvin Singh	Katson house Delhi 1987
2	Engineering Geology for Civil Engineers	D. Venkat Reddy	Oxford, IBH, 1995.
3	Principles of petrology	Tyrell	Asia, Bombay
4	Structural Geology	Marland P. Billings	Wileyeastern Prentice-Hall, U.S.A.
5	Ground Water hydrology	Todd D.K.	John Wiley & Sons, Second edition, 1980.

CO-PO mapping

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	1	-	1	1	1	1	1	2
CO2	3	2	1	2	1	-	1	1	1	1	1	2
CO3	3	2	2	2	2	1	1	1	1	1	1	-
CO4	3	3	3	3	3	-	-	1	-	2	1	1
CO5	3	2	1	3	3	2	1	1	2	2	1	2

COURSE NAME: NUMERICAL METHODS LAB
COURSE CODE: M(CS) 391
CONTACT: 0:0:3
CREDITS : 1.50

Prerequisite: Any introductory course on programming language (example. C/ Matlab).

Course Objective: The purpose of this course is to provide basic programming skills for solving the problems in numerical methods.

Course Outcome (CO):
On successful completion of the learning sessions of the course, the learner will be able to:

CODES	DESCRIPTIONS
CO1	Understand the theoretical workings of numerical techniques with the help of C/ Matlab
CO2	Execute basic command and scripts in a mathematical programming language
CO3	Apply the programming skills to solve the problems using multiple numerical approaches.
CO4	Analyze if the results are reasonable, and then interpret and clearly communicate the results.

LIST OF EXPERIMENT:

1. Assignments on Newton forward /backward, Lagrange's interpolation, Sterling & Bessel's Interpolation formula, Newton's divided difference Interpolation.

2. Assignments on numerical integration using Trapezoidal rule, Simpson's 1/3 rule.

3. Assignments on numerical solution of a system of linear equations using Gauss elimination, Tridiagonal matrix algorithm, Gauss-Seidel iterations. Successive over Relaxation (SOR) method, LU Factorization method.

4. Assignments on numerical solution of Algebraic Equation by Bisection method, Regula-Falsi method, Secant Method, Newton-Raphson method

5. Assignments on ordinary differential equation: Euler's method, Euler's modified method, Runge-Kutta methods, Taylor series method and Predictor-Corrector method.

6. Assignments on numerical solution of partial differential equation: Finite Difference method, Crank–Nicolson method.

7. Implementation of numerical methods on computer through C/C++ and commercial Software Packages: Matlab / Scilab / Labview / Mathematica/NAG (Numerical Algorithms Group)/Python.

CO-PO Mapping:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	3	2	1	-	-	-	-	-	-	-	-	1
CO2	3	2	2	-	-	-	-	-	-	-	-	1
CO3	3	2	2	-	-	-	-	-	-	-	-	1
CO4	3	3	2	3	-	-	-	-	-	-	-	1

COURSE NAME: ENGINEERING GEOLOGY LAB
COURSE CODE: CE 391
CONTACT: 0:0:2
CREDITS : 1

Pre requisites: Student should have the knowledge about Engineering geology theory.

Course Objective:
To make the students capable to identify and study properties of rock and minerals. They also should be able to use modern tools line microscope.

Course Outcome:

CO1	Student should acquire knowledge about engg. Properties of rocks and their minerals.
CO2	Student should be able to identify rocks and minerals
CO3	Student should be able to use modern tools live microscope to explore samples.
CO4	Student should be able to interpret map.

LIST OF EXPERIMENT:
Identification of Rocks and Minerals [Hand Specimens]
Identification of Rocks and Minerals [Hand Specimens]
Study of Geological maps, interpretation of geological structures
Thickness problems, Borehole problems

Text / Reference Books:

Sl no	Name	Author	Publisher
1	Engineering and General Geology	Parvin Singh	Katson publishing house Delhi 1987
2	Engineering Geology for Civil Engineers	D. Venkat Reddy	Oxford, IBH, 1995.
3	Principles of petrology	Tyrell	Asia, Bombay
4	Structural Geology	Marland P. Billings	Wiley eastern Prentice-Hall, U.S.A.
5	Ground Water hydrology	Todd D.K.	John Wiley & Sons, Second edition,1980.

CO-PO mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	1	-	1	1	1	1	1	1
CO2	3	2	2	3	2	1	2	-	1	1	-	1
CO3	2	2	1	3	3	2	-	1	1	1	1	1
CO4	2	2	2	1	1	3	1	1	-	1	-	1

COURSE NAME: SURVEYING PRACTICE
COURSE CODE: CE 392
CONTACT: 0:0:3
CREDITS : 1.50

Pre requisites: Student should have knowledge about the basic Basic Survey Theory

Course Objective: Student will be able to to function as a member of a team and Have the ability to use techniques, skills, and modern engineering tools necessary for engineering practice.

Course Outcome:

CO1	To interpret horizontal measurement with the help of Chain & Compass Surveying in the field.
CO2	To enumerate about Plane Table surveying.
CO3	To estimate vertical measurement with the help of Leveling in the field.
CO4	To apply indirect methods& demonstration of minor instruments.

LIST OF EXPERIMENT:

Chain surveying

Preparing index plans, Location sketches, Ranging, Preparation of map, Getting outline of the structures by enclosing them in triangles/quadrilaterals, Distance between inaccessible points, Obstacles in chain survey.

Compass surveying

Measurement of bearings, Preparation of map, Distance between two inaccessible points by chain and compass, Chain and compass traverse

Plane Table survey

Temporary adjustments of plane table and Radiation , Intersection, Traversing/Resection methods.

Leveling

Reduced Level calculation with Dumpy and Auto level for Differential leveling, Profile leveling and plotting the profile,

Contouring:

Direct contouring, Indirect contouring(Method of Interpolation).

Theodolite Traversing byusing Theodolite. Measurements of Horizontal & Vertical angles.

Circular Curves- Setting outof Simple Circular Curves.

Text / Reference Books:

Sl No.	**Title**	**Author**
1	Surveying:- Vol - I & II	B.C. Punmia
2	Surveying & Leveling	R. Subramanian (OXFORD)
3	Surveying& Leveling Vol - I [Part I & II]	T.P.Kanetkar & Kulkarni
4	Surveying:- Vol - I & II	S.K. Duggal
5	Fundamental of Engineering Survey	J.K. Ghosh (Studium Press, Roorkee)
6	Higher Surveying	Dr. A. M. Chandra
7	Surveying	R.B. Gupta & B.K. Gupta
9	Plane and Geodetic Surveying (Vol - I & II)	David Clark
10	Fundamental of Surveying	S. K. Roy
11	Surveying	Saikia & Das (PHI)

CO-PO mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	3	-	-	2	1	1	3	2	2	1
CO2	3	3	3	-	-	2	1	1	3	3	3	-
CO3	3	3	3	-	-	2	1	1	3	2	3	1
CO4	3	3	3	-	-	2	1	1	3	3	3	2

COURSE NAME: PHYSICS-II LAB
COURSE CODE: PH (CE) 391
CONTACT: 0:0:3
CREDITS : 1.50

Pre requisites: Basic Knowledge of Physics-I Lab.

Course Outcome:

CO1	demonstrate experiments allied to their theoretical concepts
CO2	conduct experiments using semiconductors , dielectric and ferroelectrics
CO3	classify various types of magnetic materials
CO4	participate as an individual, and as a member or leader in groups in laboratory sessions actively
CO5	analyze experimental data from graphical representations , and to communicate effectively them in Laboratory reports including innovative experiments

LIST OF EXPERIMENT:

Experiments on Module 1: Electric and Magnetic properties of materials (7L)

1. Study of dipolar magnetic field behavior.
2. Study of hysteresis curve of a ferromagnetic material using CRO.
3. Measurement of Curie temperature of the given sample.
4. Determination of dielectric constant of given sample (frequency dependent)/Measurement of losses in a dielectric using LCR circuits.

Experiments on Module 2: Building Acoustics, Ultrasound and infrasound (6L)

5. Determination of velocity of ultrasonic wave using piezoelectric crystal.

Experiments on Module 3: Quantum Mechanics-II (7L)

6. Determination of Stefan's radiation constant.
7. To study current-voltage characteristics, load response, areal characteristics and spectral response of photo voltaic solar cells & measurement of maximum workable power.
8. Measurement of specific charge of electron using CRT.
9. Study of I-V characteristics of a LED.
10. Study of I-V characteristics of a LDR
11. Study of transducer property: Determination of the thermo-electric power at a certain temperature of the given thermocouple

Experiments on Module 5: Solid state physics (8L)

12. Study of lattice dynamics.
13. Determination of band gap of a semiconductor.
14. Determination of Hall co-efficient of a semiconductor and measurement of Magnetoresistance of a given semiconductor

In addition to regular 7 experiments it is **recommended that each student should carry out at least one experiment beyond the syllabus/one experiment as Innovative experiment.

Probable experiments beyond the syllabus:

1. Determination of thermal conductivity of a bad conductor by Lees and Chorlton's method.
2. Determination of thermal conductivity of a good conductor by Searle's mothod.
3. Use of paramagnetic resonance and determination of Lande-g factor using ESR setup.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	-	-	1
CO2	2	1	-	3	-	-	-	-	-	-	-	-
CO3	-	-	2	-	-	-	-	-	-	-	-	1
CO4	-	-	-	-	-	-	-	-	3	-	-	-
CO5	-	-	-	-	-	-	-	-	-	1	-	-

4th								
Sl No	**Course Code**	**Paper Code**	**Theory**	**Contact Hours /Week**				**Credit Points**
				L	**T**	**P**	**Total**	
A. THEORY								
1	BS	M401	Mathematics III	3	1	0	4	4
2	HS	HU401	Values & Ethics in Profession	2	0	0	2	2
3	PC	CE401	Structural Analysis	3	1	0	4	4
4	PC	CE402	Concrete Technology	2	0	0	2	2
5	PC	CE403	Soil Mechanics	3	0	0	3	3
Total of Theory							**15**	**15**
B. PRACTICAL								
6	PC	CE491	Building Planning And Drawing	0	0	3	3	1.5
7	PC	CE492	Concrete Lab	0	0	3	3	1.5
8	PC	CE493	Soil Mechanics Lab-I	0	0	3	3	1.5
9	PC	CE494	Quantity Surveying, Specifications and Valuation	0	0	3	3	1.5
10	PROJ	PR 491	Project-IV	0	0	2	2	1
11	PROJ*	PR 492	Innovative activities-III	0	0	0	0	0.5
C. MANDATORY ACTIVITIES / COURSES								
12	MC	MC 401	Environmental Science	3	0	0	3	0
Total of Theory, Practical & Mandatory Activities/Courses							**32**	**22.5**

*Students may choose either to work on participation in all the activities of Institute's Innovation Council for eg: IPR workshop/ Leadership Talks/ Idea/ Design/ Innovation/ Business Completion/ Technical Expos etc.

Innovative activities to be evaluated by the Programme Head/ Event coordinator based on the viva voce and submission of necessary certificates as evidence of activities.

COURSE NAME: MATHEMATICS- III
COURSE CODE: M 401
CONTACT: 3:1:0
TOTAL CONTACT HOURS: 48 HRS
CREDITS : 4

Prerequisite:

The students to whom this course will be offered must have the concept of (10+2) standard calculus, basic probability and differential equations.

Course Objectives:

The objective of this course is to disseminate the prospective engineers with advanced techniques for solving ordinary differential equations and basic techniques for solving partial differential equations. It also aims to equip the students with concepts and tools of calculus of complex variables, Fourier series and Fourier transform, and probability distribution as an intermediate to the advanced level of applications that they would find useful in their disciplines.

Course Outcome (COs):

On successful completion of the learning sessions of the course, the learner will be able to:

CODES	DESCRIPTIONS
CO1	Recall the underlying principle and properties of Fourier series, Fourier transform, probability distribution of a random variable, calculus of complex variable, partial differential equation and ordinary differential equation.
CO2	Exemplify the variables, functions, probability distribution and differential equations and find their distinctive measures using the underlying concept of Fourier series, Fourier transform, probability distribution of a random variable, calculus of complex variable, partial differential equation and ordinary differential equation.
CO3	Apply Cauchy's integral theorem and the residue theorem to find the value of complex integration, and compute the probability of real world uncertain phenomena by indentifying probability distribution that fits the phenomena.
CO4	Solve partial differential equation using method of separation of variables and ordinary differential equation using techniques of series solution and special function (Legendre's and Bessel's).
CO5	Find the Fourier series and Fourier transform of functions by organizing understandings of underlying principles and also evaluate the integral using Parseval's identity.

Course Content: **MODULE I:** ***Fourier series and Fourier Transform: (13 Lectures)*** **Fourier series:** Dirichlet's Conditions; Euler's Formula for Fourier Series; Fourier Series for functions of period 2π; Sum of Fourier series (examples); Theorem for the convergence of Fourier series (statement only); Fourier series of a function with its periodic extension; Half range Fourier series: Construction of half range Sine series and half range Cosine Series; Parseval's identity (statement only) and related problems. **Fourier Transform:** Fourier Transform, Fourier Cosine Transforms, Fourier Sine Transforms (problems only); Properties of Fourier Transform: Linearity, Shifting, Change of Scale, Modulation (problems only); Fourier Transform of Derivatives (problems only); Convolution Theorem (statement only), Inverse of Fourier Transform (problems only).	**13L**
MODULE II: ***Probability Distributions: (11 Lectures)*** Random Variable: Discrete and Continuous (definition & examples); Probability Distribution (definition & examples); Probability Mass Function, Probability Density Functionand Distribution Function for a single random variable only (definition, properties & related problems); Expectation, Varianceand Standard Deviation for a single random variable only (definition, properties & related problems); Binomial Distribution, Poisson Distribution, Binomial Approximation to Poisson Distribution and Normal Distribution (problems only), Mean, Variance and Standard Deviation of Binomial, Poisson and Normal Distribution (problems only).	11L
MODULE III: ***Calculus of Complex Variable: (13 Lectures)*** Functions of a Complex Variable (definition and examples); Concept of Limit, Continuity and Differentiability (problems only); Analytic Functions (definition and examples); Cauchy-Riemann Equations (statement only& related problems); Sufficient condition for a function to be analytic (statement only & related problems). Concept of Simple Curve, Closed Curve, Smooth Curve & Contour; Some elementary properties of complex integrals (problems only); Cauchy's Theorem (statement only & related problems); Cauchy's Integral Formula(statement only & related problems); Cauchy's Integral Formula for the derivative of an analytic function(statement only & related problems); Cauchy's Integral Formula for the successive derivatives of an analytic function (statement only & related problems); Taylor's series and Laurent's series (problems only). Zero of an Analytic Function and its order (definition & related problems); Singularities of an Analytic Function: Isolated Singularity and Non-isolated Singularity (definition & related problems); Essential Singularities, Poles (Simple Pole and Pole of Order m) and Removable Singularities (definition & related problems); Determination of singularities and their nature (problems only); Residue (definition & examples); Determination of the residue of a given function; Cauchy's Residue theorem (statement only & related problems).	**13L**

MODULE IV: ***Partial Differential Equation (PDE) and Series Solution of Ordinary Differential Equation (ODE): (11 Lectures)*** **Solution of PDE:** Method of Separation of Variables. **Solution of Initial Value & Boundary Value Problem:** One Dimensional Wave Equation, One Dimensional Heat Equation, Two Dimensional Laplace Equation. **Series solution of ODE:** General method to solve $P_0\,y'' + P_1 y' + P_2 y = 0$ and related problems to Power series method**,** Bessel's Function, Legendre Polynomial.	**11L**

Project Domains:

1. Study of physical processes through PDE and ODE.
2. Application of calculus of complex variable in real world engineering problems.
3. Study of uncertainty in real world phenomena using probability distribution.
4. Application of Fourier series and Fourier transform in engineering problems.

Text Books:

1. Herman, R. L. *An Introduction to Fourier Analysis*, Chapman and Hall/CRC, 2016.
2. Grafakos, L. *Classical Fourier Analysis*, Springer, India, Private Ltd.
3. Das, N.G. *Probability and Statistics*; The McGraw Hill Companies.
4. Gupta, S. C. and Kapoor, V. K. *Fundamentals of Mathematical Statistics*, Sultan Chand & Sons.
5. Mathews, J. H. and Howell, R. W. *Complex Analysis for Mathematics & Engineering,* Jones & Bartlett Pub, 2006.
6. Chowdhury, B. *Elements of Complex Analysis*, New Age International, 1993.
7. Raisinghania, M .D. *Advanced Ordinary & Partial Differential. Equation*; S. Chand Publication.
8. Ross, S. L. *Differential Equations*, John Willey & Sons.
9. Grewal, B. S. *Higher Engineering Mathematics*, Khanna Pub.
10. Kreyszig, E. *Advanced Engineering Mathematics*, John Wiley & Sons, 2006.

Reference Books:

1. Gray, R. M. and Goodman, J. *Fourier Transforms: An Introduction for Engineers*, Springer, US, 1995.
2. Lipschutz & Lipson, *Schaum's Outline in Probability (2ndEd)*, McGraw Hill Education.
3. Spiegel, M. R. *Theory and Problems of Probability and Statistics (Schaum's Outline Series)*, McGraw Hill Book Co.
4. Goon, A.M., Gupta M .K. and Dasgupta, B. *Fundamental of Statistics*, The World Press Pvt. Ltd.
5. Soong, T. T. *Fundamentals of Probability and Statistics for Engineers*, John Wiley & Sons Inc, 2004.
6. Delampady, M. *Probability & Statistics*, Universities Press.
7. Spiegel, M. R. *Theory and Problems of Complex Variables (Schaum's Outline Series)*, McGraw Hill Book Co.
8. Sneddon, I. N. *Elements of Partial Differential Equations,* McGraw Hill Book Co.
9. Boyce, W. E. and DiPrima, R. C. *Elementary Differential Equations and Boundary Value Problems*, Wiley India, 2009.
10. Rao, B. *Differential Equations with Applications & Programs*, Universities Press.
11. Murray, D. *Introductory Courses in Differential Equations*, Universities Press.

CO-PO Mapping:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	3	1	1	-	-	-	-	-	-	-	-	1
CO2	3	2	1	-	-	-	-	-	-	-	-	1
CO3	3	2	2	-	-	-	-	-	-	-	-	1
CO4	3	2	2	-	-	-	-	-	-	-	-	1
CO5	3	3	2	3	-	-	-	-	-	-	-	1

COURSE NAME: VALUES AND ETHICS IN PROFESSION
COURSE CODE: HU401
CONTACT: 2:0:0
TOTAL CONTACT HOURS: 24 HRS
CREDITS : 2

Prerequisites: Ethics in engineering practice is about professional responsibilities of engineers. Professional ethics have been recognized as an important foundation in the practice of engineering for several decades in many industrialized countries. Codes of ethics have been invoked as a basis for professional engineering licensure. Violations of such ethical codes have led to many well-known tragic engineering failures that endangered human life and jeopardized public welfare. As a response to this concern, a new discipline, engineering ethics, is emerging. This discipline will doubtless take its place alongside such well-established fields as medical ethics, business ethics, and legal ethics. Recently, ethics has attracted the attention of several colleges of engineering around the world. In this regard, ethics started merging into engineering curricula for the last two decades. Implementations varied from introducing some ethics case studies into existing courses, to introducing standalone ethics courses.

Course Objective: To provide guiding principles and tools for the development of the whole person recognizing that the individual is comprised of Physical, Intellectual, and emotional dimensions.

Course Outcome: On Completion of this course student will be able to

CO-1 Understand the core values that shape the ethical behavior of an engineer and Exposed awareness on professional ethics and human values.

CO-2 Understand the basic perception of profession, professional ethics, various moral issues & uses of ethical theories

CO-3 Understand various social issues, industrial standards, code of ethics and role of professional ethics in engineering field

CO-4 Aware of responsibilities of an engineer for safety and risk benefit analysis, professional rights and responsibilities of an engineer.

CO-5 Acquire knowledge about various roles of engineers in variety of global issues and able to apply ethical principles to resolve situations that arise in their professional lives.

Course contents:	
Module: 1. Introduction: (4L) Definition, Relevance, Types of values, changing concepts of values. Concept of Morals and Ethics. Work ethic – Service learning – Civic virtue Stress Management -Concept of stress, causes and consequences, managing stress	**4L**
Module: **2**. **Psycho-social theories of moral development**: (**4L)** Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy Kohlberg's theory; Gilligan's theory.	**4L**
Module: 3. Engineering Ethics (6L) Engineering profession: Ethical issues in Engineering practice, Conflicts between business demands and professional ideals. Social and ethical responsibilities of Technologists. Codes of professional ethics. Ethical and Unethical practices – case studies Whistle blowing and beyond, Case studies.	**6L**
Module: 4 .Effects of Technological Growth (10L) Rapid Technological growth and depletion of resources, Reports of the Club of Rome. Limits of growth: sustainable development Energy Crisis: Renewable Energy Resources	**10L**

Environmental degradation and pollution
Environmental Regulations,
Environmental Ethics and appropriate Technology,
Movement of Schumacher;
Problems of Technology transfer,
Technology assessment impact analysis.
Human Operator in Engineering projects and industries.
Problems of man, machine, interaction, Impact of assembly line and automation. Concept of Human centered Technology.

Text / Reference Books:

1. Stephen H Unger, Controlling Technology: Ethics and the Responsible Engineers, John Wiley & Sons, New York 1994
(2nd Ed)
2. Deborah Johnson: Ethical Issues in Engineering, Prentice Hall, Englewood Cliffs, New Jersey 1991.
3. A N Tripathi: Human values in the Engineering Profession, Monograph published by IIM, Calcutta 1996.
4. S. K. Chakraborty: Values and Ethics in Organization, OUP
5. Caroline Whitbeck: Ethics in Engineering Practice and Research, Cambridge University Press
6. Jaysree Suresh and B.S Raghavan: Human values and Professional Ethics , S. Chand Publication

CO-PO mapping

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO1	_	_	_	_	_	1	1	1	1	2	_	_
CO2	_	_	_	_	_	1	1	3	1	2	_	_
CO3	_	_	_	_	_	3	2	3	_	1	_	_
CO4	_	_	_	_	_	3	2	1	_	_	_	_
CO5	_	_	_	_	_	3	2	2	_	1	3	_

COURSE NAME: STRUCTURAL ANALYSIS
COURSE CODE: CE 401
CONTACT: 3:1:0
TOTAL CONTACT HOURS: 48 HRS
CREDITS : 4

Pre requisites: Students must have knowledge in engineering mechanics, solving of free body diagrams and application of different structural aspects of materials in any type of structures like support reactions, bending moments, stresses, torsion etc.

Course Objective: To provide knowledge about determinate and indeterminate structures and how to calculate degree of indeterminacy of a structure, applications and analysis of determinate and indeterminate structures in various aspects.

Course Outcome:

CO1. Learn about determinate and indeterminate structures and determination of degree of static and kinematic indeterminacy for any type of structures.
CO2. Analysis of any structure by strain energy method.
CO3. Analysis of determinate and indeterminate structures by different methods.

Course contents:

Module-1: [3L+1T] Determination of stability of any type of structure, Determinate and Indeterminate structures, Degree of indeterminacy for different types of structures: Beams, Frames,Trusses.	**4L**
Module-2: [6L+2T] Analysis of determinate structures: Portal frames, arches.	**8L**
Module-3: [6L+2T] ***Strain energy:***Due to axial load, bending and shear, Torsion; Castigliano's theorems, theorem of minimum potential energy, Muller Breslau Principle, principle of virtual work, Maxwell's theorem of reciprocal deflection, Betti's law	**8L**
Module-4: [6L+2T] ***Deflection of determinate structures:***Moment area and Conjugate beam method, Energy methods,Unit load method for beams, Deflection of trusses and simple portal frames	**8L**
Module-5: [6L+2T] ***Influence line diagrams***: Statically determinate beams and trusses under series of concentrated and uniformly distributed rolling loads, criteria for maximum and absolute maximum moments and shears.	**8L**
Module-6: [3L+1T] ***Analysis of statically Indeterminate beams:*** Theorem of three moments. Energy Method, Force Method, Analysis of two hinged arch.	**4L**
MODULE –VII: [6L+2T] ***Analysis of statically indeterminate structures:*** Moment distribution method, Slope Deflection Method, Approximate method of analysis of structures-portal and cantilever	**8L**

method.

Text / Reference Books:

Sl no	Name	Author	Publishers
1	Engineering Mechanics of Solids	By E. P. Popov	Pearson Education
2	Basic structural Analysis	C.S. Reddy	TMH
3	Statically indeterminate structures	C. K. Wang	McGraw-Hill
4	StructuralAnalysis (Vol I& Vol II)	S S Bhavikatti	Vikas Publishing House Pvt. Ltd
5	Structural Analysis	Ramammurtham	
6	Structures	Schodek & M. Bechhold	Pearson Education

CO-PO mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	-	1	2	1	2	3	3	2
CO2	3	3	3	3	1	2	1	1	2	1	2	2
CO3	3	3	3	2	2	2	1	2	3	3	2	2

COURSE NAME: CONCRETE TECHNOLOGY
COURSE CODE: CE 402
CONTACT: 2:0:0
TOTAL CONTACT HOURS: 24 HRS
CREDITS : 2

Pre requisites: Student should have knowledge about the building materials and construction.

Course Objective: The objective of this course is to produce knowledge to the student ingredients of concrete, specific

Course Outcome:

CO1	Identify the functional role of ingredients of concrete
CO2	Student should be able to gather knowledge to mix design philosophy
CO3	Student will be able to differentiate various types of cement used for various specific purpose
CO4	Student will be able to apply fundamental knowledge in the freshand hardened properties of concrete
CO5	Student will be able to design ordinary and control concretes, replacement of cement and their specific applications

Course contents:

Module-1: [4L] ***Introduction:-*** Concrete as a Structural Material, Good Concrete Manufacture of Portland Cement, Chemical Composition of Cement, Hydration of Cement, Heat ofHydration [4L]	**4L**
Module-2: [6L] ***Types of Cement***:– ordinary, Rapid hardening, low-heat, sulphate resisting, Portland slag, Portland pozzolana, super sulphated cement, white cement .Tests on cement and cement paste – fineness, consistency, setting time, soundness, strength.[3L] ***Water &Aggregates***– Classification, Mechanical and Physical Properties, Deletarious Substances, Alkali-Aggregate Reaction, Sieve Analysis, Grading Curves, Fineness modules, Grading Requirements. Testing of Aggregates – Flakiness, Elongation Tests, Aggregate Crushing Value, Ten Percent Fines Value, Impactm Value, Abrasian Value.Quality of Water – Mixing Water, Curing Water, Harmful Contents.[3L]	**6L**

Module-3: [6L] ***Properties of Fresh Concrete***– Workability, Factors Affecting Workability, Slump Test Compacting Factor Test, Flow Table Test, Segregation, Bleeding, Setting Time, Mixing and Vibration of Concrete, Mixers and Vibrators, curing, Methods, Maturity. [3L] ***Strength & durability of Concrete***– Water/Cement ratio, Gel/Space ratio, Strength in Tension, Compression, Effect of Age on Strength, Relation between Compressive and Tensile Strength, Fatigue Strength, Stress Strain Relation and Modules of Elasticity, Poisson's Ratio, Shrinkage and Creep, Compression Test on Cubes, Cylinders, Non-Destructive Tests. [3L]	**6L**
Module-4: [8L] ***Permeability of concrete.***Chloride & Sulphate attack on concrete, carbonation of concrete [2L] ***Admixtures*** – different types (chemical and mineral), effects, uses, Retarders and Super plasticizers. Mix Design by I.S. 10262(2009) Code method. [4L] ***Special concrete***: Light-weight, Polymer and Fiber-reinforced concrete. [2L]	**8L**

Text / Reference Books:

SL NO	NAME	Author	publisher
1	Concrete Technology	Neville	Pearson Education
2	Concrete Technology	M.S. Shetty	S.Chand
3	Concrete Technology	A. R. Santakumar	OXFORD University Press
4	Concrete Technology	M.L. Gambhir	Tata McGraw Hill
5	Text book of Concrete Technology	P.D. Kulkarni	Tata McGraw Hill

CO-PO mapping :

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	-	-	2	-	-	-	1	3
CO2	3	3	3	2	3	1	2	-	-	1	1	2
CO3	3	1	2	1	3	-	-	1	-	1	-	1
CO4	3	-	2	-	3	2	2	-	-	-	-	2
CO5	3	3	-	2	2	2	3	-	1	1	-	2

COURSE NAME: SOIL MECHANICS
COURSE CODE: CE 403
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36 HRS
CREDITS : 3

Pre requisites: Student should have knowledge about the basic of strength of materials, physics and chemistry

Course Objective: To provide students with basic understanding of physical and mechanical properties of soil, together with knowledge of basic engineering procedures to identify factors controlling soil behavior and methods to determine soil properties. Students will acquire basic knowledge in engineering design of geotechnical systems

Course Outcome:

CO1	Identify the fundamental differences in engineering behavior between cohesive and cohesion less soils
CO2	Compute the groundwater seepage and distribution of groundwater pressure.
CO3	Calculate the applied stress beneath the ground surface.
CO4	Demonstrate that you know the fundamental difference in the strength and deformation characteristics of cohesive and cohesion less soils.
CO5	Analyze field and laboratory data to determine the strength and deformation properties of cohesive and cohesion less soils.
CO6	Determine settlements due to consolidation of soil

Course contents: SOIL MECHANICS

Module-I: [4L+1T] ***Origin & formation of Soil:-***Types, Typical Indian Soil, Fundamental of Soil Structure, Clay Mineralogy. [2L] ***Soil as a Three Phase System :-***Weight- Volume Relationship, Measurement of Physical Properties of Soil: Insitu Density, Moisture Content, Specific Gravity, Relative Density.[2L+1T]	**5L**
Module-II: [6L+1T] ***Particle Size Distribution :-***By Sieving, Sedimentation Analysis. [2L] ***Index Properties of Soil***:- Attarbergs Limits- Determination of Index Properties of Soil by Casagrandes Apparatus, Cone Penetrometer,Soil Indices.[2L] ***Soil Classification :-***As per Unified Classification System, As per IS Code Recommendation, AASHTO Classification, Field Identification of Soil, Consistency of Soil. [2L+1T]	**7L**
Module-III: [6L+3T] ***Soil Moisture :-***Darcy,s Law, Capillarity in Soil, Permeability, Determination of Coefficient of Permeability of Soil in Laboratory, Permeability for Stratified Deposits. [2L+1T] ***Effective Stress Principles***:- Definition of Effective Stress, Estimation of Effective Pressure Due to different conditions [2L+1T]	**9L**

Two Dimensional Flow Through Soil :-Laplace's Equations, Flow nets, Flow Through Earthen Dam,estimation of Seepage, Uplift due to Seepage, Design of Fillers, Critical Hydraulic Gradient, Quick Sand condition[2L+1T]	
Module-IV: [4L+2T] ***Stress Distribution In Soil :-***Bousinesqs & Westergaads Assumption & Formula for Determination of stress due to Point Loads, Stress Beneath Line, Strip & Uniformly Loaded Circular - Pressure Bulbs, Newmarks charts- Use For Determination of Stress due to Arbitrarily Loaded Areas, Contact Stress distribution for various types of Loading & on Different Types of Soils. [2L+1T] **Compaction of Soil :-** Principles of Compaction, IS Light & Heavy Compaction Test, Field Compaction Equipments, Various methods of field Compaction Control. [2L+1T]	**6L**
Module-V: [6L+3T] ***Compressibility & Consolidation of Soil***: - Terzaghi's Theory of One Dimensional Consolidation, CompressibilityCharacteristics of Soils, Compression Index, Coefficient of Compressibility & Volume change, Coefficient of Consolidation, Degree & rate of Consolidation, Consolidemeter & Laboratory One Dimensional Consolidation Test as per latest IS Code, Determination of Consolidation Parameters, Secondary Consolidation. [4L+2T] **Shear Strength of Soil**:- Basic Concept of Shear Resistance & Shear Strength of Soil, Mohr- Columb's Theory, Laboratory Determination of Soil Shear Parameter-Direct Shear, Tri-axial Test, Unconfined Compression, Vane Shear Test, Sensitivity & thixotropy of clay. [2L+1T]	**9L**

Text / Reference Books:

Sl no	Name	Author	Publishers
1	Text book of Soil Mechanics & Foundation Engineering	V.N.S. Murthy	CBS Publisher's & Distributors
2	Principles of Foundation Engineering	B.M. Das	Thomson Book
3	Principles of Geotechnical Engineering	B. M. Das	Thomson Book Store
4	Basic & Applied Soil Mechanics	Gopal Ranjan & A.S.R.Rao	Willes EasternLtd
5	Soil Mechanics	Lambe & Whitman	WIE
6	Hand Book of Bureau of Indian Standard IS –1904, 6403, 8009, 2950, 2911 etc		

CO-PO mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	1	1	1	1	1	1	1	2
CO2	2	2	3	3	2	3	1	1	2	2	2	3
CO3	2	2	3	2	2	1	1	3	2	1	1	2
CO4	3	3	3	3	3	2	1	3	2	1	3	3
CO5	2	3	1	2	1	3	1	2	2	2	2	2
CO6	2	2	2	3	1	2	2	2	3	2	3	2

COURSE NAME: BUILDING PLANNING AND DRAWING
COURSE CODE: CE 491
CONTACT: 0:0:3
CREDITS : 1.50

Pre requisites: Student should have knowledge about building materials and construction and alsomathematics

Course Objective: The objective of this course is to make student able to Learn to sketch and take field dimensions and to take data and transform it into graphic drawings and Auto Cad skills.

Course Outcome:

CO1	Prepare simple layout of buildings.
CO2	Produce working drawings for individual components like doors and windows etc.
CO3	Develop line diagram, building section, elevation, key plan and sectional elevation.
CO4	Illustrate hand drafting any parts of a building and implement the regulations for layout of plan.

LIST OF EXPERIMENT:

Foundations - Spread foundation for walls and columns; Footing for a RCC column, raft and pile foundations

Doors and Windows - Glazed and paneled doors of standard sizes; Glazed and paneled windows of standard sizes; special windows and ventilators

Stairs- Proportioning and design of a dog-legged, open well RCC stair case for an office / Residential building; Details of reinforcements for RCC stair cases; Plan and elevation of straight run, quarter turn, dog-legged and open well staircases.

Roofs - Types of sloping roof, lean-to roofs, RCC roof with details of reinforcements

Trusses - King post and Queen post trusses.

Functional Design of Buildings -To draw the line diagram, plan, elevation and section of the following: Residential Buildings (flat & pitched roofs), Office Buildings (flat roof), School.The designs must show positions of various components including lift well and their sizes. Introduction to drawing by using software package.

Text / Reference Books:

Sl No	Title	Author
1	Principles of Building Drawing	Shah & Kale
2	Text Book of Building Construction	Sharma & Kaul
3	Building Construction	B C Punmia
4	Civil engineering drawing	M.Chakrabory

CO-PO mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	1	2	-	-	-	1	-	-	1
CO2	3	2	-	1	2	-	-	-	1	-	-	1
CO3	3	2	-	1	2	-	-	-	1	-	-	1
CO4	3	2	-	1	2	-	-	-	1	-	-	1

COURSE NAME: CONCRETE LAB
COURSE CODE: CE 492
CONTACT: 0:0:3
CREDITS : 1.50

Pre requisites: Student should have the basic knowledge about concrete technology theory

Course Objective: The objective of this course is to understand the characteristics and behavior of civil engineering materials used in buildings and infrastructure. Students will learn standard principles and procedure to design prepare and/or test materials such as concrete mix design including field test methods for fresh concrete. Know how to select materials based on their properties and their proper use for a particular facility under prevailing loads and environmental conditions.

Course Outcome:

CO1	Identify the functional role of ingredients of concrete
CO2	Apply this knowledge to mix design philosophy to get different grade of concrete
CO3	Student should be able to test of different concrete property to specify quality of concrete
CO4	Student shall learn to work in a team to achieve the objective

LIST OF EXPERIMENT:

Tests on cement –specific gravity, fineness, soundness, normal consistency, setting time, compressive strength on cement mortar Cubes.

Tests on fine aggregate –specific gravity, bulking sieve analysis, fineness modulus, moisture content, bulk density, voids and Deleteriousmaterials.

Tests on coarse aggregate-specific gravity, sieve analysis, fineness modulus, bulk density and voids.

Tests on Fresh Concrete: Workability : Slump, Vee-Bee, Compaction factortests

Tests on Fresh Concrete: Workability : Slump, Vee-Bee, Compaction factortests

Hardened Concrete: Compressive strength on Cubes, Split tensile strength, Static modulus of elasticity, Flexure tests , Non destructive testing (Rebound hammer & Ultrasonic pulse velocity)

Mix Design-As per IS 10262(2009) method

Text / Reference Books:

SL NO	NAME	Author	publisher
1	Concrete Technology	Neville	Pearson Education
2	Concrete Technology	M.S. Shetty	S.Chand
3	Concrete Technology	. R. Santakumar	OXFORD University Press
4	Concrete Technology	M.L. Gambhir	Tata McGraw Hill
5	Text book of Concrete Technology	P.D. Kulkarni	Tata McGraw Hill

CO-PO mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2	-	-	-	1	1	-	1
CO2	3	2	2	2	2	1	1	1	1	-	-	1
CO3	3	2	2	2	2	1	-	-	1	-	-	1
CO4	1	1	1	1	1	-	1	1	3	2	2	1

COURSE NAME: SOIL MECHANICS LAB – I
COURSE CODE: CE 493
CONTACT: 0:0:3
CREDITS : 1.50

Pre requisites: Student should have the basic knowledge about Basic Soil Mechanics theory

Course Objective: Provide civil engineering students with the basic knowledge to carry out field investigations and to indentify soils in geotechnical engineering practice and educate civil engineering students in performing and interpretation laboratory tests for evaluating soil property.

Course Outcome:
CO1: Identify soils with reference to their characteristics
CO2: Describe the behavior and effect of water in soils
CO3: Examine modes of soil behavior
CO4: Calculate and plot soil strength parameters
CO5: Interpret different methods of improving soil stability including reference to compaction plant

LIST OF EXPERIMENT:

1. Field identification of different types of soil as per Indian standards [collection of field samples and identifications without laboratory testing], determination of natural moisture content.
2. Determination of specific gravity of i) Cohesion less ii) cohesivesoil
3. Determination of In situ density by core cutter method & sand replacementmethod.
4. Grain size distribution of cohessionless soil by sieving & fine-grained soil by hydrometer analysis.
5. Determination of Atterberg's limits (liquid limit, plastic limit & shrinkagelimit).
6. Determination of co- efficient of permeability by constant head permeameter (coarse grained soil) & variable head permeameter (fine grainedsoil).
7. Determination of compaction characteristics of soil.

Reference

1. Soil Testing by T.W. Lamb (John willey)
2. SP-36 (Part-I & Part-II)
3. Measurement of Engineering properties of soil by E. Saibaba Reddy & K. Rama sastri.(New age International publication.

CO-PO mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	3	3	2	1	-	1	3	2	2
CO2	3	3	2	2	3	2	1	1	-	2	3	1
CO3	3	2	1	2	1	3	1	2	-	2	1	2
CO4	2	3	2	3	1	1	2	1	2	1	2	3
CO5	2	3	3	2	2	1	1	1	2	1	2	2

COURSE NAME: QUANTITY SURVEYING, SPECIFICATIONS AND VALUATION
COURSE CODE: CE 494
CONTACT: 0:0:3
CREDITS : 1.5

Pre requisites: Student should have knowledge about building construction and material details.

Course Objective: The objective of this course is to give the students basics knowledge of estimating and valuation of civil engineering works. After completing this course the students will also be able to analyze the rates and estimate the various construction works

Course Outcome:

CO1: Student will be able to prepare specification for using materials of construction and its items ofworks.

CO2: Student will be able to illustrate a detailed estimation of material consumption and abstracts for entire construction projects

CO3: Student will learn how to analyze the rates for different items of work including labor and material.

CO4: Interpret fundamental concepts of valuation

CO5: Students will be able to identify various legal issues related to construction.

LIST OF EXPERIMENT:

Unit I: Different types of estimates, Concept of items of work, unit of measurement, unit rate of payment. Quantity estimate of a single storied building. Bar bending schedule. Details of measurement and calculation of quantities with cost, bill of quantities, abstract of quantities. Quantity estimate of Road, Underground reservoir, Surface drain, Septictank

Unit II: Analysis and schedule of rates for Earthwork, brick flat soling, DPC, PCC and RCC, brick work, plastering, flooring andFinishing.

Unit III: Specification of materials: Brick, cement, fine and coarse aggregates; Specification of works: PCC, RCC, First class brickwork, cement plastering and pointing, white washing, colour washing, distempering, lime punning, painting andvarnishing

Unit IV: Basic concept of Values and cost, gross income, outgoing, net income, scrap value, salvage value, market value, Book Value, Sinking fund, capitalized value, Year of purchase, depreciation, obsolescence, deferred income, freehold and leasehold property, Mortgage, rent fixation, valuationtable.

Text / Reference Books:

B. N. Datta, Costing, Estimation and Valuation, UBSPublication
S. C. Rangwala, Estimating & Costing (Civil Engg.), CharotarPublication
G. S. Birdie, A text book of Estimating & Costing, Dhanpat Rai &Sons
S. C. Rangwala, Valuation of Real properties, CharotarPublication
Estimating, Costing, Specification & Valuation In Civil Engineering byM.chakrabory

CO-PO mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	1	2	1	-	-	-	2	2
CO2	3	3	3	2	-	-	-	-	-	-	1	2
CO3	3	3	3	1	-	-	-	-	-	-	2	2
CO4	3	3	3	2	-	-	-	-	-	-	2	2
CO5	3	3	3	2	1	2	-	-	2	2	2	2

5th Semester								
Sl No	**Course Code**	**Paper Code**	**Theory**	**Contact Hours /Week**				**Credit Points**
				L	**T**	**P**	**Total**	
A. THEORY								
1	HS	HU502	Economics for Engineers	2	0	0	2	2
2	PC	CE501	Structural Design-I	2	1	0	3	3
3	PC	CE502	Foundation Engineering	3	0	0	3	3
4	PE	CE503	A. Hydraulics B. Water Supply and Plumbing C. Waste Water and Treatment	3	0	0	3	3
5	PE	CE504	A. Transportation Engineering B. Infrastructure Planning & Design C. Public Transport System	3	0	0	3	3
Total of Theory							**14**	**14**
B. PRACTICAL								
6	PE	CE591	A. Transportation and Highway Engineering Lab B. Infrastructure Planning & Design Lab C. Public Transport System Lab	0	0	3	3	1.5
7	PC	CE592	Soil Mechanics Lab-II	0	0	3	3	1.5
8	PC	CE593	Civil Engineering Lab	0	0	3	3	1.5
9	ES	CE594	Advanced Programming for Problem solving	0	0	3	3	1.5
10	PROJ	PR 591	Project-V	0	0	2	2	1
11	PROJ*	PR 592	Innovative activities-IV	0	0	0	0	0.5
C. MANDATORY ACTIVITIES / COURSES								
12	MC	MC 501	Constitution of India	3	0	0	3	
Total of Theory, Practical & Mandatory Activities/Courses							**31**	**21.5**

* Students may choose either to work on participation in Hackathons etc. Development of new product/ Business Plan/ registration of start-up.

Students may choose to undergo Internship / Innovation / Entrepreneurship related activities. Students may choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry/ NGO's/ Government organizations/ Micro/ Small/ Medium enterprises to make themselves ready for the industry/ Long Term goals under rural Internship. (Duration 4-6 weeks)

Innovative activities to be evaluated by the Programme Head/ Event coordinator based on the viva voce and submission of necessary certificates as evidence of activities.

COURSE NAME: ECONOMICS FOR ENGINEERS
COURSE CODE: HU 502
CONTACT: 2:0:0
TOTAL CONTACT HOURS: 24 HRS
CREDITS : 2

Pre requisites: NIL

Course Objective:

- To develop decision making skills using basic economic Principles
- To educate the students in evaluating various Business Projects

Course Outcome:

CO1 : To Identify various uses for scares resources
CO2 : To understand key economic concepts and implement in real world problems
CO3 : To apply critical thinking skills to analyze financial data and their impacts
CO4 : To evaluate business performance through cost accounting principles

Course contents:

Module - 1.Introduction to Economics : Meaning, Nature and Scope of Economics	**2L**
Module - 2. Theory of Demand and Supply : Concept of demand, Determinants of demand, Individual and Market Demand, Exception to the law of demand. Concept of Supply, Shift in Demand and Supply Curve, Movement along the demand and supply curve,Determinants of equilibrium price and quantity, Elasticity of Demand and Supply.	**4L**
Module - 3.Theory of Production and Costs : concept of Production function, types pf Production function,Laws of returnn to scale and variable Proportion,Cost Function, Types of Cost Function, Different Cost curves, Relation between Average and marginal cost, Relationship between Short Run costs and Long Run costs,Profit maximisation	**6L**
Module-4.Macroeconomic Aggregates and Concepts : GDP, GNP. Concepts of National Income . Concept of Business Cycle.	**3L**
Module -5.Inflation : Concept , Causes and Remedies of Inflation.	**2l**
Module -6.Accounting Basic concept of Journal ,Preparation of Income Statement and Balance Sheet	**4L**
Module – 7. Cost Volume Profit Analysis: Contribution, P/V Ratio, Break-Even Point, Margin of Safety, Short term decision making: Make or Buy, Shut-down point, Export Pricing, Opportunity and Sunk cost.	**3L**

Text / Reference Books:

Sl no	Name	Author	Publishers
1	Economics	Lipsey and Chrystal	Oxford university Press
2	Modern Economic Theory :	K.K. Dewett.	S.Chand
3	Principle of Economics	H.L. Ahuja	S. Chand
4	Engineering Economics:	R.PaneerSeelvan:	PHI
5	Modern Accountancy	Hanif &Mukherjee	TMH
6	Economics for Engineers:	Dr. Shantanu Chakra borty &Dr. Nilanjana singharoy.	Law Point Publication

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO8	PO9	PO10	PO11	PO12
CO1	-	**3**	-	-	-	-	-	-	-	-	-	**2**	-
CO2		-		-	-	-	**3**	-	-	-	-	**2**	-
CO3	-	-	-	**2**	**2**	**3**	-	-	-	-	-	**2**	**2**
CO4	-	-	-	**3**		-	-	-	-	-	-	**3**	**2**

COURSE NAME: STRUCTURAL DESIGN – I
COURSE CODE: CE 501
CONTACT: 2:1:0
TOTAL CONTACT HOURS: 36 HRS
CREDITS : 3

Pre requisites: Student should have knowledge about how to solve analysis of structural problem.

Course Objective:

1. Student will be able to perform analysis and design of reinforced concrete members and connections and be able to identify and interpret the appropriate relevant industry design codes.
2. To become familiar with professional and contemporary issues in the design and construction of reinforced concretemembers.

Course Outcome:

CO1 : Exhibit the knowledge of concrete design philosophies, by working and limit state methodology
CO2 : Design the structural details of beam and slab
CO3 : Design the structural details of column.
CO4 : Interpret and use the I.S Code specifications

Course contents:

Module-I: [1L+1T] Introduction: Principles of design of reinforced concrete members - Working stress and Limit State method of design.	**2L**
Module-II: [2L+2T] Working stress method of design: Basic concepts and IS code provisions (IS: 456 2000)for design against bending moment and shear forces - Balanced, under reinforced and over reinforced beam/ slab sections; design of singly and doubly reinforced sections.	**4L**
Module-III: [2L+2T] Limit state method of design: Basic concepts and IS code provisions (IS: 456 2000) for design against bending moment and shear forces; concepts of bond stress and development length; Use of 'design aids for reinforced concrete' (SP:16).	**4L**
Module-IV: [2L+2T] Analysis, design and detailing of singly reinforced rectangular , "T"," L" and doubly reinforced beam sections by limit state method.	**4L**
Module-V: [2L+2T] Design and detailing of one-way and two-way slab panels as per IS code provisions	**4L**
Module-VI: [2L+2T] Design and detailing of continuous beams and slabs as per IS code provisions	**4L**
Module-VII: [2L+2T] Staircases: Types; Design and detailing of reinforced concrete doglegged staircase	**4L**
Module-VIII: [2L+2T] Design and detailing of reinforced concrete short columns of rectangular and circular cross sections under axial load. Design of short columns subjected to axial load with moments (uniaxial and biaxial bending) – using SP 16.	**4L**

Module-IX: [3L+3T] Shallow foundations: Types; Design and detailing of reinforced concrete isolated square and Rectangular footing for columns as per IS code provisions by limit state method.	**6L**
Limit state method should be followed for serial number 4 to 9 as above as per IS 456 - 2000	

Text / Reference Books:

Name	Author	Publishers
IS: 456- 2000 "Indian Standard for Plain and reinforced concrete – code of practice	Bureau of Indian Standard	
SP:16 Design Aid to IS 456		
Reinforced Concrete Design by	Pillai and Menon	TMH
Reinforced concrete Limit state design	Ashok K. Jain,Arun kv jain,B.C. Punmia	Laxmi publication
Reinforced concrete	S.N.Sinha	TMH
Fundamentals of reinforced concrete	N.C.Sinha and S.K. Roy	S.Chand &Co
Limit State Design of Reinforced Concrete	P. C. Varghese	PHI
Reinforced Concrete	S. K. Mallick and A. P. Gupta	Oxford IBH
Reinforced cement Concrete Design	Neelam Sharma	S.K hataria & sons

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**	**3**	**2**	**-**	**1**	**2**	**1**	**-**	**3**	**3**	**2**
CO2	**3**	**3**	**3**	**3**	**-**	**2**	**-**	**-**	**-**	**1**	**2**	**2**
CO3	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**
CO4	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**

COURSE NAME: FOUNDATION ENGINEERING
COURSE CODE: CE 502
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36 HRS
CREDITS : 3

Pre requisites: Student should have knowledge about basic of Soil Mechanics

Course Objective:

Application of soil mechanics and other related techniques to design of foundation. Methods and site and soil exploration; bearing capacity and settlements; shallow and deep foundation; bracing and retaining structures. Case studies.

Course Outcome:

CO1 : Describe bearing capacity of soil.
CO2 : Define earth pressure theories
CO3 : Design of shallow foundations
CO4 : Classify piles & their loading capacity for deep foundation.

Course contents:

Module-1: **Earth Pressure Theories: -**Plastic equilibrium of soil, Earth pressure at rest, Active & passive Earth pressure, Rankin's & Coulombs earth pressure theories, wedge method of analysis, estimation of earth pressure by graphical construction (Culmann method).	**4L**
Module-2: **Retaining Wall & sheet pile structures:**Proportions of retaining walls, stability checks, cantilever and anchored sheet piles, free earth and fixed earth method of analysis of anchored bulk heads, coffer dam structures types.	**8L**
Module-3: **Stability of slopes:**Analysis of finite and infinite slopes, Swedish And friction circle method, Taylor's stability number, Bishop's method of stabilityanalysis.	**4L**
Module-4: **Site Investigation & Soil Exploration:**Planning of sub-surface explanation, methods, sampling, samples, Insitu tests: SPT, SCPT, DCPT, field vane shear, Plate load test.	**4L**
Module-5: **Shallow foundations :**Safe bearing capacity, Terzaghi's bearing capacity theory, effect of depth of embedment, water table, eccentricity of load, foundation shape on bearing capacity, Bearing capacity as per 1S 6403	**4L**
Module-6: **Settlement analysis of shallow foundation:**Immediate and consolidation settlement, correction for rigidity and dimensional effects, settlement in various types of soil, IS-1904 and 8009 recommendations, Allowable bearingcapacity	**4L**

Module-7:	**8L**
Deep foundations: Pile: Types, load transfer mechanism Determination of load carrying capacities of piles by static and dynamic formulae, Recommendations of IS 2911, Pile group: Group efficiency, Negative skin friction, pile load test.	

Text / Reference Books:

Name	**Author**	**Publishers**
Principles of Geotechnical Engineering	B. M. Das	Thomson Book Store
Text book of Soil Mechanics & Foundation Engineering	V.N.S. Murthy	CBS Publisher's & Distributors
Geotechnical Engineering – Principles and Practice	Coduto	Pearson Education
Soil Mechanics	Lambe & Whitman	WIE
Basic & Applied Soil Mechanics	Gopal Ranjan & A.S.R.Rao	Willes EasternLtd
SP 36 (Part I) Numerical Problems – Geotechnical Engineering	Rao & Venkatramaiah	University Press

CO-PO mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**2**	**3**	**1**	**2**	**3**
CO2	**2**	**2**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**1**	**2**	**3**
CO3	**2**	**2**	**1**	**2**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**2**
CO4	**2**	**1**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**1**	**2**	**2**

COURSE NAME: HYDRAULICS
COURSE CODE: CE 503A
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36 HRS
CREDITS : 3

Pre requisites: Basic knowledge of Fluid Mechanics

Course Objective:

Students will understand and be able to apply fundamental concepts and techniques of hydraulics and hydrology in the analysis, design, and operation of water resources systems.

Course Outcome:

CO1 : Students will be able to recognize with different water resources terminology like hydrology, ground water, hydraulics of pipelines and open channel.
CO2 : Students will be able to explain and be able to use the energy and momentum equations.
CO3 : Students will be able to separate flow in closed pipes, and design and recommend of pipes including sizes.
CO4 : Students will be able to summarize pumps classification and be able to select a system curve used in pump selection.

Course contents:

Module-1: Center of pressure, Stability of floating bodies, Meta center, Difference between weir and barrage, Types of weirs, Selection of site.	**4L**
Module-2: Weir and notches, Rectangular, Triangular, Submerged weirs, Theories of seepage and design of weirs and barrages. Failures of hydraulic structure founded on pervious foundation.	**8L**
Module-3: Friction in pipes, Head loss due to friction, Drag-weisbach Equation, Variation of friction factor with wall roughness, Hydraulics structure for canals --- Canal falls---Necessity, locations, Types, Trapezoidal notches fall.	**4L**
Module-4: Water hammer---speed of pressure wave, Slow and rapid closer Cross drainage work, Necessity, type, selection of suitable type (Introduction only)	**4L**
Module-5: Steady uniform flow in open channel, Mannings and Bazin's formula, Hydraulically efficient cross section, Varied flow through open channel, gradually varied & rapidly varied flows. Dam (General): Definition, classification of Dams, Types of Earthen Dams, Methods of Construction,	**8L**
Module 6: Introduction of Hydraulic Turbines and various type of Pumps. Gravity Dam: Typical cross- section, Concept of High and low Gravity Dam.	**8L**

Text / Reference Books:

Name	Author	Publishers
Fluid Mechanics	Modi & Seth	Standard Book House, New Delhi
Fluid Mechanics	A.K.Jain	Khanna Publishers, New Delhi
Fluid Mechanics & Machinery	H. M. Raghunath	CBS Publishers, New Delhi
Fluid Mechanics and Fluid Machines	S. K. Som & G. Biswas	Tata McGraw Hill.
Fluid Mechanics, Hydraulics and Fluid Machines	S. Ramamrutham	Dhanpat Rai
Water Supply Engineering	Santosh Kumar Garg	Khanna Publishers

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**2**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**3**	**2**	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**2**	**3**	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

COURSE NAME: WATER SUPPLY AND PLUMBING
COURSE CODE: CE 503B
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36 HRS
CREDITS : 3

Pre requisites: Student should knowledge about hydraulic

Course Objective:

Student should be able to make technology choice to deal with water quality issues, operate and maintain working treatment systems and do troubleshooting of the problems in these systems. The student will be able to apply the knowledge gained from the subject in EIA studies for water component and water pollution control strategies.

Course Outcome:

CO1 : Student will be able to apply appropriate treatment to raw water i.e. surface water/ground water useful for domestic as well as drinking purpose, industries liquid waste and reuse ofwater.
CO2 : Student will be able to calculate and recommend the pipe- network for water supply and Sewage disposal effectively.
CO3 : Student may clarify and identify the impurities present in water used for domestic, different types of industrial as well as constructionworks.
CO4 : Student will able to produce and select water distribution and sewer-network system.

Course contents:

Unit I: Water Demands and Importance Necessity of Planned Water Supply. – Various Types of Water Demands,Water Requirements of a town or acity,The Per Capita Demand ,Factors affecting per Capita Demands, Variations in Demands, Effects of Variations in Demand on the Design Capacities of Different Components of a Water Supply Scheme, Design Periods, Population Data and Population Growth, Population Forecasting Method	**6L**
Unit II: Sources of Water and Study of Sources of Water -Hydrologic Cycle, Precipitation, Types of Precipitation, Rainfall and Measurement, Average Annual Rainfall, Minimum Rainfall, Index of Wetness, Run off and Estimation of Run off, Surface Sources of water, Subsurface Sources of Water, Development of Ground Water, Various Forms of Underground Sources, Wells, Open Wells,Dug Well, Tube Wells, Comparative Study of Surface and SubsurfaceSupplies	**6L**
Unit III: Intake Structure – Definition and Introduction, Types of Conduits, Hydraulics of Flow and Design of Pressure Pipes as Gravity Mains, Flow in Pipe System, Various types of Pipe System,PipeAppurtenances	**3L**
Unit IV: Conduits for Transporting Water-Definition and Introduction, Types of Conduits, Hydraulics of Flow and Design of Pressure Pipes as Gravity Mains, Flow in Pipe System, Various types of Pipe System, Pipe Appurtenances	**3L**
Unit V: Water Quality - Characteristics of Water, Water Borne Diseases and their control Quality Standards for Municipal and Industrial Supply.	**4L**
Unit -VI Purification of Water Supplies-Screening, Course and Fine Screens, Theory of Sedimentation, Sedimentation Tanks, Sedimentation Aided with Coagulation ,Analysis of Flocculent Settling, Chemicals used for Coagulation, Coagulation Sedimentation Plant. Sedimentation Tank, Filtration, Filter Material, Types of Filters, Rapid Gravity Filter, Slow	**6L**

Sand Filter, Rapid Gravity Filter and Pressure Filter. Disinfection Methods, Chlorination, Methods of Removing Temporary Hardness and Permanent Hardness, Removal of Iron, Manganese, De-fluoridation of Water, Removal of Radioactive from water, Desalination of Brakish Water.	
Unit -VII Distribution System, Layouts of Distribution System, Requirements, Arrangement of Distribution Pipes and Other Accessories, Method of Distribution System, Pressure in Distribution System, Systems of Supply	**4L**
Unit -VIII Water Supply Plumbing Systems in Buildings and Houses, Plumbing Systems in Water Supplies, The House Water Connections, Stop Cocks, Water Taps and Bib Cocks, Pipe Fittings, Pipe Fittings, Storage of Water Buildings, Design Considerations for Water Piping Systems	**4L**

Text / Reference Books:

Name	**Author**	**Publishers**
Engineering Hydrology	K. Subramanya	Tata McGraw-Hill
A Text Book of Hydrology-	P. Jaya Ram Reddy	Laxmi Publications-New Delhi
Hydrology & Water Resource Engineering-	S.K Garg	Khanna Publishers.
Hydrology Principles, Analysis and Design	H. M. Raghunath.	
Hydraulics of Groundwater	J. Bear	McGraw-Hill
Water Resources Engineering Through Objective Questions	K. Subramanya	Tata McGraw-Hill

CO-PO mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**2**	**1**	**-**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**2**	**3**	**2**	**-**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**3**	**2**	**2**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**3**	**2**	**2**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

COURSE NAME: WASTE WATER AND TREATMENT
COURSE CODE: CE 503C
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36 HRS
CREDITS : 3

Pre requisites: Fluid Mechanics or an equivalent course in fluid flow or hydraulics.

Course Objective:

Explore the relationship between the natural water cycle and human water use, and understand the principles of water resources planning and total water management. Describing the physical, chemical,and biological processes necessary for designing and managing drinking water treatment processes and water conveyance and distribution systems and the physical, chemical, and biological processes necessary for designing and managing primary, secondary, tertiary and advanced wastewater treatment processes and solids handlingsystems.

Course Outcome:

CO1 : Students will be able to summarize the quality parameters typically used to differentiate wastewater and judge the different classes of treated wastewater

CO2 : Students will be able to describe various types of process units used for preliminary, primary and secondary treatment and explain how they achieve the target level oftreatment

CO3 : Students will be able to identify and summarize emerging technologies for advanced wastewater treatment and water recycling

CO4 : Students will be able to differentiate water and wastewater treatment on solid wastes management.

Course contents:

Unit I: Estimating the Design Sewage Discharge -Estimating Sewage Discharge, Design Periods for Different Components of a Sewerage Scheme, Future Forecasts and Estimating Design Sewage Discharge, Variations in Sewage Flow and their Effects.	**6L**
Unit II: Hydraulic Design of Sewers and S.W Drain Sections-Difference in the Design of Water Supply Pipes and Sewer Pipes and Sewer Pipes, Hydraulic Formulas for Determining Flow Velocities in Sewers, Effect of flow variations on Velocity in a Sewer, Hydraulic Characteristics of Circular Sewer, Various Forms of Underground Sources, Use of Tables and Nomograms for Hydraulic Computations for the Design of Sewers, Limitation on Depth of Flow, Egg Shaped Sewer	**8L**
Unit III: Quality and Characteristics of Sewage-Decomposition of Sewage, Characteristics ofSewage	**4L**
Unit IV: Disposing of the Sewage Effluents-Disposal by Dilution, Disposal of Wastewaters in Rivers and Self, Disposal on Land for Irrigation, Dilution Method Vs Land Disposal Method	**6L**
Unit V: Treatment of Sewage-Classification of Treatment Processes, Screening, Types of Screens, Their Designs and Cleaning, Grit Removal basins, Grit Chambers, Sedimentation, Principle of Sedimentation, Sedimentation Tank, Sedimentation Aided with Coagulation, Contact Beds for Biological Filtration of Sewage, Trickling Filters for Biological Filtration of Sewage, Recirculation of Treated Sewage and its Use in High Rate Trickling Filters, Secondary Sedimentation, Sludge and its Moisture Content, Sludge Digestion Process,	**12L**

Secondary Treatment Through Activated Sludge Process, Secondary Treatment Through Rotating Biological Contractors, Oxidation Ponds and Aeration Lagoons, Anaerobic Stabilization Units	

Text / Reference Books:

Name	Author
Waste Water Treatment and Water Management : Water Treatment and Management	Anamika Srivastava
INDUSTRIAL WASTE WATER TREATMENT	A. D. Patwardhan

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	-	-	-	-	1	-	-	-	-	-
CO2	2	2	3	-	1	-	-	-	-	-	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-	-
CO4	3	2	1	-	1	2	-	-	-	-	-	-

COURSE NAME: TRANSPORTATION ENGINEERING
COURSE CODE: CE 504A
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36 HRS
CREDITS : 3

Pre requisites: Knowledge on IRC codes, Loading pattern base on IRC, Traffic features etc.

Course Objective:

Introduction of IRC loading
Introduction of Traffic Engineering.
Utility of study of traffic management.
Basic concept of Railway track, railway governing body and engineering fundamentals.

Course Outcome:

CO1 : Understanding of traffic loading pattern
CO2 : Understanding of traffic engineering and traffic management
CO3 : Basic concept of railway engineering

Course contents:

Module-I: **INTRODUCTION OF DIFFERENT TYPES OF LOADING FOR BRIDGE DESIGN BASED ON IRC GUIDELINES:** Definition and Basic Forms, Component of bridge, classification of bridge, short history of bridge development. I.R.C Loads. Analysis of IRC Loads, Impact factors, other loads to be considered, Importance of Hydraulic factors in Bridge Design.	**6L**
Module- II: **TRAFFIC ENGINEERING:** Traffic Engineering : Road user and vehicle characteristics; Traffic flow characteristics – Traffic Volume, Speed, Headway, Concentration and Delay; Traffic surveys & studies; Traffic estimation; Statistical applications in traffic engineering analysis; Parking; Road intersections – Basic traffic conflicts, classification of at-grade intersections, channelization, rotaries, traffic signals, signs and marking; Road Safety; Traffic System Management.	**10L**
Module–III: **TRANSPORTATION MANAGEMENT:** Functions of IRC, Central Road Research Institute. Motor Vehicle Act, Jayakar committee Recommendations, Saturation system, Population unit and productivity units. Highway cost analysis, Transportation Demand Analysis, Preparation of Project Report.	**6L**
Module- IV: **INTRODUCTION OF RAILWAY ENGINEERING:** Basic Terminologies of Railway Engineering, Different types of Railway planning, Classification of Indian Railways, Classification of Indian Railways based on speed criteria, Undertakings Under Ministry Of Railways, Initiatives By Indian Railways For Development Of Tourism Sector, Global Trains Of Tomorrow, Construction And Renewal Of Track, Development of High And Super High Speeds, Modernization Of Track For High Speeds,	**14L**

Administration Of Indian Railways, Railway Expenses, Rates and Fares.

Text / Reference Books:

Name	Author	Publishers
High Way Engineering	Khanna& Justo	Nemchand& Brothers, Roorkee
Principles of Transportation Engineering	P. Chakraborty& A. Das	PHI
Transportation Engineering	C.J Khisty& B.K Lall	-
I.S Specifications on Concrete , Aggregate & Bitumen	Bureau of Indian Standard	
Relevant latest IRC Codes (IRC-37 – 2001, IRC 58 – 2002, IRC 73 - 1980, IRC 86 - - 1983, IRC 106 – 1990, IRC 64 – 1990, IRC 15- 2002 Indian Road Congress	-	-

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	3	1	1	1	3	3	3	3
CO2	3	3	3	2	2	2	1	1	3	2	3	2
CO3	3	1	2	1	2	3	2	2	1	3	3	3

COURSE NAME: INFRASTRUCTURE PLANNING & DESIGN
COURSE CODE: CE 504B
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36 HRS
CREDITS : 3

Pre requisites: Basic Civil Engineering knowledge in design and construction management.

Course Objective: To provide students with the demanding business environments and economy, infrastructure planning & design which must utilize current technologies and deliver the highest performance at the lowest cost. Infrastructure is composed of public and private physical improvements such as roads, railways, bridges, tunnels, water supply system and sewers.

Course Outcome*:*

CO1 : Students will summarise basic knowledge about the role of infrastructure in economic development, India's infrastructural capacity and its scenario in adequacy and quality.

CO2 : Students will understand application of techniques to estimate supply and demand for infrastructure along with stratergic planning required in urban, regional and national levels

CO3 : To know the common aspects of rural and urban infrastructure management and to fuse them into an integrated infrastructure management.

CO4 : Assessment of risk management, understanding the stakeholders concerns and overviewing of policies involved in infrastructure management.

Course contents:

Module-1: [6L+3T] **Introduction to Infrastructure Planning and management:** Definition of basic terminologies, role of infrastructure in economic development, present scenario in India [2L+1T] **Development of infrastructure capacity:** Build-operate-transfer (BOT) schemes, concessions, development gain, public and private funding and quantification of demand and supply of various types of infrastructure [2L+1T] **Indian scenario in respect of infrastructure**: The importance of its infrastructure at present and its requirements in future to develop progressively. [2L+1T]	**9L**
Module -2: [6L+3T] **Infrastructure planning:** Goals and objectives of infrastructure planning, identification and quantification of factors influencing infrastructural demand. [2L+1T] **Perspectives on planning:** A technical perspective, a political perspective and a combination of both perspectives at work.[2L+1T] **Planning indicators:** Use of econometric, social and land use indicators and models to forecast the demand and level of service of infrastructure. Identification and prioritization of preferred areas for development. [2L+1T]	**9L**
Module -3: [7L+3T]	**10L**

Infrastructure Management: Usage of Cost-benefit Analysis (**CBA**) to arrive at sustainable and feasible investment decisions.[2L+1T] **Evaluation techniques:** The economic evaluation versus financial evaluation of two major essential turnkey projects with help of case study. Public unease and private finance.[2L+1T] **Integrated infrastructure management**: health assessment through expert committee and implementation of suggestive remedial measures, sizing of each infrastructure component, ordering, installation, initial configuration, optimization and their follow up for each incidents along with remedies to create a new management model. [3L+1T]	
Module -4 [6L+2T] **Participation in infrastructure projects**: Public-Private Sector Participation in infrastructure projects and their overview. Risk management in infrastructure projects. [2L+1T] **Infrastucture sector overview:** Analysis of highways, railways, waterways, airports, urban and rural infrastructure: roads, housing, water supply and sanitation systems with help of prominent case studies.[4L+1T]	**8L**

Text / Reference Books:

Name	Author	Publishers
Infrastructure Planning and Finance: A Smart and Sustainable Guide for local practitioners	Vicki Elmer, Adam Leigland	Routledge
Infrastructure planning	James Parkin	Thomas Telford
Public Infrastructure Asset Management	Ralph Haas, W. Ronald Hudson, and Waheed Uddin	McGrawhill publications
Public- private partnership projects in infrastructure	Jeffrey delmon	Cambridge University Press
Infrastructure Planning Handbook	Alvin.S Goodman ,Makarand Hastak	MH/ASCE Press

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**1**	**-**	**-**	**-**	**2**	**-**	**-**	**3**	**2**	**1**	**3**	**2**
CO2	**1**	**1**	**-**	**-**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**
CO3	**1**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**
CO4	**1**	**-**	**2**	**2**	**1**	**1**	**3**	**1**	**1**	**1**	**1**	**2**

COURSE NAME: PUBLIC TRANSPORT SYSTEM
COURSE CODE: CE 504C
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36 HRS
CREDITS : 3

Pre requisites: Basic knowledge of Civil Engineering

Course Objective:

- Explain different transit modes, routing management activities including demand analysis.
- Provide information on functioning, designing and scheduling of transit terminal design, fleet management, and cost benefit analysis and bus transit operation.
- Provide information on loading and unloading transit platforms, traffic management techniques and IPT service improvements.
- Explain demand management techniques, intersection management techniques, planning for pedestrian, bicycle and parking management.

Course Outcome:

CO1 : Able to remember transit modes, management activities and demand analysis.
CO2 : Capable of designing transit terminal units, fleet management and cost analysis.
CO3 : Capable of planning and scheduling transit terminal platform for loading and un loading, selecting suitable traffic management techniques.
CO4 : Capable of selecting different demand management techniques, intersection management techniques and small area management.

Course contents:

Module 1: **System and Technologies:** Urban passenger transportation modes, transit classifications and definitions, theory of urban passenger transport modes, rail transit, bus transit, Para transit and ride sharing, designing for pedestrians, trends in transit rider ship and use of different modes.	**8L**
Module 2: **Comparing Alternatives:** Comparing costs, comparative analysis, operational and technological characteristics of different rapid transit modes, evaluating rapid transit **Planning:** Transportation system management, system and service planning, financing public transportation, management of public transportation, public transportation marketing.	**10L**
Module 3: **Transit System Evaluation:** Definition of quantitative performance attributes, transit lane capacity, way capacity, station capacity, theoretical and practical capacities of major transit modes, quantification of performance	**8L**
Module 4: **City Traffic:** Classification of transportation systems, conventional transportation systems, unconventional transportation systems, prototypes and tomorrow's solutions, analysis and	**10L**

interpretation of information on transportation systems, perspectives of future transportation.

Text / Reference Books:

Name	Author	Publishers
Public Transportation	George E. Gray and Lester A. Hoel	Prentice Hall, New Jersey
Urban Public Transportation Systems and Technology	Vukan R Vuchic	Prentice Hall Inc., New Jersey
City Traffic - A Systems Digest'	Horst R. Weigelt, Rainer E. Gotz, Helmut H. Weiss	Van Nostrand Reinhold Company, New York
Metropolitan Transportation Planning'	John W. Dickey	Tata McGraw-Hill Publishing Co. New Delhi

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	3	1	-	-	-	-	-	-	1
CO2	3	2	2	2	1	-	-	-	-	-	-	1
CO3	2	2	2	2	2	-	-	-	-	-	-	1
CO4	3	2	2	3	2	-	-	-	-	-	-	1

COURSE NAME: TRANSPORTATION & HIGHWAY ENGINEERING LAB
COURSE CODE: CE 591 A
CONTACT: 0:0:3
CREDITS : 1.50

Pre requisites: Student should have the basic knowledge about Highway&Transportation engineering.

Course Objective: The objective of this course is to understand the characteristics and behavior of highway materials used in highway engineering. Students will learn standard principles and procedure to design prepare and/or test materials such as B.M. & S.D.B.C. mixdesign including Marshal Stability Test. Know how to select materials based on their properties and their proper use for a particular facility under prevailing loads and environmental conditions.

Course Outcome:

CO1: Identify the functional role of different materials of highway engineering.
CO2: Apply this knowledge to mix design philosophy to get different suitable B.M. & S.D.B.C. Mix.
CO3: Student should be able to test of existing highway and examine the quality of that highway by Benkelman Beam Test.
CO4: Student shall learn to work in a team to achieve the objective.

LIST OF EXPERIMENT:

1. **Tests on highway materials –** Aggregates- Impact value, los-Angeles Abrasion value water absorption, Elongation & Flakiness Index.
2. **Bitumen & bituminous materials –** Specific Gravity, Penetration Value, Ductility, Softening Point, Loss on Heating, Flash & Fire Point Test.
3. **Stripping value test**
4. **Design of mix gradation** for mix seal surfacing Design of B.M. &S.D.B.C. Mix
5. **Marshal Stability Test.**
6. **Benkelman Beam Test.**

Text / Reference Books:

Highway material testing(Laboratory Manual)by S.K. Khanna and CE.G. Justo
Relevant IS & I.R.C. codes.
BIS codes on Aggregates & Bituminous materials

CO-PO mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2	-	-	-	1	1	-	1
CO2	3	2	2	2	2	1	1	1	1	-	-	1
CO3	3	2	2	2	2	1	-	-	1	-	-	1
CO4	1	1	1	1	1	-	1	1	3	2	2	1

COURSE NAME: INFRASTRUCTURE PLANNING & DESIGN LAB
COURSE CODE: CE 591 B
CONTACT: 0:0:3
CREDITS : 1.50

Pre requisites: Basic Civil Engineering knowledge in design and construction management.

Course Objective: To make students understand the practical importance of infrastructural planning and management for the societal benefit and contribution to sustainable demand for infrastructures which are composed of public and private physical improvements such as roads, railways, bridges, tunnels, water supply system and sewers.

Course Outcome:

CO1: To enumerate various economic, financial, social and sustainable tools in infrastructure management.
CO2: To enumerate various planning and management tools adopted for infrastructural development.
CO3: To estimate the actual cost involved in a small scale to large scale infrastructure project.
CO4: To study case studies and relate them with practical explorations for nearby ongoing infrastructural projects.

LIST OF EXPERIMENT:

Cost Benefit Analysis:
Usage of Cost-benefit Analysis (**CBA**) to arrive at sustainable and feasible investment decisions for any scale of infrastructure project.

Comparison of public and private investments:
Analysis of two different public and private investment for infrastructural development, selection of merits in each system and an effort to collaborate to produce an optimum investment sytem.

Planning of sustainable infrastructure projects:
Selection of available sustainable products, methodologies and their convergence to bring in the need of sustainable resourced infrastructure, Non-Destructive Test method for health monitoring of structures.

Layout of an infrastructural plan of a civil engineering work:
A detailed work comprising the layout of a civil engineering work like a dam, canal or bridge with the provision of support linking urban, regional and national commodities.

Case study preparation:
Collect data from nearby areas of any scaled infrastructure work and prepare a case study about implementations, improvisations and key additions for a work of infrastructural importance.

Text / Reference Books:

Name	Author	Publishers
Infrastructure Planning and Finance: A Smart and Sustainable Guide for local practitioners	Vicki Elmer, Adam Leigland	Routledge
Infrastructure planning	James Parkin	Thomas Telford
Public Infrastructure Asset Management	Ralph Haas, W. Ronald Hudson, and Waheed Uddin	McGrawhill publications
Public- private partnership projects in infrastructure	Jeffrey delmon	Cambridge University Press
Infrastructure Planning Handbook	Alvin.S Goodman ,Makarand Hastak	MH/ASCE Press

CO-PO mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	-	1	2	-	-	3	2	1	3	2
CO2	1	2	-	1	2	1	2	1	2	1	2	2
CO3	1	1	3	1	-	-	-	-	1	1	3	2
CO4	1	1	2	2	2	1	3	1	2	1	2	2

COURSE NAME: PUBLIC TRANSPORT SYSTEM LAB
COURSE CODE: CE 591 C
CONTACT: 0:0:3
CREDITS : 1.50

Pre requisites: Basic knowledge of Civil Engineering

Course Objective: To make students know the practical implication of public transport system for the societal benefit and contribution to sustainable demand for public transport which are composed of public and private physical improvements such as roads, various modes, routing, demand and cost.

Course Outcome:

CO1: To solve network and routing problem through some case study discussion.
CO2: To evaluate various costs involve in designing and scheduling of public transit service.
CO3: To estimate various basic parameters like traffic demand, passenger car unit (PCU) value in field.
CO4: To understand the various design aspect in parking and traffic intersection design.

LIST OF EXPERIMENT:

NETWORK CONFIGURATION:
Case study base analysis on network and shortest route identification through collected data from field study.

DEMAND CALCULATION:
Demand calculation for different type of modes using various demand problems on real time data collected from field.

COST BENEFIT ANALYSIS (CBA):
A comparative cost analysis for different types of modes transit system based on their operational & Technological characteristics**.**

TRAFFIC CAPACITY ANALYSIS:
Study of various types of traffic capacities for different types of lanes for different types of transit modes based on their performance.

PASSENGER CAR UNIT (PCU) ANALYSIS:
Calculation of traffic volume in terms of PCU value at urban straight road and intersection through survey and filed data collection.

LEVEL OF SERVICE (LOS) IDENTIFICATION:
Determination of LOS of different modes of public transit in urban area through survey and field data collection.

FUTURE PERSPECTIVE:
Visualization and presentation of your idea on public transit system through some prototype as tomorrow's solution for a hassle free transit system for the society.

Text / Reference Books:

- George E. Gray and Lester A. Hoel. "Public Transportation", Prentice Hall, New Jersey.
- Vukan R Vuchic, "Urban Public Transportation Systems and Technology", Prentice Hall Inc., New Jersey.

- Horst R. Weigelt, Rainer E. Gotz, Helmut H. Weiss,' City Traffic - A Systems Digest', Van Nostrand Reinhold Company, New York.
- John W. Dickey,' Metropolitan Transportation Planning', Tata McGraw-Hill Publishing Co. New Delhi.

CO-PO mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	3	1	-	-	-	-	-	-	1
CO2	3	2	2	2	1	-	-	-	-	-	-	1
CO3	2	2	2	2	2	-	-	-	-	-	-	1
CO4	3	2	2	3	2	-	-	-	-	-	-	1

COURSE NAME: SOIL MECHANICS LAB-II
COURSE CODE: CE 592
CONTACT: 0:0:3
CREDITS : 1.50

Pre requisites: Basic course on soil mechanics with understanding of soil parameters, behavior and response against loading.

Course Objective: Students will be able to access unconfined compressive strength of soil, shear parameter of soil by direct shear test and undrained shear strength by vane shear test . Students will be familier with fractional test standard penetration test.

Course Outcome:

CO1: Ability to caculate the compressive strength of soil
CO2: Ability to perform shear strength of soil
CO3: Ability to understand standard penetration test
CO4: Ability to understand consolidation parameters of soil

LIST OF EXPERIMENT:

1. Determination of compressibility characteristics of soil by Oedometer test (co-efficient of consolidation & compression Index)
2. Determination of unconfined compressive strength of soil
3. Determination of Shear parameter of soil by Direct shear test
4. Determination of undrained shear strength of soil by Vane shear test.
5. Determination of shear parameter of soil by Triaxial test (UU)
6. Standard Penetration Test
7. Expt No. 6 by large groups in the field.

Text / Reference Books:

Soil testing by T.W. Lamb (John Willey)
SP-36 (Part-I & Part –II)
Soil Mechanics Laboratory Manual by B. M. Das, OXFORD UNIVERSITY PRESS
Measurement of engineering properties of soil by E.Jaibaba Reddy & K. Ramasastri.

CO-PO mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	3	3	-	-	-	-	2	-	2
CO2	3	3	-	3	3	-	-	-	-	2	-	2
CO3	3	3	-	3	3	-	-	-	-	2	-	2
CO4	3	3	-	3	3	-	-	-	-	2	-	2

COURSE NAME: CIVIL ENGINEERING LAB
COURSE CODE: CE 593
CONTACT: 0:0:3
CREDITS : 1.50

Pre requisites: Student should have the basic knowledge about building material and construction and also should have knowledge about basic concrete property.

Course Objective: The objective of this course is to understand the characteristics and behavior of civil engineering materials used in buildings and infrastructure. Students will learn standard principles and procedure to design prepare and/or test materials such as concrete mix design including field test methods for fresh concrete. Know how to select materials based on their properties and their proper use for a particular facility under prevailing loads and environmental conditions.

Course Outcome:

CO1: Test of beams for deflection, flexure and shear
CO2: Experiments on Concrete, including Mix design
CO3: Illustrate knowledge on Non destructive testing (NDT) equipments – Rebound hammer, Ultra sonic pulse velocity meter

LIST OF EXPERIMENT:

Determination of physical properties of bricks:

Size, shape, weight, water absorption, efflorescence test, crushing strength test

39B**Determination of physical properties of Coarse Aggregate:**

Abrasion, Crushing and Impact Test of Coarse Aggregate

40B**Determination of physical properties of Structural Steel:**

Stress Strain Behavior for the tensile test of Mild Steel and HYSD Bar

41B**Structural Behavior of RC Beam:**

Load deflection behavior of flexural beam member for flexure

42B**Survey using Total Station**

RDM(Remote Distance Measurement), REM(Remote Elevation Measurement), Horizontal & Vertical Angle determination using Total Station

Text / Reference Books: Properties of concrete by A.M Neville, Trans-Atlantic Publications

CO-PO mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	3	3	-	1	1	2	3	-	1
CO2	3	2	3	2	2	1	1	-	2	1	2	2
CO3	3	2	2	2	3	2	2	2	1	-	2	1

COURSE NAME: ADVANCED PROGRAMMING FOR PROBLEM SOLVING
COURSE CODE: CE 594
CONTACT: 0:0:3
CREDITS : 1.50

Pre requisites: Number system, Boolean Algebra, Basic C programming concepts.

Course Objective: Students will be able to understand the algorithms for arithmetic and logical problems and translate the algorithms to C programs and able to test and execute the programs and correct syntax and logical errors during compile and run time.

Course Outcome:

CO1: To formulate the algorithms for arithmetic and logical problems and translate the algorithms to C programs.
CO2: To be able to test and execute the programs and correct syntax and logical errors during compile and run time.
CO3: To implement conditional branching, iteration and recursion.
CO4: To decompose a problem into functions and synthesize a complete program using divide and conquer approach.
CO5: To use arrays, pointers, structures, unions and files to formulate algorithms and programs and apply programming to solve searching and sorting problems.

LIST OF EXPERIMENT:

Experiment should include but not limited to the following:

- Writing C Programs on variable types, type conversions and simple computational problems using arithmetic expressions.
- Writing C Programs on various problems involving if-then-else structures to implement branching and logical expressions.
- Writing C Programs on loops (for, while, do-while) to implement iterative problems.
- Writing C Programs on 1D array and various searching and sorting techniques.
- Writing C Programs to implement String operations.
- Writing C Programs to implement matrix operations using 2D array.
- Writing C Programs to implement user defined function concept and to implement various programs using ‘call-by-value’ and ‘call-by-reference’.
- Writing C Programs to implement recursion concept to understand the advantages of recursion.
- Writing C Programs to implement various properties of pointers.
- Writing C Programs to implement self defined structures.
- Writing C Programs to implement dynamic memory allocation.
- Writing C Programs to implement file operations.

Text / Reference Books:

Text Books:

1. Kanetkar Y. - Let us C, BPB Publication, 15th Edition
2. E Balagurusamy – Programming in ANSI C, TMH, 3rd Edition

Reference Book:

K R Venugopal & S R Prasad – MASTERING C, TMH, 2nd Edition

CO-PO mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	2	2		1		1	2	3
CO2	3	3	3	-	-	-	-	-	-	-	-	2
CO3	2	2	2	2	2	-	-	-	-	-	-	3
CO4	1	2	2	2	2	-	-	-	-	-	-	2
CO5	2	3	3	3	2	2	3	1	3	3	3	3

COURSE NAME: CONSTITUTION OF INDIA
COURSE CODE: MC 501
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 32

Pre requisites: NA

Course Outcome:

CO1: Develop human values, create awareness about law ratification and significance of Constitution

CO2: Comprehend the Fundamental Rights and Fundamental Duties of the Indian Citizen to implant morality, social values and their social responsibilities.

CO3: Create understanding of their Surroundings, Society, Social problems and their suitable solutions.

CO4: Familiarize with distribution of powers and functions of Local Self Government.

CO5: Realize the National Emergency, Financial Emergency and their impact on Economy of the country.

Course content:

1. Meaning of the constitution law and constitutionalism (2L)
2. Historical perspective of the Constitution of India (2L)
3. Salient features and characteristics of the Constitution of India (1L)
4. Scheme of the fundamental rights (2L)
5. The scheme of the Fundamental Duties and its legal status (2L)
6. The Directive Principles of State Policy – Its importance and implementation (2L)
7. Federal structure and distribution of legislative and financial powers between the Union and the States (3L)
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India (2L)
9. Amendment of the Constitutional Powers and Procedure (2L)
10. The historical perspectives of the constitutional amendments in India (2L)
11. Emergency Provisions: National Emergency, President Rule, Financial Emergency (3L)
12. Local Self Government – Constitutional Scheme in India (3L)
13. Scheme of the Fundamental Right to Equality (2L)
14. Scheme of the Fundamental Right to certain Freedom under Article 19 (2L)
15. Scope of the Right to Life and Personal Liberty under Article 21. (2L)

Text / Reference Books:

1. Introduction to Constitution of India, D.D. Basu, Lexis Nexus
2. The Constitution of India, PM Bhakshi, Universal Law

CO-PO mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	3	2	3	-	-	-	2
CO2	-	-	-	-	-	3	2	3	-	-	-	2
CO3	-	-	-	-	-	3	2	3	-	1	-	2
CO4	-	-	-	-	-	3	2	3	-	1	-	2
CO5	-	-	-	-	-	3	2	3	-	1	-	2

DEPARTMENT OF CIVIL ENGINEERING

Syllabus of
6^{th}
Semester

6th Semester								
Sl No	**Course Code**	**Paper Code**	**Theory**	**Contact Hours /Week**				**Credit Points**
				L	**T**	**P**	**Total**	
A. THEORY								
1	PC	CE601	Structural Design – II	3	0	0	3	3
2	PC	CE602	Construction Planning And Management	2	1	0	3	3
4	PE	CE603	A.Bridge Engineering B.Pre stressed Concrete C.Structural Dynamics and Earthquake Engineering	3	1	0	4	4
5	OE	CE604	A. Operations Research B. Human Resource Management C.Studies On Six Sigma	3	0	0	3	3
Total of Theory							**13**	**13**
B. PRACTICAL								
6	PC	CE691	Structural Design And Detailing	0	0	2	2	1
7	PC	CE692	Computer Aided Design and Drafting	0	0	3	3	1.5
11	PROJ	PR 691	Project-VI	0	0	2	2	1
12	PROJ*	PR 692	Innovative activities-V	0	0	0	0	0.5
C. MANDATORY ACTIVITIES / COURSES								
13	MC	MC 681	Technical Lecture Presentation & Group Discussion-I	0	0	3	3	
Total of Theory, Practical & Mandatory Activities/Courses							**23**	**17**

*Students may choose either to work on participation in all the activities of Institute's Innovation Council for eg: IPR workshop/ Leadership Talks/ Idea/ Design/ Innovation/ Business Completion/ Technical Expos etc.

Innovative activities to be evaluated by the Programme Head/ Event coordinator based on the viva voce andsubmission of necessary certificates as evidence of activities.

COURSE NAME: STRUCTURAL DESIGN – II
COURSE CODE: CE 601
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36 HRS
CREDITS : 3

Pre requisites: A basic concept of material properties and behavior with basic knowledge of structural analysis and structural elements behaviorunder different loading pattern. Knowledge of stress and strain with fundamental concept of Engineering mechanics.

Course Objective: Students will be able to analyse the behaviour of steel structure under different type of loading.To design a connection using IS:800-2007 and satisfy the serviceability and strength parameters.To acquire the knowledge to design tension ,compression, members columns, beams. Using the codal Stipullation and basic knowledge of structural analysis students will be able to design plate girders and gentry girders considering lateral buckling.

Course Outcome:

CO1 : Understand various types of design methodology as per limit and working stress method
CO2: Interpret different type of connections
CO3 : Design compression, tension and beam members
CO4 : Analyze column bases
CO5 : Design plate girder, uses of stiffeners

Course contents:

Module-I: **Materials and Specification:-**Rolled steel section, types of structural steel, specifications, Residual stress	**2L**
Module-II: **Structure connections:** Riveted, welded and bolted including High strength friction grip bolted joints– types of riveted & bolted joints, assumptions, failure of joints,efficiency of joints, and design of bolted riveted, fillet and butt welded joints for axial load, IS code provisions. **Eccentric connection:-** Riveted & bolted joints subjected to torsion & shear, tension & shear, design of riveted, bolted & welded connection.	**6L**
Module-III: **Tension members:** Design of tension members, I.S code provisions. Permissible stresses, Design rules, Examples	**4L**
Module-IV: **Compression members:** Effective lengths about major & minor principal axes, I.S code provisions. Permissible stresses, Design rules, Design of one component, two components and built up compression members under axial load, Examples. **Built up columns under eccentric loading**: Design of lacing and batten plates, Different types of Column Bases- Slab Base, Gusseted Base, and Connection details.	**6L**
Module-V: **Beams:** Permissible stresses in bending, compression and tension, lateral buckling. Design of	**6L**

rolled steel sections, plated beams. Simple Beam end connections, beam -Column connections. I.S code provisions	
Module-VI: **Plate girders:** Design of webs & flanges, Concepts of curtailment of flanges – Riveted & welded web stiffeners, web flange splices - Riveted, welded& bolted. I.S code provisions	**6L**
Module-VII: **Gantry Girder:** Design gantry girder considering lateral buckling – I.S code provisions.	**6L**
IS 800 – 2007 to be followed for all IS code provisions.	

Text / Reference Books:

Name	Author	Publishers
Design Of Steel Structures	S.K.Duggal	Tata Mc-Graw Hill , New Delhi
Design of Steel structures	N. Subramanian	Oxford University Press
Design of steel structures	A.S.Arya and J.L.Ajmani	Nemchand& Bros.
Design of steel structures	Vol. I & II Ramachandra	
Design of steel structures	PasalaDayaratnam	A.H.Wheeler& Co Ltd. 1990
Design of steel structures	B.S.Krishnamachar and D.AjithaSinha	Tata McGraw – Hill publishing Co. Delhi.
Design of steel structures	Ramamurtham	
IS 800 – 2007(Latest Revised code) Bureau of Indian Standard		
S.P.: 6(1) – 1964 Structural Steel Sections Bureau of Indian Standard		

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	3	-	-	-	-	-	-
CO2	-	2	3	3	-	3	-	-	-	-	-	-
CO3	-	2	-	3	3	3	-	2	-	-	-	-
CO4	-	-	2	3	2	2	-	2	-	-	-	-
CO5	-	2	2	3	2	2	-	-	-	-	-	-

COURSE NAME: CONSTRUCTION PLANNING AND MANAGEMENT
COURSE CODE: CE 602
CONTACT: 2:1:0
TOTAL CONTACT HOURS: 36 HRS
CREDITS : 3

Pre requisites: Basic course in construction material and methodology with understanding of structural elements and their uses and sequence of construction, erection. Basic knowledge of quantity Estimation and valuation.

Course Objective: Students will gain knowledge on planning, Regulation and by laws for construction. students will be familiar with fire protection, construction plant and equipments. students will be able to plan and schedule construction project by CPM and CEAT. some knowledge on management and departmental procedures of PWD, EMD and SD and familiarity Cost Analysis, project cost, cost slopes and time optimization.

Course Outcome:

CO1 : Students will be able to successfully apply business and Management skills in positions within the construction industry.
CO2: Use industry resources including associations and organizations.
CO3 : Practice informed decision- making in personal and professional endovers.
CO4 : Manage a quality construction project from start to completion while maintaining budget, schedule, and safety requirements.

Course contents:

Module-I: **Planning**: General consideration, Definition of aspect, prospect, roominess, grouping, circulation Privacy, acclusion	**4L**
Module-II: **Regulation and Bye laws**: Bye Laws in respect of side space, Back and front space, Covered areas, height of building etc., Lavatory blocks, ventilation, Requirements for stairs, lifts in public assembly building, offices	**4L**
Module-III: **Fire Protection**: Fire fighting arrangements in public assembly buildings, planning, offices, auditorium	**4L**
Module-IV: **Construction plants & Equipment**: Plants & equipment for earth moving, road constructions, excavators, dozers, scrapers, spreaders, rollers, their uses. Plants &Equipment for concrete construction: Batching plants, Ready Mix Concrete, concrete mixers, Vibrators etc., quality control	**6L**
Module-V: **Planning & scheduling of constructions Projects:** Planning by CPM &PERT, Preparation of network, Determination of slacks or floats. Critical activities. Critical path, project duration .expected mean time, probability of completion of project, Estimation of critical path, problems	**6L**
Module-VI:	**6L**

Management: Professional practice, Definition, Rights and responsibilities of owner, engineer, Contractors, types of contract	
Module-VII: **Departmental Procedures:** Administration, Technical and financial sanction, operation of PWD, EMD and SD, Acceptance of tenders, Arbritation, cost Analysis, Direct and Indirect project costs, Total costs- cost slopes. Crushing cost and time optimization	**6L**

Text / Reference Books:

Name	Author	Publishers
Construction Planning, Equipments and methods	Puerifoy	R.L. McGraw Hill
Management in construction industry	P.P.Dharwadkar	Oxford and IBH Publishing company New Delhi
Construction Management, Critical path Methods in Construction	J.O.Brien	Wiley Interscience
PERT and CPM	L.S. Srinath	-
Project planning and control with PERT and CPM' Construction equipments and its management	B.C.Punmia and K.K.Kandelwal	S.C.Sharma
National Building code BIS	-	-

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**2**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**-**	**2**	**2**	**2**	**-**
CO3	**2**	**2**	**1**	**2**	**3**	**2**	**2**	**-**	**2**	**1**	**1**	**-**
CO4	**-**	**-**	**1**	**1**	**1**	**-**	**-**	**-**	**2**	**1**	**3**	**-**

COURSE NAME: BRIDGE ENGINEERING
COURSE CODE: CE 603A
CONTACT: 3:1:0
TOTAL CONTACT HOURS: 48 HRS
CREDITS : 4

Pre requisites: Student should have knowledge about how to solve analysis of structural problem, reinforced concrete structure design and steel structure design.

Course Objective: Student will be able to know about the bridges and perform analysis of different types of bridges and also able to design of reinforced concrete and steel bridges of different types.

Course Outcome:

CO1 : Exhibit the knowledge of the history of bridges and know about the IRC guidelines.
CO2: Design the RCC bridges of different type.
CO3 : Design the Balanced Cantilever Bridges.
CO4 : Design the steel bridges of different type. schedule, and safety requirements.
CO5 : Exhibit the knowledge of Composite Bridges and Cable Stayed Bridges.

Course contents:

Module-I: [3L+1T] **Introduction:** Definition and Basic Forms, Component of bridge, classification of bridge, short history of bridge development. I.R.C Loads. Analysis of IRC Loads, Impact factors, Other loads to be considered, Importance of Hydraulic factors in Bridge Design.	**4L**
Module-II: [3L+1T] **Reinforced concrete solid slab bridge:** Introduction, General design features, Effective width method. Simply supported and cantilever Slab Bridge, analysis and design.	**4L**
Module-III: [3L+1T] **Box Culvert:** Introduction, Design method and Design example.	**4L**
Module-IV: [3L+1T] **Beam and Slab Bridges:** Introduction, Design of interior panel of slab. Pigeauds method, Design of longitudinal girder, Calculation of longitudinal moment, design example.	**4L**
Module-V: [3L+1T] **Balanced Cantilever Bridges:** General Features, Arrangement of supports, design features Articulation, Design example.	**6L**
Module-VI: [3L+1T] **Steel Bridges:** General features, types of stress, Design example.	**4L**
Module-VII: [3L+1T] **Plate Girder Bridge:** Elements, design, lateral bracing, Box- girder Bridges.	**6L**
Module-VIII: [6L+2T] **Composite Bridges:** General aspects, method of construction, analysis of composite section, shear connectors, design of composite beam.	**8L**
Module-IX: [5L+1T] **Cable Stayed Bridge:** General features, Philosophy of design.	**8L**

Text / Reference Books:

Name	Author	Publishers
Bridge engineering	Krishnaraju	-
Principle & Practice of Bridge Engineering	S.P. Bindra	DhanpatRai Pub
Essentials of bridge engineering	D.J. Victor	-
Bridge engineering	Ponnuswamy	-
Design of Bridge Structures	T.R. Jagadesh, M.A. Jayaram	-
Design of concrete bridges	Aswani, Vizirani , Ratwani	-
Design of steel structures	Arya&Ajmani	-
Concrete Structures	Vaziram&Ratwani	-
Structures design and drawing	Krishnamurthy	-
Relevant IS & IRC codes	-	-

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**	**3**	**2**	**-**	**1**	**2**	**1**	**-**	**3**	**3**	**2**
CO2	**3**	**3**	**3**	**3**	**-**	**2**	**-**	**-**	**-**	**1**	**2**	**2**
CO3	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**
CO4	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**
CO5	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**2**

COURSE NAME: PRESTRESSED CONCRETE
COURSE CODE: CE 603B
CONTACT: 3:1:0
TOTAL CONTACT HOURS: 48 HRS
CREDITS : 4

Pre requisites: Basic understanding of R.C.C. design and analysis with fundamental knowledge of limit state behavior of R.C.C. with basic knowledge of structural analysis

Course Objective: Students will gain knowledge on pre-stressed concrete behavior analysis methods, stress calculation, losses, limit state design criteria and methods. student will be familiar with anchorage zone stress in post tension member. Basic knowledge on composite construction of pre-stressed and in situ concrete. Preliminary idea on partial pre-stressing and non stressed reinforcement.

Course Outcome:

CO1 : The student will get basic concept of pre-stressing materials and procedures.
CO2: Detail understanding on losses in prestressed
CO3 : Become familiar with IS Codes on Prestressing.
CO4 : Understand design of various parts of a prestressed structure for many kind of loading.
CO5 : Detail Idea on anchorage zone and composite members

Course contents:

Module-I: [6L+2T] **Introduction of Pre-stressed concrete**: Materials, pre-stressing system, analysis of prestress and Bending stress, losses Shear and torsion al resistance: design of shear reinforcement, design of reinforcement for torsion Shear and bending Deflections of pre-stressed concrete members: Importance, factors, short term and long term Deflection	**8L**
Module-II: [6L+2T] **Limit state design criteria:** Inadequacy of elastic and ultimate load method, criteria for limit states,strength and serviceability. Design of sections for flexure: methods by Lin and Magnel	**8L**
Module-III: [6L+2T] **Anchorage Zone stresses in post tensioned members:** Stress distribution in end block, anchorage zone reinforcement	**8L**
Module-IV: [6L+2T] **Composite construction of pre-stressed and in-situ concrete:** Types, analysis of stresses Statically Indeterminate structures: advantages of continuous member, effect of pre stressing, methods of achieving continuity and method of analysis of secondary moments	**8L**
Module-V: [6L+2T] **Pre-stressed concrete poles and sleepers:**Design of sections for compression and bending	**8L**
Module-VI: [6L+2T] **Partial pre-stressing and non pre-stressed reinforcement**	**8L**

Text / Reference Books:

Name	Author	Publishers
Prestressed Concrete	N Krishna Raju	McGraw Hill
Design of Prestressed Structures	T.Y.Lin and N.H.Burns	Wiley Eastern Ltd
Fundamentals of Prestressed Concrete	N.C.Sinha and S.K.Roy	-
Prestressed Concrete	S.Ramamurthan	-

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	-	-	1	-	-	-	-	-
CO2	3	2	1	2	-	-	1	-	-	-	-	-
CO3	-	2	1	-	1	3	1	-	-	-	-	-
CO4	2	2	3	2	2	-	1	-	-	-	-	-
CO5	2	2	1	2	2	-	1	-	-	-	-	-

COURSE NAME: STRUCTURAL DYNAMICS & EARTHQUAKE ENGINEERING
COURSE CODE: CE 603C
CONTACT: 3:1:0
TOTAL CONTACT HOURS: 48 HRS
CREDITS : 4

Pre requisites: Student should knowledge about earthquake ,retrofitting and dynamics of the structure

Course Objective: Student should be able to deal dynamic behaviour and dynamics of structure as well as earthquake resistant design properly.

Course Outcome:

CO1 : Student will be able know Degrees of freedom, Undamped single degree freedom system, Damped single degree freedom system

CO2: Student will be able to know about Response of single degree freedom system due to harmonic loading

CO3 : Student will be able to know about Duhamel's Integral, Response due to constant force, Rectangular load, Introduction to numerical evaluation of Duhamel's integral of undamped system.

CO4 : Student will able to know about Fundamentals: Elastic rebound theory, Plate tectonics, Definitions of magnitude, Intensity, Epicenter etc., Seismographs, Seismic zoning, Response of Simple Structural Systems

CO5 : Student will able to know about Principles of earthquake resistant design

Course contents:

Module-I: **Theory of vibrations:** Degrees of freedom, Undamped single degree freedom system, Damped single degree freedom system, Natural frequency, modes of vibration, Introduction to multiple degree freedom system	**10L**
Module-II: **Response of single degree freedom system due to harmonic loading:** Undamped harmonic excitation, Damped Harmonic excitation	**8L**
Module-III: **Response due to Transient loading:** Duhamel's Integral, Response due to constant force, Rectangular load, Introduction to numerical evaluation of Duhamel's integral of undamped system.	**10L**
Module-IV: **Elements of seismology:** Fundamentals: Elastic rebound theory, Plate tectonics, Definitions of magnitude, Intensity, Epicenter etc., Seismographs, Seismic zoning, Response of Simple Structural Systems	**10L**
Module-V: **Principles of earthquake resistant design:** Terminology, General principles and Design criteria, Methods of Analysis, Equivalent lateral force method of Analysis for multistoried building as per Indian Standard Code of Practice, Introduction to Response Spectrum Method, Fundamental concepts of Ductile detailing	**10L**

Text / Reference Books:

Name	Author	Publishers
Structural Dynamics (Theory and Computation)	Mario Paz	CBS Publishers and Distributor
Dynamics of Structure (Theory and Application to Earthquake Engineering)	A.K.Chopra	Pearson Education
Elements of Eathquake Engineering	Jai Krishna, A. R. Chandrashekhar and Brijesh Chandra N.C.Sinha and S.K.Roy	South Asian Publishers
Earthquake Resistant Design	D. J. Dowrick	John Willey & Sons
IS 1893 (Part 1): 2002, IS 3920, IS 4326 - Bureau of Indian Standard	-	-

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**	**3**	**2**	**3**	**1**	**1**	**1**	**3**	**3**	**3**	**3**
CO2	**3**	**3**	**3**	**2**	**2**	**2**	**1**	**1**	**3**	**2**	**3**	**2**
CO3	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**3**	**3**	**3**	**3**	**2**	**2**	**1**	**1**	**3**	**2**	**2**	**2**
CO5	**3**	**3**	**3**	**3**	**3**	**1**	**1**	**1**	**3**	**3**	**2**	**-**

COURSE NAME: OPERATIONS RESEARCH
COURSE CODE: CE 604A
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36 HRS
CREDITS : 3

Pre requisites: Basic concepts of Probability distribution , statistical estimation, regression analysis and ANOVA, Basic Mathematics

Course Objective:

1) To study various optimization techniques in real world problems related to civil engineering
2) To study the inventory models
3) To study about assigning jobs to people in an efficient way
4) To study about sequencing techniques
5) To understand transportation model utility in construction industry

Course Outcome:

CO1 : At the end of the course, the students will be able to identify and develop operational research models from the verbal description of the real System.
CO2: Apply the mathematical tools that are needed to solve optimisation problems.
CO3 : Use mathematical software to solve the proposed models.
CO4 : Develop a report that describes the model and the solving technique, analyse the results and propose recommendations in language understandable to the decisionmaking processes in Management Engineering.

Course contents:

Module 1: Introduction: Definition and scope of operations research (OR), OR model, solving the OR model, art of modeling, phases of OR study. Linear Programming: Two variable Linear Programming model and Graphical method of solution, Simplex method, Dual Simplex method, special cases of Linear Programming, duality, sensitivity analysis.	**8L**
Module 2 : Transportation Problems: Types of transportation problems, mathematical models, transportation algorithms, Assignment: Allocation and assignment problems and models, processing of job through machines.	**6L**
Module 3: Network Techniques: Shortest path model, minimum spanning Tree Problem, Max-Flow problem and Min-cost problem. Project Management: Phases of project management, guidelines for network construction, CPM and PERT.	**8L**
Module 4: Theory of Games: Rectangular games, Minimax theorem, graphical solution of 2 x n or m x 2 games, game with mixed strategies, reduction to linear programming model. Quality Systems: Elements of Queuing model, generalized poisson queing model, single server models.	**6L**
Module 5: Inventory Control: Models of inventory, operation of inventory system, quantity discount. Replacement: Replacement models: Equipments that deteriorate with time, equipments that fail with time.	**8L**

Text / Reference Books:

Name	Author	Publishers
Operations Research	Wayne L	Thomson Learning,2003.
Operations Research-An Introduction	Hamdy H. Taha	Pearson Education,2003
Operations Research	R. Panneer Seevam	PHI Learning, 2008
Total Quality Management	V.K.Khanna	New Age International, 2008
Linear Programming and Theory of Games	P. M. Karak	ABS Publishing House
Linear Programming and Theory of Games	Ghosh and Chakraborty	Central Book Agency
Operations Research	M. V. Durga Prasad	CENGAGE Learning

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	3	2	-	3	-	-	3
CO2	-	-	-	-	-	1	-	1	-	3	-	1
CO3	-	-	-	-	-	2	-	-	-	-	-	1
CO4	-	-	-	-	-	3	2	-	3	3	-	2

COURSE NAME: HUMAN RESOURCE MANAGEMENT
COURSE CODE: CE 604B
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36 HRS
CREDITS : 3

Pre requisites: Basic concepts of Management and Planning

Course Objective:

1) Explain the importance of human resources and their effective management in organizations
2) Demonstrate a basic understanding of different tools used in forecasting and planning human resource needs
3) Outline the current theory and practice of recruitment and selection and demonstrate the ability to prepare a selection strategy for a specific job.
4) Evaluate a benefits package that supports the organization's strategy in line with HRM cost-containment policies and practices and Recommend actions based on results of the compensation analysis and design compensation schemes that are cost effective, that increase productivity of the work force, and comply with the legal framework
5) Explain their understanding of the administrative complexities of providing a full array of benefits to employees and the ways and means of delivering these benefits

Course Outcome:

CO1 : On completion of this course the students will be able to know resource
CO2: planning and management in construction.
CO3 : Plan and manage key human resource functions within organizations.
CO4 : Contribute to employee performance management and organizational Effectiveness

Course contents:

Module 1: Introduction – Nature and scope of HRM, HRM: functions and objectives of HRM, HRM model, evaluation of HRM, need of HRD in the context of globalization.	**6L**
Module 2 : Human Resource Planning-Importance of HRP, Factors affecting HRP, Planning process Manpower calculations: techniques of manpower planning for company project, Various HRD parameters, functional skills, supervisory skills, entrepreneurship skills	**6L**
Module 3: Recruitment & Selection & Training- Recruiting Human resources: Nature, purpose and importance of recruitment, Factors governing recruitment, Recruitment process Selecting Human Resources: Organisation for selection, selection process, barriers to effective selection, selection in India Inducting and Placing: Evaluation of orientation program, Problems of orientation, typical orientation program.	**10L**
Module 4: wage & Salary -Remuneration: Remuneration of personnel, Factors Influencing employees remuneration, various method of deciding the remuneration wage policy in India Job evaluation, Performance appraisal, Merit rating.	**6L**
Module 5: Managing HR Activities- Labour Laws: Contract Labout Act, Equal Remuneration Act,	**8L**

Minimum Wage , Payment of wage, Gratuity, Bonus payment.

Text / Reference Books:

Name	Author	Publishers
Human Resource Management	Aswathappa K	Tata McGraw Hill
Human Resource Management	DeNisi A.S., Griffin R.W	Biztantra Publishers, II Edition, 2009
Lingard H., "Human Resource Management in Construction Projects	M Loosemore M., Dainty A., Lingard H onappa A	Spon Press, 2003
Personnel Management	Monappa A	Tata McGraw Hill
HRD in the New Economic Environment	Rao T	Tata McGraw Hill
Performance Measurement, Evaluation and Incentives	William J Bruns Jr	Tata McGraw Hill.
Human Resource Management	Gary Dessler	Pearson Education, Delhi

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	2	1	2	-	3	-	-	3
CO2	-	-	-	-	-	1	-	1	3	3	-	3
CO3	-	-	-	-	1	2	-	-	-	3	-	1
CO4	-	-	-	-	-	3	2	-	3	3	-	2

COURSE NAME: STUDIES ON SIX SIGMA
COURSE CODE: CE 604C
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36 HRS
CREDITS : 3

Pre requisites: Basic concepts of Management and Planning

Course Objective:

1. To translate the selection, application and implementation of a Six Sigma project including roles and responsibility of team members
2. Collect appropriate data from process to support problem solving.
3. Create details flowchart and process maps.
4. Demonstrate ability to control and monitor process.

Course Outcome:

CO1 : Understand requirement of implementation of Six Sigma.
CO2: Relate Six Sigma concept to the overall business mission and objective.
CO3 : Understand Six Sigma methodology including DMAIC.
CO4 : Employ Six Sigma skills to lead a successful process improvement project for a meaningful result

Course contents:

Module 1: Introduction – General History of Six Sigma, Evolution and Value of Six Sigma, The Basics and meaning of Six Sigma, Basic Concepts of variation.	**4L**
Module 2 : Six sigma Roles and responsibilities, Implementing Six Sigma, Six Sigma Roadmap, Process Mapping, Lean Principles and Value Stream Mapping, Selection and defining Six Sigma Projects.	**4L**
Module 3: Becoming a Customer and Market-Driven Enterprise, Voice of the customer, Customer Expectations and Needs, Linking Six Sigma Projects to Strategies	**3L**
Module 4: Attributes of Good Metrics, Using Resources Wisely, Project Management Using the DMAIC and DMADV Models	**3L**
Module 5: The Lean enterprise, The History of Lean, Understanding lean, Lean & Six Sigma, The seven elements of waste	**3L**
Module 6: The Define Phase – Defining a process, Critical to Quality Characteristics, Cost of Poor Quality, Basic Six Sigma Metrics, Pareto Analysis	**3L**
Module 7: The Measure Phase – Process Definition, Cause and effect / Fishbone Diagram, Basic Probability and Statistics, X-Y Diagram, Normal Distribution and Normality, Precision & Accuracy, Process Capability	**4L**
Module 8:	**4L**

The Analyze Phase- Pattern of Variation, Multi-Vari Analysis, Inferential Statistics, Sampling Techniques & Uses, Central Limit Theorem, Hypothesis Testing, Confidence Intervals, Analysis of Variance (ANOVA)	
Module 9: Improve Phase: Simple linear Regression, Correlation, Regression Equations, Residual analysis, Multiple and Non- linear regression, Data transformation, Box Cox.	**4L**
Module 10: The Control Phase: Lean Controls, Control Methods for 5S, Kanban, Poka – Yoka (Mistake Proofing), Statistical process Control (SPC), Data collection of SPC, Six Sigma Control Plans, Cost benefit analysis, Elements of control Plan, Elements of Response Plan.	**4L**

Text / Reference Books:

Name	Author	Publishers
Simplified six sigma methodology tools and implementation	N. Gopala Krishnan	PHI
Eight steps to problem solving- six sigma	Mohit Sharma	Zorba Books
Six Sigma Handbook	PYZBEK	-
ASQ Certified Six Sigma Handbook	American Society of Quality	-

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**
CO2	**2**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**
CO3	**3**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**
CO4	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**2**	**2**	**2**	**1**

COURSE NAME: STRUCTURAL DESIGN AND DETAILING
COURSE CODE: CE 691
CONTACT: 0:0:2
CREDITS : 1.0

Pre requisites: Student should knowledge about rcc and steel structure design of various structural components and building structure.

Course Objective: Student should be able to design structural components and RCC and steel structure .Students will be able to understand about the members of structure , different loading condition how it behaves and where to use such member

Course Outcome:

CO1: Design principle of R.C.C. sections. Limit state method of design Loads and stresses to be considered in the design as per I.S. code provision.
CO2: Design & detailing of a i) simply supported R.C.C Beam ii) Continuous T- Beam
CO3: Student should be able to Design & Detailing of columns, isolated and combined footing.
CO4: Design of different units: Slab, beam column, roofing and staircase from floor plan of a multistoried frame building, typical detailing of a two way floor slab.
CO5: Problems on general consideration and basic concepts

LIST OF TOPICS:

1. General considerations: Design principle of R.C.C. sections. Limit state method of design Loads and stresses to be considered in the design as per I.S. code provision.
2. Design & detailing of a i) simply supported R.C.C Beam ii) Continuous T- Beam.
3. Design & Detailing of columns, isolated and combined footing
4. Design & detailing of a i) simply supported one way slab ii) One way Continuous slab.
5. Design of different units: Slab, beam column, roofing and staircase from floor plan of a multistoried frame building, typical detailing of a two way floor slab.
6. Problems on general consideration and basic concepts
7. Discussion on different loads (i.e. wind load, Dead load, live load and others) as per IS875
8. Design & drawing of the following components of a roof truss:

Members of the roof truss. Joints of the roof truss members, Purlins, Gable bracings, Column with bracings, Column base plate, Column foundation

Text Books/ Reference Books:

R.C.C design: Punmia, Jain, Jain
Design Of Steel Structures - S.K.Duggal Tata Mc-Graw Hill , New Delhi New Delhi
Reinforeced cement concrete design- Nilam shrama
Design of Steel structures N. Subramanian Oxford University Press
Design of steel structures A.S.Arya and J.L.Ajmani Nemchand& Bros.,

CO-PO mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**1**	**1**	**-**	**1**
CO2	**3**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**-**	**-**	**1**
CO3	**3**	**2**	**2**	**2**	**2**	**1**	**-**	**-**	**1**	**-**	**-**	**1**
CO4	**3**	**1**	**1**	**1**	**1**	**-**	**1**	**1**	**3**	**2**	**2**	**1**
CO5	**3**	**3**	**3**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**2**	**1**

COURSE NAME: COMPUTER AIDED DESIGN AND DRAFTING
COURSE CODE: CE 692
CONTACT: 0:0:3
CREDITS : 1.50

Pre requisites: Fundamentals of computer operation with basic knowledge of Structure Analysis and Design for different structural components with basic knowledge of engineering drawing.

Course Objective: Students will be familiar with features of detailing and design of structure by using software detailing of different structural elements and analysis and design of those by using softwares.

Course Outcome:

CO1: Students will be able to integrate the role of graphic communication in the engineering design process
CO2: Students will be able to use CAD software to generate a computer model and technical drawing for a simple, well-defined part or assembly.
CO3: Students will be able to apply basic concepts to develop construction (drawing) techniques and produce 2D Orthographic Projections
CO4: Understand and demonstrate dimensioning concepts and techniques
CO5: Become familiar with the use of Blocks, Design Center, and Tool Palettes, Solid Modeling concepts and techniques

LIST OF LESSONS:

1. Introduction and important features of a software dealing with analysis and design of structures
2. Analysis and design of a multistoried building using software.
3. Preparation of detailed drawings of different structural elements including ductility detailing.
4. RCC Slab, beam, column and footing design.
5. Design and detailing of Steel Structures.
6. Analysis, Design and Detailing of Isolated and combined RC Footings

Text Books/ Reference Books:

1. Design of RCC Buildings usingSTAAD Prp V8i with
   Indian Example: Static and Dynamic Methods – T.S.Sharma – Educreation Publishing
2. Exploring Bentley STAAD Pro
   CONNECT Edition - - Prof. Sham Tickoo Purdue Univ. – Cadcim Technologies
3. Analysis and Design of Structures:
   A Practical Guide to Modelling – D. Trevor Jones – Bentley

CO-PO mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**1**	**2**	**1**	**1**	**3**	**-**	**-**	**-**	**-**	**3**	**2**	**-**
CO2	**1**	**2**	**1**	**1**	**3**	**-**	**-**	**-**	**-**	**3**	**2**	**-**
CO3	**1**	**2**	**1**	**1**	**3**	**-**	**-**	**-**	**-**	**3**	**1**	**-**
CO4	**1**	**2**	**1**	**1**	**3**	**-**	**-**	**-**	**-**	**3**	**1**	**-**
CO5	**1**	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**1**	**-**	**-**