SRM
UNIVERSITY *AP*
Amaravati

B. Tech Civil Engineering

(For the students admitted during AY 2018-22)

B. Tech Civil Engineering Curriculum

Semester I

Code	Course Name	L-T-P	Total Cr hrs
ENL 101	Communicative English	3-0-0	3
PHY 112	Classical Mechanics	2-0-2	3
ENG 111	Basic Electronics	3-0-0	3
BIO 101	Introduction to Biology	3-0-0	3
MAT 112	Single Variable Calculus (Mathematics I)	3-0-0	3
CSE 102	Basic Computer Science and Programming	3-0-2	3
CDC 111	Soft Skills - 1	1-0-0	1
		Total	19

Semester II

Code	Course Name	L-T-P	Total Cr hrs
CDC 102	Soft Skills - 2	1-0-0	1
CSE 223	Data Structures and Algorithm Using C	3-0-2	4
ECO 221	Principles of Economics	3-0-0	3
CHE 101	Principles of Chemistry	3-0-0	3
MAT 121	Multi Variable Calculus	3-0-0	3
ENG 105	Engineering Graphics	0-0-2	1
PHY 221	Electricity and Magnetism	3-0-0	3
		Total	18

Semester III

Code	Course Name	L-T-P	Total Cr hrs
CE 201	Introduction to Thermodynamics	3-0-0	3
CE 201L	Introduction to Thermodynamics LAB	0-0-2	1
MAT	Linear Algebra	3-0-0	3
CE 202	Engineering Mechanics	3-0-0	3
CE 203	Environmental Engineering	3-0-0	3
HS	Humanities Elective	3-0-0	3
ENG 101	Engineering Fundamentals	2-0-0	3
ME	Mechanical Engineering Tools (Workshop)	0-0-2	1
CDC 103	CDC/CCC	1-0-0	1
		Total	21

Semester IV

Code	Course Name	L-T-P	Total Cr hrs
CDC 104	CDC/CCC	1-0-0	1
OE	Open Elective - I	3-0-0	3
CE 204	Engineering Geology	2-0-0	2
CE 204L	Engineering Geology LAB	0-0-2	1
CE 205	Geotechnical Engineering	3-0-0	3
CE 205L	Geotechnical Engineering LAB	0-0-2	1
CE	TE Elective - I	3-0-0	3
MAT	Differential Equations	3-0-0	3
CE 206	Surveying and Geomatics	2-0-0	2
CE 206L	Surveying and Geomatics LAB	0-0-2	1
		Total	20

Semester V

Code	Course Name	L-T-P	Total Cr hrs
CE 301	Mechanics of Materials	3-0-0	3
CE 301L	Mechanics of Materials LAB	0-0-2	1
OE	Open Elective - II	3-0-0	3
CE 302	Water Resources Engineering	3-0-0	3
CE 303	Structural Engineering	3-0-0	3
CE 304	Hydraulic Engineering	3-0-0	3
CE 304L	Hydraulic Engineering LAB	0-0-2	1
	TE Elective - II	3-0-0	3
CE 305	Construction Engineering & Management	3-0-0	3
		Total	23

Semester VI

Code	Course Name	L-T-P	Total Cr hrs
CE 306	Finite Element Methods	3-0-0	3
	TE Elective - III	3-0-0	3
CE P01	Design Project/UROP	0-0-6	3
	Open Elective - III	3-0-0	3
	Open Elective - IV	3-0-0	3
CE 307	Transportation Engineering	3-0-0	3
OE	Open Elective - V	3-0-0	3
		Total	21

Semester VII

Code	Course Name	L-T-P	Total Cr hrs
CE 401	Engineering Economy, Estimation & Costing	3-0-0	3
CE 402	Sensing Technologies for Civil Engineering	3-0-0	3
	TE Elective - IV	3-0-0	3
	TE Elective - V	3-0-0	3
	TE Elective - VI	3-0-0	3
OE	Open Elective - VI	3-0-0	3
OE	Open Elective - VII	3-0-0	3
		Total	21

Semester VIII

Code	Course Name	L-T-P	Total Cr hrs
CE	Capstone Project	0-0-24	12

SEMESTER – I

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
EGL 101	Introduction to Communication	C	3	0	0	3

Course Objective: Introduction to Communication is designed to help students with the principles and practice of effective oral communication skills. This course will help students through formal and informal speaking activities. Strategies for effective communication in social, business, and professional situations are examined. In all speaking assignments, articulation and the best way to frame ideas will be covered. The course objectives are for students to demonstrate an understanding of the value of rhetorical speaking skills; Paraphrase and cite research correctly; write and speak well-developed, clear, unified ideas with appropriate college-level language choices; Demonstrate a growing understanding of critical thinking in speaking, writing and in public situations.

UNIT I: Rhetoric and Public Speaking
Rhetoric, Critical Thinking and Public Speaking; Thinking Outside the Box; How to Deliver a Speech; Fundamentals of Persuasion.

UNIT II: Nonverbal Communication
Nonverbal Communication; Spatial distance, eye contact and appearances; How nonverbal communication is more important than words.

UNIT III: Communication and the Media
Persuasion and the media; Radio, television, film, social media and the internet; How the media sells ideas, images, products and life styles; Fundamentals of Informative/Scientific Speeches and Research; The Heart of the Speech – Powerful Narratives; The Power of Narrative.

UNIT IV: Small Group Communication
Small group communication; Leadership, conflict and persuasion in groups; The importance of small groups in business; Dr. A. Fisher's Fundamentals of Small Groups; Group Problem Solving; Learning to say no – don't say you will when you won't, don't say yes and then don't do it, be true to your word.

UNIT V: Persuasion, Ideology and Media Bias.
Advanced Rhetoric; Ideology; Persuasive Fallacies; How to Construct a Persuasive Speech; How to Present Scientific Data in a Speech; Unmasking Media Bias and Ideology; Full circle – the dangers of rhetoric and ideology.

Books of Study:

1. Communication: Principles for a Lifetime. Beebe, Beebe and Ivy, 6th Edition, Pearson Publishing.

References:

1. Qualitative Communication Research Methods (2011) Bryan C. Taylor and Thomas R. Lindlof. Sage Publications, New Delhi, India, 3rd Edition.
2. The Fundamentals of Small Group Communication (2008) Scott A. Myers and Carolyn M. Anderson. Sage Publications, New Delhi, India.

SEMESTER – I

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
PHY112	Classic Mechanics	C	2	0	2	3

Course description

The course aims to cover the fundamental formalism and applications of classical mechanics. It mainly includes basic Newtonian mechanics and special theory of relativity.

Unit – I Review of Newtonian Mechanics (6 hours)

Review of Scalars, Vectors and Kinematics, Newton's Laws of Motion and applications, Contact Forces, Static Friction, worked examples, Tension and springs, Pushing Pulling and Tension, Solving Pulley Systems, Hooke's Law and applications.

Unit – II Circular Motion (6 hours)

Polar Coordinates, Position and Velocity Vectors, Angular Velocity, Uniform Circular Motion, Direction of the Acceleration, Period and Frequency, Angular Acceleration, Newton’s Second law and circular motion, worked examples

Unit –III Momentum and Impulse (6 hours)

Momentum and Impulse, Impulse momentum theorem, Conservation of Momentum, Momentum Diagrams, worked examples, Center of Mass and Motion of the Center of Mass, Center of Mass of 3 Objects, Center of Mass of a Continuous System, Center of Mass of a Uniform Rod and different objects, Velocity and Acceleration of the Center of Mass, Reduction of a System to a Point Particle, Center of Mass Trajectory.

Unit-IV Work Energy and Collision (8 hours)

Kinetic Energy and Work in 1D, Work by a Constant Force, Work by a Non- Constant Force, Work-Kinetic Energy Theorem and related problems, Kinetic Energy and Work in 2D and 3D, Work-Kinetic Energy Theorem in 2D and 3D, Worked Example, Conservative and Nonconservative Forces, Path Independence - Gravity, Path Dependence – Friction, Potential Energy due to gravity and of a spring, worked examples, Principle of energy conservation and worked examples, Collision and its type. Collision in 1D and worked examples Collision in 2D and worked examples

Rotational Motion: (6 hours)

Motion of a rigid body and moment of inertia, Parallel and perpendicular axis theorem, Moment of inertia of different objects, Torque and Angular momentum, worked examples

Unit-V Gravitation: (6 hours)

Central forces, Newton's Law of Gravitation, Principle of Superposition, Acceleration due to gravity and its variation, Gravitational Potential Energy, Kepler's Laws, hyperbolic and parabolic orbits, Satellites' Orbits and Energy, worked examples

Special Theory of Relativity: **(6 hours)**

Michelson-Morley experiment, Postulates of special theory of relativity, Galilean and Lorentz transformations, Relative Velocity, Velocity in ground frame and moving frame. Length contraction and time dilation, Worked examples, Relativistic addition of velocities, Mass energy and Energy-momentum relation.

Books of Srudy

1. MIT-- 8.01X online course material
2. University Physics with Modern Physics with Mastering Physics, (12th Edition) - Hugh D.Young, Roger A. Freedman and Lewis Ford (Publisher – Pearson Education)
1. Introduction to Classical Mechanics - R. G. Takwale, P. S. Puranik (Publisher - Tata McGraw- Hill Education)

References:

1. Classical Mechanics (2011) - Herbert Goldstein (Publisher – Pearson Education)
2. Classical Mechanics (2014) - J. C Upadhayaya (Publisher – Himalaya Publishing House)

SEMESTER – I

Course Code	Course Title	Core / Elective	L	T	P
ENG 111	Basic Electronics	C	3	0	2

Unit I Basic Circuits and Diodes **(9 hours)**

Ohm's law, Kirchhoff's current and voltage laws.

Review of semiconductor materials, doping. Forward and reverse bias characteristics of PN junction diode, depletion and diffusion capacitance, diode piecewise linear model. Design of half-wave, full-wave, bridge rectifiers with and without capacitor, clipping and clamping circuits with and without bias.

Unit II Bipolar junction Transistor (**9 hours**)

Introduction to bipolar junction transistors (BJTs), NPN and PNP types. Study of common-base, common-collector and common-emitter configurations using BJTs including their input and output I-V characteristics. Current and voltage gain, BJT in active, cut-off and saturation regions. Q-point of BJT.

Unit III Field effect Transistor (**9 hours**)

Introduction to filed effect transistor (FET), operation of JFET, transfer and drain characteristics of JFET, pinch-off region and pinch-off voltage. Introduction to MOSFET, operation of depletion type and enhancement type MOSFET. Transfer and drain characteristics of DMOSFET and EMOSFET. Q-point of FET.

Unit IV Operational Amplifiers (**9 hours**)

Introduction to operational amplifier, characteristics of an operational amplifier, negative feedback, inverting and non-inverting op-amps, integrator and differentiator design using op-amp, difference op-amp. Effect of positive feedback, Schmitt trigger circuit.

Unit V Digital **logic fundamentals** **(9 hours)**

Number systems: binary, decimal, octal and hexadecimal number systems, number system

conversions. Logic gates: AND, OR, NOT, NAND, NOR, X-OR, X-NOR. De Morgan's laws,

Karnaugh maps. Basic combinational logic blocks: adder, subtractor.

Books Of Study:

1. "Electronic devices and circuits" by David A. Bell, 5th edition, Oxford University Press, ISBN: 9780195693409.
2. "Electronic Devices and Circuit Theory" by R L Boylestad, L Nashelsky, 15th edition.
3. "Op-Amps and Linear Integrated Circuits" by Ramakant A. Gayakwad, 4th edition.
4. "Digital design" by Morris Mano, 5th edition.

References:

1. Engineering Circuit Analysis, by William Hayt, J E Kemmerly and S.M. Durbin, 8th Edition, Mc Graw Hill.
2. "Integrated Electronics" by Millman and Halkias, 2nd edition, Tata McGraw Hill, ISBN: 9780074622452.
3. "Electronic Devices and Circuits" by Jimme J Cathey, 2nd edition. Schaum's Outlines.

SEMESTER – I

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
BIO 101	Introduction to Biology	C	2	0	2	3

UNIT I Basic Cell Biology (9 hours)

Cells: Cell theory, prokaryotes and eukaryotes, cell structure, composition and function, cellular organelles. Biomolecules: carbohydrates and lipids. Cellular energy: ATP, Cellular transport: pumps, channels and transporters.

UNIT II Protein Structure and Function (9 hours)

Protein structure: Amino acids, Primary, secondary and tertiary structures. protein folding, protein secretion and localization, protein modification and degradation. Introduction to Enzymes: classification, kinetics, synthesis and characterization.

UNIT III Basic Molecular Biology (9 hours)

Nucleic acids, DNA: structure and function, RNA: types, structure and function. Flow of genetic information: replication, transcription and translation. Regulation of gene expression. Molecular biology tools: recombinant DNA (rDNA) technology and DNA sequencing.

UNIT IV Cellular Signalling And Cancer (9 hours)

Cell cycle. Signalling molecules, Signaling pathways: Transmembrane receptor, Intracellular receptor, nuclear hormone receptor. Signalling to environmental stress: sensory systems and immune system. Introduction to Cancer Biology; nature, types, metastasis, diagnostics and treatment.

UNIT V Applied Microbiology (9 hours)

Microbial Biotechnology: microbial growth and fermentation, large-scale production, generation of microbial-based antibiotics, microbial-based nanoparticles and their characterization. Industrial and environmental applications: dairy, bio-fuels, bioremediation.

Books of Study

1. Thrives in Biochemistry and Molecular Biology, Edition 1, 2014, Cox, Harris, Pears,Oxford University Press.
2. Exploring Proteins, Ed. 1, 2014, Price and Nairn,Oxford University Press.
3. Thrives in Cell Biology, Ed. 1, 2013, Qiuyu Wang, Cris Smith and Davis, Oxford University Press.
4. Metallic Nanocrystallites and their Interaction with Microbial Systems, Ed. 1, 2012,Anil K. Suresh, Springer Netherlands.

Books of References

1. The cell: a molecular approach. Cooper, G. M., Hausman, R. E. (2009). ASM Press, Washington D. C.

2. Lehninger principles of biochemistry. Lehninger, A. L., Nelson, D. L., &Cox,M. M. (2000). Worth Publishers, New York.

3. Principle and techniques of biochemistry and molecular biology, Wilson, K., Walker,J. (2005). 6th edn. Cambridge University Press, Cambridge.

4. Kuby Immunology, Ed. 5, 2006, Kindt, Goldsbyand Osborn, W. H Freeman & Co (Sd).

5. Molecular Cell Biology, Ed. 8, 2016, Harvey Lodish, Arnold Berk and Chris A. Kaiser,W. H Freeman & Co (Sd).

6. Microbial Biotechnology: Principles and Applications, Ed. 1, 2006, Yuan Kun Lee,World Scientific Publishing Co Pt. Ltd.

SEMESTER – I

Subject Code	Subject Name	Core/ Elective	Credits			
			L	T	P	C
MAT 111	**Single Variable Calculus**	**C**	**3**	**0**	**0**	**3**

Course description: This course is an introduction to Single Variable Calculus to all engineering students. The objective is to equip the students with the knowledge of calculus and its applications

Unit I – Derivatives and Differentiation (21 hours)

Limit, Continuity and limits of quotients, Derivatives and its geometrical Interpretation, Derivative as a function and calculating derivative, Leibnitz notation and higher derivatives, Trigonometric functions, Linear Approximations, Product and quotient rules, Chain rule, Implicit differentiation, Inverse, exponential and logarithm functions.

Unit II- Approximations and their Applications (11 hours)

Measurement error of linear approximation, Quadratic approximation, Newton's method,1st and 2nd derivative test, Limits and asymptotic, Max min problems, Related application inreal-life problems.

Unit III – The Integral and Integration Theory (12 hours)

Mean Value Theorem, Differentials and anti-derivatives, Differential equations, The definite integral, First and Second Fundamental Theorem of Calculus.

Unit IV – Different Integration Techniques and Application of Calculus (15 hours)

Areas and Volumes, Average value, Probability, Numerical Integration, Integrals of Trigonometric Power, Trigonometric substitution, Partial fractions, Integration by Parts, Arc length and Surface area.

Unit V – Polar Co-ordinate systems and Infinite Series (16 hours)

Parametric curves, Polar co-ordinates, L'Hospital's rule, Improper Integrals, Infinite Series,

Taylor's series.

Books of Study:

1. R. G. Bartle and D. R. Sherbert, Introduction to Real Analysis, Third edition, Wiley India ,2005
2. S. R. Ghorpade and B. V. Limaye, An Introduction to Calculus and Real Analysis, Springer India,2007
3. Michael Spivak, Calculus, Third Edition, Cambridge University, 2008.

Books of Reference:

1. G. B. Thomas, Jr. and R. L. Finney, Calculus and Analytic Geometry, 3rd Ed., Pearson Education India 9th Edition 1999.
2. P.M. Fitzpatrick, Advanced Calculus, 2nd Edition, AMS Indian Edition, 2010.

SEMESTER – I

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CSE 101	Introduction to Computer Science and Programming	C	3	0	2	4

Unit I Introduction to Python:

Knowledge, Machines, Languages, Types, Variables Operators and Branching –– **Core elements of programs**: Bindings, Strings, Input/Output, IDEs, Control Flow, Iteration, Guess and Check – **Simple Programs**: Approximate Solutions, Bisection Search, Floats and Fractions, Newton-Raphson.

Unit II Functions:

Decomposition and Abstraction, Functions and Scope, Keyword Arguments, Specifications, Iteration vs Recursion, Inductive Reasoning, Towers of Hanoi, Fibonacci, Recursion on non-numerics, Files

Unit III Tuples and Lists:

Tuples, Lists, List Operations, Mutation, Aliasing, Cloning – **Dictionaries**: Functions as Objects, Dictionaries, Example with a Dictionary, Fibonacci and Dictionaries, Global Variables – **Debugging**: Programming Challenges, Classes of Tests, Bugs, Debugging, Debugging Examples– Assertions and Exceptions**,** Assertions, Exceptions, Exception Examples

Unit IV Classes and Inheritance:

Object Oriented Programming, Class Instances, Methods Classes Examples, Why OOP, Hierarchies, Your Own Types – **An Extended Example**: Building a Class, Visualizing the Hierarchy, adding another Class, Using Inherited Methods, Gradebook Example, Generators

Unit V Computational Complexity:

Program Efficiency, Big Oh Notation, Complexity Classes Analyzing Complexity – **Searching and Sorting Algorithms**: Indirection, Linear Search, Bisection Search, Bogo and Bubble Sort, Selection Sort, Merge Sort

Books of Study

1. Introduction to Computation and Programming using Python, by John Guttag, PHI Publisher, Revised and Expanded version (Referred by MIT)

Books of References

1. Python Programming using problem solving Approach by ReemaThareja, Oxford University, Higher EducationOxford University Press; First edition (10 June 2017),

   ISBN-10: 0199480173

2. Data Structures and Algorithms in Python by Michael T Goodrich and Robertto Thamassia, Micheal S Goldwasser, Wiley Publisher(2016)
3. Fundamentals of Python first Programmes by Kenneth A Lambert, Copyrighted material Course Technology Inc. 1st edition(6th February 2009)

SEMESTER – I

Subject Code		Core/ Elective	L-T-P	Credits
CDC 101	Soft Skills - I	C	1-0-0	1

UNIT I: Interpersonal Skills

Understanding the relationship between Leadership Networking & Team work, Realizing Ones Skills in Leadership, Networking & Team Work, and Assessing Interpersonal Skills Situation description of Interpersonal Skill. Team Work Necessity of Team Work Personally, Sociallyand Educationally.

UNIT II: Leadership

Skills for a good Leader, Assessment of Leadership Skills Change Management Exploring - Challenges, Risking Comfort Zone, Managing Change

UNIT III: Stress Management

Causes of Stress and its impact, how to manage & distress, Understanding the circle of control, Stress Busters. Emotional Intelligence What is Emotional Intelligence, emotional quotient why Emotional Intelligence matters, Emotion Scales. Managing Emotions.

UNIT IV: Conflict Resolution

Conflicts in Human Relations – Reasons Case Studies, Approaches to conflict resolution.

UNIT V: Decision Making

Importance and necessity of Decision Making, process of Decision Making, Practical way of Decision Making, Weighing Positives & Negatives.

References:

1. Covey Sean, Seven Habit of Highly Effective Teens, New York, Fireside Publishers, 1998.

2. Carnegie Dale, How to Win Friends and Influence People, New York: Simon & Schuster, 1998.

3. Thomas A Harris, I am ok, You are ok, New York-Harper and Row, 1972 4. Daniel Coleman,

Emotional Intelligence, Bantam Book, 2006

SEMESTER – II

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CDC-102	Soft Skills -2	Mandatory	1	0	0	1

Objective: The most conspicuous perceptual error is the thought that personality is confined to physical appearance alone. Personality is a complete package of an individual's identity; it is infact a person's reality. The development of one's personality is essential for having an impressive image both in the personal & professional areas to create an electrifying impact and a lasting impression.

UNIT I: Motivation

Soldiers' Walk and The Japanese Fan (Activities on factors of motivation), Steps to ward off de-motivation

UNIT II: Creativity & Innovation

Short Film: Students would be encouraged to make a ten-minute documentary on various topics to enhance the power of aesthetics and precision. This activity is aimed at creating an interest in research and think out of the box.

UNIT III: Critical & Lateral Thinking

Fill Me Up, Stimulating Lateral Thinking, The Curious Case of Mary and Kevin (Activities triggering the different types of thinking), The Creative Collage. Critical and lateral thinking can be inculcated with a structured re programming of the neural pathways. These specially designed activities will enhance critical and lateral thinking

UNIT IV: Team Dynamics

Story boarding, Frenzy, come to my Island, Striking Cars, Defend the Egg, Tallest Tower (Activities on the different stages of team building, team communication, coordination and collaboration)

Unit V: Mini Project

Individual projects on topics provided by faculties.

SEMESTER – II

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CHE 101	Principles of Chemistry	C	2	0	2	3

Unit I Chemical Bonding (10 hours)

Ionic, covalent, and metallic bonds. Theories of bonding: Valence bond theory, nature of covalent bond, sigma (σ) bond, Pi (π) bond. Hybridization: Types of hybridization, sp, sp2, sp3, sp3d, d2sp3. Shapes of molecules (VSEPR Theory): $BeCl_2$, CO_2, BF_3, H_2O, NH_3, CH_4, PCl_5, XeF_2, SF_6, XeF_4. Molecular orbital theory: Linear combination of atomic orbitals (LCAO Method), bond order, homo- (H_2, O_2, N_2) and heteronuclear diatomic Molecules (NO, CO). Non-covalent interactions: Van der Waals interactions, dipole-dipole interactions, and hydrogen bonding.

Unit II Phase Rule and Kinetics (8 hours)

Phase rule: Introduction. Definition of the terms used in phase rule with examples. Application of phase rule to water system, sulphur system and lead-silver system. Kinetics: Order and molecularity of reactions, zero order, first order and second order reactions.

Unit III Water Technology (8 hours)

Standards for drinking water. Methods of Treatment of water for domestic and industrial purposes: Sedimentation, Coagulation, Filtration, Sterilization, Break point chlorination. Determination of Hardness of water by EDTA method. Demineralization of water. Softening of water: Lime-soda Process, Ion exchange process, Zeolite process. Boiler Troubles: Priming, Foaming, Scale, Sludge, Corrosion, Caustic Embrittlement.

Unit IV Polymer Chemistry (9 hours)

Classification of polymers: Natural and synthetic. Thermoplastic and Thermosetting. Degree of polymerization. Types and mechanism of polymerization: Addition (Free Radical, cationic and anionic); condensation and copolymerization. Properties of polymers: Tg, Tactility, Molecular weight – weight average, number average and polydispersity index. Techniques of polymerization: Bulk, emulsion, solution and suspension.

Unit V Electrochemistry (10 hours)

Arrhenius theory of electrolytic dissociation, classification of electrolytes; degree of dissociation of acids, dissociation constant of weak acids, concept of pH and pOH, buffer solutions, solubility product, common ion effect, indicators and theory of acid-base indicators; conductance of solutions- specific, molar and equivalent conductance, variation of molar conductance with dilution for strong and weak electrolytes; Migration of ions- Kohlrausch's law of independent migration of ions, Ostwald's dilution law; Nernst equation for single electrode and electrochemical cells.

Books of Study

1. A. Bahl and B. S. Bahl, G. D. Tuli, Essentials of physical chemistry, S Chand Publication, **2014**, ISBN: 8121929784.
2. P.W. Atkins, T.L. Overton, J.P. Rourke, M.T. Weller and F.A. Armstrong Shriver and Atkins' Inorganic Chemistry, 5thEd., Oxford University Press,London, **2010**, ISBN 978-1-42-921820-7.
3. Atkins, P.W.; de Paula, J. Physical chemistry, 8th ed., **2006** Oxford University Press. ISBN 0-19-870072-5.
4. B. R. Puri, L. R. Sharma & M. S. Pathania, Principles of Physical Chemistry, 46th Ed.,**2013**, Vishal Publication Company.
5. F.W. Billmeyer, Text Book of Polymer Science, 3rd Ed., John Wiley & Sons, New York, **2003**.

Books of Reference

1. J. Bard and L.R. Faulkner, Electrochemical methods –Fundamentals and Applications, 2ndEd., John Wiley and Sons,**2001**.
2.
3. Jain P.C. & Monika Jain, Engineering Chemistry, Dhanpat Roy & Sons, **2015,** ISBN 10: 8187433175 / ISBN 13: 9788187433170.

SEMESTER – II

Sub.Code	Sub. Name	Core/ Elective	L-T-P	Credits
PHY 221	Electricity and Magnetism	C	2-0-2	03

UNIT I Introduction to Vector Algebra

Gradient, Divergence and curl and their physical significances, Gauss and Stokes theorems, Vector operators in different coordinate (Curvilinear, Cartesian, Cylindrical and spherical) systems

UNIT II Electrostatics

Coulomb's law, Gauss law, Electric field, Electrostatic Potential, Potential energy of system of charges, Boundary Value problems in electrostatics-solution of Laplace equation in Cartesian system, Method of image charge.

UNIT III Dielectrics and Polarization

Electric dipole and dipole moment, Electric potential due to dipole, Electric field intensity due to dipole, Polarization P, Electric displacement D, Electric susceptibility and dielectric constant, Bound volume and surface charge densities, Electric field at an exterior and interior point of dielectric.

UNIT IV Magneto statics

Biot-Savart law, Ampere's law for force between two current carrying loops, Ampere's circuital law, Equation of continuity, Magnetic vector potential A, Energy density in magnetic field, magnetization of matter (B, H, M)

Magnetic susceptibility and permeability, Hysteresis loss, B-H curve, Diamagnetic, paramagnetic and ferromagnetic substances.

UNIT V Introduction to Electrodynamics

Time varying fields: Faradays law of induction, generalization of Amperes' law, Maxwell's equation (Differential and Integral form), Wave equation and plane waves in free space

Books of Study

1. MIT-- 8.02X online course material
2. Introduction to Electrodynamics (4rd Edition) - David J. Griffiths (Publisher - PHI Learning, Eastern Economy Editions, 2012)
3. Electricity and Magnetism (Reprints 2007, 1st Edition 2001) A. S. Mahajan, A. A.
4. Rangwala, (Publisher - McGraw-Hill Education)
5.

References:

1. Electricity and magnetism Edward M Purcell, David J Morin, 3rd edition, Cambridge University, 2013
2. Classical Electrodynamics (3rd Edition) - John David Jackson (Publisher – Wiley)

SEMESTER – I

SUBJECT CODE	SUBJECT TITLE	CORE/ELECTIVE	CREDITS			
			L	T	P	C
ECO 221	Principles of Economics	Elective	3	0	0	3

UNIT I Introduction (7 hours)

Nature and scope of Economics, Principles of Economics, Production Possibility Frontier, opportunity Costs, Comparative Advantage and Scope for Trade. Demand and Supply curves, Equilibrium, Shift in curve versus movement along the curve, Elasticity of Demand and Supply. Changes in equilibrium in response to policy changes, income, tastes and supply "shocks"

UNIT II Consumer Behaviour (6 hours)

Consumer preferences and Indifference curve analysis – substitution, income and price effect.

UNIT III Production and cost (8 hours)

Production, short- run production function and returns to factor – Average-marginal relationship, long – run production function and laws of return to scale- role of technology.

Cost function and cost structure of a firm in the short- run, long run cost function and cost structure.

UNIT IV Types of markets (7 hours)

Perfect competition including shut-down and break-even points. Monopoly. Monopolistic competition and product differentiation.

UNIT V Equilibrium in the short, medium and long run (10 hours)

Short-run equilibrium: The Goods market, the money market and General equilibrium (IS-LM)

Medium-run equilibrium: The labour market General Equilibrium (AD-AS)

Long-run equilibrium: Introduction to growth, capital accumulation and growth, technological progress and growth.

Unit VI The open economy (International trade) (7 hours)

Openness in goods and financial markets, the goods market, the financial markets and General equilibrium. Exchange rate regime.

Books of study:

1. Principles of microeconomics, N. Gregory Mankiw, Publisher: Cengage Learning 5th edition.
2. Macroeconomics, Oliver Blanchard and David R Johnson, Publisher: Pearson; 6thedition.

Books of reference:

1. Intermediate Microeconomics: A Modern Approach, Hal R. Varian, Affiliated East-West Press Pvt. Ltd., 8thedition.
2. Principles of Macroeconomics with CourseMate, N. Gregory Mankiw, Cengage India, 6thedition.

SEMESTER – II

Sub. Code	Sub. Name	Core/ Elective	L-T-P	Credits
CSE 223	Data Structures and Algorithms	C	3-0-2	04

UNIT I

Introduction to C programming, identifiers, basic data types, constants, variables, keywords, operators: arithmetic, relational and logical, increment and decrement operators, conditional operator, assignment operators, Instruction: type declaration, Input-output, conditional, loop control, Arrays, Functions, pointers, dynamic memory management functions Derived types- structures- declaration, definition and initialization of structures, accessing member of structure, arrays of structures, structures and functions, pointers to structures, self-referential structures.

UNIT II

Introduction to data structures, Stacks and Queues: representation and application, implementation of stack and queue operations using C. Linked lists: Single linked lists, implementation of link list and various operation using C, Double linked list, circular list.

UNIT III

Trees: Tree terminology, Binary tree, Binary search tree, infix to post fix conversion, postfix expression evaluation. General tree, AVL Tree, Complete Binary Tree representation.

UNIT IV

Graphs: Graph terminology, Representation of graphs, Path matrix, BFS (breadth first search), DFS (depth first search), topological sorting, Shortest path algorithms.

UNIT V

Sorting and Searching techniques – Bubble sort, selection sort, Insertion sort, Quick sort, merge sort, Heap sort, Radix sort, implementation using C. Linear and binary search methods, implementation using C, Hashing techniques and hash functions.

Books of Study:

1. “Data structure using C”, Aaron M. Tenenbaum, Y Langsam and Mosche J. Augenstein, Pearson publication.
2. Data structures and Algorithm Analysis in C , Mark Allen Weiss, Pearson publications, Second Edition Programming in C. P. Dey and M Ghosh , Second Edition, Oxford University Press.
3. Programming with C, Byron Gottfried, Mcgrawhill Education, Fourteenth reprint, 2016

References:

1. “Fundamentals of data structure in C” Horowitz, Sahani & Anderson Freed, Computer Science Press.
2. “Fundamental of Data Structures” , (Schaums Series) Tata-McGraw-Hill.
3. G. A.V.Pai: “Data Structures & Algorithms; Concepts, Techniques & Algorithms”Tata McGraw Hill.
4. Gilberg and Forouzan, “Data Structure- A Pseudo code approach with C” by Thomson publication

Semester- II

Sub. Code	Sub. Name	Core/ Elective	L-T-P	Credits
MAT 121	Multi Variable Calculus	C	3-0-0	03

This course covers vector and multi-variable calculus. Topics include vectors and matrices, partial derivatives, double and triple integrals, and vector calculus in 2 and 3-space.

UNIT I Vector and Matrices (15 hours)

Vectors, Dot product, Determinants; cross product, Matrices; inverse matrices, Square systems; equations of planes, Parametric equations for lines and curves, Velocity, acceleration, Kepler's second law

UNIT II Partial Derivatives (16 hours)

Level curves; partial derivatives; tangent plane approximation, Max-min problems; least squares, Second derivative test; boundaries and infinity, Differentials; chain rule, Gradient; directional derivative; tangent plane, Lagrange multipliers, Non-independent variables, Partial differential equations

UNIT III Double Integral and Line Integrals in the Plane (15 hours)

Double integrals, Double integrals in polar coordinates; applications, Change of variables, Vector fields and line integrals in the plane, Path independence and conservative fields, Gradient fields and potential functions, Green's theorem, Flux; normal form of Green's theorem, simply connected regions

UNIT IV Triple Integrals in 3D (17 hours)

Triple integrals in rectangular and cylindrical coordinates, Spherical coordinates; surface area, Vector fields in 3D; surface integrals and flux, Divergence theorem: applications and proof.

UNIT V Surface Integral in 3D (12 hours)

Line integrals in space, curl, exactness and potentials, Stokes' theorem, Topological considerations, Maxwell's equations.

Books of Study:

1. Edwards, Henry C., and David E. Penney. Multivariable Calculus. 6th ed. Lebanon, IN: Prentice
   Hall, 2002.
2. G. B. Thomas, Jr. and R. L. Finney, Calculus and Analytic Geometry, 9th Edn., Pearson Education India, 1996.

References:

1. T. M. Apostol, Calculus - Vol.2, 2nd Edn., Wiley India, 2003.

Semester- III

Sub. Code	Sub. Name	Core/ Elective	L-T-P	Credits
CE 201	Thermodynamics	C	3-0-0	03

Course description

The basic principles of thermodynamics are introduced in this course. Concepts of energy and entropy from elementary considerations of the microscopic nature of matter are discussed. The principles are applied in thermodynamic analyses directed towards understanding the performances of engineering systems.

Unit 1:

Basic Concepts Continuum and macroscopic approach; thermodynamic systems, thermodynamic properties and equilibrium; state of a system, state diagrams, paths and processes on state diagrams; concepts of heat and work, different modes of work; zeroth law of thermodynamics.

Unit 2:

First Law of Thermodynamics, Concept of energy and various forms of energy; internal energy, enthalpy; specific heats; first law applied to elementary processes, closed systems and control volume, steady and unsteady flow analysis, Perpetual motion machine I

Unit 3:

Second Law of Thermodynamics Limitations of the first law of thermodynamics, concepts of heat engines and heat pumps/refrigerators, Perpetual motion machine II, Kelvin-Planck and Clausius statements and their equivalence; Carnot cycle and Carnot principles/theorems; thermodynamic temperature scale; Clausius inequality and concept of entropy, third law of thermodynamics.

Unit 4:

Steam formation - Temperature entropy diagram-Mollier diagram-Specific properties of steam - Use of steam tables & Mollier chart - Methods of heating and expanding the steam - Constant volume heating - Constant pressure expansion - Isothermal expansion - Hyperbolic expansion- isentropic expansion - Polytrophic expansion - Throttling process - Dryness fraction measurement.

Unit 5:

T-ds relations, Maxwell equations, Joule-Thomson coefficient, coefficient of volume expansion, adiabatic and isothermal compressibility, Clapeyron equation.

List of Experiments:

1. Perform a trial on refrigeration test rig
2. Perform a trial on air conditioning test rig
3. Performance and analysis of single stage reciprocating air compressor test rig
4. Perform a trial on single cylinder diesel engine for variable load test and energy balance.
5. Perform a trial on single cylinder petrol engine for variable speed test and energy balance.
6. Development of cylinder pressure and crank angle (p-theta) diagram and p-v diagram
7. Perform a trial on multi-cylinder SI engine for variable speed test and energy balance
8. Perform a trial on multi-cylinder CI engine for variable load test

Books of Study :

1. P. K Nag, Engineering Thermodynamics, McGraw Hill Education (India) Private Limited, 2013.
2. P. Chattopadhyay, Engineering Thermodynamics, Oxford University Press, 2015.

Reference Books:

1. S.C Gupta, Thermodynamics, Pearson Education, 2009.
2. Enrico Fermi, Thermodynamics, Dover Publications Inc., 2012.
3. C.P Arora, Thermodynamics, Tata McGraw Hill Publishing Company Limited, 2001.

Semester – III

Sub. Code	Sub. Name	Core/ Elective	L-T-P	Credits
MAT 211	Linear Algebra	C	3-0-0	03

UNIT I Vector Space

Elimination, LU factorization, null-spaces and other subspaces, bases and dimensions, vector spaces, complexity

UNIT II Factorization

Orthogonality, projections, least-squares, QR, Gram–Schmidt, orthogonal functions

UNIT III Matrices

Eigenvectors, determinants, similar matrices, Markov matrices, ODEs, symmetric matrices, definite matrices

UNIT IV Iterative Methods

Defective matrices, SVD and principal-components analysis, sparse matrices and iterative methods, complex matrices, symmetric linear operators on functions.

UNIT V Applications

Matrices from graphs and engineering.

Books of Study:

1. G. Strang, Linear Algebra and Its applications, Nelson Engineering, 4th Edn., 2007
2. K. Hoffman and R. Kunze, Linear Algebra, Prentice Hall of India, 1996

References:

1. S. Axler, Linear Algebra Done Right, 2nd Edn., UTM, Springer, Indian edition, 2010.
2. G. Schay, Introduction to Linear Algebra, Narosa, 1997.

3. **SEMESTER – III**

Sub. Code	Sub. Name	Core/ Elective	L-T-P	Credits
CE 202	**Engineering Mechanics**	**C**	**3-0-0**	**03**

Unit I – Statics of Particles and Rigid Bodies

Static equilibrium, forces on particles, free body diagram, forces in planes, forces in space, equilibrium of rigid bodies, reduction of system of forces into a single force,

Unit II- Friction

Law of friction, dry friction, rolling friction, tension ratio of flat and V belt, ladder friction, screw friction

Unit III – Analysis of trusses and centroids

Type of loads, supports, reactions, simple trusses, method of joints, method of sections, center of gravity, centroid

Unit IV – Moment of inertias of surfaces and volumes

Calculation of moment of inertia, radius of gyration, parallel and perpendicular axis theorem, polar moment of inertia, mass moment of inertia

Unit V – Dynamics of particles

Rectilinear motion, uniform velocity, uniform acceleration, curvilinear motion, projectile motion, D'alemberts principle, principles of work and energy, impulse and momentum, impact of elastic bodies

Text Books

1. Ferdinand. P. Beer. E, Russell Johnston Jr., David Mazurek, Philip J Cornwell, “Vector Mechanics for Engineers: Statics and Dynamics”, McGraw - Hill, New Delhi, 10th Edition, 2013

Reference books

1. Hibbeler. R.C., “Engineering Mechanics: Statics & Dynamics”, Pearson Education (US), 14th Edition, 2015.

2. Meriam J.L and Kraige L.G., Engineering Mechanics, Volume I - statics, Volume II - dynamics, John Wiley & Sons, New York,7th Edition, 2012

3. Shames. I. H, and Krishna Mohana Rao.G, “Engineering Mechanics (Statics and Dynamics)”, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), 2006.

4. Timoshenko, Young, “Engineering Mechanics”, Tata Mc-Graw Hill Book Company, 5th Edition, New Delhi, 2013

Semester – III

Sub. Code	Sub. Name	Core/ Elective	L-T-P	Credits
EVS 111	Environmental Science	C	3-0-0	03

UNIT I Environmental Education, Sustainability, and Ecological Systems:

How ecosystems works

Environmental Education, Concept of sustainability, Tragedy of the commons; Root causes of environmental crisis, Earth systems – atmosphere, hydrosphere, Lithosphere, and Biosphere. Ecosystem structure and function, Ecological systems and major biomes, Water and nutrients cycles - Water cycle, phosphorous cycle, nitrogen cycle, Case study – Cape Town water crisis.

UNIT II Biodiversity and its conservation

Biodiversity: -Why do we care? (Values of biodiversity); Threats to biodiversity; Saving Biodiversity – sustainable approaches; Case Study-The Last White Rhino; GMO; Technological advancement and biodiversity conservation.

UNIT III Environmental Pollution and its role on global climate change and human health

Pollution – air, water, and soil pollution. Air pollution: Composition of air, Sources of air pollution, Primary and secondary pollutants, Air quality index (AQI), Effects of air pollution, Air pollution and infant mortality, Air pollution control: Sustainable strategies Greenhouse gases; Carbon cycle; Global warming and climate change; Renewable and Non-renewable Energy sources Water pollution: Surface water, Groundwater, and Ocean pollution; Point and Non-points sources; Organic and inorganic nutrients pollution; Eutrophication; Microbial contamination; Oil pollution in the seas -Exxon Valdez Oil spill; Plastic pollution Soil Pollution: Chemical contamination, Major contributors of soil pollution (Coal ash, sewerage, Pesticides and herbicides, etc.)

UNIT IV Environmental Microbiology and Biotechnology

Environmental Microbiology: Microbes in our daily lives; Microbial life in air, water, and soil; Indicator microorganisms; Microbial interactions, signaling, biotransformation, and bioremediation; Molecular Ecology: The rare Biosphere; Microbial contribution to global climate change – Methane, and Nitrous oxide emissions; Global warming and microbial infectious disease.

UNIT V Environmental ethics, Economics, policy development

Environmental ethics for a sustainable society; Economics of pollution control, Carbon credits, taxes, and role in environmental protection; Environmental movements; Environmental protection acts in India; Sustainable Economic Developments: Challenges of developing nations, Political decision making for Environmental Protections. Case study- Chinese Environmental Protection Tax, Water resource tax, CNG vehicles in Delhi/Delhi odd-or-even rule.

Books of Study:

1. Basu. M, Xavier. S. "Fundamentals of Environmental Studies", 1st edition, Cambridge University Press, 2016.
2. Raina. M. Maier, Ian L. Pepper, Charles. P. "Environmental Microbiology" 2nd edition, Academic Press, 2004.

References:

1. Danial. D. C. "Environmental Science", 8th edition, Jones and Barlett Publishers, MA,2010.

SEMESTER – III

Sub. Code	Sub. Name	Core/ Elective	L-T-P	Credits
ENG 101	**Engineering Fundamentals**	**C**	**3-0-0**	**03**

UNIT I

Sources of Energy, Types of Prime Movers, Force, Mass, Pressure, Work, Power, Energy, Heat, Temperature, Internal Energy, Enthalpy, Efficiency, Zeroth Law, First Law, Thermodynamic System, Different Types of Fuels, Non-Conventional Energy - Wind, Solar, Bio, Global Warming

UNIT II

Introduction - Fluids, Physical Properties of Fluids, Relationship Between Stress and Strain-Rate for Newtonian and Non-Newtonian Fluids, Description of Fluid Flow, Classification of Flows- Laminar and Turbulent Flows, Measurement of Flow.

UNIT III

Heat Engines - External, Internal, Carnot, Rankine, Otto, Diesel Cycles; Steam Boilers - Fire Tube, Water Tube Boilers, Valves; IC Engine - Components, 2 Stroke, 4 Stroke, Engine Performance, Efficiency.

UNIT IV

Pumps Reciprocating, Rotary, Pump Efficiency; Air Compressors-Reciprocating/Rotary; Refrigeration and Air Conditioning- Principles of Working; Brakes, Clutches and Couplings, Drives- Transmission of Power- Belt Drive, Gear Drive, Chain Drive.

UNIT V

Mechanics of Materials- Engineering Materials, Material Properties- Tensile Strength, Toughness, Malleability, Hardness, Ductility, Stiffness, Brittleness, Elasticity, Plasticity, Creep, Fatigue, Failure, Stress-strain plots, failures.

Books of Study:

1. Elements of Mechanical Engineering, S Trymbak Murthy, IK International Publishing, 2010.
2. Elements of Mechanical Engineering, R K Rajput, Laxmi Publications Ltd, 2005.

References:

1. Elements of Mechanical Engineering, V.K . Manglik, PHI Publications, 2013.
2. Elements of Mechanical Engineering, B. L. Theraja, S.Chand Ltd. 1999.
3. Elements of Mechanical Engineering, Sadhu Singh, S.Chand and Company Ltd. 2013.

Semester -III

Sub. Code	Sub. Name	Core/ Elective	L-T-P	Credits
ME 103	Mechanical Engineering Tools	C	3-0-0	03

Unit I Lathe (10 hours)

Basic constructional features, working principle and applications. Lathe tool bits- Introduction, classification and geometry. Step turning, taper turning, chamfering, eccentric turning, right hand threading and knurling operations. CNC lathe.

Unit II Manual and CNC Milling (8 hours

Basic constructional features, working principle and applications.
Classification. Spur gear and helical gear cutting using milling machine Gear- Introduction and

Shaping, Slotting and Drilling (2 hours)

Basic constructional features, working principle and applications. Simple shaping and slotting exercises. Drilling, boring and reaming operations using radial drilling machine.

Unit III Grinding (2 hours) Basic constructional features, working principle and applications. Cylindrical and plain

surface grinding operations. Grinding of tool angles. Analysis of generated surfaces using a surface profile meter.

Welding and Laser Cutting (2 hours)

Working p r i n c i p l e , t y p e s , and methods.
Welding a n d s i m p l e laser cutting
exercises (Demonstration only).

Unit IV Foundry/Smithy/Carpentry/Fitting/Plumbing/Power tools (2 hours)

Unit V Introduction to MAT LAB (4 hours)
Simple engineering program (for example matrix operations) exercises in Mat lab

Text books:

Gopal, T.V., Kumar, T., and Murali, G., A first course on workshop practice –Theory, Practice and Work Book, Suma Publications, Chennai, 2005.

Kannaiah.P., and Narayanan, K. C., Manual on Workshop Practice, SciTech Publications, Chennai, 1999.

3. Venkatachalapathy, V. S., First year Engineering Workshop Practice, Ramalinga Publications, Madurai, 1999.

Reference book

Ernie Conover, The Lathe Book: A Complete Guide to the Machine and Its Accessories, Taunton Press, 2001.

2. Peter Smid, A Comprehensive Guide to Practical CNC Programming, Industrial press Inc., 2008.

3. Larry Jeffus, Welding: Principles and Applications, Engage Learning, 2016.

4. Chapman, Workshop Technology, Part 3, CBS Publication

5. RK Rajput, Manufacturing Technology, 2nd edition, LP Publicati

Semester – III

Sub. Code	Sub. Name	Core/ Elective	L-T-P	Credits
CDC 211	**Soft Skills III**	**C**	**1-0-0**	**01**

UNIT I Quantitative Reasoning

Number properties, Percentage, Ratio and proportion, Profit and loss, Simple and compound interest, Speed, Time and work, Powers and roots, Linear equations, Quadratic equations, Pipes, cisterns.

UNIT II Verbal Reasoning

Proposition, Premise: Syllogism: Verbal Analogies, Verification of truth of the statement, Assertion and reason, Situation reaction test, Decision making, Alpha-numerical sequence puzzle.

UNIT III Non-Verbal Reasoning

Symbols and their relationships, Arithmetical Decision making, Analytical functions, Space

Visualization, Blood Relations, Seating Arrangement, Coding-Decoding, Input- Output.

UNIT IV Data Analysis and Interpretation

Statistics: Average, Median, Mode, Range, Standard deviation, Graphical and Numerical Methods for Describing Data, Interpretation of data in tables and graphs, Permutations and Venn diagrams Counting Methods, Probability, Distributions of Data, Random Variables, and Probability Distributions.

UNIT V Emotional Intelligence

Self-Awareness, Self-Regulation, Social Skills, Empathy and Motivation.

Books of Study:

1. R.S. Agarwal, A Modern Approach to Verbal & Non Verbal Reasoning, S. Chand Publication
2. P. Anand, Quantitative Aptitude, Wiley, 2015

References:

1. The Games People Play, Eric Berne; Grove Press; 1964 of Human Interaction; Joseph Luft; Mayfield Publishing. 1969
2. Emotional Intelligence; Daniel Goleman; Bantam Books, 1995

Semester IV

Sub. Code	Sub. Name	Core/ Elective	L-T-P	Credits
CDC 212	**Soft skills - IV**	**C**	**1-0-0**	**01**

Objective: A grasp over numeric skills enable an individual to apply the mathematical techniques to situations that call for the interpretation or evaluation of quantitative information. The logical ability is sharpened through the practice of quantitative reasoning. Emotional intelligence on the other hand enables the development of intra and interpersonal relationship skills. Both these disciplines are aimed at enhancing the professional and personal effectiveness of the student

UNIT I Quantitative Reasoning (12 hours)
Number properties (3), Speed, Time and work (2), Powers and roots (1), Pipes, cisterns (1). Problems on Clock, Calendar and Cubes (3), Height and Distance (1) , Logarithms (1)

UNIT II Non-Verbal Reasoning (7 hours)

Alpha-numerical sequence puzzle, Symbols and their relationships, Blood Relations, Seating Arrangement, Coding-Decoding, Input- Output, test Direction Sense Test

UNIT III Data Analysis and Interpretation (10 hours)

Sets and Functions (1), Data Sufficiency (2), Statistics: Average, Median, Mode, Range, Standard deviation (2), Graphical and Numerical Methods for Describing Data, Interpretation of data in tables and graphs (2), Permutations and Venn diagrams Counting Methods, Probability (3).

UNIT IV Emotional Intelligence II

Self-Awareness, Self-Regulation, Social Skills, Empathy and Motivation.

Books of Study:

1. R.S. Agarwal, A Modern Approach to Verbal & Non Verbal Reasoning, S. Chand Publication
2. P. Anand, Quantitative Aptitude, Wiley, 2015

References:

1. The Games People Play, Eric Berne; Grove Press; 1964
2. Of Human Interaction; Joseph Luft; Mayfield Publishing. 1969
3. Emotional Intelligence; Daniel Goleman; Bantam Books, 1995

Semester IV

Sub. Code	Sub. Name	Core/ Elective	L-T-P	Credits
CE 204	Engineering Geology	**C**	**2-0-0**	**2**

UNIT 1: Introduction-
Branches of geology useful to civil engineering, scope of geological studies in various civil engineering projects. Department dealing with this subject in India and their scope of work- GSI, Granite Dimension Stone Cell, NIRM. Mineralogy-Mineral, Origin and composition. Physical properties of minerals, susceptibility of minerals to alteration, basic of optical mineralogy, SEM, XRD., Rock forming minerals, megascopic identification of common primary & secondary minerals.

UNIT 2: Petrology-
Rock forming processes. Specific gravity of rocks. Ternary diagram.
Igneous petrology- Volcanic Phenomenon and different materials ejected by volcanoes. Types of volcanic eruption. Concept of Hot spring and Geysers. Characteristics of different types of magma. Division of rock on the basis of depth of formation, and their characteristics. Chemical and Mineralogical Composition. Texture and its types. Various forms of rocks. IUGS Classification of phaneritic and volcanic rock.. Field Classification chart. Structures. Classification of Igneous rocks on the basis of Chemical composition. Detailed study of Acidic Igneous rocks like Granite, Rhyolite or Tuff, Felsite, Pegmatite, Hornfels. Metamorphic Aureole, Kaolinization. Landform as Tors. Engineering aspect to granite. Basic Igneous rocks Like Gabbro, Dolerite, Basalt. Engineering aspect to Basalt. Sedimentary petrology- mode of formation, Mineralogical Composition. Texture and its types, Structures, Gradation of Clastic rocks. Classification of sedimentary rocks and their characteristics. Detailed study of Conglomerate, Breccia, Sandstone, Mudstone and Shale, Limestone Metamorphic petrology- Agents and types of metamorphism, metamorphic grades, Mineralogical composition, structures & textures in metamorphic rocks. Important Distinguishing features of rocks as Rock cleavage, Schistosity, Foliation. Classification. Detailed study of Gneiss, Schist, Slate with engineering consideration.

UNIT3: Physical Geology-
Weathering. Erosion and Denudation. Factors affecting weathering and product of weathering. Engineering consideration. Superficial deposits and its geotechnical importance: Water fall and Gorges, River meandering, Alluvium, Glacial deposits, Laterite (engineering aspects), Desert Landform, Loess, Residual deposits of Clay with flints, Solifluction deposits, mudflows, Coastal deposits.

UNIT 4: Strength Behaviour of Rocks-
Stress and Strain in rocks. Concept of Rock Deformation & Tectonics. Dip and Strike. Outcrop and width of outcrop. Inliers and Outliers. Main types of discontinuities according to size. Fold- Types and nomenclature, Criteria for their recognition in field. Faults: Classification, recognition in field, effects on outcrops. Joints & Unconformity; Types, Stresses responsible, geotechnical importance. Importance of

structural elements in engineering operations. Consequences of failure as land sliding, Earthquake and Subsidence. Strength of Igneous rock structures.

UNIT 5: Geological Hazards-
Rock Instability and Slope movement: Concept of sliding
blocks. Different controlling factors. Instability in vertical rock structures and measures to prevent collapse. Types of landslide. Prevention by surface drainage, slope reinforcement by Rock bolting and Rock anchoring, retaining wall, Slope treatment. Case study on black clay. Ground water: Factors controlling water bearing capacity of rock. Pervious & impervious rocks and ground water. Lowering of water table and Subsidence. Earthquake: Magnitude and intensity of earthquake. Seismic sea waves. Revelation from Seismic Records of structure of earth. Case Study on Elevation and Subsidence in Himalayan region in India. Seismic Zone in India.

UNIT 6: Rock masses as construction material:
Definition of Rock masses. Main features
constituting rock mass. Main features that affects the quality of rock engineering and design. Basic element and structures of rock those are relevant in civil engineering areas. Main types of works connected to rocks and rock masses. Important variables influencing rock properties and behavior such as Fresh rock Influence from some minerals. Effect of alteration and weathering. Measurement of velocity of sound in rock. Classification of Rock material strength. Core logging .Rock Quality Designation. Rock mass description.

UNIT 7: Geology of dam and reservoir site-
Required geological consideration for selecting
dam and reservoir site. Failure of Reservoir. Favorable & unfavorable conditions in different types of rocks in presence of various structural features, precautions to be taken to counteract
unsuitable conditions, significance of discontinuities on the dam site and treatment giving to such structures.

UNIT 8: Rock Mechanics-
Sub surface 9nvestigations in rocks and engineering
characteristics or rocks masses; Structural geology of rocks. Classification of rocks, Field & laboratory tests on rocks, Stress deformation of rocks, Failure theories and sheer strength of rocks, Bearing capacity of rocks.

Practicals:

1. Study of physical properties of minerals.
2. Study of different group of minerals.
3. Study of Crystal and Crystal system.
4. Identification of minerals: Silica group: Quartz, Amethyst, Opal; Feldspar group: Orthoclase, Plagioclase; Cryptocrystalline group: Jasper; Carbonate group: Calcite; Element group: Graphite; Pyroxene group: Talc; Mica group: Muscovite; Amphibole group: Asbestos, Olivine, Hornblende, Magnetite, Hematite, Corundum, Kyanite, Garnet, Galena, Gypsum.

5. Identification of rocks (Igneous Petrology): Acidic Igneous rock: Granite and its varieties, Syenite, Rhyolite, Pumice, Obsidian, Scoria, Pegmatite, Volcanic Tuff. Basic rock: Gabbro, Dolerite, Basalt and its varieties, Trachyte.
6. Identification of rocks (Sedimentary Petrology): Conglomerate, Breccia, Sandstone and its varieties, Laterite, Limestone and its varieties, Shales and its varieties.
7. Identification of rocks (Metamorphic Petrolody): Marble, slate, Gneiss and its varieties, Schist and its varieties. Quartzite, Phyllite.
8. Study of topographical features from Geological maps. Identification of symbols in maps.

Text/Reference Books:

1. Engineering and General Geology, Parbin Singh, 8th Edition (2010), S K Kataria & Sons.
2. Text Book of Engineering Geology, N. Chenna Kesavulu, 2nd Edition (2009), Macmillan Publishers India.
3. Geology for Geotechnical Engineers, J.C.Harvey, Cambridge University Press (1982).

Semeester IV

Sub. Code	Sub. Name	Core/ Elective	L-T-P	Credits
CE 205	Geotechnical Engineering	**C**	**3-0-0**	**3**

UNIT 1: Introduction–
Types of soils, their formation and deposition, Definitions: soil mechanics, soil engineering, rock mechanics, geotechnical engineering. Scope of soil engineering. Comparison and difference between soil and rock. Basic Definitions and
Relationships-Soil as three-phase system in terms of weight, volume, voids ratio, and porosity. Definitions: moisture content, unit weights, degree of saturation, voids ratio,
porosity, specific gravity, mass specific gravity, etc. Relationship between volume weight, voids ratio- moisture content, unit weight- percent air voids, saturation- moisture content, moisture content- specific gravity etc. Determination of various parameters such as: Moisture content by oven dry method, pycnometer, sand bath method, torsional balance method,nuclear method, alcohol method and sensors. Specific gravity by density bottle method, pycnometer method, measuring flask method. Unit weight by water displacement method, submerged weight method, core-cutter method, sand-replacement method.
On completion of this UNIT, the students must be able to:

- Understand the different types of soil based on their formation mechanism;
- Understand the various phase diagrams and derive various phase relationships of the soil;
- Perform various laboratory experiments to determine moisture content, specific gravity;
- Perform field experiments to estimate the field density of the soil mass.

UNIT 2: Plasticity Characteristics of Soil –
Introduction to definitions of: plasticity of soil,
consistency limits-liquid limit, plastic limit, shrinkage limit, plasticity, liquidity and consistency indices, flow & toughness indices, definitions of activity and sensitivity. Determination of: liquid limit, plastic limit and shrinkage limit. Use of consistency limits. Classification of Soils-Introduction of soil classification: particle size classification, textural classification, unified soil classification system, Indian standard soil classification system. Identification: field identification of soils, general characteristics of soil in different groups.
On completion of this UNIT, the students must be able to:

- Understand the behaviour of soils based on their moisture contents;
- Perform laboratory experiments to estimate various Atterberg limits and evaluate
- index properties of soils;
- Classify any soils based on their particle size distribution and index properties;

UNIT 3: Permeability of Soil –

Darcy's law, validity of Darcy's law. Determination of
coefficient of permeability: Laboratory method: constant-head method, falling-head method.

Field method: pumping- in test, pumping- out test. Permeability aspects: permeability of stratified soils, factors affecting permeability of soil. Seepage Analysis- Introduction, stream and potential functions, characteristics of flow nets, graphical method to plot flow nets.
On completion of this UNIT, the student must be able to:

- Determine the permeability of soils through various laboratory and field tests;
- Analytically calculate the effective permeability of anisotropic soil mass;
- Determine the seepage quantities and pore water pressures below the ground;
- Graphically plot the equipotential lines and flow lines in a seepage flow.

UNIT 4: Effective Stress Principle –
Introduction, effective stress principle, nature of
effective stress, effect of water table. Fluctuations of effective stress, effective stress in soils saturated by capillary action, seepage pressure, quick sand condition.
On completion of this UNIT, the student must be able to:

- Understand the physical significance of effective stress and its relation with pore
- pressure;
- Plot various stress distribution diagrams along the depth of the soil mass;
- Understand the effect of capillary action and seepage flow direction on the effective
- stress at a point in the soil mass.

UNIT 5: Compaction of Soil
Introduction, theory of compaction, laboratory determination
of optimum moisture content and maximum dry density. Compaction in field, compaction specifications and field control.
On completion of this UNIT, the student must be able to:

- Perform laboratory test to determine the maximum dry density and optimum moisture
- content of the soil;
- Variation in compaction curve with compaction effort and soil type;
- Determine the compactive effort required to obtain necessary degree of compaction
- in-situ;
- Differentiate among various field methods of compaction and their usage based on the
- type of soil.

UNIT 6: Stresses in soils –

Introduction, stresses due to point load, line load, strip load,
uniformly loaded circular area, rectangular loaded area. Influence factors, Isobars, Boussinesq's equation, Newmark's Influence Chart. Contact pressure under rigid and flexible area, computation of displacements from elastic theory.
On completion of this UNIT, the student must be able to:

- Analytically compute the vertical stress in a semi-infinite soil mass due to various loading conditions;
- Plot isobars due various loading conditions.

UNIT 7: Consolidation of Soil –
Introduction, comparison between compaction and

consolidation, initial, primary & secondary consolidation, spring analogy for primary consolidation, interpretation of consolidation test results, Terzaghi's theory of consolidation, final settlement of soil deposits, computation of consolidation settlement and secondary consolidation.
On completion of this UNIT, the student must be able to:

- Understand the basic mechanism of consolidation of soil;
- Determine various consolidation parameters of soil through laboratory test;
- Evaluate ground settlements against time.

UNIT 8: *Shear Strength* –
Mohr circle and its characteristics, principal planes, relation
between major and minor principal stresses,Mohr-Coulomb theory, types of shear tests: direct
shear test, merits of direct shear test, triaxial compression tests, test behaviour of UU, CU and CD tests, pore-pressure measurement, computation of effective shear strength parameters. unconfined compression test, vane shear test
On completion of this UNIT, the student must be able to:

- Determine graphically and analytically the stress state in any plane of the soil mass;
- Perform various shear strength tests and appreciate the different field conditions which they simulate;
- Understand the significance of shear strength parameters in various geotechnical analyses;
- Evaluate the stiffness of soil using shear strength parameters

UNIT 9: *Stability of Slopes* –
Introduction, types of slopes and their failure mechanisms,
factor of safety, analysis of finite and infinite slopes, wedge failure Swedish circle method, friction circle method, stability numbers and charts.
On completion of this UNIT, the student must be able to:

- Differentiate various modes of slope failure;
- Evaluate factor of safety of infinite slopes based on different ground conditions;
- Understand various methods for computation of factor of safety for finite slopes.

UNIT 10: *Soil Exploration*-
Introduction, methods of site exploration and soil investigation,
methods of boring, soil samplers, sampling procedures, trail pits, borings, penetrometer tests, analysis of borehole logs, geophysical and advance soil exploration methods.
On completion of this UNIT, the student must be able to:

- Specify a strategy for site investigation to identify the soil deposits and determine the
- depth and spatial extent within the ground;
- Understand various site investigation techniques and their in-situ applications;
- Prepare a soil investigation report based on borehole log data and various in-situ tests
- like SPT, CPT, etc.

Practical Work: List of tests on-

1. Field Density using Core Cutter method.
2. Field Density using Sand replacement method.
3. Natural moisture content using Oven Drying method.
4. Field identification of Fine Grained soils.
5. Specific gravity of Soils.
6. Grain size distribution by Sieve Analysis.
7. Grain size distribution by Hydrometer Analysis.
8. Consistency limits by Liquid limit
9. Consistency limits by Plastic limit
10. Consistency limits by Shrinkage limit.
11. Permeability test using Constant-head test method.
12. Permeability test using Falling-head method.
13. Compaction test: Standard Proctor test.
14. Compaction test: Modified Proctor test.
15. Relative density.
16. Consolidation Test.
17. Triaxial Test (UU)
18. Vane shear test
19. Direct Shear Test
20. Unconfined Compression Strength Test.

Text/Reference Books:

1. Soil Mechanics by Craig R.F., Chapman & Hall
2. Fundamentals of Soil Engineering by Taylor, John Wiley & Sons
3. An Introduction to Geotechnical Engineering, by Holtz R.D. and Kovacs, W.D., Prentice Hall, NJ
4. Principles of Geotechnical Engineering, by Braja M. Das, Cengage Learning
5. Principles of Foundation Engineering, by Braja M. Das, Cengage Learning
6. Essentials of Soil Mechanics and Foundations: Basic Geotechnics by David F. McCarthy
7. Soil Mechanics in Engineering Practice by Karl Terzaghi, Ralph B. Peck, and Gholamreza Mesri.
8. Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering (Civil and Environmental Engineering) by V.N.S. Murthy

Semester-IV

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
MAT 131	Differential Equations	Core	3	0	0	3

- **Hours Time**: Three hours per week, each of 50 minutes. The class hours include tutorial sessions and there will be total 15 such sessions.
- **Prerequisites:**
  - MAT-112 (Single Variable Calculus), in particular, being familiar with vectors, differentiation, and integration.

- **Course Overview**: This introductory course on ordinary differential equations (**ODEs**) covers the theory, solution techniques, and applications surrounding linear and non-linear first and second-order differential equations, including systems of equations.

Course Objective: The emphasis should be on mastering the mathematics and use techniques, skills, modern tools for engineering practices. Further this course helps to identify, formulate, & solve engineering problems

- **Learning Outcome**: Upon successful completion of this course, you should be able to:
  - model some elementary physical situations by writing an appropriate differential equation.
  - be able to solve first order simple, linear, and separable equations.
  - solve higher order differential equations using characteristic roots, undetermined coefficients, and the Laplace transform.
  - understand the qualitative nature of the solution to the linear and non-linear systems of equations.

UNIT-1 First Order Differential Equations:

Geometric meaning of $y' = f(x, y)$, Direction Fields, Euler's Method, Classification of ODEs (Linear, Non-linear, Exact, Separable), Integrating Factor, Bernoulli Equations, Initial Value Problem, Modelling (Population Dynamics, Radioactivity, Subsonic Flight).

UNIT-2 Second and Higher Order Linear ODEs:

Homogeneous Linear ODEs, Modelling of Free Oscillations of a Mass-Spring System, Euler-Cauchy Equations, Non-homogeneous ODEs, Variation of Parameters, Modelling (Forced Oscillations. Resonance, Electric Circuits)

UNIT-3 System of ODEs:

Modelling Engineering problems (Electric Network, Mixing problem in two tanks etc.) as systems of ODEs, Wronskian, Phase-Plane Method, Critical Points & Stability, Qualitative Methods for Nonlinear Systems, Nonhomogeneous Linear Systems of ODEs.

UNIT-4 Series Solutions of ODEs:

Introduction to power series method, Legendre's equation & polynomials, Frobenius Method, Bessel's Equations & Functions.

UNIT-5 Laplace Transforms:

Laplace transforms of standard functions, Shifting Theorems, Transforms of derivatives and integrals, Unit step function, Dirac's delta function, Inverse Laplace transforms, Convolution theorem (without proof). Application: Solutions of ordinary differential equations using Laplace transforms.

Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley-India.

References:

1.Mary L. Boas, *Mathematical Methods in Physical Sciences*, 3rd Edition, Wiley-India.

2.G. F. Simmons, *Differential Equation with Applications and Historical Notes*, TATA McGraw Hill.

3.S. Vaidyanathan, *Advanced Applicable Engineering Mathematics*, CBS Publishers.

Semester IV

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CE 206	Surveying and Geomatics	Core	2	0	0	2

UNIT 1: Introduction to Surveying: **(8 hours)**
Principles, Linear, angular and graphical
methods, Survey stations, Survey lines- ranging, bearing of survey lines, Levelling: Plane table surveying, Principles of levelling- booking and reducing levels; differential, reciprocal leveling, profile levelling and cross sectioning. Digital and Auto Level, Errors in levelling; contouring: Characteristics, methods, uses; areas and volumes.
Triangulation and Trilateration (6 Hours)**:** Theodolite survey: Instruments, Measurement of horizontal and vertical angle; Horizontal and vertical control - methods -triangulation - network- Signals. Baseline - choices - instruments and accessories - extension of base lines - corrections - Satellite station - reduction to centre - Intervisibility of height and distances - Trigonometric leveling - Axis single corrections.

UNIT 2: Curves **(6 hours)**
Elements of simple and compound curves – Method of setting
out– Elements of Reverse curve - Transition curve – length of curve – Elements of transition curve - Vertical curves.

UNIT 3: Modern Field Survey Systems: **(8 Hours)**
Principle of Electronic DistanceMeasurement, Modulation, Types of EDM instruments, Distomat, Total Station – Parts of aTotal Station – Accessories –Advantages and Applications, Field Procedure for total station survey, Errors in Total Station Survey; Global Positioning Systems- Segments, GPS measurements, errors and biases, Surveying with GPS, Co-ordinate transformation, accuracy considerations.

UNIT 4: Photogrammetry Surveying **(8 Hours):**
Introduction, Basic concepts, perspectivegeometry of aerial photograph, relief and tilt displacements, terrestrial photogrammetry,flight planning; Stereoscopy, ground control extension for photographic mapping- aerialtriangulation, radial triangulation, methods; photographic mapping- mapping using paperprints, mapping using stereoplotting instruments, mosaics, map substitutes.

UNIT 5: Remote Sensing **(9 Hours):**
Introduction –Electromagnetic Spectrum, interaction
of electromagnetic radiation with the atmosphere and earth surface, remote sensing data acquisition: platforms and sensors; visual image interpretation; digital image processing.

Text/Reference Books:

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

Semester V

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CE 301	Mechanics of Materials	Core	3	0	0	3

UNIT 1: Deformation and Strain covering description of finite deformation, Infinitesimal deformation; Analysis of statically determinate trusses; Stability of dams, retaining walls and chimneys; Stress analysis of thin, thick and compound cylinder.

UNIT 2: Generalized state of stress and strain:
Stress and strain tensor, Yield criteria and
theories of failure; Tresca, Von-Mises, Hill criteria, Heigh-Westerguard's stress space.

UNIT 3: Momentum Balance and Stresses covering Forces and Moments Transmitted by Slender Members, Shear Force and Bending Moment Diagrams, Momentum Balance, Stress States / Failure Criterion.

UNIT 4: Mechanics of Deformable Bodies covering Force-deformation Relationships and Static Indeterminacy, Uniaxial Loading and Material Properties, Trusses and Their Deformations, Statically Determinate and Indeterminate Trusses,

UNIT 5: Force-Stress-Equilibrium covering Multiaxial Stress and Strain

UNIT 6: Displacement – Strain covering Multiaxial Strain and Multiaxial Stress-strain Relationships

UNIT 7: Elasticity and Elasticity Bounds covering Stress-strain-temperature Relationships and Thin-walled Pressure Vessels, Stress and strain Transformations and Principal Stress, Failure of Materials.

UNIT 8: Bending: Stress and Strains; Deflections and Torsion covering Pure Bending, Moment-curvature Relationship, Beam Deflection, Symmetry, Superposition, and Statically Indeterminate Beams, Shear and Torsion, Torsion and Twisting, Thermoelectricity, Energy methods, Variational Methods; Strain energy, elastic, complementary and total strain energy, Strain energy of axially loaded bar, Beam in bending, shear and torsion; General energy theorems, Castigliano's theorem, Maxwell Bettie's reciprocal theorem; Virtual work and unit load method for deflection, Application to problems of beams and frames.

UNIT 9: Structural stability; Stability of columns, Euler's formula, end conditions and effective length factor, Columns with eccentric and lateral load; Plasticity and Yield Design covering 1D-Plasticity – An Energy Approach, Plasticity Models, Limit Analysis and Yield Design.

Text/Reference Books:

1. Norris, C.H. and Wilber, J. B. and Utku, S. “Elementary Structural Analysis” Mc Graw Hill, Tokyo, Japan.
2. Timoshenko, S. and Young, D. H., “Elements of Strength of Materials”, DVNC, New York, USA.
3. Kazmi, S. M. A., ‘Solid Mechanics” TMH, Delhi, India.
4. Hibbeler, R. C. Mechanics of Materials. 6th ed. East Rutherford, NJ: Pearson Prentice Hall, 2004
5. Crandall, S. H., N. C. Dahl, and T. J. Lardner. An Introduction to the Mechanics of Solids. 2nd ed. New York, NY: McGraw Hill, 1979
6. Gere, J. M., and S. P. Timoshenko. Mechanics of Materials. 5th ed. Boston: PWS Kent Publishing, 1970.
7. Ashby, M. F., and D. R. H. Jones. Engineering Materials, An Introduction to their Properties and Applications. 2nd ed. Butterworth Heinemann.
8. Collins, J. A. Failure of Materials in Mechanical Design. 2nd ed. John Wiley & Sons, 1993.
9. Courtney, T. H. Mechanical Behavior of Materials. McGraw-Hill, 1990.
10. Hertzberg, R. W. Deformation and Fracture Mechanics of Engineering Materials. 4th ed. John Wiley & Sons, 1996.
11. Nash, W. A. Strength of Materials. 3d ed. Schaum's Outline Series, McGraw-Hill, 1994.

Semester V

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CE 302	Water Resources Engineering	Core	3	0	0	3

UNIT 1: Introduction - hydrologic cycle, water-budget equation, history of hydrology, World water balance, applications in engineering, sources of data.

UNIT 2: Precipitation - forms of precipitation, characteristics of precipitation in India, measurement of precipitation, rain gauge network, mean precipitation over an area, deptharea-
duration relationships, maximum intensity/depth-duration-frequency relationship, Probable Maximum Precipitation (PMP), rainfall data in India.

UNIT 3: Abstractions from precipitation - evaporation process, evaporimeters, analytical methods of evaporation estimation, reservoir evaporation and methods for its reduction, evapotranspiration, measurement of evapotranspiration, evapotranspiration equations, potential evapotranspiration over India, actual evapotranspiration, interception, depression storage, infiltration, infiltration capacity, measurement of infiltration, modelling infiltration capacity, classification of infiltration capacities, infiltration indices.

UNIT 4: Runoff - runoff volume, SCS-CN method of estimating runoff volume, flow duration curve, flow-mass curve, hydrograph, factors affecting runoff hydrograph, components of hydrograph, base flow separation, effective rainfall, unit hydrograph surface water resources of India, environmental flows.

UNIT 5: Ground water and well hydrology - forms of subsurface water, saturated formation, aquifer properties, geologic formations of aquifers, well hydraulics: steady state flow in wells, equilibrium equations for confined and unconfined aquifers, aquifer tests.

UNIT 6: Water withdrawals and uses – water for energy production, water for agriculture, water for hydroelectric generation; flood control. Analysis of surface water supply, Water requirement of Crops-Crops and crop seasons in India, cropping pattern, duty and delta; Quality of irrigation water; Soil-water relationships, root zone soil water, infiltration, consumptive use, irrigation requirement, frequency of irrigation; Methods of applying water to the fields: surface, sub-surface, sprinkler and trickle / drip irrigation.

UNIT 7: Distribution systems - canal systems, alignment of canals, canal losses, estimation of design discharge. Design of channels- rigid boundary channels, alluvial channels, Kennedy's and Lacey's theory of regime channels. Canal outlets: non-modular, semi-modular and modular outlets. Water logging: causes, effects and remedial measures. Lining of canals, types of lining. Drainage of irrigated lands: necessity, methods.

Semester V

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CE 303	**STRUCTURAL ENGINEERING**	Core	3	0	0	3

UNIT 1: Introduction- concepts of energy principles, safety, sustainable development in performance; what makes a structure; principles of stability, equilibrium; what is a structural engineer, role of engineer, architect, user, builder; what are the functions' what do the engineers design, first principles of process of design

UNIT 2: Planning and Design Process; Materials, Loads, and Design Safety; Behaviour and Properties of Concrete and Steel; Wind and Earthquake Loads

UNIT 3: Materials and Structural Design Criteria: Introduction to the analysis and design of structural systems. Analyses of determinate and indeterminate trusses, beams, and frames, and design philosophies for structural engineering. Laboratory experiments dealing with the analysis of determinate and indeterminate structures;

UNIT 4: Design of Structural Elements; Concrete Elements, Steel Elements, Structural Joints; Theories and concepts of both concrete and steel design and analysis both at the element and system levels. Approximate Analysis Methods as a Basis for Design; Design of Reinforced Concrete Beams for Flexure; Design of Reinforced Concrete Beams for Shear; Bond, Anchorage, and Serviceability; Reinforced Concrete Columns; Reinforced Concrete Slabs; Introduction to Steel Design; Tension Members and Connections; Bending Members; Structural Systems

UNIT 5: System Design Concepts; Special Topics that may be Covered as Part of the Design Project Discussions; Cable Structures; Prestressed Concrete Bridges; Constructability and Structural Control; Fire Protection

Text/Reference Books:

1. Nilson, A. H. Design of Concrete Structures. 13th edition. McGraw Hill, 2004
2. McCormac, J.C., Nelson, J.K. Jr., Structural Steel Design. 3rd edition. Prentice Hall, N.J., 2003.
3. Galambos, T.V., Lin, F.J., Johnston, B.G., Basic Steel Design with LRFD, Prentice Hall, 1996
4. Segui, W. T., LRFD Steel Design, 2nd Ed., PWS Publishing, Boston.
5. Salmon, C.G. and Johnson, J.E., Steel Structures: Design and Behavior, 3rd Edition, Harper & Row, Publishers, New York, 1990.
6. MacGregor, J. G., Reinforced Concrete: Mechanics and Design, 3rd Edition, Prentice Hall, New Jersey, 1997.
7. Nawy, E. G., Reinforced Concrete: A Fundamental Approach, 5th Edition, Prentice Hall, New Jersey.
8. Wang C-K. and Salmon, C. G., Reinforced Concrete Design, 6th Edition, Addison Wesley, New York.
9. Nawy, E. G. Prestressed Concrete: A Fundamental Approach, Prentice Hall, NJ, (2003).
10. Related Codes of Practice of BIS
11. Smith, J. C., Structural Analysis, Harpor and Row, Publishers, New York.
12. W. McGuire, R. H. Gallagher and R. D. Ziemian. “Matrix Structural Analysis", 2nd Edition, John Wiley and Sons, 2000.
13. NBC, National Building Code, BIS (2017).
14. ASCE, Minimum Design Loads for Buildings and Other Structures, ASCE 7-02, American Society of Civil Engineers, Virginia, 2002.

Semester V

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CE 304	**HYDRAULIC ENGINEERING**	Core	3	0	0	3

UNIT 1: Laminar Flow- Laminar flow through:
circular pipes, annulus and parallel plates.Stoke's law, Measurement of viscosity.

UNIT 2: Turbulent Flow- Reynolds experiment,
Transition from laminar to turbulent flow.Definition of turbulence, scale and intensity, Causes of turbulence, instability, mechanism ofturbulence and effect of turbulent flow in pipes. Reynolds stresses, semi-empirical theories ofturbulence, Prandtl's mixing length theory, universal velocity distribution equation.Resistance to flow of fluid in smooth and rough pipes, Moody's diagram.

UNIT 3:Boundary Layer Analysis
Assumption and concept of boundary layer theory.Boundary-layer thickness, displacement, momentum & energy thickness, laminar andTurbulent boundary layers on a flat plate; Laminar sub-layer, smooth and rough boundaries.Local and average friction coefficients. Separation and Control.

UNIT 4: Dimensional Analysis and Hydraulic Similitude
Dimensional homogeneity,Rayleigh method, Buckingham's Pi method and other methods. Dimensionless groups.Similitude, Model studies, Types of models. Application of dimensional analysis and modelstudies to fluid flow problem.

UNIT 5: Introduction to Open Channel Flow-
Comparison between open channel flow andpipe flow, geometrical parameters of a channel, classification of open channels, classificationof open channel flow, Velocity Distribution of channel section.

UNIT 6: Uniform Flow
Continuity Equation, Energy Equation and Momentum Equation,Characteristics of uniform flow, Chezy's formula, Manning's formula. Factors affectingManning's Roughness Coefficient, n.*Most economical section of ch*annel. Computation of
Uniform flow, Normal depth.

UNIT 7 : Non-Uniform Flow-
Specific energy, Specific energy curve, critical flow,discharge curve Specific force Specific depth, and Critical depth. Channel Transitions.Measurement of Discharge and Velocity – Venturi Flume, Standing Wave Flume, ParshallFlume, Broad Crested Weir. Measurement of Velocity- Current meter, Floats, Hot-wireanemometer. Gradually Varied Flow-Dynamic Equation of Gradually Varied Flow,Classification of channel bottom slopes, Classification of surface profile, Characteristics ofsurface profile. Computation of water surface profile by

graphical, numerical and analyticalapproaches. Direct Step method, Graphical Integration method and Direct integrationmethod.

UNIT 8: Hydraulic Jump
Theory of hydraulic jump, Elements and characteristics ofhydraulic jump in a rectangular Channel, length and height of jump, location of jump,Types,applications and location of hydraulic jump. Energy dissipation and other uses, surgeas a moving hydraulic jump. Positive and negative surges. Dynamics of Fluid Flow-Momentum principle, applications: Force onplates, pipe bends, moments of momentumEquation

UNIT 9: Flow through Pipes:
Loss of head through pipes, Darcy-Wiesbatch equation,minor losses, total energy equation, hydraulic gradient line, Pipes in series, equivalent pipes,pipes in parallel, flow through laterals, flows in dead end pipes, siphon, power transmissionthrough pipes, nozzles.
Analysis of pipe networks: Hardy Cross method, water hammer inpipes and control measures, branching of pipes, three reservoir problem.

UNIT 10: Computational Fluid Dynamics:
Basic equations of fluid dynamics, Gridgeneration, Introduction to in viscid incompressible flow, Boundary layer flow as applicableto C.F.D. Hydro informatics: Concept of hydro informatics –scope of internet and web basedmodeling in water resources engineering.

Practical Work:
1. Flow Visualization
2. Studies in Wind Tunnel
3. Boundary Layer
4. Flow around an Aerofoil / circular cylinder
5. Uniform Flow
6. Velocity Distribution in Open channel flow
7. Venturi Flume
8. Standing Wave Flume
9. Gradually Varied Flow
10. Hydraulic Jump
11. Flow under Sluice Gate
12. Flow through pipes
13. Turbulent flow through pipes
14. Flow visualization
15. Laminar flow through pipes
16. Major losses / Minor losses in pipe

Text/Reference Books:

1. Hydraulics and Fluid Mechanics, P.M. Modi and S.M. Seth, Standard Book House
2. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill.
3. Open channel Flow, K. Subramanya, Tata McGraw Hill.
4. Open Channel Hydraulics, Ven Te Chow, Tata McGraw Hill.
5. Burnside, C.D., "*Electromagnetic Distance Measurement*," Beekman Publishers, 1971.

Semester V

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CE 305	**CONSTRUCTION ENGINEERING AND MANAGEMENT**	Core	3	0	0	3

UNIT 1: Basics of Construction-
Unique features of construction, construction projects types and features, phases of a project, agencies involved and their methods of execution;

UNIT 2: Construction project planning-
Stages of project planning: pre-tender planning,pre-construction planning, detailed construction planning, role of client and contractor, levelof detail. Process of development of plans and schedules, work break-down structure, activitylists, assessment of work content, concept of productivities, estimating durations, sequence ofactivities, activity utility data; Techniques of planning- Bar charts, Gantt Charts. Networks:basic terminology, types of precedence relationships, preparation of CPM networks: activityon link and activity on node representation, computation of float values, critical and semicritical paths, calendaring networks.PERT- Assumptions underlying PERT analysis,determining three time estimates, analysis, slack computations, calculation of probability ofcompletion.

UNIT 3: Construction Methods basics:
Types of foundations and construction methods;Basics of Formwork and Staging; Common building construction methods (conventionalwalls and slabs; conventional framed structure with blockwork walls; Modular constructionmethods for repetitive works; Precast concrete construction methods; Basics of Slip formingfor tall structures; Basic construction methods for steel structures; Basics of constructionmethods for Bridges.

UNIT 4: Construction Equipment basics: Conventional construction methods Vs Mechanized methods and advantages of latter; Equipment for Earthmoving, Dewatering; Concrete mixing, transporting & placing; Cranes, Hoists and other equipment for lifting; Equipment for transportation of materials. Equipment Productivities

UNIT 5: Planning and organizing construction site and resources- Site:
site layout includingenabling structures, developing site organization, Documentation at site; Manpower:planning, organizing, staffing, motivation; Materials: concepts of planning, procurement andinventory control; Equipment: basic concepts of planning and organizing; Funds: cash flow,sources of funds; Histograms and S-Curves. Earned Value; Resource Scheduling- Bar chart,line of balance technique, resource constraints and conflicts; resource aggregation, allocation,smoothening and leveling. Common Good Practices in Construction

UNIT 6: Project Monitoring & Control-
Supervision, record keeping, periodic progressreports, periodical progress meetings. Updating of plans: purpose, frequency and methods ofupdating. Common causes of time and costoverruns and corrective measures. Basics ofModern Project management systems such

asLean Construction; Use of BuildingInformation Modelling (BIM) in project management; Quality control: concept of quality, quality of constructed structure, use of manuals and checklists for quality control, role ofinspection, basics of statistical quality control. Safety, Health and Environment on project sites: accidents; their causes, effects and preventive measures, costs of accidents, occupational health problems in construction, organizing for safety and health.

UNIT 7: Contracts Management basics:
Importance of contracts; Types of Contracts,parties to a contract; Common contract clauses (Notice to proceed, rights and duties ofvarious parties, notices to be given, Contract Duration and Price. Performance parameters;Delays, penalties and liquidated damages; Force Majeure, Suspension and Termination.Changes & variations, Dispute Resolution methods.

UNIT 8: Construction Costs: Make-up of construction costs; Classification of costs, timecost trade-off in construction projects, compression and decompression.

Text/Reference Books:

1. Varghese, P.C., “Building Construction”, Prentice Hall India, 2007.
2. National Building Code, Bureau of Indian Standards, New Delhi, 2017.
3. Chudley, R., Construction Technology, ELBS Publishers, 2007.
4. Peurifoy, R.L. Construction Planning, Methods and Equipment, McGraw Hill, 2011
5. Nunnally, S.W. Construction Methods and Management, Prentice Hall, 2006
6. Jha, Kumar Neeraj., Construction Project management, Theory & Practice, Pearson Education India, 2015
7. Punmia, B.C., Khandelwal, K.K., Project Planning with PERT and CPM, Laxmi Publications, 2016.

Semester VI

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CE 307	**TRANSPORTATION ENGINEERING**	Core	3	0	0	3

UNIT 1: Highway development and planning –
Classification of roads, road development inIndia, Current road projects in India; highway alignment and project preparation.

UNIT 2: Geometric design of highways-:
Introduction; highway cross section elements;sight distance, design of horizontal alignment; design of vertical alignment; design of
intersections, problems

UNIT 3: Traffic engineering & control-
Traffic Characteristics, traffic engineering studies,traffic flow and capacity, traffic regulation and control; design of road intersections; design ofparking facilities; highway lighting; problems

UNIT 4: Pavement materials-
Materials used in Highway Construction- Soils, Stoneaggregates, bituminous binders, bituminous paving mixes; Portland cement and cementconcrete: desirable properties, tests, requirements for different types of pavements. Problems

UNIT 5: Design of pavements-
Introduction; flexible pavements, factors affecting designand performance; stresses in flexible pavements; design of flexible pavements as per IRC;rigid pavements- components and functions; factors affecting design and performance of CC pavements; stresses in rigid pavements; design of concrete pavements as per IRC; problems

Text/Reference Books:

1. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, 'Highway Engineering', Revised 10th Edition, Nem Chand & Bros, 2017
2. Kadiyalai, L.R., ' Traffic Engineering and Transport Planning', Khanna Publishers.
3. Partha Chakraborty, ' Principles Of Transportation Engineering, PHI Learning
4. Fred L. Mannering, Scott S. Washburn, Walter P. Kilareski,'Principles of Highway Engineering and Traffic Analysis', 4th Edition, John Wiley
5. Srinivasa Kumar, R, Textbook of Highway Engineering, Universities Press, 2011.
6. Paul H. Wright and Karen K. Dixon, Highway Engineering, 7th Edition, Wiley Student Edition, 2009.

Semester VII

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CE 401	**ENGINEERING ECONOMICS, ESTIMATION & COSTING**	Core	3	0	0	3

UNIT 1: Basic Principles and Methodology of Economics (3 hours)
Demand/Supply – elasticity –Government Policies and Application. Theory of the Firm and Market Structure. Basic Macro-Economic Concepts (including GDP/GNP/NI/Disposable Income) and Identities for both closed and open economies. Aggregate demand and Supply (IS/LM). Price Indices(WPI/CPI), Interest rates, Direct and Indirect Taxes

UNIT 2: Public Sector Economics – (2 hours)
Welfare, Externalities, Labour Market. Components of Monetary and Financial System, Central Bank –Monetary Aggregates; Commercial Banks &their functions; Capital and Debt Markets. Monetary and Fiscal Policy Tools & their impaction the economy – Inflation and Phillips Curve.

UNIT 3: Elements of Business/Managerial (3 hours)
Economics and forms of organizations. Cost &Cost Control –Techniques, Types of Costs, Lifecycle costs, Budgets, Break even Analysis, Capital Budgeting, Application of Linear Programming. Investment Analysis – NPV, ROI, IRR, Payback Period, Depreciation, Time value of money (present and future worth of cash flows). Business Forecasting – Elementary techniques. Statements – Cash flow, Financial. Case Study Method.

UNIT 4: Indian economy – (2 hours)
Brief overview of post-independence period – plans. Postreform Growth, Structure of productive activity. Issues of Inclusion – Sectors,States/Regions, Groups of people (M/F), Urbanization. Employment–Informal, Organized,Unorganized, Public, Private. Challenges and Policy Debates in Monetary, Fiscal, Social,External sectors. (

UNIT 5: Estimation / Measurements for various items- (7hours)
Introduction to the process ofEstimation; Use of relevant Indian Standard Specifications for the same, taking out quantitiesfrom the given requirements of the work, comparison of different alternatives, Bar bendingschedules, Mass haul Diagrams, Estimating Earthwork and Foundations, Estimating Concreteand Masonry, Finishes, Interiors, MEP works; BIM and quantity take-offs; adding equipmentcosts; labour costs; rate analysis; Material survey-Thumb rules for computation of materialsrequirement for different materials for buildings, percentage breakup of the cost, costsensitive index, market survey of basic materials. Use of Computers in quantity surveying

UNIT 6: Specifications (3 hours)
-Types, requirements and importance, detailed specifications for buildings, roads, minor bridges and industrial structures.

UNIT 7: Rate analysis-Purpose, (3 hours)

importance and necessity of the same, factors affecting, task work, daily output from different equipment/ productivity.

UNIT 8: Tender- (6 hours)
Preparation of tender documents, importance of inviting tenders, contract types, relative merits, prequalification. general and special conditions, termination of contracts, extra work and Changes, penalty and liquidated charges, Settlement of disputes, R.A. Bill & Final Bill, Payment of advance, insurance, claims, price variation, etc. Preparing Bids- Bid Price buildup: Material, Labour, Equipment costs, Risks, Direct & Indirect Overheads, Profits; Bid conditions, alternative specifications; Alternative Bids. Bid process management

UNIT 9: Introduction to Acts (1 hours)
pertaining to-Minimum wages, Workman's compensation, Contracts, Arbitration, Easement rights.

Text/Reference Books:

1. Mankiw Gregory N. (2002), Principles of Economics, Thompson Asia
2. V. Mote, S. Paul, G. Gupta(2004), Managerial Economics, Tata McGraw Hill
3. Misra, S.K. and Puri (2009), Indian Economy, Himalaya
4. Pareek Saroj (2003), Textbook of Business Economics, Sunrise Publishers
5. M Chakravarty, Estimating, Costing Specifications & Valuation
6. Joy P K, Handbook of Construction Management, Macmillan
7. B.S. Patil, Building & Engineering Contracts
8. Relevant Indian Standard Specifications.
9. World Bank Approved Contract Documents.
10. FIDIC Contract Conditions.
11. Acts Related to Minimum Wages, Workmen’s Compensation, Contract, and Arbitration
12. Typical PWD Rate Analysis documents.
13. UBS Publishers & Distributors, Estimating and Costing in Civil Engineering: Theory and Practice including Specification and Valuations,2016
14. Dutta, B.N., Estimating and Costing in Civil Engineering (Theory & Practice), UBS Publishers, 2016

Semester VII

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CE 402	**SENSING TECHNOLOGIES FOR CIVIL ENGINEERING**	Core	3	0	0	3

Unit 1: Fundamentals of Measurement, Sensing and Instrumentation covering definition of measurement and instrumentation, physical variables, common types of sensors; Describe the function of these sensors; Use appropriate terminology to discuss sensor applications; and qualitatively interpret signals from a known sensor type, types of instrumentation, Sensor Specifics, Permanent installations, Temporary installations;

Unit 2: Sensor Installation and Operation covering to: i) Predict the response of sensors to various inputs; ii) Construct a conceptual instrumentation and monitoring program; iii) Describe the order and methodology for sensor installation; and iv) Differentiate between types of sensors and their modes of operation and measurement and v) Approach to Planning Monitoring Programs, Define target, Sensor selection, Sensor siting, Sensor Installation & Configuration, Advanced topic, Sensor design, Measurement uncertainty

Unit 3: Data Analysis and Interpretation covering a) Fundamental statistical concepts, b) Data reduction and interpretation, c) Piezometer, Inclinometer, Strain gauge, etc. d) Time domain signal processing, e) Discrete signals, Signals and noise and f) a few examples of statistical information to calculate are: Average value (mean), On average, how much each measurement deviates from the mean (standard deviation), Midpoint between the lowest and
highest value of the set (median), Most frequently occurring value (mode), Span of values over which your data set occurs (range)

Unit 4: Frequency Domain Signal Processing and Analysis covering Explain the need for frequency domain analysis and its principles; Draw conclusions about physical processes based on analysis of sensor data; Combine signals in a meaningful way to gain deeper insight into physical phenomena, Basic concepts in frequency domain signal processing and analysis, Fourier Transform, FFT (Fast Fourier Transform), Example problems: Noise reduction with filters, Leakage, Frequency resolution

Practicals:
Instrumentation of typical civil engineering members/structures/structural elements
Use of different sensors, strain gauges, inclinometers,
Performance characteristics
Errors during the measurement process
Calibration of measuring sensors and instruments
Measurement, noise and signal processing
Analog Signal processing
Digital Signal Processing

Demonstration & use of sensor technologies

Text/Reference Books:

1. Alan S Morris (2001), Measurement and Instrumentation Principles, 3rd/e, Butterworth Hienemann
2. David A. Bell (2007), Electronic Instrumentation and Measurements 2nd/e, Oxford Press
3. S. Tumanski (2006), Principle of Electrical Measurement, Taylor & Francis
4. Ilya Gertsbakh (2010), Measurement Theory for Engineers, Springer