B.Tech CIVIL Engineering
Curriculum

(For the students admitted during AY 2019-23)

Detailed Syllabus of Courses

(**Syllabus shown here is just a guideline, Please contact your instructor for the updated detailed syllabus, grading scheme, books and other details**)

Semester – I

Course Name	Code	L-T-P	Total Cr hrs
Communicative English (Minerva)	EGL 101	3-0-0	3
Engineering Physics	PHY 101	2-0-0	2
Engineering Physics LAB	PHY 101L	0-0-2	1
Basic Electronics	ENG 111	3-0-0	3
Basic Electronics LAB	ENG 111L	0-0-2	1
Single Variable Calculus	MAT111	3-0-0	3
Introduction to Computer Science and Programming	CSE 102	3-0-0	3
Introduction to Computer Science and Programming LAB	CSE 102L	0-0-2	1
CDC/CCC	CDC 101	1-0-0	1

Semester - 1

Course Code	Course Name	Credit hr	L/T/P
ENL 101	Communicative English	3	3-0-0

Course: ENL 101 INTRODUCTION TO COMMUNICATION

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.

Books of Study:

Required Book 1. Communication: Principles for a Lifetime. Beebe, Beebe and Ivy, Sixth Edition, Pearson Publishing.

References:

Reference Books 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 - 1

Course Code	Course Title	L	T	P
ENG 111	Basic Electronics	3	0	0

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.

Textbooks:

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 - 1

Course Code	Course Name	Core/ Elective	Credit hr	L/T/P
CSE 101	Introduction to programming with Python	C	3	3-0-0

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 – 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 II 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 III 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 IV 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

Unit V Optimization and Knapsack Problem:

Computational models, Intro to optimization 0/1 Knapsack Problem, Greedy solutions –
Decision Trees and Dynamic Programming: Decision tree solution to knapsack Dynamic
programming and knapsack, Divide and conquer – Graphs: Graph problems, Shortest path,
Depth first search, Breadth first search

Unit VI   Stochastic Thinking:

Rolling a Die, Random walks – Random Walks: Drunk walk,

Biased random walks, Treacherous fields – Inferential Statistics: Probabilities, Confidence intervals – Monte Carlo Simulations: Sampling, Standard error Experimental Data: Errors in Experimental Observations, Curve Fitting, Goodness of Fit, Using a Model for Predictions

Unit VII Machine Learning:
Feature Vectors, Distance Metrics, Clustering – Statistical

Fallacies: Misusing Statistics, Garbage In Garbage Out, Data Enhancement - Visualization of Data: Visualizing Results, Overlapping Displays, Adding More Documentation, Changing Data Display

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 Reema Thareja, Oxford University, Higher Education Oxford 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 - 1

Course Code	Course Name	Core/ Elective	Credit hr	L/T/P
MAT 111	Single Variable Calculus	C	3	3-0-0

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, 1 and 2nd derivative test, Limits and asymptotic, Max min problems, Related application in real-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 - 1

Course: CDC 101 SOFT SKILLS

Course Code	Course Name	Core/ Elective	Credit hr	L/T/P
CDC 101	Soft Skills	1	1	1-0-0

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
Know Thyself 2 Hours
Personality profiling based on the 16 personality types. Assessment of individual personality type.

UNIT II
Personality Development 4 Hours
Personality construct, The KSAB Model, Components of perception, perceptual errors, perception as a precursor of attitude and behaviour

UNIT III
Communication 6 Hours
The 3 Vs of communication: Visual or Kinesics, Vocal (Articulation), Verbal, Active listening, Barriers to listening, GARF (Giving and Receiving Feedback)

UNIT IV
Presentation Skills 4 Hours
The four Ps of presentation, Handling different types of target audience

UNIT V
TIME MANAGEMENT & GOAL SETTING 2 Hours

Pressure Cooker (Activity based on Planning, Organizing and Prioritization), Roller Coaster (Activity on setting SMARTER goals, planning & organizing, short & long term goals).

Reference:

1. The Perception of Deception, David Icke, David Icke Books, 2014,
2. Eye and Brain: The Psychology of Seeing, Richard, Langton Gregory, Princeton University Press, 1997
3. Awaken The Giant Within, Anthony Robbins, Pocket Books, 2001

SEMESTER – II

CDC/CCC	CDC 102	1-0-0
Statistical Intiution (Minerva)		3-0-0
Engineering Economics	ECO 221	3-0-0
Introduction to Biology	BIO 101	2-0-0
Introduction to Biology LAB	BIO 101L	0-0-2
Chemistry	CHE 101	3-0-0
Chemistry LAB	CHE 101L	0-0-2
Multi Variable Calculus	MAT 121	3-0-0
Engineering Graphics	ME	0-0-2
Critical Thinking (Minerva)	HS	3-0-0

Semester - II

Sub.Code	Sub. Name	Core/ Elective	L-T-P	Credits
BIO 101	Introduction to Biology	C	3-0-2	04

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 Signaling and Cancer   (9 hours)
Cell cycle. Signaling molecules, Signaling pathways: Transmembrane receptor, Intracellular receptor, nuclear hormone receptor. Signaling 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
2. University Press.
3. Exploring Proteins, Ed. 1, 2014, Price and Nairn, Oxford University Press.
4. Thrives in Cell Biology, Ed. 1, 2013, Qiuyu Wang, Cris Smith and Davis, Oxford University
5. Press.
6. Metallic Nano crystallites and their Interaction with Microbial Systems, Ed. 1, 2012, Anil K.
7. Suresh, Springer Netherlands.

References:
1. 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).
4. 6th edn. Cambridge University Press, Cambridge.
   Kuby Immunology, Ed. 5, 2006, Kindt, Goldsby and Osborn, W. H Freeman & Co (Sd).
5. 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
7. Scientific Publishing Co Pt. Ltd.

SEMESTER – II

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
MAT 121	Multi Variable Calculus	Core	3	0	0	3

Course Instructors: TBA

Scope & Aim of this course**: This course is an introduction to multiple variable calculus to the B. Tech students (of all branches)

Unit I
Three dimensional coordinate system, Vectors, Dot product, Cross Product, Lines and Planes.

Unit II
Functions of several variables, Limits and continuity for them, Partial Derivatives, The Chain Rule, Directional Derivatives, Gradient.

Unit III
Extreme values, Saddle points, Lagrange multipliers.

Unit IV
Double and Iterated integrals, Area by Double Integration.

Unit V
Triple Integrals and Application.

Recommended Text book:

1. Thomas' Calculus, 14th Edition, Joel R. Hass, Christopher E. Heil, Maurice D. Weir, 2018.

Suggested Grade Distribution

Exam type	Marks
Quiz	10
Assignments	10
Mid sem-I	15
Mid sem-II	15
Final exam	50
Total	**100**

SEMESTER – II

Course: CHE102 INTRODUCTION TO CHEMISTRY

Course Code	Course Name	Core/ Elective	Credit hr	L/T/P
CHE102	INTRODUCTION TO CHEMISTRY	C	3	3-0-0

Unit I Chemical Bonding (10 hours)

Ionic, covalent, and metallic bonds. Theories of bonding: Valence bond theory, nature of covalentbond, 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 Crystalline Materials (9 hours)

Crystal structure: crystal systems, Bravais lattices, Miller indices. Properties of cubic crystals. X-ray diffraction. Defects: point, line, surface and bulk.

Unit III Electronic and Magnetic Materials (8 hours)

Band theory: metals, insulators, and semiconductors. Band gaps, doping, and devices. Dia-, para-and ferro-magnetic materials.

Unit IV Organic Material (10 hours)

Organic compounds: nomenclature, alkanes, alkenes, alkynes, aromatics, functional groups. Polymers: polystyrene, nylon and PET (Polyethylene terephthalate). Biochemistry: amino acids, peptides and proteins.

Unit V Inorganic Materials (9 hours)

Framework solids: silicates, zeolites, aluminophosphates. Metal-organic frameworks, covalent-organic frameworks – their structure and properties.

Books/reviews of study

1.A. Bahl and B. S. Bahl, G. D. Tuli, Essentials of physical chemistry, S Chand Publication, 2014, ISBN: 8121929784.

2. A.R. West, Solid State Chemistry and its applications, 2nd Edition, Student Edition, 584 pages, 2014, ISBN: 978-1-119-94294-8.

3. L. Smart and E. Moore, Solid state chemistry: An introduction, CRC Press, 2012, ISBN 9781439847909.

4. B. M. Weckhuysen and J. Yu, Recent advances in zeolite chemistry and catalysis, Chem. Soc. Rev., 2015, 44, 7022-7024.

5. F.W. Billmeyer, Text Book of Polymer Science, 3rd Ed., John Wiley & Sons, New York, 2003.

6. Yi Li and Jihong Yu, New Stories of Zeolite Structures: Their Descriptions, Determinations, Predictions, and Evaluations, Chem. Rev., 2014, 114, 7268–7316.

7. P. Silva, S. M. F. Vilela, J. P. C. Tomé and F. A. A. Paz, Multifunctional metal–organic frameworks: from academia to industrial applications, Chem. Soc. Rev., 2015, 44, 6774-6803.

8. S-Y. Ding and W. Wang, Covalent organic frameworks (COFs): from design to applications, Chem. Soc. Rev., 2013, 42, 548-568

Books of reference

1. Shackelford, J. Introduction to Materials Science for Engineers. 6th edition. Upper Saddle River, NJ: Pearson, 2004. ISBN: 9780131424869.

2. D. K. Chakrabarty, Solid State Chemistry, 2nd Ed., New Age International, 2010, ISBN: 978-81-224-2737-0.

C.N.R. Rao and J. Gopalakrishnan, New directions in solid state chemistry, Cambridge University Press, 1997, Online ISBN: 978051162314

SEMESTER – III

Introduction to Thermodynamics	CE 211	3-0-0	3
Introduction to Thermodynamics LAB	CE 211L	0-0-2	1
Linear Algebra	MAT	3-0-0	3
Engineering Mechanics	CE 212	3-0-0	3
Environmental Engineering	CE 213	3-0-0	3
Differential Equations	MAT	3-0-0	3
Engineering Fundamentals	ENG 101	3-0-0	3
Mechanical Engineering Tools (Workshop)	ME	0-0-2	1
Soft Skills - 3	CDC 103	1-0-0	1

SEMESTER – III

Course: DIFFERENTIAL EQUATIONS

Course Code	Course Name	Core/ Elective	Credit hr	L/T/P
MAT	DIFFERENTIAL EQUATIONS			

UNIT I First Order Differential Equations

Geometric Methods, Numerical Methods, Linear ODE's, Integrating Factors, Complex Arithmetic, Sinusoidal Functions, Constant Coefficients, Exponential Input, Autonomous Equations, Linear vs. Nonlinear

UNIT II Second Order Constant Coefficient Linear Equations

Characteristic Equation, Damped Oscillators, Exponential Response, Gain and Phase Lag, Undetermined Coefficients, Linear Operators, Pure Resonance, Frequency Response, Applications

UNIT III Fourier Series and Laplace Transform

Fourier Series: Basics, Operations, Periodic Input, Step And Delta, Impulse Response, Convolution, Laplace Transform, Partial Fractions, Solving Ivp's, Transfer Functions

UNIT IV First-order Systems

Matrix Methods, Phase Portraits, Nonlinear Systems, Linearization, Limit Cycles and Chaos

UNIT V Second-order Systems

Linear systems, Matrix Exponentials, Nonlinear Systems, Linearization,

Books of Study

1. A.H. siddiqi, P. Manchanda - A First Course in Differential Equations with Application
2. G. F. Simmons - Differential equation with applications and historical notes (Tata Mc Graw Hill)

Books of Reference

1. Haberman, R., Elementary Applied Partial Differential Equations, PrenticeHall, 1998.

SEMESTER – III

Course: CE 211 ENGINEERING MECHANICS

Course Code	Course Name	Core/ Elective	Credit hr	L/T/P
CE 212	Engineering Mechanics	C	3	3-0-0

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

Course: CE211 INTRODUCTION TO THERMODYNAMICS

Credit: 3 hrs   Lect/Tut/Lab: 2-0-2

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.

Chapter 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.

Chapter 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 volumes, steady and unsteady flow analysis, Perpetual motion machine I.

Chapter 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.

Chapter 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.

Chapter 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

Grading policy:

Laboratory assignments	20%
Homework assignments	20%
Mid-semester examination(s)	20%
End-semester examination	40%

Text Books:

1. P. K Nag, <u>Engineering Thermodynamics,</u> 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

Course: MAT 151 LINEAR ALGEBRA

Course Code	Course Name	Core/ Elective	Credit hr	L/T/P
MAT151	Linear Algebra	C	3	3-0-0

UNIT I

Systems of linear equations, Matrices, Elementary row operations, Row-reduced echelon matrices. Vector spaces, Subspaces, Bases and dimension, Ordered bases and coordinates.

UNIT II

Linear transformations, Rank-nullity theorem, Algebra of linear transformations, Isomorphism, Matrix representation, Linear functionalz, Annihilator, Double dual, Transpose of a linear transformation.

UNIT III

Characteristic values and characteristic vectors of linear transformations, Diagonalizability, Minimal polynomial of a linear transformation, Cayley-Hamilton theorem

UNIT IV

Invariant subspaces, Direct-sum decompositions, Invariant direct sums, The primary decomposition theorem, Cyclic subspaces and annihilators, Cyclic decomposition, Rational, Jordan forms.

UNIT V

Inner product spaces, Orthonormal bases, Gram-Schmidt process.

Books of study:

1. Axler, Sheldon J. Linear Algebra Done Right. 2nd Edition, Springer, 2004,

Course: ENV 101 INTRODUCTION TO ENVIRONMENTAL SCIENCE

Course Code	Course Name	Core/ Elective	Credit hr	L/T/P
ENV101	INTRODUCTION TO ENVIRONMENTAL SCIENCE			

UNIT I: Environment

Structure and functions in an ecosystem; Ecological succession; Ecological pyramids; Biosphere; Ecological systems and cycles – carbon cycle, water cycle, phosphorous cycle, nitrogen cycle, oxygen cycle; Broad nature of chemical composition of plants and animals; Natural resources covering renewable and non-renewable resources, forests, water, minerals, food and land; Energy sources, growing energy demands;

UNIT II: Environmental Pollution

Structure and composition of atmosphere. Pollution – air, water, soil, thermal and radiation. Effects – acid rain, ozone layer depletion and greenhouse gas emission. Control measures. Determination of water and air quality – BOD, COD, TDS, AQI.

UNIT III: Environmental Biotechnology

Environmental microbiology; Biomarkers; Biosensors; Biofuels; Biotransformation; Bioremediation, factors affecting bioremediation; Molecular Ecology

UNIT IV: Biodiversity and its conservation

Biodiversity hotspots; Values of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values; threats to biodiversity – habitat loss, poaching of wildlife; *in-situ* and *ex-situ* conservation.

UNIT V: Environmental protection and sustainability

Problems related to urban living, waste management, climate change, sustainable solutions, environmental regulation, and environmental protection acts in India and environmental ethics

Textbook required:

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.

Reference book:

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

SEMESTER – IV

Soft Skills- 4	CDC 104	1-0-0	1
Open Elective - I	OE	3-0-0	3
Engineering Geology	CE 214	2-0-0	2
Engineering Geology LAB	CE 214L	0-0-2	1
Geotechnical Engineering	CE 215	3-0-0	3
Geotechnical Engineering LAB	CE 215L	0-0-2	1
TE Elective - I		3-0-0	3
Humanities Elective	HS	3-0-0	3
Surveying and Geomatics	CE 216	2-0-0	2
Surveying and Geomatics LAB	CE 216L	0-0-2	1

SEMESTER V

Mechanics of Materials	CE 311	3-0-0	3
Mechanics of Materials LAB	CE 311L	0-0-2	1
Open Elective - II	OE	3-0-0	3
Water Resources Engineering	CE 312	3-0-0	3
Structural Engineering	CE 313	3-0-0	3
Hydraulic Engineering	CE 314	3-0-0	3
Hydraulic Engineering LAB	CE 314L	0-0-2	1
TE Elective - II		3-0-0	3
Construction Engineering & Management	CE 315	3-0-0	3

SEMESTER VI

Finite Element Methods	CE 316	3-0-0	3
TE Elective - III		3-0-0	3
Design Project/UROP	CE P02	0-0-6	3
Open Elective - III		3-0-0	3
Open Elective - IV		3-0-0	3
Transportation Engineering	CE 317	3-0-0	3
Open Elective - V	OE	3-0-0	3

SEMESTER VII

Civil Infrastructure for Smart Cities	CE 411	3-0-0	3
Sensing Technologies for Civil Engineering	CE 412	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
Open Elective - VI	OE	3-0-0	3
Open Elective - VII	OE	3-0-0	3

SEMESTER VIII

Capstone Project	CE	0-0-24	12