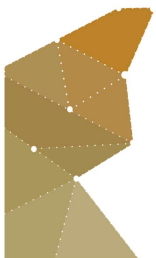




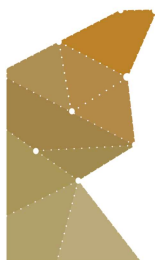
B. Tech Mechanical Engineering
Curriculum
SEMESTER III



B.Tech. Mechanical Engineering

Semester III

Course Code	Course Name	L-T-P	Credit
MAT 211	Linear Algebra	3-0-0	3
PHY 211	Introduction to Electricity and Magnetism	2-0-2	3
ENV 111	Environmental Science	2-0-2	3
ME211	Thermodynamics	3-0-2	4
ME 212	Engineering Mechanics	3-0-0	3
ME 213	Material Science and Metallurgy	2-0-2	3
CDC 211	Soft skills III	1-0-0	1
		16-0-8	20



Semester III

Code	Title	Core/ Elective	L-T-P	Credits
MAT 211	Linear Algebra	C	3-0-0	3

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.



Semester III

Code	Title	Core/ Elective	L-T-P	Credits
PHY 211	Introduction to Electricity & Magnetism	C	2-0-2	3

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: MAGNETOSTATICS

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. Rangwala, (Publisher - McGraw-Hill Education)

References:

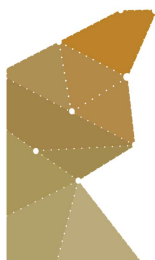
1. Electricity and magnetism Edward M Purcell, David J Morin, 3rd edition, Cambridge University, 2013
2. Classical Electrodynamics (3rd Edition) - John David Jackson (Publisher – Wiley)

LIST OF EXPERIMENTS

Sl.No	Experiment name	Objectives
1	Determination of susceptibility of paramagnetic material	To determine susceptibility of paramagnetic sample by using Quinck's tube method
2	Dielectric Constant	<ol style="list-style-type: none"> To determine the capacitance of a parallel plate capacitor by the measurement of charge. To measure the capacitance as a function of area and distance between the plates. To determine the dielectric constant of different dielectric materials.
3	Four-probe Resistivity Measurement	Measurement of resistivity of a semiconductor by Four-probe method and determination of Energy Band Gap.
4	Biot-Savart's Law	<ol style="list-style-type: none"> To study the magnetic field along the axis of a current carrying circular loop. To study the dependency of magnetic field on the diameter of coil.
5	Faraday's Law & Induced E.M.F	<ol style="list-style-type: none"> Measurement of the induced voltage impulse as a function of the velocity of the magnet. Calculation of the magnetic flux induced by the falling magnet as a function of the velocity of the magnet.
6	Magnetic Field in Helmholtz Coil	<ol style="list-style-type: none"> To investigate the spatial distribution of magnetic field between coils and determine the spacing for uniform magnetic field. To demonstrate the superposition of the magnetic fields of the two individual coils.



7	Determination of magnetic property of a given material	To demonstrate Dia-Para-Ferro magnetism in a given material using an inhomogeneous magnetic field
8	Study of B-H-Curve	To study permeability curve of a given material
9	Franck Hertz Experiment	To observe the neon spectral bands formation in Franck-Hertz tube and record the Franck-Hertz characteristic curve for neon.
10	Hall effect Experiment	To determine the type of charge carrier, carrier density and Hall coefficient of a given semiconductor.



Semester III

Code	Title	Core/ Elective	L-T-P	Credits
EVS 111	Environmental Science	C	2-0-2	3

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

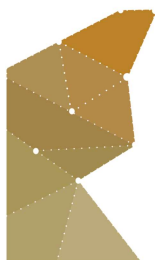
Pollution – air, water, and soil pollution. Air pollution: Composition of air, Sources of air pollution, Primary and secondary pollutants, Air quality index (AQI), Effects of air pollution, Air pollution and infant mortality, Air pollution control: Sustainable strategies Greenhouse gases; Carbon cycle; 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, signalling, 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.

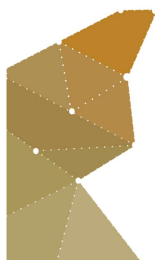


Books of Study:

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

Code	Title	Core/ Elective	L-T-P	Credits
ME 211	Thermodynamics	C	3-0-2	4

UNIT I

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 II

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.

UNIT III

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 IV

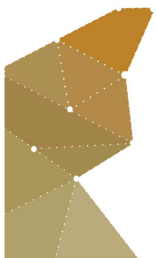
Steam formation - Temperature entropy diagram-Mollier diagram-Specific properties of steam - Use of steam tables & Mollier chart - Methods of heating and expanding the steam - Constant volume heating - Constant pressure expansion - Isothermal expansion - Hyperbolic expansion-isentropic expansion - Polytrophic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

UNIT V

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

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.

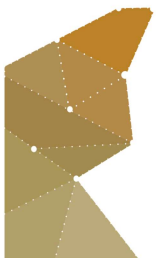


References:

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.

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



Semester III

Code	Title	Core/ Elective	L-T-P	Credits
ME 212	Engineering Mechanics	C	3-0-0	3

UNIT I: STATICS OF PARTICLES AND RIGID BODIES

Equilibrium of particles, forces on particles, resolution of forces, free body diagrams, forces in a plane, forces in space, rigid body equilibrium, force equivalence.

UNIT II: FRICTION

Laws of friction, dry friction, wedge friction, rolling friction, belt friction, ladder friction, screw friction

UNIT III: ANALYSIS OF TRUSSES AND CENTROIDS

Types of loads, type of supports, reaction, simple trusses, method of joints, method of sections, center of gravity-lines, areas, volumes, determination of centroid-integration method

UNIT IV: MOMENT OF INERTIAS OF SURFACE AND VOLUMES

Determination of moment of inertia using area integration method, analytical method, radius of gyration, polar moment of inertia, moment of inertia of different sections

UNIT V: DYNAMICS

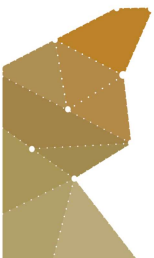
Rectilinear motion, curvilinear motion, projectile motion, Newtons second law of motion, D'Alemberts principle, Work, energy impulse, momentum, Impact/collision of elastic bodies, oblique impact

Books of Study:

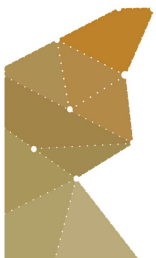
1. R.K.Bansal, Engineering Mechanics, laxmi Publications Ltd, 2005

References:

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.
2. Hibbeler. R.C., Engineering Mechanics: Statics & Dynamics, Pearson Education (US), 14th Edition, 2015.
3. Meriam J.L and Kraige L.G., Engineering Mechanics, Volume I - statics, Volume II - dynamics, John Wiley & Sons, New York, 7th Edition, 2012



4. Shames. I. H, and Krishna Mohana Rao.G, Engineering Mechanics (Statics and Dynamics), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), 2006.
5. Timoshenko, Young, Engineering Mechanics, Tata Mc-Graw Hill Book Company, 5th Edition, New Delhi,



Semester III

Code	Title	Core/ Elective	L-T-P	Credits
ME 213	Material Science and Metallurgy	C	2-0-2	3

UNIT I: MATERIAL STRUCTURE

Crystal structures, elastic-plastic behavior, deformation mechanisms, slip, twinning, imperfections, types of fracture, Three Stages in creep, Fatigue mechanism

UNIT II: MATERIAL PROPERTIES

Testing of metals, properties, strength, plasticity, stiffness, toughness, brittleness, ductility, hardness, creep and fatigue tests

UNIT III: HEAT TREATMENT

Solidification, crystal growth, Phase diagram, Gibbs Phase rule, Equilibrium diagrams, lever rule, Iron Carbon diagram, solidification of steel and cast irons.

Heat treatment, TTT curves, annealing, normalising, hardening, tempering, martempering, austempering, carburising, cyaniding, nitriding, flame and inductin hareneng, age hardening Ferrous, Non-ferrous metals, Cast Iron, Steel, Copper, Aluminium alloys.

UNIT IV: COMPOSITE MATERIALS

Composites- fibre reinforced composites, matrix materials, fibre materials, manufacturing methods, metal matrix composites

UNIT V: POWDER METALLURGY

Powder metallurgy: manufacturing methods, additive manufacturing

Books of Study:

1. Callister's Material Science and Engineering, John Wiley and Sons, 2014 edition
2. Material Science and Metallurgy by U.C.Jindal, Pearson Publication, 2011 edition

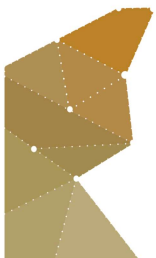
References:

1. Introduction to Metallurgy by Allen Cottrell, University Press, 2000 edition
2. Engineering materials and metallurgy, R. Srinivasan, McGraw Hill, 2009 edition



List of Experiments:

1. Measure the hardness of given materials using Vickers hardness tester
2. Measure the hardness of given materials using Brinell hardness tester
3. Measure the hardness of given materials using Rockwell hardness tester
4. Measure the hardness of given materials using End Quench hardness tester
5. Heat treat given materials at different levels
6. Polish the samples until one can see the microscopic phases clearly
7. Study micrographs of differently heat treated materials and compare them



Semester III

Code	Title	Core/ Elective	L-T-P	Credits
CDC 211	Soft Skills	C	1-0-0	1

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
2. Of Human Interaction; Joseph Luft; Mayfield Publishing. 1969
3. Emotional Intelligence; Daniel Goleman; Bantam Books, 1995

