Indira Gandhi University, Meerpur, Rewari
SCHEME OF STUDIES AND EXAMINATION
B.TECH (MECHANICAL ENGINEERING)
SEMESTER 3\textsuperscript{rd} & 4th
Scheme effective from 2019-20

COURSE CODE AND DEFINITIONS

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>Lecture</td>
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<tr>
<td>T</td>
<td>Tutorial</td>
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<td>P</td>
<td>Practical</td>
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<tr>
<td>BSC</td>
<td>Basic Science Courses</td>
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<tr>
<td>ESC</td>
<td>Engineering Science Courses</td>
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<tr>
<td>HSMC</td>
<td>Humanities and Social Sciences including Management courses</td>
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<tr>
<td>PCC</td>
<td>Professional Core Courses</td>
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<tr>
<td>LC</td>
<td>Laboratory Courses</td>
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<td>MC</td>
<td>Mandatory Courses</td>
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<td>PT</td>
<td>Practical Training</td>
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<tr>
<td>S</td>
<td>Seminar</td>
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Seminar

Max.Marks-25

Every candidate will have to deliver a seminar of 30 minutes duration on a topic (not from the syllabus) which will be chosen by him / her in consultation with the teacher of the department. The seminar will be delivered before the students and teachers of the department. A three member committee (one coordinator and two teachers of the department of different branches) duly approved by the departmental council will be constituted to evaluate the seminar. The following factors will be taken into consideration while evaluating the candidate.

Distribution of marks will be as follows:

1. Presentation 10 marks
2. Depth of the subject matter 10 marks
3. Answers to the questions 05 marks
<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Category</th>
<th>Course Notation</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Total Contact hrs/w</th>
<th>Credit</th>
<th>Examination Schedule (Marks)</th>
<th>Duration of Exam (Hour)</th>
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<tr>
<td>1</td>
<td>Basic Science course</td>
<td>BSC-ME-201</td>
<td>L 3 T 0 P 0</td>
<td>Physics II (Optics &amp; Waves)</td>
<td>3</td>
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<td>L 3 T 1 P 0</td>
<td>Mathematics-III</td>
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<td>ESC-ECE-207</td>
<td>L 2 T 0 P 0</td>
<td>Basics of Electronics Engg.</td>
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<td>L 3 T 0 P 0</td>
<td>Engineering Mechanics</td>
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<td>PCC-ME-213</td>
<td>L 3 T 1 P 0</td>
<td>Thermodynamics</td>
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**Indira Gandhi University, Meerpur, Rewari**  
Scheme of Examination for Semester IV (Second Year)  
B.Tech. (MECHANICAL ENGINEERING) w.e.f. 2019-20

<table>
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<th>Sr. No.</th>
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**TOTAL CREDIT**  
24  
775

*MC-106* is a mandatory non-credit course in which the students will be required passing marks in theory.

**NOTE:** At the end of 4th semester each student has to undergo Practical Training of 4/6 weeks in an Industry/ Institute/ Professional Organization/ Research Laboratory/ training centre etc. and submit typed report along with a certificate from the organization & its evaluation shall be carried out in the 5th Semester.
Course code | BSC-ME-201
Category | Basic Science course
Course title | Physics-II (Optics and Waves)

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<tr>
<th>Scheme and Credits</th>
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<th>P</th>
<th>Credits</th>
<th>Semester-III</th>
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Objectives:
- To acquire skills allowing the student to identify and apply formulas of optics and wave physics using course literature
- To be able to identify and illustrate physical concepts and terminology used in optics and to be able to explain them in appropriate detail.
- To be able to make approximate judgements about optical and other wave phenomena when necessary

Class work | 25 Marks
Exam | 75 Marks
Total | 100 Marks
Duration of Exam | 03 Hours

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-1
Simple harmonic motion, damped and forced simple harmonic oscillator, mechanical and electrical simple harmonic oscillators, differential equation of simple harmonic motion, damped harmonic oscillator, quality factor, forced mechanical and electrical oscillators, steady state motion of forced damped harmonic oscillator.

UNIT-2
Sinusoidal waves (concept of frequency and wavelength), types of waves, the one dimensional wave, transverse vibrations of stretched strings. Longitudinal sound wave in solid, The matrix method in paraxial optics (unit plane and nodal plane) wave group and group velocity, Fermat’s principle and its applications (mirage effect, laws of reflection and refraction), Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster’s angle and total internal reflection.
UNIT-3

Wave optics
Huygen’s principle, superposition of waves and interference of light by wavefront splitting and amplitude splitting, Young’s double slit experiment, Newton’s rings, Michelson interferometer, Fraunhofer’s diffraction from a single slit, the Rayleigh criterion for limit of just resolution and its application to vision, Diffraction grating (Transmission), its dispersive and resolving power.

UNIT-4

Lasers
Stimulated and spontaneous emission, Einstein’s theory of matter-radiation interaction, Einstein’s coefficients, amplification of light by population inversion, Pumping in lasers, three and four level laser systems, different types of lasers: gas lasers (He-Ne, CO₂), solid-state lasers (Ruby, Neodymium), Properties of laser beams: mono-chromaticity, coherence, directionality and intensity, laser speckles, applications of lasers in science, engineering and medicine.

References:

2. Engineering Physics: Theory and Practical, 2ed by Katiyar, Wiley India Ltd
Course code | BSC-ME- 203
Category | Basic Science course
Course title | Mathematics III (PDE, Probability & Statistics)

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<th>Scheme and Credits</th>
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<td>Semester-III</td>
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Objectives:
(1) To introduce the solution methodologies for second order Partial Differential Equations with applications in engineering
(2) To provide an overview of probability and statistics to engineers

Class work | 25 Marks
Exam | 75 Marks
Total | 100 Marks
Duration of Exam | 03 Hours

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I
Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear PDEs; Solution to homogeneous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method. Second-order linear equations and their classification, Initial and boundary conditions, D'Alembert's solution of the wave equation;

UNIT-II
Duhamel's principle for one dimensional wave equation. Heat diffusion and vibration problems, Separation of variables method to simple problems in Cartesian coordinates. The Laplacian in plane, cylindrical and spherical polar coordinates, solutions with Bessel functions and Legendre functions. One dimensional diffusion equation and its solution by separation of variables.

UNIT-III
Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality.
Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities. Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

UNIT-IV
Basic Statistics, Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation. Curve fitting by the method
of least squares-fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, Tests for single mean, difference of means, and difference of standard deviations. Test for ratio of variances – Chisquare test for goodness of fit and independence of attributes.

Textbooks/References:
Course code  | BSC-BIO-205  
---|---  
Category  | Basic Science Course  
Course title  | Biology  
Scheme and Credits  | L  | T  | P  | Credits  | Semester-III/ V/ VII  
---|---|---|---|---|---  
2  | 1  |  | 3  |  
Branches (B. Tech.)  | All Branches  
Class work  | 25 Marks  
Exam  | 75 Marks  
Total  | 100 Marks  
Duration of Exam  | 03 Hours  

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Objectives

1. To convey that Biology as an important scientific discipline.
2. To convey that “Genetics is to biology what Newton’s laws are to Physical Sciences”
3. To convey that all forms of life has the same building blocks and yet the manifestations are as diverse as one can imagine
4. The molecular basis of coding and decoding genetic information is universal.
5. How to analyse biological processes at the reductionist level

UNIT – I

Introduction to living world: Concept and definition of Biology; Aspect of biology. Need to study biology. Characteristic features of living organisms; Cell theory, Structure of Prokaryotic and Eukaryotic cell. Distinguish between animal and plant cell. Concept of single celled organisms, Ecological aspects of single celled organisms, Types of microbes and their important properties. Economic importance of microbes.


UNIT – II

Introduction to Biomolecules: Definition, structure and important functions of carbohydrates (glucose, fructose, disaccharides, starch and cellulose), lipids (phospholipid, cholesterol), Amino acids. Proteins- structure and function. Primary secondary, tertiary and quaternary structure.

Nucleic acid- Structure of DNA and RNA, types of RNA, Watson and Crick model of DNA

UNIT – III
**Introduction to Genetic Engineering**: Concept of genetic engineering. Tools used in recombinant DNA Technology. Restriction enzymes and DNA modifying enzymes, ligases. Gene cloning; plasmid vector. Transgenic plants and animals

**UNIT – IV**

**Applications of Biotechnology**: Applications of biotechnology in Agriculture, Medicine, Environment (sewage treatment), enzyme technology.

**References:**
1. Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M;
2. L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
3. Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H. John Wiley and Sons
5. Molecular Genetics (Second edition), Stent, G. S.; and Calender, R. W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher
9. Biology for Engineers by Wiley Editorial team
Course code
ESC-ECE-207
Category
Engineering Science course
Course title
Basics of Electronic Engineering

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Objectives:
To provide an overview of electronic device components to Mechanical engineering students.

Class work 25 Marks
Exam 75 Marks
Total 100 Marks
Duration of Exam 03 Hours

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I
Semiconductor Devices and Applications: Introduction to P-N junction Diode and V-I characteristics, Half wave and Full-wave rectifiers, capacitor filter. Zener diode and its characteristics, Zener diode as voltage regulator. Regulated power supply IC based on 78XX and 79XX series, Introduction to BJT, its input-output and transfer characteristics, BJT as a single stage CE amplifier, frequency response and bandwidth.

UNIT-II

UNIT-III
Timing Circuits and Oscillators: RC-timing circuits, IC 555 and its applications as astable and mono-stable multi-vibrators, positive feedback, Barkhausen’s criteria for oscillation, R-C phase shift and Wein bridge oscillator.

UNIT-IV
Digital Electronics Fundamentals: Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using K-map, Logic ICs, half and full adder/subtractor, multiplexers, de-multiplexers, flip-flops, shift registers, counters, Block diagram of microprocessor/microcontroller and their applications.

Text/Reference Books:
2. Basic Electrical and Electronics Engineering by Jagathesan, Wiley India Ltd.
5. Basic Electronics engineering by Wiley Editorial team.
Course code: ESC-ME-209

Category: Basic Science course

Course title: Engineering Mechanics

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Objectives:

1. To understand the basic force system.
2. To learn about Applying principles of particle kinematics.
3. To understand the concepts of particle dynamics.
4. To Learn energy methods & momentum methods.

Class work: 25 Marks
Exam: 75 Marks
Total: 100 Marks
Duration of Exam: 03 Hours

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I
Introduction: Force system, dimensions and units in mechanics, laws of mechanics, vector algebra, addition and subtraction of forces, cross and dot products of vectors, moment of a force about a point and axis, couple and couple moment, transfer of a force to a parallel position, resultant of a force system using vector method, Problems involving vector application
Equilibrium: Static and dynamic equilibrium, static indeterminacy, general equations of equilibrium, Varignon's theorem, Lami's theorem, equilibrium of bodies under a force system, Problems.

UNIT-II
Truss and Frames: Truss, classification of truss, assumptions in truss analysis, perfect truss, analysis of perfect plane truss using method of joints and method of sections, Problems. Centroid, Centre of mass and Centre of gravity, Determination of centroid, centre of mass and centre of gravity by integration method of regular and composite figures and solid objects, Problems.

UNIT-III
Moment of Inertia: Area moment of inertia, mass moment of inertia, parallel axis and perpendicular axis theorems, radius of gyration, polar moment of inertia, product of inertia, principle axis, problem based on composite figures and solid objects. Kinematics: Concept of rigid body, velocity and acceleration, relative velocity, translation and rotation of rigid bodies, equations of motion for translation and rotation, problems.

UNIT-IV
Particle Dynamics: Energy methods and momentum methods, Newton’s laws, work energy equation for a system of particles, linear and angular momentum equations, projectile motion, problem.

Shear Force and Bending Moment Diagram for statically determinant beams

Classification of beams, types of loads, shear force and bending moment calculation and their graphical presentation, point of inflection, problem.

**Recommended Books:-**

2. Engineering Mechanics by Chandra, Wiley India Ltd.
5. Engineering Mechanics: Statics, by Meriam, Wiley India Ltd.
Course code | ESC-ME-211
---|---
Category | Engineering Science courses
Course title | Basics of Mechanical Engineering

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Objectives:
1. To Learn Manufacturing Processes.
2. To Understand Basic Refrigeration & Air Conditioning Processes.
3. To Understand Hydraulic Turbines & Pumps.
4. To learn power transmission methods.

Class work mark | 25 Marks
---|---
Practical mark | 75 Marks
Total | 100 Marks
Duration of Exam | 03 Hours

**Note:** Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I


**Properties of Steam & Steam Generator:** Formation of steam under constant pressure, Thermodynamic properties of steam, use of steam tables, measurement of dryness fraction by throttling calorimeter.

UNIT-II

**Refrigeration & Airconditioning:** Introduction to refrigeration and air-conditioning, Rating of refrigeration machines, Coefficient of performance, simple refrigeration vapour compression cycle, Psychrometric charts and its use, Human comforts.

**Hydraulic Turbines & Pumps:** Introduction, Classification, Construction details and working of Pelton, Francis and Kaplan turbines, Specific speed and selection of turbines, Classification of water pumps and their working.

UNIT-III

**Power Transmission Methods and Devices:** Introduction to Power transmission, Belt, Rope, Chain and Gear drive, Types and functioning of clutches.

**Stresses and Strains:** Introduction, Concept & types of stresses and strains, Poisson's ratio, stresses and strains in simple and compound bars under axial loading, flexure & torsional loading, Stress-strain diagrams. Hook's law, Elastic constants & their relationships.

UNIT-IV

**Text Books:**

2. Elements of Mechanical Engineering by Kittur, Wiley India Ltd.
3. Elements of Mechanical Engineering- D.S. Kumar, S.K. Kataria and Sons
5. Basic Mechanical Engineering by Agarwal, Wiley India Ltd.

**Reference Books:**

10. Mechanical Engineering Data Handbook by Pandey, Wiley India Ltd.
Course code | PCC-ME 213
---|---
Category | Professional Core Courses
Course title | Thermodynamics

**Scheme and Credits**

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**Objectives:**

- To learn about work and heat interactions, and balance of energy between system and its surroundings
- To learn about application of I law to various energy conversion devices
- To evaluate the changes in properties of substances in various processes
- To understand the difference between high grade and low grade energies and II law limitations on energy conversion

**Class work** | 25 Marks
**Exam** | 75 Marks
**Total** | 100 Marks
**Duration of Exam** | 03 Hours

**Note:** Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

**UNIT-I**

Fundamentals - System & Control volume; Property, State & Process; Exact & Inexact differentials; Work-Thermodynamic definition of work; examples; Displacement work; Path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work.

Temperature, Definition of thermal equilibrium and Zeroth law; Temperature scales; Various Thermometers- Definition of heat; examples of heat/work interaction in systems- First Law for Cyclic & Non-cyclic processes; Concept of total energy E; Demonstration that E is a property; Various modes of energy, Internal energy and Enthalpy.

**UNIT-II**

Definition of Pure substance, Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures, Compressibility charts- Properties of two phase systems - Const. temperature and Const. pressure heating of water; Definitions of saturated states; P-v-T surface; Use of steam tables and R134a tables; Saturation tables; Superheated tables; Identification of states & determination of properties, Mollier’s chart.

**UNIT-III**

First Law for Flow Processes - Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady and unsteady I law applications for system and control volume.

Second law - Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale.
UNIT-IV

Clausius inequality; Definition of entropy $S$; Demonstration that entropy $S$ is a property; Evaluation of $S$ for solids, liquids, ideal gases and ideal gas mixtures undergoing various processes; Determination of $s$ from steam tables- Principle of increase of entropy; Illustration of processes in $T_s$ coordinates; Definition of Isentropic efficiency for compressors, turbines and nozzles-Irreversibility and Availability, Availability function for systems and Control volumes undergoing different processes, Lost work. Second law analysis for a control volume. Exergy balance equation and Exergy analysis.

**Thermodynamic cycles** - Basic Rankine cycle; Basic Brayton cycle; Basic vapor compression cycle and comparison with Carnot cycle.

**Text Books:**

6. Fundamentals of Thermodynamics, 7ed, by Borgnakke, Wiley India Ltd.
7. Applications of Thermodynamics by Kadambi, Wiley India Ltd.
Course code | LC-ME-215
---|---
Category | Engineering Science courses
Course title | Basics of Mechanical Engg. Lab

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**Objectives:**

To understand various basic issues of Mechanical Engineering like IC engines, machines and mechanics of machines.

**Class work mark** | 25 Marks
---|---
**Practical mark** | 25 Marks
**Total** | 50 Marks
**Duration of Exam** | 03 Hours

**List of Experiments**

1. To study various types of boilers & also study mountings and accessories in boilers.
2. To study various types of internal Combustions Engines.
3. To calculate the Mechanical Advantage, Velocity Ratio and Efficiency of single start, Double start and Triple start worm & Worm Wheel.
4. To find the Mechanical Advantage, velocity Ratio and Efficiency of a Differential Wheel and Axle.
5. To find Moment of Inertia of a Fly Wheel.
6. Verification of reciprocal theorem of deflection using a simply supported beam.
7. Verification of moment area theorem for slopes and deflections of the beam.
8. Deflections of a truss-horizontal deflections & vertical deflections of various joints of a pin-jointed truss.
10. Experimental and analytical study of 3 hinged arch and influence line for horizontal thrust.
11. Experimental and analytical study of behavior of struts with various end conditions.
12. To determine elastic properties of a beam.
13. Experiment on a two-hinged arch for horizontal thrust & influence line for Horizontal thrust.
14. Experimental and analytical study of a 3 bar pin jointed Truss.
15. Experimental and analytical study of deflections for unsymmetrical bending of a Cantilever beam.
SEMESTER-IV
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<td>Category</td>
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**Objectives:**

1. To learn about the first law for reacting systems and heating value of fuels.
2. To learn about gas and vapor cycles and their first law and second law efficiencies.
3. To understand about the properties of dry and wet air and the principles of psychrometry.
4. To learn about gas dynamics of air flow and steam through nozzles.
5. To learn about reciprocating compressors with and without intercooling.
6. To evaluate the performance of steam turbines.

Class work 25 Marks  
Exam 75 Marks  
Total 100 Marks  
Duration of Exam 03 Hours  

**Note:** Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

**UNIT-I**

Introduction to solid, liquid and gaseous fuels–Stoichiometry, exhaust gas analysis- First law analysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flame temperature- Chemical equilibrium and equilibrium composition calculations using free energy.

**UNIT-II**


**UNIT-III**


**UNIT-IV**

Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors. Analysis of steam turbines, velocity and pressure compounding of steam turbines.
Text Books:
Course code                  | PCC-ME-204
Category                    | Professional Core Courses
Course title                | Fluid Mechanics

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**Objectives:**

- To learn about the application of mass and momentum conservation laws for fluid flows
- To understand the importance of dimensional analysis
- To obtain the velocity and pressure variations in various types of simple flows

| Class work | 25 Marks |
| Exam       | 75 Marks  |
| Total      | 100 Marks |
| Duration of Exam | 03 Hours |

**Note:** Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

**UNIT-I**

Fluid Properties and Fluid Statics: Concept of fluid and flow, ideal and real fluids, continuum concept, and properties of fluids, Newtonian and non-Newtonian fluids. Pascal’s law, hydrostatic equation, hydrostatic forces on plane and curved surfaces, stability of floating and submerged bodies, relative equilibrium, Problems. Fluid Kinematics: Eulerian and Lagrangian description of fluid flow; stream, streak and path lines; types of flows, flow rate and continuity equation, differential equation of continuity in cylindrical and polar coordinates, rotation, vorticity and circulation, stream and potential functions, flow net, Problems.

**UNIT-II**

Fluid Dynamics: Concept of system and control volume, Euler’s equation, Bernoulli’s equation, venturimeter, orifices, orificemeter, mouthpieces, kinetic and momentum correction factors, Impulse momentum relationship and its applications, Problems. Compressible Fluid Flow: Introduction, continuity momentum and energy equation, sonic velocity, propagation of elastic waves due to compression of fluid, propagation of elastic waves due to disturbance in fluid, stagnation properties, isentropic flow, effect of area variation on flow properties, isentropic flow through nozzles, diffusers, injectors, Problems.

**UNIT-III**

Viscous Flow: Flow regimes and Reynolds’s number, Relationship between shear stress and pressure gradient, uni-directional flow between stationary and moving parallel plates, movement of piston in a dashpot, power absorbed in bearings. Problems. Flow Through Pipes: Major and minor losses in pipes, Hagen-Poiseuilli law, hydraulic gradient and total energy lines, series and parallel connection of pipes, branched pipes; equivalent pipe, power transmission through pipes, Problems.

**UNIT-IV**

Boundary Layer Flow: Boundary layer concept, displacement, momentum and energy thickness, von-kauman momentum integral equation, laminar and turbulent boundary layer flows, drag on a flat plate, boundary layer separation and control. Streamlined and bluff bodies lift and drag on a cylinder and an airfoil, Problems. Turbulent Flow: Shear stress in turbulent flow, Prandtl mixing length hypothesis, hydraulically smooth and rough pipes, velocity distribution in pipes, friction coefficients for smooth and rough pipes, Problems.
TEXT BOOKS:
2. Fluid Mechanics by Munson, Wiley India Ltd

REFERENCES BOOKS:
1. Introduction to Fluid Mechanics and Fluid Machines – S.K. Som and G. Biswas, TMH
2. Engineering Fluid Mechanics, 10ed, by Elger, Wiley India Ltd.
Course code | PCC-ME-206
---|---
Category | Professional Core Courses
Course title | Strength of Materials

**Scheme and Credits**

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**Objectives:**

- To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads
- To calculate the elastic deformation occurring in various simple geometries for different types of loading

**Class work** | 25 Marks
**Exam** | 75 Marks
**Total** | 100 Marks
**Duration of Exam** | 03 Hours

**Note:** Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

**UNIT-I**

Deformation in solids- Hooke’s law, stress and strain- tension, compression and shear stresses elastic constants and their relations- volumetric, linear and shear strains- principal stresses and principal planes- Mohr’s circle.

**UNIT-II**

Beams and types transverse loading on beams- shear force and bend moment diagrams- Types of beam supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads.

**UNIT-III**

Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell’s reciprocal theorems. Columns & Struts: Column under axial load, concept of instability and buckling, slenderness ratio, derivation of Euler’s formulae for the elastic buckling load, Eulers, Rankine, Gordom’s formulae Johnson’s empirical formula for axial loading columns and their applications, eccentric compression of a short strut of rectangular & circular sections, Numerical.

**UNIT-IV**

Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs.
Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure.
Slope & Deflection: Relationship between bending moment, slope & deflection, Mohr’s theorem, moment area method, method of integration, Macaulay’s method, calculations for slope and deflection of (i) cantilevers and (ii) simply supported beams with or without overhang under concentrated load, Uniformly distributed loads or combination of concentrated and uniformly distributed loads, Numerical.
Text Books:
2. Strength of Materials, 2ed, w/cd by Nag, Wiley India Ltd.
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<td>Category</td>
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<td>Materials Engineering</td>
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**Objectives:**
1. Understanding of the correlation between the internal structure of materials, their mechanical properties and various methods to quantify their mechanical integrity and failure criteria.
2. To provide a detailed interpretation of equilibrium phase diagrams.
3. Learning about different phases and heat treatment methods to tailor the properties of Fe-C alloys.

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**Note:** Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

### UNIT-I
Crystal Structure: Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress.

Mechanical Property measurement: Tensile, compression and torsion tests; Young’s modulus, relations between true and engineering stress-strain curves, generalized Hooke’s law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength.

### UNIT-II
Static failure theories: Ductile and brittle failure mechanisms, Tresca, Von-mises, Maximum normal stress, Mohr-Coulomb and Modified Mohr-Coulomb; Fracture mechanics: Introduction to Stressintensity factor approach and Griffith criterion. Fatigue failure: High cycle fatigue, Stress-life approach, SN curve, endurance and fatigue limits, effects of mean stress using the Modified Goodman diagram; Fracture with fatigue, Introduction to non-destructive testing (NDT)

### UNIT-III
Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron Iron-carbide phase diagram and microstructural aspects of ledeburite, austenite, ferrite and cementite, cast iron.TTT-curve

### UNIT-IV
Heat treatment of Steel: Annealing, tempering, normalising and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening
Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and cupronickel; Aluminium and Al-Cu – Mg alloys- Nickel based superalloys and Titanium alloys

Text Books:
5. DeGarmo's Materials and Processes in Manufacturing, by Black, Wiley India Ltd.
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<td>Course title</td>
<td>Instrumentation and Control</td>
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<td>Scheme and Credits</td>
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**Objectives:**
1. To provide a basic knowledge about measurement systems and their components
2. To learn about various sensors used for measurement of mechanical quantities
3. To learn about system stability and control
4. To integrate the measurement systems with the process for process monitoring and control

| Class work | 25 Marks |
| Exam       | 75 Marks |
| Total      | 100 Marks |
| Duration of Exam | 03 Hours |

**Note:** Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

**UNIT-I**
Measurement systems and performance – accuracy, range, resolution, error sources; Instrumentation system elements – sensors for common engineering measurements; Signal processing and conditioning;
Instruments and Their representation : Introduction, Typical Applications of Instrument Systems, Functional Elements of a Measurement System, Classification of Instruments, Standards and Calibration..

**UNIT-II**
Transducer Elements : Introduction, Analog and Digital Transducers, Electromechanical; Potentiometric,

**UNIT-III**

UNIT-IV
Control systems – basic elements, open/closed loop, design of block diagram; control method – P, PI, PID, when to choose what, tuning of controllers; System models, transfer function and system response, frequency response; Nyquist diagrams and their use.
Practical group based project utilizing above concepts.

Text Books:
1. Instrumentation and control systems by W. Bolton, 2nd edition, Newnes, 200
2. Instrumentation and Process Control by Prasad, Wiley India Ltd.
5. Fundamentals of Industrial Instrumentation by Barua, Wiley India Ltd.
Course code | LC-ME-212
---|---
Category | Professional Core Courses
Course title | Applied Thermodynamics Lab

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Objectives:
1. To understand Vapour power cycles.
2. To understand steam boilers, their types and components.
3. To learn fundamentals of flow of steam through a nozzle.
4. To understand Steam turbines, condensers and compressors.

Class work mark | 25 Marks
Practical mark | 25 Marks
Total | 50 Marks
Duration of Exam | 03 Hours

List of Experiments:
1. To study low pressure boilers and their accessories and mountings.
2. To study high pressure boilers and their accessories and mountings.
3. To prepare heat balance sheet for given boiler.
4. To study the working of impulse and reaction steam turbines.
5. To find dryness fraction of steam by separating and throttling calorimeter.
6. To find power output & efficiency of a steam turbine.
7. To find the condenser efficiencies.
8. To study and find volumetric efficiency of a reciprocating air compressor.
9. To study cooling tower and find its efficiency.
10. To find calorific value of a sample of fuel using Bomb calorimeter.
11. Calibration of Thermometers and pressure gauges.

Note:
1. At least eight experiments should be performed from the above list.
Course code | LC-ME-214
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Category | Professional Core courses
Course title | Strength of MaterialsLab

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Objectives:
1. To learn the principles of mechanics of solid and various properties of materials.
2. Able to understand the concepts of stress, strain of materials and ability to interpret the data from the experiments.

Class work mark | 25 Marks
Practical mark | 25 Marks
Total | 50 Marks
Duration of Exam | 03 Hours

List of Experiments:

1. To study the Brinell hardness testing machine & perform the Brinell hardness test.
2. To study the Rockwell hardness testing machine & perform the Rockwell hardness test.
3. To study the Vickers hardness testing machine & perform the Vickers hardness test.
4. To study the Erichsen sheet metal testing machine & perform the Erichsen sheet metal test.
5. To study the Impact testing machine and perform the Impact tests (Izod & Charpy).
6. To study the Universal testing machine and perform the tensile test.
7. To perform compression & bending tests on UTM.
8. To perform the shear test on UTM.
9. To study the torsion testing machine and perform the torsion test.

Note:
1. At least Seven experiments are to be performed in the semester.
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<td>Category</td>
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<tr>
<td>Course title</td>
<td>Fluid Mechanics Lab</td>
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**Objectives:**
1. Understand the techniques and concept of stability.
2. Learning continuity and Bernoulli’s equation.
3. Learn discharge measuring devices and hydraulic coefficients.
4. Knowledge of different types of pipe losses and determine the velocity profile in a pipe.

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<td>Duration of Exam</td>
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**List of Experiments:**
1. To determine the coefficient of impact for vanes.
2. To determine coefficient of discharge of an orificemeter.
3. To determine the coefficient of discharge of Notch (V and Rectangular types).
4. To determine the friction factor for the pipes.
5. To determine the coefficient of discharge of venturimeter.
6. To determine the coefficient of discharge, contraction & velocity of an orifice.
7. To verify the Bernoullis Theorem.
8. To find critical Reynolds number for a pipe flow.
9. To determine the meta-centric height of a floating body.
10. To determine the minor losses due to sudden enlargement, sudden contraction and bends.
11. To show the velocity and pressure variation with radius in a forced vertex flow.
12. To verify the momentum equation.

**Note:**
1. **At least eight experiments are to be performed in the semester.**
**Course code** | **LC-ME-218**  
---|---  
**Category** | Professional Core courses  
**Course title** | **Materials Lab**  
**Scheme and Credits** | **L** | **T** | **P** | **Credits** |  
| | 0 | 0 | 2 | 1 |  
**Objectives:**  
1. Learn the principles of materials science and engineering through lab investigation.  
2. Understand the basics structure of materials and ability to interpret the data from the experiments.  
**Class work mark** | 25 Marks  
**Practical mark** | 25 Marks  
**Total** | 50 Marks  
**Duration of Exam** | 03 Hours  

**List of Experiments:**  
1. To study crystal structures of a given specimen.  
2. To study crystal imperfections in a given specimen.  
3. To study microstructures of metals/alloys.  
4. To prepare solidification curve for a given specimen.  
5. To study heat treatment processes (hardening and tempering) of steel specimen.  
6. To study microstructure of heat-treated steel.  
7. To study thermo-setting of plastics.  
8. To study the creep behavior of a given specimen.  
9. To study the mechanism of chemical corrosion and its protection.  
10. To study the properties of various types of plastics.  
11. To study Bravais lattices with the help of models.  
12. To study crystal structures and crystals imperfections using ball models.  

**Note:**  
1. At least eight experiments are to be performed in the semester.
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<td>Category</td>
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<tr>
<td>Course title</td>
<td>Instrumentation Lab</td>
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**Objectives:**

1. To understand about the applications of measurement systems.
2. To understand about the basics and working principle of pressure, temperature and flow measurement.
3. Identify the different variation of measurement parameter with various input conditions.
4. To analyze the primary, secondary and tertiary measurements.
5. To learn about the various control devices and parts of measurement systems.

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<td>Practical mark</td>
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<td>Duration of Exam</td>
<td>03 Hours</td>
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**List of Experiments:**

1. To Study various Temperature Measuring Instruments
   (a) Mercury – in glass thermometer
   (b) Thermocouple
2. To study the working of Bourdon Pressure Gauge and to check the calibration of the gauge in a dead-weight pressure gauge calibration set up.
3. To study a Linear Variable Differential Transformer (LVDT) and use it in a simple experimental set up to measure a small displacement.
4. To measure load (tensile/compressive) using load cell on a tutor.
5. To measure torque of a rotating shaft using torsion meter/strain gauge torque transducer.
6. To measure the speed of a motor shaft with the help of non-contact type pick-ups (magnetic or photoelectric).
7. To measure the stress & strain using strain gauges mounted on simply supported beam/cantilever beam.
8. To measure static/dynamic pressure of fluid in pipe/tube using pressure transducer/pressure cell.
10. Vibration measurement.
11. To study various types of measurement Error.

**Note:**

1. At least eight experiments are to be performed in the Semester.
UNIT-1 The Multidisciplinary nature of environment studies. Definition, scope and importance.

UNIT-2 Natural Resources:

Renewable and non-renewable resources: Natural resources and associated problems.

a) Forest resources: Use and over-exploitation: deforestation, case studies. Timber extraction, mining dams and their effects on forests and tribal people.

b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

d) Food resources: World food problems, changes, caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, Water logging, salinity, case studies.

e) Energy resources: Growing energy needs; renewable and non-renewable energy sources, use of alternate energy sources, case studies.

f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

* Role of an individual in conservation of natural resources.
* Equitable use of resources for sustainable lifestyles.

UNIT-3 Ecosystems:

* Producers, consumers and decomposers.
* Energy flow in the ecosystem.
* Ecological succession.
* Food chains, food webs and ecological pyramids.
* Introduction, types, characteristic features, structure and function of the following eco-system:
  a. Forest ecosystem.
  b. Grassland ecosystem.
  c. Desert ecosystem.
  d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) (6 lectures)

UNIT-4 Biodiversity and its conservation

* Introduction - Definition: Genetic, Species and ecosystem diversity.
* Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values.
* Biodiversity at global, National and local levels.
* India as a mega-diversity nation.
* Hot-spots of biodiversity.
* Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts.
* Endangered and endemic species of India.
* Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

**Unit-5** Environmental pollution:

Definition, causes, effects and control measures of:

a) Air pollution.
b) Water pollution
c) Soil pollution
d) Marine pollution
e) Noise pollution
f) Thermal pollution
g) Nuclear hazards

* Solids waste management: causes, effects and control measures of urban and industrial wastes.
* Role of an individual in prevention of pollution.
* Pollution case studies.
* Disaster management: floods, earthquake, cyclone and landslides.

**(8 lectures)**

**Unit-6** Social issues and the Environment:

* From unsustainable to sustainable development.
* Urban problems related to energy.
* Water conservation, rain water harvesting, watershed management.
* Resettlement and rehabilitation of people: its problems and concerns case studies.
* Environmental ethics: Issues and possible solutions.
* Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies.
* Wasteland reclamation.
* Consumerism and waste products.
* Environment Protection Act.
* Air (Prevention and Control of pollution) Act.
* Wildlife Protection Act.
* Forest Conservation Act.
* Issues involved in enforcement of environmental legislation.
* Public awareness.

**(7 lectures)**

**Unit-7** Human population and the Environment.

Population growth, variation among nations.
Population explosion- Family Welfare Programme.
Environment and human health.
Human Rights.
Value Education.

HIV/AIDS.
Woman and Child Welfare
Role of Information Technology in Environment and human health.
Case Studies. (6 lectures)

Unit-8  Field Work :
* Visit to a local area to document environmental assets - river/forest/grassland/hill/mountain.
* Visit to a local polluted site-urban/Rural/ Industrial/ Agricultural.
* Study of common plants, insects, birds.

Study of simple ecosystems- pond, river, hill slopes, etc. (Field work equal to 10 lecture hours)

References

7. Down to Earth, Centre for Science and Environment (R).

The scheme of the paper will be under:
The subject of Environmental Studies will be included as a qualifying paper in all UG Courses and the students will be required to qualify the same otherwise the final result will not be declared and degree will not be awarded.

The duration of the course will be 40 lectures. The examination will be conducted along with the semester examinations.

Exam. Pattern: In case of awarding the marks, the paper will carry 100 marks. Theory: 75 marks, Practical/Field visit: 25 marks.

The structure of the question paper will be:

Part- A: Short Answer Pattern : 15 marks
Part- B: Essay Type with inbuilt choice : 60 marks
Part-C: Field Work (Practical) : 25 marks

Instructions for Examiners:
Part- A: Question No. 1 is compulsory and will contain five short-answer type question of 3 marks each covering the entire syllabus.
Part-B: Eight essay type questions (with inbuilt choice) will be set from the entire syllabus and the candidate will be required to answer any four of them. Each essay type question will be of 15 marks.

The examination of the regular students will be conducted by the concerned college/Institute. Each student will be required to score minimum 40% marks separately in theory and practical/Field visit. The marks in this qualifying paper will not be included in determining the percentage of marks obtained for the award of degree.

However, these marks will be shown in the detailed marks certificate of the students.