<table>
<thead>
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<th>Course No.</th>
<th>Course title</th>
<th>Teaching Schedule</th>
<th>Allotment of marks</th>
<th>Duration of Exams.</th>
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<td>Physics-I</td>
<td>3</td>
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<td>BT-101E</td>
<td>Introduction to Biotechnology OR Communication skills in English</td>
<td>3</td>
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<td>HUM-101E</td>
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<td>ME-101E</td>
<td>Elements of Mechanical Engineering / Elements of Civil Engg. / Elements of Electronics Engg. *</td>
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<td>ME-105E</td>
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<tr>
<td>ME-103E</td>
<td>Manufacturing Processes OR Chemistry</td>
<td>4</td>
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<td>CH-101E</td>
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<tr>
<td>CSE-101E</td>
<td>Fundamentals of Computer &amp; Programming in c OR Electrical Technology</td>
<td>3</td>
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<td>-</td>
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<tr>
<td>EE-101E</td>
<td></td>
<td>3</td>
<td>2</td>
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<tr>
<td>ES-101E</td>
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Students are allowed to use single memory, non-programmable scientific calculator during examination.

Practical Examination will consist of 10 marks for viva-voce and 15 marks for Experiment.

*Institutes will offer one of these electives

**Subject is qualifying. It shall carry 25 sessional marks for field work (to be conducted by the institute) report.
## KURUKSHETRA UNIVERSITY KURUKSHETRA
### SCHEME OF STUDIES & EXAMINATIONS

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course title</th>
<th>Teaching Schedule</th>
<th>Allotment of marks</th>
<th>Duration of Exams.</th>
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<td>Mathematics-II</td>
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<td>Physics-II</td>
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<td>Me-101E/CE-101E/EL-101E</td>
<td>3     2     -     5</td>
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<td>Computer Programming Lab. OR Electrical Technology Lab.</td>
<td>--     2     2     2</td>
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</table>

**Note:**

2. Students are allowed to use single memory, non-programmable scientific calculator during examination.

3. Practical Examination will consist of 10 marks for viva-voce and 15 marks for Experiment.

*Institutes will offer one of these electives

**Subject is qualifying. It shall carry 25 sessional marks for field work (to be conducted by the institute) report.
MATH-101E
MATHEMATICS-I
(COMMON FOR ALL BRANCHES)

L T P Theory: 100 Marks
4 1 - Sessional: 50 Marks

Total: 150 Marks

During of exam: 3 Hrs.

UNIT-I
Applications of Differentiation: Taylor’s & Maclaurin’s series, Expansion by use of known series, Expansion by forming a differential equation, Asymptotes, Curvature, Radius of Curvature for Cartesian, Parametric & polar curves, Centre of curvature & chord of curvature, Tracing of Cartesian & polar curves (standard curves).

UNIT – II
Partial Differentiation & its Applications: Functions of two or more variables Partial derivatives, Total differential and differentiability, Derivatives of composite and implicit functions, change of variables. Homogeneous functions, Euler’s theorem, Jacobian, Taylor’s & Maclaurin’s series for functions of two variables (without proof), Errors and approximations, Maxima-minima of functions of two variables, Lagrange’s method of undetermined multipliers, Differentiation under the integral sign.

UNIT – III
Multiple Integrals and their Applications: Double integral, change of order of integration Double integral in polar coordinates, Applications of double integral to find area enclosed by plane curves and volume of solids of revolution. Triple integral, volume of solids, change of variables, Beta and gamma functions and relationship between them.

UNIT – IV
Vector Calculus: Differentiation of vectors, scalar and vector point functions Gradient of a scalar field and directional derivative, divergence and curl of a vector field and their physical interpretations, Del applied twice to point functions, Del applied to product of point functions. Integration of vectors, line integral, surface integral, volume integral, Green’s, Stoke’s and Gauss divergence theorems (without proof), and their simple applications.

TEXT BOOKS:

REFERENCE BOOKS:

Note: The Examiners will set eight questions, taking two from each unit. The students are required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.
HY-101E
PHYSICS-I
(COMMON FOR ALL BRANCHES)

L    T    P    Theory: 100 marks
3    1    1    Sessional: 50 marks
Total: 150 marks
Time: 3 Hrs.

UNIT-I
PHYSICAL OPTICS
Interference: Division of wave front-Fresnel's biprism, Division of amplitude–Newton's rings, Michelson interferometer, applications.
Diffraction: Difference between Fraunhofer and Fresnel diffraction. Fraunhofer diffraction through a slit. Plane transmission diffraction grating, its dispersive and resolving powers.
Polarization: Polarised and unpolarized light, double refraction; Nicol prism, quarter and half wave plates, Polarimetry; Biquartz and Laurent's half-shade polarimeters, Simple concepts of photoelasticity.

UNIT-II
LASER:
Spontaneous and stimulated emissions, Laser action, characteristics of laser beam-concepts of coherence, He-Ne and semiconductor lasers (simple ideas), applications.
FIBRE OPTICS: Propagation of light in fibres, numerical aperture, single mode and multi mode fibres, applications.

UNIT-III
EM Theory: E.M. wave theory-review of basic ideas, Gauss’s Law, Ampere’s Law and its applications to infinite line charge & Infinite plane, eMaxwell's equations, simple plane wave equations, simple concepts of wave guides and co-axial cables, Poynting vector. DIELECTRICS: Molecular theory, polarization, displacement, susceptibility, dielectric coefficient, permittivity & various relations between these, Gauss's law in the presence of a dielectric, Energy stored in an electric field. Behavior of dielectrics in a.c. field-simple concepts, dielectric losses.

UNIT-IV
SPECIAL THEORY OF RELATIVITY: Michelson-Moreley experiment, Lorentz transformations, variation of mass with velocity, mass energy equivalence.
NUCLEAR PHYSICS: Neutron Cross-section, Nuclear fission, Moderators, Nuclear reactors, Reactor criticality, Nuclear fusion. Interaction of radiation with matter-basic concepts, radiation detectors-ionisation chamber, G.M. Counter, Scintillation and solid state detectors, cloud chamber and bubble chamber.

TEXT BOOKS:
1. Physics of the Atom - Wehr, Richards & Adair (Narosa)
2. Perspectives of Modern Physics - Arthur Beiser (TMH)
3. Modern Engineering Physics – A.S. Vasudeva (S. Chand)
Introduction to Biotechnology (BT-101 E)

L T P/D Theory: 100 marks
3 1 Sessional: 50 marks
Total: 150 marks
Time: 3 Hrs.

UNIT - I

Introduction to life: Characteristics of living organisms. Hierarchy of organisation and factors responsible for regulating different levels of organisations. Structure of Prokaryotic and Eukaryotic cell. Basic concept of State and Homeostasis.

Introduction to Biomolecules: Definition, general classification and important functions of carbohydrates, lipids, proteins, nucleic acids and vitamins.

Enzymes as biocatalysts: General characteristics, nomenclature and classification of Enzymes. Effect of temperature, pH, enzyme and substrate concentrations on the activity of enzymes. Elementary concept of co-factors and co-enzymes.

UNIT - II

Biodiversity:
(i) Plant System: Basic concepts of plant growth, nutrition, photosynthesis and nitrogen fixation. Types of growth regulators and their physiological effects.
(ii) Animal System: Elementary study of Digestive, Respiratory, Circulatory, Excretory systems and their functions.
(iii) Microbial System: History of Microbiology, types of microbes and properties. Economic importance and control of microbes.

UNIT - III


Genetic Engineering: Elementary knowledge of Recombinant DNA Technology, Bioinformatics and Genomics.

UNIT - IV

Introduction to Biotechnology: Definition, scope and achievements. Tools used in biotechnology.

Applications of Biotechnology in Agriculture, Medicine and Environment – an elementary knowledge.

Prospects and public perception of Biotechnology.

Text/Reference Books:
This course is designed for the students of Engineering and Technology who need English for specific purposes in specific situations. It aims at imparting the communication skills that are needed in their academic and professional pursuits. This is achieved through an amalgamation of traditional lecture-oriented approach of teaching with the task based skill oriented methodology of learning.

Unit-I
Communicative Grammar
Part A: Spotting the errors pertaining to nouns, pronouns, adjective and adverbs; Concord - grammatical concord, notional concord and the principle of proximity between subject and verb.
Part B: Changing the voice: from Active to Passive and Passive to Active.

Unit-II
Lexis:
Idioms and phrases; Words often confused; One-Word Substitutes; Formation of words (suffixes, prefixes and derivatives);

Unit-III
Oral Communication:
Part-A: Introduction to principal components of spoken English – Transcription, Word-accent, Intonation, Weak forms in English
Part-B: Developing listening and speaking skills through various activities, such as (a) role play activities, (b) Practising short dialogues (c) Group discussion (d) Debates (e) Speeches (f) Listening to news bulletins (g) Viewing and reviewing T.V. programmes etc.

Unit-IV
Written Communication: Developing reading and writing skills through such tasks/activities as developing outlines, key expressions, situations, slogan writing and theme building exercises, dialogue writing, interpreting pictures/cartoons.

Unit-V
(Book Review – Herein the students will be required to read and submit a review of a book (Literary or non-literary) of their own choice. This will be followed by a presentation of the same in the class

Unit-VI
Technical Writing:
(a) Business Letters, Format of Business letters and Business letter writing
(b) E-mail writing
(c) Reports, Types of Reports and Format of Formal Reports
(d) Press Report Writing

SUGGESTED READING:
Language in Use (Upper intermediate Level, Adrian Doff Christopher Jones, Cambridge University Press
Common Errors in English, Abul Hashem, Ramesh Publishing House, new Delhi.
Spoken English for India, R.K. Bansal & J.B. Harrison, Orient Longman, Delhi.
The sounds of English, Veena Kumar, Makaav Educational Software, New Delhi.
Business Communication, M.S. Ramesh and C.C. Pattanshetti, R.Chand and Company, Delhi

SCHEME OF EXAMINATION:
All questions will be compulsory and will cover all the aspects of the syllabus except unit V. There will be sufficient internal choice.
Unit-I: 20 Marks
Questions No. 1 will require the students to carefully read the sentences given and trace the errors, if any, and then supply the correct alternatives/answers.
Unit-II: 20 Marks
Question No. 2 may have four or five parts testing knowledge of different items of vocabulary.
Unit-III: 20 Marks
Question No. 3 will have four parts of 5 marks each from part A of the unit.
Note: Speaking and listening skills of part B will primarily be tested orally through internal assessment.

Unit-IV: 20 Marks
Question No. 4 may have many parts. The questions will be framed to test students' composition skills on the elements prescribed in the unit. For example, the students may be required to develop a hypothetical situation in a dialogue form, or to develop an outline, key expression etc.

Unit-V is for internal assessment only.
Unit-VI: 20 Marks
Question No. 5 may have two parts. While the one part may require the students to frame either a press/news report for the print media or write the given business letter, or e-mail a message, the second part will have a theory question on the format of formal report and business letter.
ME-101E
ELEMENTS OF MECHANICAL ENGINEERING

L  T  P  Theory: 75 marks
3  1  Sessional: 25 marks

Total: 100 marks
Time: 3 Hrs.

Unit-I

Properties of Steam & Boilers: Formation of steam at constant pressure, Thermodynamics properties of steam, Condition of steam, Steam tables, Measurement of dryness fraction by throttling calorimeter, Classification of boilers, Comparison of water and fire tube boilers mounting and accessories with their functions, Constructional and operational details of Cochran and Babcock and Wilcox boilers, Problems.

Steam Turbines and Condensers: Classification of turbines, Working principle of impulse and reaction turbine, Compounding of impulse turbine, Comparison of impulse and reaction turbines, Types of condensers, Cooling ponds and cooling towers, Condenser and vacuum efficiencies.

Unit-II


Water Turbines, Pumps and Hydraulic Devices: 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, Hydraulic jack and lift.

Unit-III

Power Transmission Methods and Devices: Introduction to Power transmission, Belt drive, Rope drive, Chain drive, Pulley, Gear drive, Types of gears, Gear train, Clutches, Types and function of clutches, Types and function of brakes, Power measurement by dynamometer, Types of dynamometers.

Unit-IV

Stresses and Strains: Introduction, Concept & types of Stresses and strains, Poisson’s ratio, stresses and strains in simple and compound bars under axial loading, Stress-strain diagrams, Hooks law, Elastic constants & their relationships, Principle stresses & strains and principal- planes, Mohr’s circle of stresses. Numerical problems.

Bending Moment & Shear Force: Definitions, SF and BM diagrams for cantilever and simply supported beam. Calculation of maximum SF, BM and point of contra- flexure under the loads of (i) concentrated load (ii) uniformly distributed load (iii) combination of concentrated and uniformly distributed loads. Problems.

Text Books:

Reference Books:

Note: The Examiners will set eight questions, taking two from each unit. The students are required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.
ELEMENTS OF CIVIL ENGINEERING

UNIT-I
Building Materials & Construction: Cement, sand, aggregate, bricks, reinforcing bars, structural steel sections.
Brick masonry: Bonds in brick work, reinforced brick work, load bearing walls, damp-proofing and water proofing, doors and windows

UNIT-II
Structural Steel: Properties, design of tension and compression members, beams and roof Trusses, constructions- rewetted bolted and welded, industrial buildings and towers

UNIT-III
Soils and Foundations: Types of soils, bearing capacity of soils, improving the bearing capacity, earth pressure, foundation for walls, columns, machines and transmission towers, pile foundation.

UNIT-IV
Water supply and treatment: Water needs, estimation of water demand, impurities in water and their sanitary significance, water quality standards, water treatment systems, distribution systems- gravity, pumping and dual system, need for sanitation, systems of sanitation-water borne and conservancy methods of sanitation, sewerage systems-partial, combined and separate systems.

References:

Note: The Examiners will set eight questions, taking two from each unit. The students are required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

EL-101E

ELEMENTS OF ELECTRONICS ENGINEERING

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UNIT-I
Semiconductors p-type, n-type, pn junction diodes, pn junction as a circuit element, its characteristics, half wave and full wave and bridge type rectifier circuits basic filter circuits, diode as voltage multiplier, clipper & clamper circuit. Zener diode as a voltage regulator. LED its characteristics construction & applications

UNIT-II
Characteristics of transistors in different configuration. Concept of d.c. and a.c. load line and operating point selection. Various amplifiers configurations their h-parameter equivalent circuits determination of voltage gain current gain input resistance and output resistance & power gain. Concept of feedback in amplifiers, different oscillators circuits (without analysis)

UNIT-III
Differential amplifier and its transfer characteristics. IC Op-Amps, its ideal & practical specifications and measurement of parameters. Op-Amp in different modes as inverting amplifier non inverting amplifier scale changer, differentiator & integrator.

UNIT-IV
Characteristics of JFET, MOSFET. Various amplifier configurations using FET. Characteristics and Construction of SCR, TRIAC, UJT. Their basic areas applications.

Reference:
2. Integrated Electronics By Millman & Halkias.
3. Electronic Principles – Malvino
5. Electronic Circuits – Donald L. Shilling & Charles Belowl

Note: The Examiners will set eight questions, taking two from each unit. The students are required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

ME-105E

ENGINEERING GRAPHICS AND DRAWING

L T P marks Examination : 100
- 3 Sessional: 50 marks
Total: 150 marks
Time: 3 Hrs.

Unit-I

Various types of projections, First and Third angle systems of orthographic projections. Projections of points in different quadrants. Projections of straight lines – parallel to one or both reference planes, contained by one or both planes, perpendicular to one of the planes, inclined to one plane but parallel to the other plane, inclined to both the planes, true length of a line and its inclinations with reference planes, traces of a line.

Unit-II

Projections of Polyhedra Solids and solids of Revolution – in simple positions with axis perpendicular to a plane, with axis parallel to both planes, with axis parallel to one plane and inclined to the other. Development of surface of various simple solids such as cubes, cylinders, prisms, pyramids etc. orthographic views, orthographic drawings of Bolts, Nuts, Bolted joints, screw threads, screwed joints.

Note: Some simple exercise may be attempted with AUTOCAD.

Text Book

Reference Books

ME- 103E
MANUFACTURING PROCESSES

L T P Theory : 100 marks
4 1 0       Sessional : 50 marks
Total: 150 marks
Time: 3 Hrs.

Unit-I

Unit-II
Foundry: Introduction to Casting Processes, Basic Steps in Casting Process, Pattern, Types of Patterns, Pattern Allowances, Risers, Runners, Gates, Moulding Sand and its composition, Sand Preparation, Molding Methods, Core Sands and Core Making, Core Assembly, Mold Assembly, Melting (Cupola) and Pouring, Fettling, Casting Defects and Remedies.

Unit-III

Unit-IV

Text Books:

Reference Books:

Note: The Examiners will set eight questions, taking two from each unit. The students are required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

CH-101E
CHEMISTRY
(COMMON FOR ALL BRANCHES)

L T P Sessional : 50 Marks
3 1 - Exam.: 100 Marks
Total: 150 Marks
Time: 3 Hrs.

Unit-1
Thermodynamics - Second law, concept of Entropy, Entropy change for an ideal gas, free energy and work functions, free energy change, Chemical Potential, Gibb's Helmholtz equation, Clausius - Clapeyron equation, Related numerical problems with above topics. Phase-Rule - Terminology, Derivation of Gibb's Phase Rule Equation, One Component System (H₂O System), Two Components systems, Eutectic system (Pb-Ag), system with congruent m.pt. (Zn-Mg), systems with incongruent m.pt. (Na-K), Applications of above Systems.

Unit-2

Unit-3
Corrosion and its prevention - Galvanic & concentration cell, Dry and wet corrosion, Electrochemical theory of corrosion, Galvanic corrosion, pitting corrosion, water-line corrosion, differential aeration corrosion, stress corrosion, factors affecting corrosion, Preventive measures (proper design, Cathodic protection, protective coatings). Lubrication and Lubricants-Friction, mechanism of lubrication, classification and properties of lubricants, Additives for lubricants, synthetic lubricants, Greases – Preparation & properties (consistency, drop point) and uses.

Unit-4
Polymers and Polymerization-Organic polymers, polymerisation, various types of polymerisation, effect of structure on properties of polymers, preparation properties and technical applications of thermo-plastics (PVC, PVA), thermosets (PF, UF), and elastomers (SBR, GR-N), Silicones, Introduction to polymeric composites. Analytical methods; its needs and different methods; Spectroscopy; its definition and scope; salient features of spectrophotometer, brief introduction of titrimetric methods, Elementary discussion on flame photometry

**TEXT BOOKS:**
1. Engineering Chemistry, P.C. Jain, Monica Jain (Dhanpat Rai & Co.).

**REFERENCE BOOKS:**
1. Instrumental methods of Chemical Analysis, MERITT & WILLARD (East-West Press).

**Note:** The Examiners will set eight questions, taking two from each unit. The students are required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

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**CSE -101E**

**FUNDAMENTALS OF COMPUTERS & PROGRAMMING IN C**

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**Unit-1**


**Unit-2**


**Internet basics:** How Internet works, Major features of internet, Emails, FTP, Using the internet.

**Unit-3**
C Programming language: C fundamentals, formatted input/output, expressions, selection statements, loops and their applications; Basic types, arrays, functions, including recursive functions, program organization: local and external variables and scope & arrays.

Unit-4

Strings: strings literals, string variables, I/O of strings, arrays of strings; applications. Structures, Unions and Enumerations: Structure variables and operations on structures; Structured types, nested array structures; unions; enumeration as integers, tags and types. Standard library: Input / output; streams, file operations, formatted I/O, character I/O, line I/O, block, string I/O, Library support for numbers and character data, error handling;

Text Books:
2. The C Programming Language by Dennis M Ritchie, Brian W. Kernighan, 1988, PHI.

Reference Books:
1. Information technology, Dennis P. Curtin, Kim Foley, Kunal Sen, Cathleen Morin, 1998, TMH
2. Theory and problem of programming with C, Byron C Gottfried, TMH
3. Teach yourself all about computers by Barry Press and Marcia Press, 2000, IDG Books India.

Note: The Examiners will set eight questions, taking two from each unit. The students are required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.
EE-101E
ELECTRICAL TECHNOLOGY

L T P Theory: 100 marks
3 2 Sessional : 50 marks
          Total: 150 marks
          Time: 3 Hrs.

UNIT-I
D.C. CIRCUITS: Ohm’s Law, Kirchoff’s Laws, D.C. Circuits, Nodal and Loop methods of analysis. A.C. CIRCUITS: Sinusoidal signal, instantaneous and peak values, RMS and average values, phase angle, polar & rectangular, exponential and trigonometric representations; R.L and C components, behaviors of these components in A.C. circuits. Concept of complex power, power factor.

UNIT-II
TRANSIENT RESPONSE: Transient response of RL, RC and RLC Circuits with step input. NETWORK THEOREMS: Thevenin’s theorem, Norton’s theorem, superposition theorem, maximum power transfer theorem, Star to Delta & Delta to Star transformation. SERIES AND PARALLEL A.C. CIRCUITS: Series and parallel A.C. circuits, series and parallel resonance, Q factor, cut-off frequencies and bandwidth.

UNIT-III
THREE PHASE CIRCUITS: Phase and line voltages and currents, balanced star and delta circuits, power equation, measurement of power by two wattmeter method, Importance of earthing. TRANSFORMERS: Principle, construction & working of transformer, Efficiency and regulation.

UNIT-IV

TEXT BOOKS:
1. Basic Electrical Engg (2nd Edition) : Kothari & Nagarath, TMH
2. Electrical Technology (Vol-I) : B.L Theraja & A K Theraja, S.Chand
REFERENCE BOOKS:
1. Electrical Engineering Fundamentals : Deltoro, PHI
2. Network Analysis : Valkenburg, PHI

Note: The Examiners will set eight questions, taking two from each unit. The students are required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

ENVIRONMENTAL STUDIES
(For Under-Graduate Students)

Unit 1: The Multidisciplinary nature of environmental studies
Definition, scope and importance.
Need for public awareness.

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 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
• Concept of an ecosystem.
• Structure and function of an ecosystem.
• 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 ecosystem:
a) Forest ecosystem
b) Grassland ecosystem
c) Desert ecosystem
d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).
Unit 4: Biodiversity and its conservation

- Biogeographical classification of India.
- 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
- Solid 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.

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.
- Water (Prevention and Control of Pollution) Act
- Wildlife Protection Act
• Forest Conservation Act
• Issues involved in enforcement of environmental legislation
• Public awareness.

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
• Women and Child Welfare.
• Role of Information Technology in Environment and human health.
• Case Studies.

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.

Examination Pattern: The question paper should carry 100 marks
The structure of the question paper being:

| PART – A    | Short Answer Pattern         | 25 Marks |
| PART – B    | Essay type with inbuilt choice | 50 Marks |
| PART – C    | Field Work                      | 25 Marks |

INSTRUCTIONS FOR THE EXAMINERS

Part – A Question 1 is compulsory and will contain ten short-answer type question of 2.5 marks each covering the entire syllabus.

Part – B Eight essay type questions (with inbuilt choice) will be set from the entire syllabus and the candidates will be required to answer, any four of them. Each essay type question will be of the 12½ marks.

The examination will be conducted by the college concerned at its own level earlier than the annual examination and each student will be required to score minimum of 35% marks each in theory and Practical. The marks obtained in this qualifying paper will not be included in determining the percentage of marks obtained for the award of degree. However, these will be shown in the detailed marks certificate of the student.
PHY-103E

PHYSICS LAB.-I
(COMMON FOR ALL BRANCHES)

L   T    P
-     -     2

Sessional Work: 25 Marks
Examination: 25 Marks
Total: 50 Marks
Duration of Exam: 3 Hrs.

Note: Students will be required to perform atleast 10 experiments out of the list in a semester.

LIST OF EXPERIMENTS

The experiments in Ist semester will be based mainly upon optics, electrostatics, wave and oscillations which are the parts of the theory syllabus of Ist semester.

1. To find the wavelength of sodium light by Newton's rings experiment.
2. To find the wavelength of sodium light by Fresnel's biprism experiment.
3. To find the wavelength of various colours of white light with the help of a plane transmission diffraction grating.
4. To verify Newton's formula and hence to find the focal length of convex lens.
5. To find the wavelength of sodium light by Michelson interferometer.
6. To find the resolving power of a telescope.
7. To find the specific rotation of sugar solution by using a polarimeter.
8. To compare the capacitances of two capacitors by De Sauty's bridge and hence to find the dielectric constant of a medium.
9. To find the frequency of A.C. mains by using sonometer.
10. To find low resistance by Carrey Foster Bridge
11. To find the resistance of a galvanometer by Post office Box
12. To Find Value of high Resistance by substitution method
13. To Find the value of high resistance by leakage method
14. To Convert a galvanometer in to an Ammeter of given range.

RECOMMENDED BOOKS:
1. Advanced Practical Physics – B.L. Worshnop and H.T. Flint (KPH)
ME-107E

WORKSHOP PRACTICE

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Examination: 25 Marks
Total: 50 Marks
Duration of Exam: 3 Hrs.

NOTE:
1. At least ten experiments/jobs are to be performed/prepared by students in the semester.
2. At least 8 experiments/jobs should be performed/prepared from the above list, remaining two may either be performed/prepared from the above list or designed & set by the concerned institution as per the scope of the syllabus of Manufacturing Processes and facilities available in the Institute.

List of Experiments / Jobs
1. To study different types of measuring tools used in metrology and determine least counts of vernier calipers, micrometers and vernier height gauges.
2. To study different types of machine tools (lathe, shape or planer or slotter, milling, drilling machines)
3. To prepare a job on a lathe involving facing, outside turning, taper turning, step turning, radius making and parting-off.
4. To study different types of fitting tools and marking tools used in fitting practice.
5. To prepare lay out on a metal sheet by making and prepare rectangular tray, pipe shaped components e.g. funnel.
6. To prepare joints for welding suitable for butt welding and lap welding.
7. To perform pipe welding.
8. To study various types of carpentry tools and prepare simple types of at least two wooden joints.
9. To prepare simple engineering components/shapes by forging.
10. To prepare mold and core assembly, to put metal in the mold and fettle the casting.
11. To prepare horizontal surface/vertical surface/curved surface/slots or V-grooves on a shaper/planner.
12. To prepare a job involving side and face milling on a milling machine.

B.E. I/II Semester
CH-103E
CHEMISTRY LAB
(COMMON FOR ALL BRANCHES)
Note: At least ten experiments are to be performed by the students.

LIST OF EXPERIMENTS
1. Determination of Ca\(^{++}\) and Mg\(^{++}\) hardness of water using EDTA solution.
2. Determination of alkalinity of water sample.
3. Determination of dissolved oxygen (DO) in the given water sample.
4. To find the melting & eutectic point for a two component system by using method of cooling curve.
5. Determination of viscosity of lubricant by Red Wood viscometer (No. 1 & No. 2).
6. To determine flash point & fire point of an oil by Pensky-Marten's flash point apparatus.
7. To prepare Phenol-formaldehyde and Urea formaldehyde resin.
8. To find out saponification No. of an oil.
10. Determination of concentration of KMnO\(_4\) solution spectrophotometrically.
11. Determination of strength of HCl solution by titrating it against NaOH solution conductometrically.
12. To determine amount of sodium and potassium in a given water sample by flame photometer.
13. Estimation of total iron in an iron alloy.

SUGGESTED BOOKS:
EE-103E

ELECTRICAL TECHNOLOGY LAB

L T P
Marks
- -  2

Sessional Work:25

Examination:  25 Marks
Total:      50 Marks
Duration of Exam:  3

Hrs.

LIST OF EXPERIMENTS

1. To verify KCL and KVL.
2. To verify Thevenin’s & Norton's Theorems.
3. To verify Superposition theorems.
4. To study frequency response of a series R-L-C circuit and determine resonant
   frequency & Q-factor for various values of R,L,C.
5. To study frequency response of a parallel R-L-C circuit and determine resonant
   frequency & Q-factor for various values of R,L,C.
6. To perform direct load test of a transformer and plot efficiency Vs load
   characteristic.
7. To perform O.C. and S.C. tests on transformer.
8. To perform speed control of DC motor.
10. Measurement of power in a 3 phase system by two watt meter method.
CSE-103E
COMPUTER PROGRAMMING LAB.

L  T  P  Sessional Work:25 Marks
-  -  2 Examination:  25 Marks
Total:  50 Marks
Duration of Exam:  3 Hrs.

Note: At least 5 to 10 more exercises to be given by the teacher concerned.

Representative programming problems:-

1. Write a program to find the largest of three numbers. (if-then-else)
2. Write a program to find the largest number out of ten numbers (for-statement)
3. Write a program to find the average male height & average female heights in the class (input is in form of sex code, height).
4. Write a program to find roots of quadratic equation using functions and switch statements.
5. Write a program using arrays to find the largest and second largest no. out of given 50 nos.
6. Write a program to multiply two matrices
7. Write a program to read a string and write it in reverse order
8. Write a program to concatenate two strings
9. Write a program to sort numbers using the Algorithm.
11. Write a program to check that the input string is a palindrome or not.
EL-109E
ELEMENTS OF ELECTRONICS ENGINEERING LAB.

L T P
Marks
- - 2

Sessional Work: 25 Marks
Examination: 25 Marks
Total: 50 Marks
Duration of Exam: 3 Hrs.

LIST OF EXPERIMENTS:

1. To study the half wave & full wave rectifier.
2. To study the effect of various filters circuits.
3. To study the characteristics of pnp & npn transistor in common emitter & determine H- parameter from characteristics.
4. To study the characteristics of pnp & npn transistor in CB & determine h-parameter from characteristics.
5. To determine the Av, Ai of the coupled CE transistor amplifier.
6. Determine the frequency of oscillation in herteley oscillator.
7. Determine the frequency of oscillation in phase shift oscillator.
8. Determine the effect of negative feedback on bandwidth & gain in CE, RC coupled amplifier.
9. Study TC Op-Amp as a inverting amplifier & scale changer.
10. Study IC Op-Amp as a non inverting amplifier.
11. Study IC Op-Amp as an integrator.
12. Study IC Op-Amp as a differentiator.
ME-109E

ELEMENTS OF MECHANICAL ENGINEERING LAB.

L   T    P                                                    Sessional Work:25 Marks
-    -    2                                                 Examination:  25 Marks

Total:               50 Marks
Duration of Exam:  3 Hrs.

Note:
1. Total ten experiments are to be performed in the Semester.
2. At least seven experiments should be performed from the above list. Remaining three experiments should be performed as designed & set by the concerned Institution as per the scope of the syllabus.

LIST OF EXPERIMENTS

1. To study Cochran & Babcock & Wilcox boilers.
2. To study the working & function of mountings & accessories in boilers.
3. To study 2-Stroke & 4-Stroke diesel engines.
4. To study 2-Stroke & 4-Stroke petrol engines.
5. To calculate the V.R., M.A. & efficiency of single, double & triple start worm & worm wheel.
6. To calculate the V.R., M.A. & efficiency of single & double purchase winch crabs.
7. To find the percentage error between observed and calculated values of stresses in the members of a Jib crane.
8. To draw the SF & BM diagrams of a simply supported beam with concentrated loads.
9. To study the simple & compound screw jacks and find their MA, VR & efficiency.
10. To study the various types of dynamometers.
11. To the constructional features & working of Pelton/Kaplan/Francis.
12. To prepare stress-strain diagram for mild steel & cast iron specimens under tension and compression respectively on a Universal testing machine.
13. To determine the Rockwell / Brinell /Vickers hardness no. of a given specimen on the respective machines.
UNIT-I
Matrices & its Applications: Rank of a matrix, elementary transformations, elementary matrices, inverse using elementary transformations, normal form of a matrix, linear dependence and independence of vectors, consistency of linear system of equations, linear and orthogonal transformations, eigen values and eigen vectors, properties of eigen values, Cayley-Hamilton theorem and its applications.

UNIT-II

UNIT-III
Laplace Transforms and its Applications: Laplace transforms of elementary functions, properties of Laplace transforms, existence conditions, transforms of derivatives, transforms of integrals, multiplication by $t^n$, division by $t$. Evaluation of integrals by Laplace transforms. Laplace transform of Unit step function, unit impulse function and periodic function. Inverse transforms, convolution theorem, application to linear differential equations and simultaneous linear differential equations with constant coefficients.

UNIT-IV

TEXT BOOKS:
1. Advanced Engg. Mathematics F Kreyszig

REFERENCE BOOKS:

**Note:** The Examiners will set eight questions, taking two from each unit. The students are required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.
UNIT-I


UNIT-II

QUANTUM PHYSICS: Difficulties with Classical physics, Introduction to quantum mechanics-simple concepts, discovery of Planck's constant, Group velocity and phase velocity, Schrodinger wave equations - time dependent and time independent Schrodinger equations, Elementary ideas of quantum statistics.


UNIT-III

BAND THEORY OF SOLIDS: Origin of energy bands, Kronig, Penney Model (qualitative), E-K diagrams, Brillouin Zones, Concept of effective mass and holes, Classification of solids into metals, Semiconductors and Insulators, Fermi energy and its variation with temperature. Hall effect and its Applications.

UNIT-IV

PHOTOCONDUCTIVITY AND PHOTOVOLTAICS: Photoconductivity in insulating crystals, variation with illumination, effect of traps, applications of photoconductivity, photovoltaic cells and their characteristics.

MAGNETIC PROPERTIES OF SOLIDS: Atomic magnetic moments, orbital diamagnetism, Classical theory of paramagnetism, ferro magnetism - molecular fields and domains.

SUPER CONDUCTIVITY: Introduction (experimental survey), Meissner effect, London equation.

TEXT BOOKS:
1. Introduction to Solid State Physics (VII Ed.) - Charles Kittel (John Wiley).
2. Quantum Mechanics – Powell and Crasemann (Oxford & IBH)
REFERENCE BOOKS:

Note: The Examiners will set eight questions, taking two from each unit. The students are required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.
PHY-104E
PHYSICS LAB.-II
(COMMON FOR ALL BRANCHES)

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Sessional Work:25 Marks
Examination: 25 Marks
Total: 50 Marks
Duration of Exam: 3 Hrs.

Note: Students will be required to perform at least 10 experiments out of the list in a semester.

LIST OF EXPERIMENTS

The experiments in Second semester will be based upon electricity, Magnetism, Modern Physics and Solid State Physics, which are the parts of theory syllabus.

1. To study He Ne laser
2. To find the frequency of ultrasonic waves by piezo electric methods
3. To find the value of e/m for electrons by Helical method.
4. To find the ionisation potential of Argon/Mercury using a thyratron tube.
5. To study the variation of magnetic field with distance and to find the radius of coil by Stewart and Gee's apparatus.
6. To study the characteristics of (Cu-Fe, Cu-Constantan) thermo couple.
7. To find the value of Planck's constant by using a photo electric cell.
8. To find the value of co-efficient of self inductance by using a Rayleigh bridge.
9. To find the value of Hall Co-efficient of semi-conductor.
10. To study the V-I characteristics of a p-n diode.
11. To find the band gap of intrinsic semi-conductor using four probe method.
12. To calculate the hysteresis loss by tracing a B-H curve.
13. To verify richerdson thermionic equation
14. To find the flashing and quenching potential of Argon and to find the cap.of unknown capacitor
15. To find the temp coeff. of resistance by using Pt resistance thermometer by post office box

RECOMMENDED BOOKS:
1. Advanced Practical Physics – B.L. Worshnop and H.T. Flint (KPH)
### 2nd year Mechanical Engg. Semester-III

<table>
<thead>
<tr>
<th>Course No</th>
<th>Course Title</th>
<th>Teaching Schedule</th>
<th>Marks for Class Work</th>
<th>Marks for Exam</th>
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<td>Thermodynamics</td>
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<td>ME-203 E</td>
<td>Strength of Materials-I</td>
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<td>ME-205 E</td>
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<td>Kinematics of Machine</td>
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Note: Students will be allowed to use Non-Programmable scientific calculator. However, sharing of calculator will not be permitted. Duration of theory as well as practical exams time is three hrs for all courses except ME-205 E for which it is 4 hrs. Course Contents of HUM-201 E to be provided by Humanities Group.
B.Tech. (Third semester) Mechanical engineering
BASICS OF INDUSTRIAL SOCIOLOGY, ECONOMICS
& MANAGEMENT

HUM – 201 E         Sessional :     50
L     T     P       Theory    :     100
3     1     -       Total :     150
Duration of Exam. :     3 Hrs.

UNIT-I
Meaning of social change, nature of social change, theories of social change. The
direction of social change, the causes of social change, the process of social change.
Factors of social change – the technological factors, the cultural factors, effects of
technology on major social institutions, social need of status system, social relations in
industry.

UNIT-II
Meaning of Industrial Economic, Production Function, its types, Least Cost
Combination, Law of Variable Proportion, Laws of Return – Increasing, Constant &
Diminishing. Fixed & variable costs in short run & long run, opportunity costs,
relation between AC & MC, U-shaped short run AC Curve. Price & Output
Determination under Monopoly in short run & long run. Price Discrimination, Price
Determination under Discriminating Monopoly. Comparison between Monopoly &
Perfect Competition.
UNIT – III


UNIT – IV


Note: Eight questions are to be set taking two from each unit. The students are required to attempt five questions in all, taking at least one from each unit.
MATHEMATICS - III

UNIT – I

Fourier Series: Euler’s Formulae, Conditions for Fourier expansions, Fourier expansion of functions having points of discontinuity, change of interval, Odd & even functions, Half-range series.


UNIT-II

Functions of a Complex Variables: Functions of a complex variable, Exponential function, Trigonometric, Hyperbolic and Logarithmic functions, limit and continuity of a function, Differentiability and analyticity.

Cauchy-Riemann equations, Necessary and sufficient conditions for a function to be analytic, Polar form of the Cauchy-Riemann equations, Harmonic functions, Application to flow problems, Conformal transformation, Standard transformations (Translation, Magnification & rotation, inversion & reflection, Bilinear).
UNIT-III

Probability Distributions: Probability, Baye’s theorem, Discrete & Continuous probability distributions, Moment generating function, Probability generating function, Properties and applications of Binomial, Poisson and normal distributions.

UNIT-IV

Linear Programming: Linear programming problems formulation, Solution of Linear Programming Problem using Graphical method, Simplex Method, Dual-Simplex Method.

Text Book


Reference Book

1. Complex variables and Applications: R.V. Churchil; Mc. Graw Hill
3. Operation Research: H.A. Taha
4. Probability and statistics for Engineer: Johnson. PHI.

Note: Examiner will set eight question, taking two from each unit. Students will be required to attempt five questions taking at least one from each unit.
ME- 201 E  THERMODYNAMICS

Unit I

Ideal and Real Gases: Concept of an Ideal Gas, Basic Gas Laws, Characteristic Gas Equation, Avagadro’s law and Universal Gas Constant, P-V-T surface of an Ideal Gas. Vander Waal’s Equation of state, Reduced Co-ordinates, Compressibility factor and law of corresponding states. Mixture of Gases, Bass, Mole and Volume Fraction, Gibson Dalton’s law, Gas Constant and Specific Heats, Entropy for a mixture of Gases.

Unit II


Unit III

Entropy: Clausius Inequality and Entropy, Principle of Entropy Increase, Temperature Entropy Plot, Entropy Change in Different Processes, Introduction to Third Law of Thermodynamics.

Unit IV

Entropy (T-S) and Enthalpy – Entropy (H-S) Diagrams, Throttling and Measurement of Dryness Fraction of Steam.
Thermodynamic Relations:  T-Ds Relations, Enthalpy and Internal Energy as a Function of Independent Variables, Specific Heat Capacity Relations, Clapeyron Equation, Maxwell Relations.
B.Tech. (Third semester) Mechanical engineering

ME- 203 E  STRENGTH OF MATERIALS –I

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Sessional :  50 Marks
Theory   :  100 Marks
Total    :  150 Marks
Duration of Exam. :  3 Hrs.

Unit I

Simple stresses & strains : Concept & types of Stresses and strains, Polson’s ratio, stresses and strain in simple and compound bars under axial loading, stress strain diagrams, Hooks law, elastic constants & their relationships, temperature stress & strain in simple & compound bars under axial loading, Numerical.

Compound stresses & strains: Concept of surface and volumetric strains, two dimensional stress system, conjugate shear stress at a point on a plane, principle stresses & strains and principal- planes, Mohr’s circle of stresses, Numerical.

Unit II

Shear Force & Bending Moments : Definitions, SF & BM diagrams for cantilevers, simply supported beams with or without over-hang and calculation of maximum BM & SF and the point of contraflexure under (i) concentrated loads, (ii) uniformly distributed loads over whole span or a part of it, (iii) combination of concentrated loads and uniformly distributed loads, (iv) uniformly varying loads and (v) application of moments, relation between the rate of loading, the shear force and the bending moments, Problems.

Torsion of circular Members : Torsion of thin circular tube, Solid and hollow circular shafts, tapered shaft, stepped shaft & composite circular shafts, combined bending and torsion, equivalent torque, effect of end thrust. Numericals.

Unit III

Bending & shear Stresses in Beams: Bending stresses in beams with derivation & application to beams of circular, rectangular, I,T and channel sections, composite beams, shear stresses in beams with derivation combined bending torsion & axial loading of beams. Numericals.

Columns & Struts: Column under axial load, concept of instability and buckling, slenderness ratio, derivation of Eulers 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

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.
Fixed Beams: Deflections, reactions and fixing moments with SF & BM calculations & diagrams for fixed beams under (i) concentrated loads, (ii) uniformly distributed load and (iii) a combination of concentrated loads & uniformly distributed load.

**Text Books:**

**Reference Books:**
Strength of Materials – Popov, PHI, New Delhi.
Strength of Materials – Sadhu Singh, Khanna Publications
Strength of Materials – U.C.Jindal
Strength Materials – I. Kripal Singh
B.Tech. (Third semester) Mechanical engineering

ME- 205 E \hspace{1cm} MACHINE DRAWING

Unit I

Unit II

Unit III
Assembly drawing with sectioning and bill of materials from given detail drawings of assemblies : Lathe Tail stock, machine vice, pedestal bearing, Steam stop valve, drill jigs and milling fixture.

NOTE :
(1) In the semester examination, the examiner will set two questions from each unit. The students have to attempt three questions taking one from each unit.
(2) The questions from Unit I and Unit II will carry 20 marks each. Question from Unit III will carry 60 marks.

Text Books:
   Charotar Publishing House
2. A Text Book of Machine Drawing by P S Gill
   Pub.: S K Kataria & Sons

Reference Books:
1. A Text Book of Machine Drawing : Laxmi narayana and Mathur
ME 207 E KINEMATICS OF MACHINES

Sessional : 50 Marks

Theory : 100 Marks

Total : 150 Marks

Duration of Exam. : 3 Hrs.

UNIT I  Kinematics, introduction to analysis and synthesis of mechanisms, Kinematics’ pairs, Degree of freedom, Dynamitic chain mechanism, Machine, Four-bar chain, inversions, Single and double slider crank chain, Quick return mechanisms, Introduction to function generation, Path generation and rigid bodied guidance.

Velocity determination; Relative velocity methods, Instantaneous center method Acceleration determination, Kennedy’s Space cent rode and body cent rode,

UNIT II  Centripetal and tangential accelerations, Acceleration determination by graphical method using velocity polygons, Cariole’s component of acceleration, Klein’s and other constructions.

Analytical methods to find velocity and acceleration of four –link mechanism, slider crank mechanism, freumdenstein’s equation, Coordinate a angular displacements of input and output links (Path generation function generation), Least square technique, Rigid body guidance.

UNIT III  Pantograph, straight-line motion mechanisms (Peculiar, Hart, Scott Russell, Grasshopper, Watt, Kemp’s Tchymbayev, Parallel linkages) Indicator mechanisms (Simplex Crosby, Thomson, etc ) Automobile steering gears (Davis and Ackerman),Hooks joint (universal coupling), Double hooks joints.

Types of friction, Laws of dry friction, Motion along inclined plane Screw threads, Wedge, Pivots and collars, Plate and cone clutches, Antifiction bearings, friction circle and friction axis, bearings and lubrication. Motion along inclined plane and screws, Pivots and Collars Thrust Bearings lubrication

UNIT IV  Types of cams and followers, various motions of the follower, Construction of cam profiles, Analysis for velocities and accelerations of tangent and circular arc cams with roller and flat –faced followers.

Open and crossed belt drives, velocity ratio, slip , material for belts, crowning of pulleys, law of belting, types of pulleys, length of belts ratio Of tensions, centrifugal tension, power transmitted by belts and ropes, initial tension, creep, chain drive, chain length, classification of chains

Suggested reading:


Theory of Mechanism and Machines: Jagdish Lal, Metropolitan Book Co.
UNIT I  Metal cutting & Tool life

Basic tool geometry, single point tool nomenclature, chips-various types and their characteristics, mechanism of chip formation, theoretical and experimental determination of shear angle, orthogonal and oblique metal cutting, metal cutting theories, relationship of velocities, forces and power consumption.
Effect of operating parameters like tool geometry, cutting speed, feed depth of cut, coolant, materials etc on forces, temp, tool life, surface finish etc., tool life relationship, tailor equation of tool life, tool material and mechanism.

UNIT II  Economics of metal machining & Multi edged tools

Element of machining cost, tooling economics, machines economics and optimization.
Broach tools-types materials and applications, geometry of twist drills, thrust torque and power calculation in drills, form tools-application.

UNIT III  Metal forming & Jigs and Fixtures

Metal blow condition, theories of plasticity conditions of plane strains, friction condition in metal working, wire drawing-extension of rods, theory of forging, rolling of metals and elementary rolling theory, no slip angle and forward slip.
Tool engineering, types of tools, usefulness, principles of location, locating and clamping devices, Jigs bushes, drilling Jigs, milling fixtures, turning fixtures, boring and broaching fixtures, different materials for Jigs and fixtures, economic of Jigs and fixtures.

UNIT IV  Metrology

Measurements, linear and angular simple measuring instruments various clamps, screw gauge, sine bar, auto-collimator, comparator-mechanical, electrical, optical, surface finish and its measurement, micro and macro deviation, factors influencing surface finish and evaluation of surface finish.

Suggested reading:
1. Manufacturing science: Ghosh and Malik, E.W. Press
List of experiments

1. To determine the modulus of rigidity of the material of a closed coil helical spring and the stiffness of a spring.
2. To determine the value of coefficient of friction for a given pair of surfaces using friction apparatus.
3. To determine the modulus of rigidity of horizontal shaft.
4. To determine experimentally the ratio of the cutting time to idle time (cutting stroke to idle stroke) of the crank and slotted lever (QRM)/Whitworth and compare the result to theoretical values plot the following:
   a. $\theta$ v/s $X$ (displacement of slider).
   b. $\theta$ v/s velocity.
   c. $\theta$ v/s Acceleration and to compare the values of velocities.
      (Take angles $\theta = 45^\circ, 90^\circ, 135^\circ, 225^\circ, 270^\circ & 335^\circ$, $\omega = 1$ rad/s).
5. To determine the value of coefficient of friction between the screw and nut of the jack, while:
   a. Raising the load
   b. Lowering the load.
6. To draw experimentally a curve of the follower-displacement v/s cam-angle. Differentiate the above curve to get velocity and acceleration plot and compare the values with those obtained analytically.
7. To determine the coefficient of friction between belt and pulley and plot a graph between $\log_{10} \frac{T_1}{T_2}$ v/s, $\theta$.
8. To determine the displacement, velocities, & accelerations of the driven shaft of a Hooke’s joint for a constant speed of the driver shaft.
9. To determine velocity & acceleration of slider in slider-crank mechanism and plot the following:
   a. $\theta$ v/s $x$ (displacement of slider)
   b. $\theta$ v/s velocity and
   c. $\theta$ v/s acceleration.
   Compare the values of velocities & acceleration with those obtained theoretically. (Assume $\omega=1$ rad/sec.).
10. Study of the inversions of the single slider crank mechanism.
B.Tech. (Third semester) Mechanical engineering
ME-213 THERMODYNAMICS (LAB.)

Class Work : 50 Marks
Exam : 25 Marks
Total : 75 Marks
Duration of exam : 3 Hrs.

List of Experiments

1. Study of 2 stroke petrol and diesel engine models.
2. Study of 4-stroke petrol/diesel engine model.
3. Study of boilers.
4. Study of Babcock-Wilcox boiler (Model).
5. Study of locomotive boiler (Model).
6. Study of Lancashire boiler (Model).
7. To study the Red wood viscometer and measure the viscosity of fluid.
8. To measure the flash point of the given fuel.
9. To study the Nestler’s boiler.
10. To study various parts of the vertical steam engine.
11. To study the diesel engine and make a trial on it.

Note : Any 8 experiments from the above list and other 2 from others developed by institute ) are required to be performed by students in the laboratory.
B.Tech. (Third semester) Mechanical engineering

ME- 215 E STRENGTH OF MATERIALS LAB

Class Work: 50 Marks  
Exam: 25 Marks  
Total: 75 Marks  
Duration of exam: 3 Hrs.

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 sheer test on UTM.
9. To study the torsion testing machine and perform the torsion test.
10. To draw shear Force, Bending Moment Diagrams for a simply Supported Beam under Point and Distributed Loads.
11. To determine Mechanical Advantage and Efficiency of Single and Double Purchase Winch Crab.
12. To determine Mechanical Advantage and Efficiency of Worm and Worm Wheel.
14. To find Moment of Inertia of a Fly Wheel.

Note: Any 8 experiments from the above list and other 2 from others (developed by institute) are required to be performed by students in the laboratory.
# Scheme of examination for B. Tech Degree Course

## 2nd YEAR (SEMESTER – IV) MECHANICAL ENGINEERING (2004-2005)

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course Title</th>
<th>Teaching Schedule</th>
<th>Marks for Class work</th>
<th>Marks for Examination</th>
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<td>HUM-201 E/ MATH-201E</td>
<td>Basics of Industrial Sociology, Economics &amp; Management / Mathematics-III</td>
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<td>Production technology-II</td>
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<td>ME-204 E</td>
<td>Material Science</td>
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<td>Strength of Materials – II</td>
<td>3</td>
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<td>ME-208 E</td>
<td>Fluid Mechanics</td>
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<td>ME-210 E</td>
<td>Dynamics of Machine</td>
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<td>Dynamics of machine lab</td>
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**TOTAL** | 19 | 5 | 10 | 34 | 400 | 600 | 100 | 1100 |

**Note:**

1. Practical training of 4 weeks duration during summer vacations and its evaluation in 5th Semester.
2. Students will be allowed to use Non-Programmable Scientific Calculator. However, Sharing of calculator will not be permitted.
B.Tech. (Fourth semester) Mechanical engineering

ME-202 E  PRODUCTION TECHNOLOGY

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UNIT I  Kinematics of Machine Tools.

Drives in machine tools for rotation movement, stepped and step less drives, mechanical and hydraulic drives, Individual and group drives, selection of extreme values of spindle speed on a lathe, principle of stepped regulation, Layout of spindle speeds. A.P., G.P. and Logarithmic progressions, Kinematics advantage of G. P. for gear box design, selection of common ratio, Number of steps in a given speed range, design of a geared head stock.

UNIT II  Manufacturing Methods

Characteristics of turret Lathes, turret-indexing mechanism, tooling equipment for turrets, tool Layout or turrets. Classification of gear production methods, gear generation, gear hobbling gear shaping, gear finishing methods; shaving, burnishing grinding, Lapping gear shaping, gear finishing methods; shaving, burnishing grinding, honing.

UNIT III  Unconventional Machining Processes & Press Working Tools

Need for unconventional processes, Ultrasonic machining, electrochemical machining, electrochemical grinding, Laser beam machining their process parameters, principle of metal removal, applications advantages and limitations. Introduction, classifications of presses and dies, hear, action in die cutting operations, center of pressure, mathematical calculation of center of pressure, clearances, cutting forces, punch dimensioning.

UNIT IV  Machine Tools Vibration and Dynamometry

Introduction, effects of vibration no-machine tools, cutting conditions, work piece and tools life, source of vibration, machine tool chatter, Need for measuring forces, basic requirements of measuring techniques, design requirements of dynamometers, 3-divisional turning dynamometer and its calibration, drill dynamometers.

Suggested reading:
1. Manufacturing science: Ghosh and Malik, E.W. Press
B.Tech. (Fourth semester) Mechanical engineering

ME- 204 E MATERIAL SCIENCE

L T P Sessional : 50 Marks
4 - - Theory : 100 Marks

Total : 150 Marks
Duration of Exam : 3 Hrs

Unit I

Crystallography: Review of crystal structure, space lattice, crystal planes and crystal directions, co-ordination number, number of atoms per unit cell, atomic packing factor, Numericals related to crystallography

Imperfection in metal crystals: Crystal imperfections and their classifications, point defects, line defects, edge & screw dislocations, surface defects, volume defects & effects of imperfections on metal properties.

Unit II

Solid solutions and phase diagram: Introduction to single and multiphase solid solutions and types of solid solutions, importance and objectives of phase diagram, systems, phase and structural constituents, cooling curves, unary & binary phase diagrams, Gibbs’s phase rule, Lever rule, eutectic and eutectoid systems, peritectic and peritectoid systems, iron carbon equilibrium diagram and TTT diagram


UNIT III


UNIT IV


Reference Books:
4. B.Tech. (Fourth semester) Mechanical engineering

**ME- 206 E STRENGTH OF MATERIALS-II**

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Sessional : 50Marks  
Theory : 100  
Total : 150 Marks  
Duration of Exam: 3Hrs.

**Unit I**  
Strain Energy & Impact Loading: Definitions, expressions for strain energy stored in a body when load is applied (i) gradually, (ii) suddenly and (iii) with impact, strain energy of beams in bending, beam deflections, strain energy of shafts in twisting, energy methods in determining spring deflection, Castigliano’s & Maxwell’s theorems, Numerical.  
Theories of Elastic Failure: Various theories of elastic failures with derivations and graphical representations, applications to problems of 2- dimensional stress system with (i) Combined direct loading and bending, and (ii) combined torsional and direct loading, Numericals.

**Unit II**  
Unsymmetrical Bending: Properties of beam cross section, product of inertia, ellipse of inertia, slope of the neutral axis, stresses & deflections, shear center and the flexural axis Numericals.  
Thin Walled Vessels: Hoop & Longitudinal stresses & strains in cylindrical & spherical vessels & their derivations under internal pressure, wire wound cylinders, Numericals.

**UNIT III**  
Thick Cylinders & Spheres: Derivation of Lame’s equations, radial & hoop stresses and strains in thick, and compound cylinders and spherical shells subjected to internal fluid pressure only, wire wound cylinders, hub shrunk on solid shaft, Numericals.  
Rotating Rims & Discs: Stresses in uniform rotating rings & discs, rotating discs of uniform strength, stresses in (i) rotating rims, neglecting the effect of spokes, (ii) rotating cylinders, hollow cylinders & solids cylinders. Numericals.

**UNIT IV**  
Bending of Curved Bars: Stresses in bars of initial large radius of curvature, bars of initial small radius of curvature, stresses in crane hooks, rings of circular & trapezoidal sections, deflection of curved bars & rings, deflection of rings by Castigliano’s theorem stresses in simple chain link, deflection of simple chain links, Problems.  
Springs: Stresses in open coiled helical spring subjected to axial loads and twisting couples, leaf springs, flat spiral springs, concentric springs, Numericals.

**Text Books:**
B.Tech. (Fourth semester) Mechanical engineering
ME- 208 E FLUID MECHANICS

L      T    P   Sessional : 50 Marks
3       1     -   Theory : 100 Marks
Total   : 150 Marks
Duration of Exam : 3 Hrs.

Unit I
Fluid Properties and Fluid Statics: Concept of fluid and flow, ideal and real fluids, continuum concept, 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.


UNIT III
Viscous Flow: Flow regimes and Reynold’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-karman 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.


Text Books:
Mechanics of Fluids – I H Shames, Mc Graw Hill

References Books:
Introduction to Fluid Mechanics and Fluid Machines – S.K. Som and G. Biswas, TMH
Fluid Mechanics and Fluid Power Engineering – D.S. Kumar, S.K. Kataria and Sons
Fluid Mechanics and Machinery – S.K. Agarwal, TMH, New Delhi
## B.Tech. (Fourth semester) Mechanical engineering

**MET –210 E  DYNAMICS OF MACHINES**

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### UNIT I

Static force analysis, Static equilibrium, free by diagram, Analysis of static forces in mechanism. D’Alembert’s principal, Equivalent offset inertia force, Dynamics of reciprocation parts, Piston effort, Crank effort, Equivalent dynamical systems, and Inertia force in reciprocating engines by graphical and analytical method. Turning moment and crank effort diagrams for single cylinder and multi-cylinder engines, coefficient of fluctuation of energy, coefficient of fluctuation of speed, flywheel and its function.

### UNIT II

Types of gears, terminology, condition for correct gearing, cyclical and involutes profiles of gear teeth, pressure angle, path of contact, arc of contact, Interference, undercutting, minimum number of teeth, number of pairs of teeth in contact, helical, spiral, worm and worm gear, bevel gear. Gear trains; simple, compound, reverted, and epicyclical. Solution of gear trains, sun and planet gear, bevel epicyclical gear, compound epicyclical gear, pre-selective gearbox, differential of automobile, torque in gear taints

### UNIT III

Types of brakes, friction brakes, external shoe brakes, band brakes, band and block brakes, internal expanding shoe brake, dynamometers, absorption, and tensional. Types of governors; watt, Porter, Proell, spring loaded centrifugal, Inertia, Sensitiveness, Stability, Isochronism’s, Hunting, Effort and power of governor, controlling force, Static and dynamic balancing of rotating parts, balancing of I. C. Engines, balancing of multi-cylinder engine; V-engines and radial engines, balancing of machines.

### UNIT IV

Gyroscopes, Gyroscopic couple and its effect on craft, naval ships during steering, pinching and rolling, Stability of an automobile (2-wheeler), Introduction, open and closed loop control, terms related to automatic control, error detector, actuator, amplification, transducers, lag in responses, damping, block diagrams, system with viscous damped output, transfer functions, relationship between open –loop and closed loop transfer function.
B.Tech. (Fourth semester) Mechanical engineering

ME- 214 E  FLUID MECHANICS  LAB

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List of Experiments:
1. To determine the coefficient of impact for vanes.
2. To determine the 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 Bernoulli's 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 variations with radius in a forced vortex flow.

Note:
1. At least ten experiments are to be performed in the semester.
B.TECH. (FOURTH SEMESTER) MECHANICAL ENGINEERING
ME-212 E PRODUCTION TECHNOLOGY LAB

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List of Experiments:

- Introduction to milling machines its types functions applications etc.
- Practice of slab milling on milling machine.
- Practice of slotting on milling machine.
- To cut gear teeth on milling machine using dividing head.
- Introduction to gear hobber, demonstration of gear hobbing and practice.
- Introduction to various grinding wheels and demonstration on the surface grinder.
- Introduction to tool and cutter grinder and dynamometer.
- Study the constructional detail and working of CNC lathes Trainer.
- To carry out welding using TIG/MIG welding set.
- Introduction, demonstration & practice on profile projector & gauges.
- To make a component on lathe machine using copy turning attachment.
- To cut external threads on a lathe.
- To cut multi slots on a shaper machine.
- To perform drilling and Boring operation on a Component.

At least eight experiments should be performed from the above list. Remaining two experiments may either be performed from the above list or designed & set by the concerned institute as per the scope of the syllabus.
B.Tech. (Fourth semester) Mechanical engineering
ME 216 E DYNAMICS OF MACHINE (LAB.)

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LIST OF EXPERIMENT
1. To determine experimentally, the moment of inertia of a flywheel and axle compare with theoretical values.
2. To find out critical speed experimentally and to compare the whirling speed of a shaft with theoretical values.
3. To find experimentally the Gyroscopic couple on motorized gyroscope and compare with applied couple.
4. To perform the experiment of balancing of rotating parts and finds the unbalanced couple and forces.
5. To determine experimentally the unbalance forces and couples of reciprocating parts.
6. To calculate the torque on a planet carrier and torque on internal gear using epicyclic gear train and holding torque apparatus.
7. To study the different types of centrifugal and inertia governors and demonstrate any one.
8. To study the automatic transmission unit.
9. To study the differential types of brakes.
10. To find out experimentally the corli and component of acceleration and compare with theoretical values.

At least eight experiments should be performed from the above list. Remaining two experiments may either be performed from the above list or designed & set by the concerned institute as per the scope of the syllabus.
UNIT I
Heat engines; Internal and external combustion engines; Classification of I.C. Engines; Cycle of operations in four strokes and two-stroke IC engines; Wankle Engine. Assumptions made in air standard cycles; Otto cycle; Diesel cycle; Dual combustion cycle; Comparison of Otto, diesel and dual combustion cycles; Sterling and Ericsson cycles; Air standard efficiency. Specific work output. Specific weight; Work ratio; Mean effective pressure; Deviation of actual engine cycle from ideal cycle.

UNIT II
Mixture requirements for various operating conditions in S.I. Engines; Elementary carburetor, Calculation of fuel air ratio; The complete carburetor; Requirements of a diesel injection system; Type of injection system; Petrol injection; Requirements of ignition system; Types of ignition systems, ignition timing; Spark plugs. S.I. engines; Ignition limits; Stages of combustion in S. I. Engines; Ignition lag; Velocity of flame propagation; Detonation; Effects of engine variables on detonation; Theories of detonation; Octane rating of fuels; Pre-ignition; S.I. engine combustion chambers. Stages of combustion in C.I. Engines; Delay period; Variables affecting delay period; Knock in C.I. Engines; Cetane rating; C.I. Engine combustion chambers.

UNIT III
Functions of a lubricating system, Types of lubrication system; Mist, Wet sump and dry sump systems; Properties of lubricating oil; SAE rating of lubricants; Engine performance and lubrication; Necessity of engine cooling; Disadvantages of overcooling; Cooling systems; Air-cooling, Water-cooling; Radiators. Performance parameters; BHP, IHP, Mechanical efficiency; Brake mean effective pressure and indicative mean effective pressure, Torque, Volumetric efficiency; Specific fuel consumption (BSFG, ISFC); Thermal efficiency; Heat balance; Basic engine measurements; Fuel and air consumption, Brake power, Indicated power and friction power, Heat lost to coolant and exhaust gases; Performance curves;

UNIT IV
Pollutants from S.I. and C.I. Engines; Methods of emission control, Alternative fuels for I.C. Engines; The current scenario on the pollution front.
Working of a single stage reciprocating air compressor; Calculation of work input; Volumetric efficiency; Isothermal efficiency; Advantages of multi stage compression; Two stage compressor with inter-cooling; Perfect inter cooling; Optimum intercooler pressure; Rotary air compressors and their applications; Isentropic efficiency. Brayton cycle; Components of a gas turbine plant; Open and closed types of gas turbine plants; Optimum pressure ratio; Improvements of the basic gas turbine cycle; Multi stage compression with inter-cooling; Multi stage expansion with reheating between stages; Exhaust gas heat exchanger; Application of gas turbines.
Recommended books
Internal combustion engine  by Ramalingam scitech publication
**UNIT I**
Impact of jet stationary and moving flat and curved plates, Force on series of vanes, Radial vanes, Vortex motion, Free and forced vortex, jet propulsion of ships Units and dimensions; Dimensional homogeneity; Dimensional analysis methods; Rayleigh and Buckingham methods, Applications and limitations of dimensional analysis Dimensionless numbers, Similitude laws.

**UNIT II**
Introduction; Development of hydraulic turbines; Components of hydropower plant; Classification of turbines; Surge tank and its type. Pelton turbine, Its components, Number and dimension of buckets, Speed ratio, Jet ratio, Energy conversion, Condition for maximum efficiency; Design considerations. Francis turbine, its components, working principles. Draft tube, Types of draft tube, Design considerations; Outward vs. Inward flow reaction turbines, Introduction to Deriaz turbine, Evolution of axial flow turbines, Kaplan turbine, Operation at off-design loads, Governing etc. it quantities, Specific speed, Runway speed, Characteristics of turbines.

**UNIT III**
Introduction, Classification, Components, Principle of working, various heads, Energy conversion, Euler’s head and its variation with vane shapes, Effect of finite number of vanes, Losses and efficiencies, Minimum starting speed, Limitation of suction lift, Net Positive Suction Head (NPSH); Multistage pumps, Specific speed and performance. Working principles, Classification, Components, Discharge, Discharge slip, Power input, Indicator diagram, Effect of friction, Acceleration and pipe friction, Maximum speed, Air vessels, Comparison with centrifugal pumps. Model testing of pumps.

**UNIT IV**
Cavitations and its effects, Cavitation parameters, Detection and Prevention of cavitations. Model testing of turbine

## B.Tech. (Fifth semester) Mechanical engineering

**ME 305 E** HEAT - TRANSFER

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<th>Theory : 100 Marks</th>
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**Sessional : 50 marks**

**Duration of Exam : 03 hours**

### UNIT I
Definition of heat; Modes of Heat Transfer; Basic Laws of heat transfer, Electrical Analogy of heat conduction; Conduction through composite Walls; Overall heat transfer coefficient. The general conduction equation in Cartesian, cylindrical and spherical coordinates Steady one dimensional heat conduction without internal heat generation; The plane slab; The cylindrical shell; The spherical shell; Critical thickness of insulation; Variable thermal conductivity, Steady one dimensional heat conduction with uniform internal heat generation the plane slab; Cylindrical and spherical systems; Fins of uniform cross section; Governing equation; Temperature distribution and heat dissipation rate; Efficiency and effectiveness of fins.

### UNIT II
Free and forced convection; Newton’s law of cooling, Convective heat transfer Coefficient; Nusselt number; Dimensional analysis of free and forced convection; Analytical solution to forced convection problems; The concept of boundary layer; Hydrodynamic and thermal boundary layer; Momentum and Energy equations for boundary layer; Exact solution for laminar flow over an isothermal plate using similarity transformation; The integral approach; Integral momentum and energy equations; Solution of forced convection over a flat plate using the integral method. Analysis of free convection; governing equations for velocity and temperature fields. Relation between fluid friction and heat transfer, Reynolds analogy Dimensionless numbers; Reynolds, Prandtl Nusselt, Grashoff and Stanton Numbers and their significance, Heat transfer with change of phase; Nusselt theory of laminar film Condensation.

### UNIT III
Theories of thermal radiation; Absorption, Reflection and transmission, Monochromatic and total emissive power; Black body concept; Planck’s distribution law; Stefan Boltzman law; Wien’s displacement law; Lambert’s cosine law; Kirchoff’s law; Shape factor; Heat transfer between black surfaces.

### UNIT IV
Introduction; Classification of heat exchangers; Logarithmic mean temperature Difference; Area calculation for parallel and counterflow heat exchangers; Effectiveness of heat exchangers; N T U method of heat exchanger design; Applications of heat exchangers.

**Reference and Text books:** A Text book of Heat Transfer by S.P Sukhatme, university press
Heat transfer by Holman, TMG
UNIT I  Introduction to work study; Method study; Basic procedure; Recording techniques (charts and diagrams); Elemental breakdown; Micro-motion studies; Therbligs; SIMO-chart; Principles of motion –economy.Introduction; Objectives; technique; (time) information recording; methods of timings; Time study allowances; Work sampling technique; Performance rating and its determination PMTS; M. T. M.; Work factor.

UNIT II  Principles of organization, Importance and characteristics of organization, Organization theories; Classical Organization theory; Neo-Classical organization theory, Modern organization theory; Types of organization, Military or line organization, Functional organization, Line and staff organization, Committees.Objectives of PPC; Functions of PPC; Preplanning and planning; Routing; Estimating; scheduling-master schedule; Daily schedule; Gantt chart; Dispatching –centralized vs. de-centralized; Control; Follow up and progress reporting.Introduction; Product development; Product characteristics; Role of product development; 3Ss – Standardization; Simplification and Specialization.

UNIT III  Introduction, Objectives and importance of sales forecasting. Types of forecasting, Methods of sales forecasting–Collective opinion method, Delphi technique, economic indicator method; Regression analysis, Moving average method, Time series analysis.Introduction, Functions of inventory; Types of inventory; Control importance and functions, Inventory costs, Factors affecting inventory control, Various inventory control models. A. B. C. analysis, Lead-time calculations.

UNIT IV  Introduction; Objectives; Concept and life cycle of a product and V.E.; Steps in VE., Methodology and techniques, Fast diagram, Matrix method.Various concepts in industrial engineering
a) WAGES AND INCENTIVES; -Concept; Types; Plans; Desirable characteristics.
b) ERGONOMICS; - its importance; Man-machine work place system; Human factors considerations in system design.
c) SUPPLY CHAIN MANAGEMENT; - its definition, Concept, Objectives, Applications, benefits, Some successful cases in Indian Industries.
d) JIT; - Its definition, Concept, Importance, Misconception, Relevance, Applications, Elements of JIT (brief description).
e) MRP; -Introduction, Objectives, factors, Guide lines, Techniques Elements of MRP system, Mechanics of MRP, MRP-II
ME 309 E  

Machine Design- 1

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</table>

Theory : 100 Marks  
Sessional : 50 marks

Duration of Exam : 03 hours

UNIT I  Properties: Chemical, Physical, Mechanical and Dimensional; Ferrous metals, Non-ferrous metals, Plastics, Composite materials etc. Selection of Engineering Materials. Design methodology; Design criterion based on fracture; Deformation and elastic stability design stresses; Factor of safety; Significant stress and significant strength; Stresses-concentration; Causes and mitigation; Endurance limit; Effect of concentration; Notch sensitivity; Size and surface finish; Goodman diagram; Gerber’s parabola and Soderberg line.

UNIT II  Supports and retention of rotating assemblies; manufacturing considerations of design, design of castings and weldments. Riveted joints for boiler shell according to I. B. R.; riveted structural joint; and riveted joint with eccentric loading; Types of welded joints; strength of welds under axial load; Welds under eccentric loading; Designation of various types of bolts and nuts, Design of bolted joints, Bolts of uniform strength, Bolted joints with eccentric loads, Design of Keys, Cotter joint and knuckle joints.

UNIT III  Design of shafts subjected to pure torsion; Pure bending load; Combined bending and torsion; Combined torsion; Bending and axial loads. Introduction, hand and foot levers, cranked lever, lever for a lever safety valve, Bell crank lever. Miscellaneous levers.

UNIT IV  Types of shaft couplings, Design of sleeve or muff coupling; Flange coupling and bush type flexible couplings. Introduction, Design of circular, oval shaped and square flanged pipe joints. Function, types of power screws, stresses in screws, design calculations.
UNIT I  Introduction; classification of boilers; comparison of fire tube and water tube boiler; their advantages; description of boiler; Lancashire; locomotive; Babcock; Wilcox etc.; boiler mountings; stop valve; safety valve; blow off valve; feed check etc.; water level indicator; fusible plug; pressure gauge; boiler accessories; feed pump; feed water heater; preheater; superheater; economizer; natural draught chimney design; artificial draught; stream jet draught; mechanical draught; calculation of boiler efficiency and equivalent evaporation (no numerical problem)

UNIT II  Carnot cycle; simple and modified Rankine cycle; effect of operating parameters on rankine cycle performance; effect of superheating; effect of maximum pressure; effect of exhaust pressure; reheating and regenerative Rankine cycle; types of feed water heater; reheat factor; binary vapour cycle. Simple steam engine, compound engine; function of various components.

UNIT III  Function of steam nozzle; shape of nozzle for subsonics and supersonics flow of stream; variation of velocity; area of specific volume; steady state energy equation; continuity equation; nozzle efficiency; critical pressure ratio for maximum discharge; physical explanation of critical pressure; super saturated flow of steam; design of steam nozzle. Advantage of steam condensation; component of steam condensing plant; types of condensers; air leakage in condensers; Dalton’s law of partial pressure; vacuum efficiency; calculation of cooling water requirement; air expansion pump.

UNIT IV  Introduction; classification of steam turbine; impulse turbine; working principal; compounding of impulse turbine; velocity diagram; calculation of power output and efficiency; maximum efficiency of a single stage impulse turbine; design of impulse turbine blade section; impulse reaction turbine; working principle; degree of reaction; parsons turbine; velocity diagram; calculation of power output; efficiency of blade height; condition of maximum efficiency; internal losses in steam turbine; governing of steam turbine.

Text Books :
1. Thermal Engineering – P L Ballaney, Khanna Publishers
2. Thermodynamics and Heat Engines vol II – R Yadav, Central Publishing House

Reference Books :
1. Applied Thermodynamics for Engineering Technologists – T D Eastop and A McConkey, Pearson Education
List of Experiments

1. To make a trial on single cylinder 4-stroke Diesel Engine to calculate B. H. P., S.F.C. and to draw its characteristics curves.
2. To make a trial on 4-stroke high-speed diesel engine and to draw its Heat Balance Sheet.
3. To make a trial on Wiley’s jeep Engine at constant speed to calculate B. H. P., S. F. C. Thermal efficiency and to draw its characteristic Curves.
4. To make Morse Test to calculate IHP of the multi cylinder petrol engine and to determine its mechanical efficiency.
5. To calculate the isothermal efficiency and volumetric efficiency of a 2 stage reciprocating air compressor.
6. To find out the efficiency of an air Blower.
7. To make a trial on the Boiler to calculate equivalent evaporation and efficiency of the Boiler.
8. To study the following models:
   a. Gas Turbine.
   b. Wankle Engine.
9. To study
   a. Lubrication and cooling systems employed in various I. C. Engines in the Lab
   b. Braking system of automobile in the lab
10. To study a Carburetor.
11. To study (1) the Fuel Injection System of a C. I. Engine.
   a. (11) Battery Ignition system of a S. I. Engine
12. To study Cooling Tower.
1. To study and perform test on the Pelton wheel and to plot curves $Q, P$ Vs $N$ at full, three fourth gate opening.

2. To study and perform test in the Francis Turbine and to plot curves $Q, P$ Vs $N$ at full, three- fourth gate opening.

3. To study and perform test on the Kaplan Turbine and to plot curves $Q, P$ Vs $N$ at full, three- fourth half opening.

4. To study and perform test on a Centrifugal Pump and to plot curves $\eta$, Power Vs $Q$.

5. To study and perform test on a Hydraulic Ram and to find its Rankine, Aubussion $\eta$.

6. To study and perform test on a Reciprocating pump and to plot the $P$ and $\eta$Vs $H$.

7. To study and perform test on a Gear Pump, and to plot the curves $Q, P$ Vs Pressure rise.

8. Study and perform test on a Torque Convertor and to plot the curves $\eta$ & $Np$. 
B.Tech. (Fifth semester) Mechanical engineering

ME 317 E       Heat Transfer (Practical)

L T P/D Total Theory: 25 Marks
- - 2 2 Sessional: 25 marks

list of Experiments

1. Determination of thermal conductivity of a metal rod
2. Determination of thermal conductivity of an insulating powder
3. Determination of thermal conductivity of a liquid using Guard plate method
4. Determination of thermal resistance of a composite wall
5. Temperature distribution of a pin fin in free-convection
6. Temperature distribution of a pin fin in forced-convection
7. Forced convection heat transfer from a cylindrical surface
8. Determination of Electiveness of a Heat exchanger
9. Determination of Stefan-Boltzman constant
10. Performance of Solar still
11. Determination of critical heat flux
12. Performance of solar water heater
B.Tech. (Fifth semester) Mechanical engineering

ME 319 E
Industrial Engineering (Practical)

List of Experiments

1. To study various Rating Factor systems and find standard time for making small sand mould.

2. To study various plat layouts and suggest improvements in existing Machines Shop layout.

3. To study and draw organizational structure of a near by industry and suggest changes.

4. To draw X and R charts for a given sample of products to check their acceptance.

5. To draw p chart for a given product lot and verify its acceptance

6. Draw a flow process chart with time estimates for a simple welding process.

7. Draw a two handed process chart for a simple process of a job preparation on a lathe.

8. To study various purchase procedures and draw organizational structure of college purchase department.


10. A case study on Quality Improvement Techniques (e.g. Hostel Mess/ Workshop / Canteen etc.)

11. A market survey and analysis.

### Scheme of examination for B. Tech Degree Course
#### Sixth Semester Examination

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Teaching Schedule (Hours)</th>
<th>Examination Schedule Marks</th>
<th>Total Marks</th>
<th>Duration of Exam. Hours</th>
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<td>MET-302</td>
<td>Refrigeration &amp; Air Conditioning</td>
<td>3</td>
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<td>MET-304</td>
<td>Tribology</td>
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<td>-</td>
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<td>MET-306</td>
<td>Mechanical Vibrations</td>
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<td>1</td>
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<td>HUT-311</td>
<td>Business Management</td>
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<td>Computer added Design &amp; Manufacturing</td>
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<td>Tribology &amp; Mechanical Vibrations (Practical)</td>
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<td>MET-316</td>
<td>Computer added Design &amp; Manufacturing (Practical)</td>
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<td>MET-318</td>
<td>Machine Design-II (Viva-voce)</td>
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**B.Tech. (Sixth semester) Mechanical engineering**

**ME 302 E** Refrigeration and Air-Conditioning
UNIT I
Basics of heat pump & refrigerator; Carnot’s refrigeration and heat pump; Units of refrigeration; COP of refrigerator and heat pump; Carnot’s COP; ICE refrigeration; evaporative refrigeration; refrigeration by expansion of air; refrigeration by throttling of gas; Vapor refrigeration system; steam jet refrigeration; thermoelectric cooling; adiabatic demagnetization. Basic principles of operation of air refrigeration system, Bell-Coleman air refrigerator; advantages of using air-refrigeration in aircrafts; disadvantages of air refrigeration in comparison to other cold producing methods; simple air refrigeration in air craft; simple evaporative type air refrigeration in aircraft; necessity of cooling the aircraft.

UNIT II
Simple Vapor Compression Refrigeration System; different compression processes( wet compression, dry or dry and saturated compression, superheated compression); Limitations of vapour compression refrigeration system if used on reverse Carnot cycle; representation of theoretical and actual cycle on T-S and P-H charts; effects of operating conditions on the performance of the system; advantages of vapour compression system over air refrigeration system.
Methods of improving COP; flash chamber; flash inter cooler; optimum Interstate pressure for two stage refrigeration system; single expansion and multi expansion processes; basic introduction of single load and multi load systems; cascade systems.
Basic absorption system; COP and Maximum COP of the absorption system; actual NH₃ absorption system; functions of various components; Li-Br absorption system; selection of refrigerant and absorbent pair in vapour absorption system; Electro refrigerator; Comparison of Compression and Absorption refrigeration systems; nomenclature of refrigerants; desirable properties of refrigerants; cold storage and ice-plants.

(b) Air conditioning

UNIT III
Difference in refrigeration and air conditioning; Psychometric properties of moist air (wet bulb, dry bulb, dew point temperature, relative and specific humidity of moist air, temperature of adiabatic saturation); empirical relation to calculate P_v in moist air.
Psychometric chart, construction and use, mixing of two air streams; sensible heating and cooling; latent heating and cooling; humidification and dehumidification; cooling with dehumidification; cooling with adiabatic humidification; heating and humidification; by-pass factor of coil; sensible heat factor; ADP of cooling coil; Air washer.

UNIT IV
Classification; factors affecting air conditioning systems; comfort air-conditioning system; winter air conditioning system; summer air-conditioning system; year round air conditioning.
unitary air-conditioning system; central air conditioning system; room sensible heat factor; Grand sensible heat factor; effective room sensible heat factor.
Inside design conditions; comfort conditions; components of cooling loads; internal heat gains from (occupancy, lighting, appliances, product and processes); system heat gain (supply air duct, A.C. fan, return air duct); external heat gain (heat gain through building, solar heat gains through outside walls and roofs); solar air temperature; solar heat gain through glass areas; heat gain due to ventilation and infiltration.
Transport air conditioning; evaporative condensers, cooling towers; heat pumps.

References and Text books
Refrigeration and air-conditioning by C.P arora
Basic Refrigeration and air-conditioning by Annanthana and Rayanan, TMG
Refrigeration and air-conditioning BY Arora and Domkundwar, Dhanpat rai

NOTE: In the semester examination, the examiner will set 8 questions in all, at least two question from each unit, and students will be B.Tech. (Sixth semester)
Mechanical engineering
ME 304 E TRIBOLOGY

L    T    P/D Total   Theory: 100 marks
3    1    -    4

Sessional: 50 marks

Duration of Exam: 03 hours

UNIT I  Introduction to trobological systems and their characteristic features; analysis and assessment of surface; topography; deterministic and stochastic tribo-models for asperity contacts; techniques of surface examination; technological properties of surfaces. Quantitative laws of sliding friction, causes of friction, adhesion theory, laws of rolling friction, measurement of friction

UNIT II  ntroduction, mechanism of wear, types of wear, quantitative laws of wear, measurement of wear, wear s resistance materials

UNIT III  Introduction, dry friction, boundary lubrication, hydrodynamic, hydrostatic and elasto-hydrodynamic lubrication, functions of lubricants, types and properties, lubricant additives. Principles, application to rolling contact bearings, cams, Gears

UNIT IV  Geometry and pressure equation of journal bearing, hydrostatic bearings, thrust bearings, porous bearings and hydrodynamic gas bearings. Journal bearings with specialized applications. General requirements and different types of bearing materials.

Suggested Reading
Tribology in Indertion- By Sushil Kumar Srivastava
Introduction to Tribology of Bearings- By B.C. Majumdar ; A.H.Wheeler
Principles of Tribology – By J. Halling, Macmillan
Mechanics and Chemistry in Lubrication- By Dorinson and Ludema , Elsevier
Friction and wear of Materials- By E. Robinowicz, Johan Wiley
Principles of Lubrication-By A. Cameron, Longmans

NOTE: In the semester examination, the examiner will set 8 questions in all, at least two question from each unit, and students will be required to attempt only 5 questions, at least one from each unit.
B.Tech. (Sixth semester) Mechanical engineering

ME 306 E  MECHANICAL VIBRATION

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<tr>
<th>L</th>
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Duration of Exam: 03 hours

UNIT I  Kinematics of simple vibrating motion, Simple harmonic motions, Vectorial representation of harmonic motion. Degree of freedom, Equations of motions, general solution of free vibration, Phase plane method


UNIT IV  Transverse vibration of strings, Longitudinal vibrations of bars, Lateral vibration of beams, Torsional vibration of circular shafts, Whirling of shafts. Introduction, Method of Laplace transformation and response to an impulsive output, response to step-input, pulse-input, and phase plane method.

REFERENCE AND TEXT BOOKS:

- Mechanical vibration - By G.K. Grover; Nemchand Chand and Sons
- Mechanical Vibration – By Thomson; Prentice Hall
- Mechanical Vibration - By Den Hartog; Mc Graw Hill
- Introductory course to mechanical vibrations – By Rao and Gupta; Wiley Eastern

NOTE: In the semester examination, the examiner will set 8 questions in all, at least two question from each unit, and students will be required to attempt only 5 questions, at least one from each unit.
UNIT I
Introduction to CAD/CAM, Historical Development, Industrial look at CAD/CAM, Introduction to CIM Basic of Geometric & Solid modeling, Coordinate systems, Explicit, Implicit, Intrinsic and parametric equation Part families, Part classification and coding, product flow analysis, Machine cell Design, Advantages of GT

UNIT II
Introduction, Transformation of points & line, 2-D rotation, Reflection, Scaling and combined transformation, Homogeneous coordinates, 3-D scaling, shearing, rotation, reflection and translation, combined transformations, Orthographic and perspective projections Algebraic and geometric forms, tangent & normal blending functions, reparametrization Straight line, conics, cubic splines, bezier curves and B-spline curves

UNIT III
Algebraic and geometric forms, tangent & twist vectors, normal blending function, reparametrization, Sixteen point form, four Curve form, Plane surface, ruled surface Surface of revolution, tabulated cylinder Bi-cubic surface, bezier surface, B-spline surface Solid models and representation scheme B-rep & CSG, sweep representation, Cell decomposition, spatial occupancy enumeration

UNIT IV
Introduction, fixed programmable and flexible automation, Types of NC systems, MCU & other components, Co-ordinate system, NC manual part programming, G & M codes, part program for simple parts, Computer assisted part programming Introduction, FMS component, Types of FMS, FMS layout, Planning for FMS, advantage and applications
UNIT I
Classification of Gears; Selection of type; Law of Gearing, Standard system of Gear tooth, Various Failure modes, Interference, undercutting & minimum no. Of teeth
Force Analysis, Beam strength of Gear tooth, Effective load on tooth, Estimation of module based on beam strength and wear strength, Gear lubrication, materials; Design Procedure, Gear Box design Terminology, Force Analysis, Virtual no. of teeth, Beam strength, Effective load, Wear strength
Terminology, force analysis, beam strength & wear strength, effective load on gear tooth
Terminology, properties, force analysis, friction, material selection

UNIT II
Design of flat belts & Pulleys, Design/selection of V belts & Pulleys, Design/selection of wire ropes, Design/selection of chains
Single & multiple Plate clutch, Cone clutch
External shoe brake, Internal shoe brakes

UNIT III
Coil Springs, Leaf Springs
Hydro dynamically lubricated bearings, Selection of ball bearings, Selection of roller bearings, Selection of taper roller bearings
Mechanism Design, Design of cam & Follower

UNIT IV
Design of Cylinder, Design of Piston, Design of Crank shaft, Design of connecting rod
DESIGN OF CRANE HOOK
Design of Flywheels

SUGGESTED READING:

- Design of Machine Elements Bhandari TMH
- Machine Design Sharma Aggarwal Katson Publishers
- PSG Design Data Book PSG College of Engg PSG Publication
- Machine Design an integrated Approach Robert l Norton, prentice hall
List of Experiments

1. Study & Performance of basic vapour compression Refrigeration Cycle.
2. To find COP of water cooler.
3. To study the walk in cooler.
4. To study and perform experiment on vapour absorption apparatus.
5. Perform the experiment & calculate various. Performance parameters on a blower apparatus.
6. To find the performance parameter of cooling tower.
7. To study various components in room air conditioner.
8. To find RH of atmosphere air by using sling Psychometric and Psychometric.
9. To find performance of a refrigeration test rig system by using different expansion devices.
10. To study different control devices of a refrigeration system.
11. To study various compressor.
12. To find the performance parameters of Ice Plant.

Note: Total Ten experiments must be performed. At least eight experiments should be performed from the above list. Remaining two experiments may either be performed from the above list or outside the list.
B.Tech. (Sixth semester) Mechanical engineering  
ME 314 E TRIBOLOGY & MECHANICAL VIBRATION (PRACTICAL)  

Practical: 25Marks  
Sessional: 50 marks  
Duration of Exam: 03 hours  

LIST OF EXPERIMENT:

1. To study undamped free vibrations of equivalent spring mass system and determine the natural frequency of vibrations  
2. To study the free vibration of system for different damper settings. Draw decay curve and determine the log decrement and damping factor. Find also the natural frequency  
3. To study the torsional vibration of a single rotor shaft system and to determine the natural frequency.  
4. To determine the radius of gyration of given bar using bifilar suspension.  
5. To verify the dunker ley's rule  
6. To study the forced vibration of system with damping. Load magnification factor vs. Frequency and phase angle vs frequency curves. Also determine the damping factor.  
7. To study the pressure distribution of a journal bearing using a journal bearing apparatus.  
8. To determine the rate of wear of a metallic pin from the plot of displacement vs time curves by using friction and wear monitor apparatus.  
9. To determine abrasion index of a material with the help of dry abrasion test rig.  
10. To evaluate the load wear index and the weld point of a lubricant with the help of a four ball stream pressure tester.  
11. To determine the two frequencies of torsional spring type double pendulum & compare them with theoretical values.  
12. To determine the radius of gyration of a compound pendulum.  
13. To determine the radius of gyration of disc using trifilar suspension.  

Note: Total Ten experiments must be performed. At least eight experiments should be performed from the above list. Remaining two experiments may either be performed from the above list or outside the list.
1. Introduction to Automobile Engineering:
Brief history of automobiles, Main components of an automobile, Brief description of each component.

2. Power requirements in an automobile:
Brief description of constructional details and working of a four stroke I.C. Engine (S.I. Engines and C.I. Engines) including lately developed overhead cam shaft, Multi-cylinder engines, Introduction to recent developments in I.C. Engines- Direct injection systems, Multi-Point fuel injection systems, Microprocessor based fuel supply systems, Multi valve engines, Mechanical balancing, Firing Order, Power balancing, Power overlap, Power flow charts.

3. Transmission System of Automobile:
Introduction, Brief description of different components of Transmission System.
   (a) Clutch: Introduction to clutch and its different types, Principle of Friction Clutch, Clutch Lining and friction materials used in Friction Clutches, Torque transmitted, Brief description of Cone Clutch, Single Plate and Multiplate Clutches, Dry and wet clutches, Automatic clutch action, Centrifugal clutches, Electromagnetic clutches, Fluid Flywheel.
   (b) Gear Box: Air resistance, gradient resistance and rolling resistance coming across a moving automobile, Tractive effort, Variation in tractive effort with speed, Performance curves (object and need of a gear box), Sliding mesh gear box, Control mechanism, Sliding type selector mechanism, Ball type selector mechanism, Steering column gear shift control, Constant mesh gear box, Synchromesh device, Automatic transmission in general, AP automatic gear box, Torque converter, Torque converter with direct drive, Lubrication of Gear Box.
   (d) Differential: Principle of operation, Constructional details of a typical -differential Unit, Traction control differentials, Multi-plate clutch’ type traction control device Traction control by viscous coupling.
   (e) The back axle: Live back axles, The final drive, single reduction live axle, Torque reaction, Driving thrust, torque & thrust member arrangements, spring serving as torque and thrust members, Hotchkiss drive with torque reaction member, single combined torque - thrust reaction member, with springs taking only vertical and lateral loads.Transverse radius rods, Three radius rods, Axle construction, Effects of wheel bearing layout on axle loading, Some actual bearing arrangements, Axle casing construction, The double reduction axles.

4. Running system:
   (a) Wheel and rim, Tyre and its function and constructional details.
   (b) Brakes. Funtion and its method of operation, Brake efficiency, Elementary theory of shoe brake, brake shoe adjustment, A modern rear wheel brake, Disk brakes, Brake linkages, Leverages and adjustment of brake linkage, Servo and power-operated brakes, Vacumm brake operation, Hydraulic Brakes-constructional details and working, Bendix Hydrovac, Direct action vacuum
servos, Power operated brakes, A dual power air brakes system, Compressed air systems, 
Actuating cyclinders for air brakes.

5. Suspension System:
Suspension principles, Road irregularities and human susceptibility, Suspension system, 
Damping, Double tube damper, Single tube damper, Lever arm type damper, Springs-Leaf 
springs, Coil and torsion springs, variable rate springs, Composite leaf springs, Rubber springs, 
Air springs, Adjustable and self-adjusting suspensions, Interconnected suspension system, Interconnected air and liquid suspensions, Independent suspension system, Different independent suspension layouts, McPherson strut type. Rear suspension-live axle, Torque reaction and axle guidance, Watt's linkage. Rear suspension-dead axles, Rear suspension-independent, McPherson strut rear suspension.

6. Steering Mechanism:
Steering geometry, Castor, Camber, Kingpin inclination, Combined angle, Toe in, Steering 
system-basic aims, Ackerman linkage, Steering linkages for independent suspension, Center 
point steering, Costarring or trailing action Cornering power, Self-righting torque, Steering 
characteristics-over steer and under steer, Axle beam, Stub-axle construction, Steering column, 
Reversible and irreversible steering, Rack-and-pinion steering mechanism, Effect of toe-in on 
steering, Power steering, Vickers System.

7. Recent trends in Automobile Engineering:
Multi-fuel automobiles, Automobiles running on alternate sources of energy, Emission control 
through catalytic converter, Double catalytic converter, Aspects of pollution control in 
Automobiles.
1. Introduction:
Definition, application of measurement instrumentation, functional elements of a
generalized measuring system, measuring standards, types of measurement,
types of input to measuring instruments and instrument system, classification of
measuring instruments, merits and demerits of mechanical measuring systems,
comparison of mechanical measuring system with electrical measuring systems,
calibration.

2. Generalized performance characteristics of instruments:
Introduction, types of error, types of uncertainties, propagation of uncertainties
in compound quantity, Static performance parameters: accuracy, precision,
resolution, static sensitivity, linearity, hysteresis, dead band, backlash, and drift.,
Sources of error, selection of a measuring instruments, mechanical and electrical
loading, fundamentals dynamic characteristics, generalized mathematical model
of measuring systems,
types of input, dynamic performance parameters: dynamic error speed of
response, etc, dynamic response of a first order mechanical system with different
inputs e.g. step, ramp, sinusoidal and impulse input.

3. Statistical analysis of experimental data:
Introduction, types of measuring data, statistical attributes, various method of
presentation, estimation of presentation and uncertainties, confidence level,
precision and statistical treatments of single and multi sample type experimental
data, Chauvenet’s criteria of rejecting a dubious data, curve fitting, best linear
calibration and its precision, significant figures and rounding off. Overall
uncertainty estimation of measuring systems, common sense approach, and
engineering applications.

4. Transducers:
Introduction, primary function, classification, electrostatic transducers: principle
time theory, types, advantages, and limitations, Fixed contact mechano-resistive
transducers: classification, and uses, Metallic resistance strain gauge: types,
construction theory of operation, Adhesive: property,
selection criteria, mounting of strain gauges, Mathematical analysis of ballast –
and DC Wheatstone bridge circuits, characteristic and comparison of ballast and
DC Wheatstone bridge circuits, temperature effects and their compensation.

5. Measuring of Non-electrical Physical quantities.
Measurement of load, force, and thrust using resistant strain gauges, Elastic load
cells, proving rings, fluid pressure measurement in pipe and containers, using strain gauges, measuring of torque in transmission shaft under axial and bending loads in varying ambient conditions.

6. Control Systems:
Introduction, classification of control systems, control system terminology, servomechanism, process control and regulators, Manual and automatic control systems, physical systems and mathematical models, linear control systems, Laplace transform, transfer function, block diagram, signal flow graphs, system stability, Time and frequency domain.

7. Hydraulic and Pneumatic control systems:
Introduction, functional operation, desirable characteristics of hydraulic fluids, hydraulic control systems: hydraulic pump, hydraulic control valve, Pneumatic control systems: pneumatic nozzle, relay, advantages and limitation of such control systems.

Reference and Text Books:
1. Mechanical measurements & control- By D.S. Kumar, Metropolitan book
2. Instrumentation and Mechanical measurements - By AX. Tayal, Galgotia Pub!
3. Measurements systems application and design -By Ernest Doebelin, McGraw-Hili
MET- 405 Statistical Quality Control and Reliability

L T P/D Total Theory: 75 marks
4 1  5  5 Sessional: 50 marks
Duration of Exams. : 03 hours

1. Introduction:
Quality-Basic Concepts: Issues in Quality, factors affecting quality, creating quality by
design, product development cycle, economics of quality, Various definitions, ISO
definition of quality and its meanings, and various phases till TQM and its meaning to
industries, customers, and employees, contribution of quality gurus etc. towards
quality concepts. Total Quality Management: its scope, application and
implementation. Quality Circle: its objectives, structure and techniques. Variability
concept in manufacturing cycle, fish bone diagrams, charts in time philosophy.

2. Quality Control:
Basic statistical concepts, various types of distributions, General theory X and R chart.
Decision preparatory to the control charts. Trial control limits. Selection of subgroups.
Charts with variable subgroups, Reject and Revoke, limits for average on X charts,
modified control limits, specification limits, practical limitations. Control charts for
fraction defectives, calculation and plotting of control limits, sensitivity of p chart,
applications. Control charts for Defects, difference between defect and defective,
calculation and plotting of control limits, applications. pi charts and u charts, plotting
of charts. Tests for various control charts. Process capability- inherent and potential
capability.

3. Acceptance Sampling:
Purpose of Acceptance by Attributes, Single sampling plans. G.C. curve, selection of
sampling plans, Acceptance number, Type A and Type B O.C. curves, Double
sampling plan and its analysis, Multiple and sequential sampling, A.O.Q.L.,
Acceptance sampling plans under risk. Design of various sampling plans, Dodge-
Roming type system for acceptance sampling by attributes (use of various tables).
Determination of process, average, Acceptance sampling by variables.

4. Reliability:
Control of reliability, factors affecting reliability, pattern of failure, mean time to
failure. Fundamentals of statistical concepts. Consideration of reliability in series and
parallel system, effect of redundancy and reliability, method of reliability
evaluation, reliability, optimization, Availability and Maintainability, Means to
improve reliability, Reliability control during manufacture.
List of Experiments

1. Study of a strain gage based cantilever beam and measurement of strain on the beam
2. Study of a LVDT and measurement of linear displacement
3. Study of an inductive pick up and measurement of linear displacement
4. Study of a LDR and measurement of linear displacement
5. Study of capacitive pick up and measurement of angular displacement
6. Study of temperature transducers and measurement of temperature of fluid
7. Study of a LVDT (strain gage based) and measurement of linear displacement
8. Study of a torque pick up and measurement of torque
9. Study of a pressure pick up and measurement of pressure of fluid
10. Study of a load cell and measurement of load with load cell
11. Study of non-contact type speed pick up and measurement of rotational speed
12. Comparison of sensitivity of thermocouple, thermister and RTD

Note: The students must perform at least eight experiments.
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* Refer List of Elective and Open Elective
MET - 401 Automobile Engineering

L T P/D Total Theory Sessional Duration of Exams.
4 1 - 5 : 75 marks : 50 marks : 03 hours

1. Introduction to Automobile Engineering:
Brief history of automobiles, Main components of an automobile, Brief description of each component.

2. Power requirements in an automobile:
Brief description of constructional details and working of a four stroke I.C. Engine (S.I. Engines and C.I. Engines) including lately developed overhead cam shaft, Multi-cylinder engines, Introduction to recent developments in I.C. Engines- Direct injection systems, Multi-Point fuel injection systems, Microprocessor based fuel supply systems, Multi valve engines, Mechanical balancing, Firing Order, Power balancing, Power overlap, Power flow charts.

3. Transmission System of Automobile:
Introduction, Brief description of different components of Transmission System.
(a) Clutch: Introduction to Clutch and its different types, Principle of Friction Clutch, Clutch Lining and friction materials used in Friction Clutches, Torque transmitted, Brief description of Cone Clutch, Single Plate and Multiplate Clutches, Dry and wet clutches, Automatic clutch action, Centrifugal clutches, Electromagnetic clutches, Fluid Flywheel.
(b) Gear Box: Air resistance, gradient resistance and rolling resistance coming across a moving automobile, Tractive effort, Variation of tractive effort with speed, Performance curves (object and need of a gear box), Sliding mesh gear box, Control mechanism, Sliding type selector mechanism, Ball type selector mechanism, Steering column gear shift control, Constant mesh gear box, Synchromesh device, Automatic transmission in general, AP automatic gear box, Torque converter, Torque converter with direct drive, Lubrication of Gear Box.
(d) Differential: Principle of operation, Constructional details of a typical -differential Unit, Traction control differentials, Multi-plate clutch' type traction control device Traction control by viscous coupling.
(e) The back axle: Live back axles, The final drive, single reduction live axle, Torque reaction, Driving thrust, torque & thrust member arrangements, spring serving as torque and thrust members, Hotchkiss drive with torque reaction member, single combined torque - thrust reaction member, with springs taking only vertical and lateral loads. Transverse radius rods, Three radius rods, Axle construction, Effects of wheel bearing layout on axle loading, Some actual bearing arrangements, Axle casing construction, The double reduction axles.

4. Running system:
(a) Wheel and rim, Tyre and its function and constructional details.
(b) Brakes. Function and its method of operation, Brake efficiency, Elementary theory of shoe brake, brake shoe adjustment, A modern rear wheel brake, Disk brakes, Brake linkages, Leverages and adjustment of brake linkage, Servo and power-operated brakes, Vacuum brake operation, Hydraulic Brakes-constructional details and working, Bendix Hydrovac, Direct action vacuum
servos, Power operated brakes, A dual power air brakes system, Compressed air systems, Actuating cylinders for air brakes.

5. Suspension System:
Suspension principles, Road irregularities and human susceptibility, Suspension system, Damping, Double tube damper, Single tube damper, Lever arm type damper, Springs-Leaf springs, Coil and torsion springs, variable rate springs, Composite leaf springs, Rubber springs, Air springs, Adjustable and self-adjusting suspensions, Interconnected suspension system, Interconnected air and liquid suspensions, Independent suspension system, Different independent suspension layouts, McPherson strut type. Rear suspension-live axle, Torque reaction and axle guidance, Watt's linkage. Rear suspension-dead axles, Rear suspension-independent, McPherson strut rear suspension.

6. Steering Mechanism:
Steering geometry, Castor, Camber, Kingpin inclination, Combined angle, Toe in, Steering system-basic aims, Ackerman linkage, Steering linkages for independent suspension, Center point steering, Costarring or trailing action Cornering power, Self-righting torque, Steering characteristics-over steer and under steer, Axle beam, Stub-axle construction, Steering column, Reversible and irreversible steering, Rack-and-pinion steering mechanism, Effect of toe-in on steering, Power steering, Vickers System.

7. Recent trends in Automobile Engineering:
Multi-fuel automobiles, Automobiles running on alternate sources of energy, Emission control through catalytic converter, Double catalytic converter, Aspects of pollution control in Automobiles.
1. **Introduction:**
Definition, application of measurement instrumentation, functional elements of a generalized measuring system, measuring standards, types of measurement, types of input to measuring instruments and instrument system, classification of measuring instruments, merits and demerits of mechanical measuring systems, comparison of mechanical measuring system with electrical measuring systems, calibration.

2. **Generalized performance characteristics of instruments:**
Introduction, types of error, types of uncertainties, propagation of uncertainties in compound quantity, Static performance parameters: accuracy, precision, resolution, static sensitivity, linearity, hysteresis, dead band, backlash, and drift., sources of error, selection of a measuring instruments, mechanical and electrical loading, fundamentals dynamic characteristics, generalized mathematical model of measuring systems, types of input, dynamic performance parameters: dynamic error speed of response, etc, dynamic response of a first order mechanical system with different inputs e.g. step, ramp, sinusoidal and impulse input.

3. **Statistical analysis of experimental data:**
Introduction, types of measuring data, statistical attributes, various method of presentation, estimation of presentation and uncertainties, confidence level, precision and statistical treatments of single and multi sample type experimental data, Chauvenet’s criteria of rejecting a dubious data, curve fitting, best linear calibration and its precision, significant figures and rounding off. Overall uncertainty estimation of measuring systems, common sense approach, and engineering applications.

4. **Transducers:**
Introduction, primary function, classification, electrostatic transducers: principle theory, types, advantages, and limitations, Fixed contact mechano-resistive transducers: classification, and uses, Metallic resistance strain gauge: types, construction theory of operation, Adhesive: property, selection criteria, mounting of strain gauges, Mathematical analysis of ballast – and DC Wheatstone bridge circuits, characteristic and comparison of ballast and DC Wheatstone bridge circuits, temperature effects and their compensation.

5. **Measuring of Non-electrical Physical quantities.**
Measurement of load, force, and thrust using resistant strain gauges, Elastic load
cells, proving rings, fluid pressure measurement in pipe and containers, using strain gauges, measuring of torque in transmission shaft under axial and bending loads in varying ambient conditions.

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3. Measurements systems application and design - By Ernest Doebelin, McGraw-Hili
MET- 405 Statistical Quality Control and Reliability

L        T        P/D       Total        Theory: 75 marks
4        1        5          5          Sessional: 50 marks

Duration of Exams. : 03 hours

1. Introduction:
Quality-Basic Concepts: Issues in Quality, factors affecting quality, creating quality by
design, product development cycle, economics of quality, Various definitions, ISO
definition of quality and its meanings, and various phases till TQM and its meaning to
industries, customers, and employees, contribution of quality gurus etc. towards
quality concepts. Total Quality Management: its scope, application and
implementation. Quality Circle: its objectives, structure and techniques. Variability
concept in manufacturing cycle, fish bone diagrams, charts in time philosophy.

2. Quality Control:
Basic statistical concepts, various types of distributions, General theory X and R chart.
Decision preparatory to the control charts. Trial control limits. Selection of subgroups.
Charts with variable subgroups, Reject and Revoke, limits for average on X charts,
modified control limits, specification limits, practical limitations. Control charts for
fraction defectives, calculation and plotting of control limits, sensitivity of p chart,
applications. Control charts for Defects, difference between defect and defective,
calculation and plotting of control limits, applications. pi charts and u charts, plotting
of charts. Tests for various control charts. Process capability- inherent and potential
capability.

3. Acceptance Sampling:
Purpose of Acceptance by Attributes, Single sampling plans. G.C. curve, selection of
sampling plans, Acceptance number, Type A and Type B O.C. curves, Double
sampling plan and its analysis, Multiple and sequential sampling, A.O.Q.L.,
Acceptance sampling plans under risk. Design of various sampling plans, Dodge-
Roming type system for acceptance sampling by attributes (use of various tables).
Determination of process, average, Acceptance sampling by variables.

4. Reliability:
Control of reliability, factors affecting reliability, pattern of failure, mean time to
failure. Fundamental of statistical concepts. Consideration of reliability in series and
parallel system, effect of redundancy and reliability, method of reliability
evaluation, reliability, optimization, Availability and Maintainability, Means to
improve reliability, Realiability control during manufacture.
List of Experiments

1. Study of a strain gage based cantilever beam and measurement of strain on the beam
2. Study of a LVDT and measurement of linear displacement
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5. Study of capacitive pick up and measurement of angular displacement
6. Study of temperature transducers and measurement of temperature of fluid
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8. Study of a torque pick up and measurement of torque
9. Study of a pressure pick up and measurement of pressure of fluid
10. Study of load cell and measurement of load with load cell
11. Study of non-contact type speed pick up and measurement of rotational speed
12. Comparison of sensitivity of thermocouple, thermister and RTD

Note: The students must perform at least eight experiments.
**MET - 409  Project - I**

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<td>Duration of Exams.</td>
<td>03 hours</td>
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The student is expected to take up a project under the guidance of teacher from the college. The project must be based on the mechanical engineering problems, which will extend full academic session in two parts. The student may be asked to work individually or in-group with not more than four students. Viva-voce must be based on the preliminary report submitted by student(s) related to project.

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**MET – 411 Seminar**

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Students will give a talk on some new technical topics.
Note: The seminar will continue in the eight semester and will be evaluated in the eight semester.

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### MET – 413 Practical Training Report

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**Duration of Exams: 03 Hours**

**DEPARTMENT OF MECHANICAL ENGG.**

**ELECTIVE & OPEN ELECTIVES (SEVENTH SEMESTER)**

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### Scheme of examination for B. Tech Degree Course

#### 8th Sem (Mechanical Engineering)

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* Refer List of Elective and Open Elective

** Project II is independent of Project I and will be completed in 8th sem. itself.
PART A

Unit-I Introduction
Evolution of maintenance, objective of maintenance, maintenance policies and philosophies, maintenance concept, maintenance management and Terro Technology, relationship with other functional areas, importance of maintenance, elements of good maintenance economics of maintenance, training and safety aspect in maintenance

Unit-II Maintenance strategies
Classification of maintenance programs, Corrective, preventive & Predictive maintenance, comparison of maintenance program, preventive maintenance concept, function, benefit, limitations

Unit-III Condition Based Maintenance (CBM)
Objective, What to monitor, when to monitor, principal of CBM, Condition based maintenance techniques, Manual inspection, performance monitoring, Vibration monitoring, Current monitoring, coil debris/spectroscopy, thermography and corrosion monitoring, step in implementation of CBM, benefit of CBM

UNIT-IV Reliability Centered Maintenance (RCM)
RCM logic maintenance and RCM, benefit of RCM, Total productive maintenance(TPM), introduction, key supporting element of TPM, methodology, evaluation and benefit

PART-B

Unit-V Non-Destructive Testing (NDT)
Purposes and challenges, techniques, Visual Aids- boroscopes, endoscopes, fiber optics scanner, magnetic particle inspection, liquid penetrants, eddy current, ultrasonic radiography, selection of NDT technique, merits and demerit and application of various Techniques.

Unit-VI Maintenance Planning and Control
Basic ingredients basic steps in maintenance management, maintenance planning and control system, documentation, maintenance productivity areas for improvement.

UNIT-VII Reliability Maintenance & Availability
Techniques For improvements of operational reliability, safety and availability of machines and production system, maintainability criteria, checklist to assess the
maintainability of a system. Maintainability program, objectives, key issues in availability improvements program, fault diagnosis, pareto principal ishikawa diagram

UNIT-VIII Application of Computers to Maintenance Management
Data processing System for Integrated Maintenance, Maintenance Information And reporting systems
CET - 423  Environmental Engineering

L  T  P/D  Total  Theory: 75 marks
3  1  -  4  Sessional: 50 marks

Duration of Exams: 03 hours
Max. Marks: 125

Introduction: Environment & its segment, Biosphere, impact of humans upon environment, impact of humans upon environment, Biodiversity and sustainable development.

Ecology: Meaning, scope and subdivision of ecology ecosystems and its types, Energy flow (Radiation & Heat Budget) food chains, trophic levels, ecological pyramid, biogeochemical cycles - nitrogen, sulphur and phosphorous cycles. Ecological balance in nature, consortium and ranks of consortium, Sources and effects of radio-actives fall-outs, disposal of radioactive waste, chemical and biological agents and effects of chemical and biological warfare, population Explosion - its affects & India’s scenario.

ENERGY & ENVIRONMENT:
Energy, uses of energy, historical background, economic of energy, conventional and non conventional sources of energy, renewable energy sources (such as solar, wind, tidal, wave, geothermal, hydro and biomass energy), and their environmental impacts with special references on Indian scenario.

Air pollution: Composition and structure of atmosphere, classification and sources of air pollutants, Meteorological parameters influencing air pollution, plume behavior, effects of air pollution on meteorological conditions like green house effects ozone depletion & acid rains, effects of air pollution on plants, animals and human health & economic effects of air pollution. El-Nin and its affects. Automobile pollution - effects and control measures and techniques of air pollution control. Air pollution control devices like settling chamber, cyclones, ESP, Bag, filters, catalytic convertors etc.

Noise pollution: General introduction to noise pollution, human acoustic. Unit of measurement, loudness, measurements of noise & weighting networks, sources and effects of noise pollution, noise abatement / control and noise standards.

Solid wastes: Definition, types and composition, sources of solid wastes, method of disposal, land filling, incineration, pulverization,
Compositioning. Selection of method of disposal. Solid waste management and reuse of material.

**Recommended Books:**
3. Air Pollution By: M.N. Rao
MET- 402 Entrepreneurship

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1. **Engineering Economics:**
   Definition and concept, Importance of economics for engineers, present value and future value, Wealth, Goods, Wants, Value and price, capital, money, utility of consumer and producer goods.

2. **Costing:**
   Introduction, Elements of cost, Prime cost, Overhead, Factory cost, Total cost, Selling price, Nature of cost, Types of cost.

3. **Depreciation:**
   Definition and concept, Causes of depreciation, Methods of calculating depreciation.

4. **Economic analysis of investment and selection of alternatives:**
   Introduction, Nature of selection problem, Nature of replacement problem, Replacement of items which deteriorate, Replacement of machines whose operating cost in crease with time and the value of money also changes with time, methods used in selection of investment and replacement alternatives.

5. **Entrepreneurship:**
   Entrepreneurship, Role of entrepreneur in Indian economy, Characteristics of an entrepreneur, Types of entrepreneurs, some myths and realities about entrepreneurship

6. **Small scale Industries:**
   Introduction, Role and scope of small scale industries, concept of small scale and ancillary industrial undertakings, How to start a small scale industry, Steps in launching own venture, procedure for registration of small scale industries, various development:tl agencies-their functions and role in industrial and entrepreneurship development, Infrastructure facilities available for entrepreneurship development in India.

7. **Product planning and Development:**
   Introduction, Requirement of a good product design, product development approaches, Product development process, Element of Concurrent engg., Quality function development, rapid prototyping, various controlling agencies, involved - their role and formalities for getting clearance before starting individual venture

8. **Financial management:**
   Financial concept for small-scale industries, financial requirements Financial support programmer of banks, government financial agencies, Hire-purchase facilities alternate sources of finance.

9. **Marketing:**
The modern concept of marketing, Definitions, functions and principle of marketing, Marketing research, Advertising, Market survey, Pre-feasibility and feasibility of project. Identification and evaluation of business opportunity, risk involved and preparation of business plan.

10. Preparation of feasibility Project Report:
Tools for evaluation of techno economic feasibility project report, SWOT analysis

Reference and Text Books:
Handbook of Entrepreneurship - By Rao and Pareek
Automobile Engineering - By K.M. Gupta, Umesh Publications
1. **Sources of Energy:**
Conventional and non-conventional sources of energy; Importance of electrical energy; Geothermal power plants; Tidal power plants; Windmills; Solar power plants; Direct energy conversion systems; Energy sources in India; Recent developments in power plants.

2. **Hydro Power Plants:**
Hydrology: rainfall, runoff, hydrographs, flow duration curves; Site selection for hydro power plants; Classification of hydro power plants; Storage type hydro power plant and its operation; Estimation of power availability; Selection of water turbines; Combination of hydro power plants with steam plants; advantages and disadvantages of hydro power points.

3. **Steam (Thermal) Power Plants:**
Analysis of steam power cycles for power plant application; High pressure boilers- La-Mont boiler, Benson boiler; Luffler boiler; Velox boiler; Super pressure steam power plants; Economizers; Air-preheaters; Super heaters and reheaters; Feed water heaters. General layout of thermal power plant; Site selection for thermal power plant; Coal as fuel, classification of coals, analysis of coal; Coal handling; Dead and live storage; Combustion of coal: coal burning methods, overfeed stokers, underfeed stokers, pulverized fuels and burners. Ash handling and disposal; Dust collectors. Heat balance sheet for thermal power plants.

4. **Diesel Power Plants:**
Introduction; Field of use; Outline of diesel electric power plant; Different systems of diesel power plant; Supercharging of diesel engines; Performance of diesel power plant; Advantages and disadvantages of diesel plants over thermal power plants.

5. **Gas Turbine Plants:**
Elements of plant; Thermal refinements; Performance of plants; Gas turbine characteristics; Comparison with other plants; Combined steam and gas turbine power plants.

6. **Nuclear Power Plants:**
Basic theory and terminology; Nuclear fission and fusion processes; Fission chain reaction; Moderation; Fertile materials; Nuclear fuels; General components of nuclear reactor; Different types of reactors; Breeder reactors; Nuclear power plants in India; Disposal of nuclear waste.

7. **Fluctuating-Loads on Power Plants:**
Introduction; Load curves; Different terms and definitions; Effects of variable loads on power plant design and operations.

8. **Economic Analysis of Power plants and Tariffs:**
Cost of electrical energy; Selection of type of generation; selection of generating
equipment; performance and operating characteristics of power plants; Load division among generators; Tariffs methods for electrical energy.

**Reference and Text Books:**
1. Power Plant Engineering - By Morse
1. Introduction:
Development of operations Research, characteristics and scope of operations
Research, operations Research in Management, Models in operations Research, Model
Formulation, Types of mathematical models, Limitations of operations Research.

2. Linear Programming:
L.P. models, simplex method, the algebra of simplex method. (Minimization and
Minimization problems), The big M method, post optimality analysis, essence of
duality theory, Application of sensitivity analysis.

3. Transportation & Assignment:
Introduction to model, matrix terminology, Formulation and solution of
Transportation model (least cost method, Vogel's Approximation method) , Least
time transportation problem, Assignment problems.

4. Net Work Analysis:
Introduction to net work logic, Numbering of events (Fulkersen Rule), PERT
calculations - Forward path, backward path. Slack, probability, comparison with
PERT, Critical path, Floats. Project cost, crashing the network, updating (PERT and
CPM).

5. Simulation:
Introduction, applications of simulation, advantages and limitations of simulation
technique, generation of random numbers, Time-flow mechanism, simulation
languages.

6. Decision Analysis:
Steps in decision theory approach, Decision machinery environment, Decision
machining under certainty and uncertainty, Decision ma..:hining under conditions of
risk, Decision Trees, minimum enchained criteria, Advantages and limitations of
decision tree solutions, post-optimality.

7. Queuing Theory:
Introduction, Applications of queuing Theory, Waiting time and idle time costs,
single channel queuing theory and multi channel queuing theory with Poisson
arrivals and exponential services, Numericals on single Channel and multi channel
queuing theory.

8. Game Theory:
MET- 408 Entrepreneurship (Practical)

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1. Exercises on assessing the industrial potentiality of any particular area.
2. Exercise on market survey for product identification and demand estimation of the product.
3. Exercise on preparation of techno economic feasibility product project report.
4. Presentation and group discussion on techno economic feasibility project report.

MET- 410 Projects - II

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The student is expected to finish the remaining portion of the project.
1. **Introduction:** Unconventional machining processes, Rapid prototyping processes, their classification, considerations in process selection.

2. **Ultrasonic Machining:**
   Elements of process, design of cutting tool, metal removal mechanism, effect of parameters, economic considerations, limitations and applications, surface finish.

3. **Electrochemical Machining:**
   Elements of process, process chemistry, metal removal mechanism, tool design, accuracy, surface finish and work material characteristics, economics advantages, limitations and applications, Electrochemical grinding, debarring and honing, Chemical machining.

4. **Electric Discharge Machining:**
   Principle and mechanism of metal removal, generators, electrode feed control, electrode material, tool electrode design, EDM wire cutting, surface finish, accuracy and applications.

5. **Jet Machining:**
   Principal and metal removal mechanism of abrasive and water jet machining, process variables, design of nozzle, advantages, limitations and applications.

6. **Other Machining Processes:**
   Plasma arc machining, Electron beam machining, Laser beam machining, their principles and metal removal mechanism, process parameters, advantages and limitations, applications.

7. **Rapid Prototyping Processes:**
   Fundamentals, process chain, physics of processes, principles and process mechanism of SLA, SGC, LOM, FDM and SLS processes, their advantages and limitations, applications of RP processes, RP data formats, STL file format, STL file problems, STL file repair, other translators and formats.

8. **Rapid Tooling Processes:**
   Introduction, fundamentals, classification, indirect RT processes, Principles of Silicone Rubber Molding, Epoxy Tooling, Spray Metal Tooling, Pattern for Investment Casting, Vacuum Casting, and Vacuum forming processes, direct RT processes, Shape Deposition manufacturing, their advantages, limitations and applications.

**Reference and Text Books:**
Modern machining processes -By P.C. Pandey and H.S. Shan, TMH.
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