APPENDIX 3-B Course Syllabi

Department offering the course, type of course and some other details can be understood from the course code as given below.

The course code has the general format (two letters followed by four digits):

\[ XYijkl \]

- **XY**: Code for department offering the course (e.g.: ME for Mechanical Engineering Dept.)
- **i**: Level of the course (e.g.: 1 indicates a course for first year students).
- **j**: Stream to which the subject belongs (0: Thermal or Design and 1: Manufacturing or Industrial Engineering)
- **kl**: 01 – 10: Core theory course of odd semester (Monsoon Semester)
  - 11-- 20: Core theory course of even semester (Winter Semester)
  - 21 – 90: Elective course
  - 91 -- 99: Practical/Seminar/Project course

The suggested evaluation methodology for each course is given along with the syllabus. However, the course instructors are given the freedom to make minor deviations for this guideline. The adopted evaluation policy should be informed to the students during the first instructional week of the semester, and should be approved in the first class committee meeting.
SEMESTERS 1 & 2
MA1001 - MATHEMATICS – I

Prerequisite: Nil

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Module I: Preliminary Calculus & Infinite Series (9L + 3T)

**Preliminary Calculus**: Partial differentiation, Total differential and total derivative, Exact differentials, Chain rule, Change of variables, Minima and Maxima of functions of two or more variables.

**Infinite Series**: Notion of convergence and divergence of infinite series, Ratio test, Comparison test, Raabe’s test, Root test, Series of positive and negative terms, Idea of absolute convergence, Taylor’s and Maclaurin’s series.

Module II: Differential Equations (13L + 4T)

**First order ordinary differential equations**: Methods of solution, Existence and uniqueness of solution, Orthogonal Trajectories, Applications of first order differential equations.

**Linear second order equations**: Homogeneous linear equations with constant coefficients, fundamental system of solutions, Existence and uniqueness conditions, Wronskian, Non homogeneous equations, Methods of Solutions, Applications.

Module III: Fourier Analysis (10L + 3T)


Module IV: Laplace Transforms (11L + 3T)

Gamma functions and Beta functions, Definition and Properties. Laplace Transforms, Inverse Laplace Transforms, shifting Theorem, Transforms of derivatives and integrals, Solution of differential Equations, Differentiation and Integration of Transforms, Convolution, Unit step function, Second shifting Theorem, Laplace Transform of Periodic functions.

Text Book:


References:


Course Outcomes

**CO1:** Learn to find the solution of constant coefficient differential equations.

**CO2:** Acquire knowledge about the notion of convergence of numerical sequences and series and learn ways of testing convergence.

**CO3:** Learn the basic definition and properties of partial differentiation of functions of several variables and to learn to use this to solve problems related to maxima and minima.

**CO4:** Learn the basic results about the properties of Fourier transform and Fourier series and its convergence.

**CO5:** Learn the properties of Laplace transforms and to learn to use this to solve differential equations.

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Module 1 – Theory of Relativity  (6 hours)
Frames of reference, Galilean Relativity, Michelson-Morley experiment, postulates of Special Theory of Relativity, Lorentz transformations, simultaneity, length contraction, time dilation, velocity addition, Doppler effect for light, relativistic mass and dynamics, mass energy relations, massless particles, Description of General Theory of Relativity.

Module 2 - Quantum Mechanics  (10 hours)
Dual nature of matter, properties of matter waves, wave packets, uncertainty principle, formulation of Schrödinger equation, physical meaning of wave function, expectation values, time-independent Schrödinger equation, quantization of energy – bound states, application of time-independent Schrödinger equation to free particle, infinite well, finite well, barrier potential, tunneling, Simple Harmonic Oscillator, two-dimensional square box, the scanning tunneling microscope.

Module 3 – Statistical Physics  (12 hours)
Temperature, microstates of a system, equal probability hypothesis, Boltzman factor and distribution, ideal gas, equipartition of energy, Maxwell speed distribution, average speed, RMS speed, applications – Lasers and Masers, Quantum distributions – many particle systems, wave functions, indistinguishable particles, Bosons and Fermions, Bose-Einstein and Fermi-Dirac distribution, Bose-Einstein condensation, Specific heat of a solid, free electron gas and other applications.

Module 4 – Applications to Solids  (14 hours)
Band theory of solids, conductors, semi-conductors and insulators, metals – Drude model and conductivity, electron wave functions in crystal lattices, E-k diagrams, band gaps, effective mass, semiconductors, Fermi energy, doping of semiconductor, conductivity and mobility of electrons, Hall effect, Fundamentals of mesoscopic physics and nano technology: size effects, interference effect, quantum confinement and Coulomb blockade. Quantum wells, wires, dots, nanotubes, semiconductor nano materials, Magnetism: dipole moments, paramagnetism, Curie’s law, magnetization and hysteresis, Ferromagnetism and Anti-Ferromagnetism.

Text Books

References


Course Outcomes

CO1: Acquire knowledge and understanding of fundamental principles of modern physics.
CO2: Acquire knowledge of basic principles of Quantum Physics and Relativity.
CO3: Acquire knowledge of the basic physics of a collection of particles and the emergent macroscopic properties.
CO4: Apply principles of quantum and statistical physics to understand properties of semiconducting and magnetic materials.

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CY1001: CHEMISTRY

Prerequisite: Nil

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Module 1: Chemical Bonding (8 hours)

Quantum mechanical methods in chemical bonding: molecular orbital theory, symmetry of molecular orbitals, MOs for homonuclear diatomic molecules, application of MO theory to heteronuclear diatomics, valence bond theory, hybridization, hybridization involving d orbitals, conjugated molecules, Huckel molecular orbital theory of conjugated systems, metallic bonding, band theory.

Module 2: Spectroscopy (14 hours)

General features of spectroscopy, interaction of radiation with matter, theory and application of rotational, vibrational, Raman, electronic, mass, NMR, fluorescence and photoelectron spectroscopy.

Module 3: Transition Metal Chemistry (12 hours)

Bonding in transition metal complexes: coordination compounds, crystal field theory, octahedral, tetrahedral and square planar complexes, crystal field stabilization energies, Jahn-Teller theorem, spectral and magnetic properties.

Bio-Inorganic chemistry: Trace elements in biology, heme and non-heme oxygen carriers, haemoglobin and myoglobin-cooperativity; Bohr effect, Hill coefficient, oxy and deoxyhaemoglobin, reversible binding of oxygen.

Module 4: Aromaticity (8 hours)

Electron delocalization, resonance and aromaticity; molecular orbital description of aromaticity and anti-aromaticity, annulenes; ring current, NMR as a tool, diamagnetic anisotropy; aromatic electrophilic substitutions, aromatic nucleophilic substitutions, benzyne; reaction mechanisms, reactivity and orientation.

Text Books:


**Course Outcomes**

**CO1**: To acquire knowledge on the role of chemistry in solving the problems related to chemical engineering.

**CO2**: To acquire knowledge about the fundamental principles of bonding in materials.

**CO3**: To acquire knowledge on the characterization of materials by modern tools.

**CO4**: To acquire knowledge on the chemistry of bio-molecules.

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MS1001 PROFESSIONAL COMMUNICATION

Prerequisite: Nil

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Module 1 (11 hours)

Verbal Communication: received pronunciation; how to activate passive vocabulary; technical/non-technical and business presentations; questioning and answer skills; soft skills for professionals; role of body postures, movements, gestures, facial expressions, dress in effective communication; Information/ Desk/ Front Office/ Telephone conversation; how to face an interview/press conference; Group discussions, debates, elocution.

Module 2 (9 hours)

Reading Comprehension: skimming and scanning; factual and inferential comprehension; prediction; guessing meaning of words from context; word reference; use and interpretation of visuals and graphics in technical writing.

Module 3 (11 hours)

Written Communication: note making and note taking; summarizing; invitation, advertisement, agenda, notice and memos; official and commercial letters; job application; resume and curriculum vitae; utility, technical, project and enquiry reports; paragraph writing: General – Specific, Problem – Solution, Process – Description, Data – Comment.

Module 4 (11 hours)

Short essays: description and argument; comparison and contrast; illustration; using graphics in writing: tables and charts, diagrams and flow charts, maps and plans, graphs; how to write research paper; skills of editing and revising; skills of referencing; what is a bibliography and how to prepare it.

Text Books

2. Sarah Freeman: Written Communication (Orient Longman)[1978]
4. T Balasubramanian: English Phonetics for Indian Students: A Workbook
(Macmillan publishers India) 2000

Reference

3 Krishna Mohan and Meera Banerji: Developing Communication Skills (Mac Millanindia Ltd)[2000]
4 Krishna Mohan and Meenakshi Raman: Effective English Communication (Tata McGraw Hill)[2000]

Course Outcomes

CO1: Effectively communicate technical material in print.
CO2: Present technical material orally with confidence and poise, including audiovisual materials.
CO3: Communicate effectively in ways appropriate to the discipline, audience and purpose.
CO4: Think critically and creatively to generate innovative and optimum solutions.
CO5: Identify, evaluate and synthesize information from a range of sources to optimize process engineering design and development.
CO6: Engage in continuous education, training and research, and take control of their own learning and development.
CO7: Work effectively and efficiently individually and in teams.
CO8: Be ‘career ready’ for the engineering profession, demonstrate leadership qualities, and work ethically and professionally.

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ZZ1001 ENGINEERING MECHANICS

Prerequisite: Nil

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Part A--Statics

Module 1 (12 hours)

Important vector quantities: Position vector, moment of a force about a point, moment of a force about an axis, the couple and couple moment, couple moment as a free vector, moment of a couple about a line.

Equivalent force systems: Translation of a force to a parallel position, resultant of a force system, simplest resultant of special force systems, distributed force systems.

Equations of equilibrium: Free body diagram, free bodies involving interior sections, general equations of equilibrium, problems of equilibrium, static indeterminacy.

Module 2 (10 hours)

Properties of surfaces: First moment, centroid, second moments and the product of a plane area, transfer theorems, rotation of axes, polar moment of area, principal axes, concept of second order tensor transformation.

Part B—Dynamics

Module 3 (10 hours)
Kinematics of a particle: Introduction, general notions, differentiation of a vector with respect to time, velocity and acceleration calculations, rectangular components, velocity and acceleration in terms of cylindrical coordinates, simple kinematical relations and applications.


Module 4 (10 hours)
Energy and momentum methods for a particle: Analysis for a single particle, conservative force field, conservation of mechanical energy, alternative form of work-energy equation, Linear momentum, impulse and momentum relations, moment of momentum.
Vibrations: Single degree of freedom systems, free vibration, undamped and damped, forced vibration, sinusoidal loading, introduction to multi degree of freedom systems, illustration using two degree-of-freedom systems.

Text Book

Reference Books

Course Outcomes

**CO1:** Draw proper free body diagrams based on the applied loads and boundary conditions.
**CO2:** Learn to identify the problem type to be static or dynamic based on the defining features.
**CO3:** Find solutions to rigid body statics problems using equations of equilibrium.
**CO4:** Find solutions to particle dynamics problems using Newton's law, energy methods and momentum methods.

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ZZ1002 ENGINEERING GRAPHICS

Prerequisite: Nil

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**Module I (4 Lecture + 6 drawing hours)**
Scales, Plain scales, Diagonal scales, Vernier scales.
Introduction to orthographic projections- Horizontal, vertical and profile planes – First angle and third angle projections – Projection of points in different coordinates – Projections of lines inclined to one of the reference planes

**Module II**
Projections of lines inclined to both the planes – True lengths of the lines and their angles of inclination with the reference planes – Traces of lines.

(4 Lecture + 6 drawing hours)

Projection of plane lamina of geometric shapes inclined to one of the reference planes – inclined to both the planes, Traces of planes (2 Lecture + 3 drawing hours)

Projections on auxiliary planes (2 lecture + 3 drawing hours)

**Module III (4 Lecture + 6 drawing hours)**
Projections of polyhedra and solids of revolution, projection of solids with axis parallel to one of the planes and parallel or perpendicular to the other plane – Projections with the axis inclined to one of the planes. Projections of solids with axis inclined to both the planes – Projections of spheres and combination of solids.

**Module IV**
Sections of solids by planes perpendicular to at least one of the reference planes – True shapes of sections.

(2 lectures, 3 drawing hours)

Developments, development of the lateral surface of regular solids like, prisms, pyramids, cylinders, cones and spheres, development of truncated solids (2 lectures + 3 drawing hours)

Isometric projection – Isometric scale – Isometric views – Isometric projection of prisms, pyramids, cylinders, cones, spheres and solids made by combination of the above. (2 lectures + 6 drawing hours)
Text book


References


Course Outcomes

CO1: Ability of writing, sketching, scale drawing and visualization skills
CO2: Gets training in the transformation of the imagined data to present as drawings so that the communication skill will be increased especially in technical subjects.
CO3: Imparts the training in multi-view representations and its conversion into pictorial views and the reverse also.
CO4: Ability to understand the different standards in technical drawing and to help in reaching future engineering positions especially in research and design.

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Module – 1 (11 Hours)

Two Terminal Element Relationships

Magnetic Circuits
MMF, Magnetic Flux, Reluctance- Energy Stored in a Magnetic Field-Solution of Magnetic Circuits.

Analysis of Resistive Circuits
Solution of resistive circuits with independent sources- Node Analysis and Mesh Analysis-Nodal Conductance Matrix and Mesh Resistance Matrix and symmetry properties of these matrices-Source Transformation- Circuit Theorems - Superposition Theorem-Thevenin’s Theorem and Norton’s Theorem- Maximum Power Transfer Theorem

Module – 2 (10 Hours)

Single Phase AC Circuits
Alternating Quantities- Average Value - Effective Value - Form and Peak factors for square, triangle, trapezoidal and sinusoidal waveforms - Phasor representation of sinusoidal quantities - phase difference -Addition and subtraction of sinusoids - Symbolic Representation: Cartesian, Polar and Exponential forms

Module - 3 (14 hrs)


Introductory Digital Electronics: Transistor as a switch – switching delays, inverter operation

Digital Electronics: Number Systems and Conversions- Logic Gates and Truth Tables – Boolean Algebra – Basic canonical realizations of combinatorial circuits.
Standard Combinatorial Circuit SSI and MSI packages (Adder, Code Converters, 7-Segment Drivers, Comparators, Priority Encoders etc). MUX-based and ROM-based implementation of combinatorial circuits.

**Module - 4 (7 hours)**

Measuring instruments

**Text Books:**

1. Electric Circuits, James W Nilsson and Susan A Riedel, Pearson, 8th Edn, 2002

**Course Outcomes:**

**CO1:** Analysis of Resistive Circuits and Solution of resistive circuits with independent sources.
**CO2:** Two Terminal Element Relationships for inductors and capacitors and analysis of magnetic circuits.
**CO3:** Analysis of Single Phase AC Circuits, the representation of alternating quantities and determining the power in these circuits.
**CO4:** To acquire the knowledge about the characteristics and working principles of semiconductor diodes, Bipolar Junction Transistor.
**CO5:** To get an insight about the basic introduction of Digital electronics.

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ZZ1004 COMPUTER PROGRAMMING

Pre-requisite: NIL

Module 1 (7 Hours)
Data Types, Operators and Expressions: Variables and constants - declarations - arithmetic, relational and logical operators – Assignment operator and expressions – conditional expressions – precedence and order of evaluation.
Control Flow: Statements and blocks – if-else, switch, while, for and do-while statements – break and continue statements, goto and labels.

Module 2 (7 Hours)

Module 3 (7 Hours)
Pointers and Arrays: Single and multidimensional arrays - Pointers and arrays – address arithmetic - Passing pointers to functions.

Module 4 (7 Hours)
Input and Output: Standard input and output – Formatted output – variable length argument list – file access.

Text Book:

References:
Course Outcomes

CO1: To introduce the role of computer programming in engineering.
CO2: Familiarization of programming languages used for computer programming.
CO3: To train the student for development of their programming skills.
CO4: To highlight the role of programming in engineering with suitable examples.

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ME1001 - Introduction to Mechanical Engineering

Pre-requisite: NIL

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1) General Introduction (Engineering, ingeniere-ingenious, Mechanical Engg profession, Historical aspects, Overview of curriculum)

2) a) Creativity and Problem Solving skills (Levels of thinking, intelligence & creativity, invention & innovation, Basic steps in problem formulation & solving, Units and significant digits). b) Communication Skills (Oral, written and graphical communication, Presentation skills)

3) Materials and Stresses (Fundamental properties, classifications, applications, simple problems).

4) Motion and Power transmission (Kinematics and dynamics of machinery, power transmission elements, concepts from friction and wear)

5) Fluids Engineering (fluid mechanics – basics & historical aspects, hydraulic machines, advanced topics like gas dynamics)

6) Thermodynamics and Heat Transfer (Basic principles, significance of thermodynamics in Mechanical Engg., relationship with mechanics subjects, modes of heat transfer)

7) Thermal Engineering and Energy Systems (Historical aspects, Internal and external combustion engines, gas turbines, heating, ventilation and air-conditioning, power plants, energy conservation)

8) Manufacturing Processes (Basic processes like machining, casting, forging etc.)

9) Manufacturing Systems (Machine tools, Production systems, advanced systems like CNC, robots, assembly lines etc.)

10) Mechanical Design (Basic steps in design, material selection, design for manufacturability etc.)

11) Industrial Engineering and Principles of Management (Work study, optimization, software tools, interesting problems transportation planning, job sequencing etc., basic concepts of management)

12) About automobile engineering; Nanotechnology, and allied topics.

References


3) Other reference materials and course materials as suggested by faculty.

Course Outcomes

**CO1:** To give an overview, introduce and motivate the students towards Mechanical Engineering.

**CO2:** To give a clear inter-relationship with various subjects in Mechanical Engineering, and even with subjects of other branches of engineering.

**CO3:** To impart an ability to solve a variety of elementary problems which gives a smooth passage into the field of Mechanical Engineering.

**CO4:** To understand and appreciate the significance of various allied aspects that are required in the field of Mechanical Engineering such as communication, drawing, mathematics and basic sciences.

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ZZU1091 WORKSHOP PRACTICE I

Pre-requisite: NIL

CIVIL ENGINEERING WORKSHOP

Introduction to Construction Materials: Cement, sand, coarse aggregate, structural steel, brick, timber, concrete – methods of testing (3 hours)
Masonry: English bond – Flemish bond – wall – junction – one brick – one and a half brick - Arch construction. (6 hours)
Plumbing: Study of water supply and sanitary fittings—water supply pipe fitting – tap connections - sanitary fittings. (3 hours)
Surveying: Introduction to land surveying and linear measurements; Introduction to leveling. (9 hours)

ELECTRICAL WORKSHOP

1
a) Familiarization of wiring tools, lighting and wiring accessories, various types of wiring systems.
b) Wiring of one lamp controlled by one switch

2
a) Study of Electric shock phenomenon, precautions, preventions; Earthing b) Wiring of one lamp controlled by two SPDT Switch and one 3 pin plug socket independently.

3
a) Familiarization of types of Fuse, MCB, ELCB etc.
b) Wiring of fluorescent lamp controlled by one switch from panel with ELCB & MCB.

4
a) Study of estimation and costing of wiring
b) Domestic appliance – Wiring, Control and maintenance: Mixer machine, Electric Iron, fan motor, pump motor, Battery etc.

Reference:


Course Outcomes

CO1: Acquire knowledge on the basic civil engineering practices of brick and concrete masonry, plumbing and surveying.
CO2: Get hands on training in basic masonry and surveying.
CO3: Understand the quality requirements and quality testing procedures of selected building material, viz., cement, fine aggregate, coarse aggregate, concrete, timber and steel.
CO4: Acquire knowledge about various types of wiring systems, wiring tools, lighting & wiring accessories, wiring estimation & costing, etc.
CO5: Acquire knowledge about household electrical appliances, need of earthing, electric shock, etc.
ZZ1092 WORKSHOP PRACTICE II

Pre-requisite: NIL

MECHANICAL WORKSHOP
(Eight classes of 3 hour duration each)

The course is intended to expose the student to the manufacturing processes through hands on training in the sections of Central Workshop. After the course, the student acquires the skill in using various tools, measuring devices, and learns the properties of different materials at varying conditions.

1) Carpentry: Study of tools and joints – plaining, chiseling, marking and sawing practice, one typical joint- Tee halving/Mortise and Tenon/ Dovetail

2) Fitting: Study of tools- chipping, filing, cutting, drilling, tapping, about male and female joints, stepped joints- one simple exercise of single V joint for welding exercise.

3) Welding: Study of arc and gas welding, accessories, joint preparation, Exercise of a single V joint

4) Smithy: Study of tools, forging of square or hexagonal prism/ chisel/bolt

5) Foundry: Study of tools, sand preparation, moulding practice.

6) Sheet Metal work: Study of tools, selection of different gauge sheets, types of joints, fabrication of a tray or a funnel

7) Plumbing Practice: Study of tools, study of pipe fittings, pipe joints, cutting, and threading

8) Lathe Exercise: Study of the basic lathe operations, a simple step turning exercise.

References


7) Olson D.W., Wood and Wood working. Prentice Hall India. 1992


**Course Outcomes**

**CO1:** Student is exposed to the practical field, which any professional must go through to be real professional, even though he/she may not be opting for this job after graduation.

**CO2:** The student is made familiar with the basis manufacturing processes- Casting, Forming, Joining and Machining.

**CO3:** The student learns about the properties of different materials- Hardness, ductility, sharpness, heat resistance, grain orientation, application, and the specific tools used for converting to useful forms, by observation, demonstrations, and self studies.

**CO4:** The student also learns about the various measuring devices apart from scales, Vernier calipers, micrometers etc. which are used in the metrology field.

**CO5:** The skill of sequencing the operations so as to execute a task with least time and least rejection too is learnt. This makes him/her confident to command over the subordinates while employed as a leader.

**CO6:** The student learns how to substantiate the academic knowledge which he acquires through class rooms with practicals.

**CO7:** How to carry out a task as a member in a group team, is professional team, is also experienced.

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**ELECTRONICS WORKSHOP**

1. a) Familiarization of electronic components colour code, multimeters.
   b) Bread board assembling - Common emitter amplifier

2. a) Study of soldering components, solders, tools, heat sink.
   b) Bread board assembling – phase shift oscillator
3
a) Soldering practice - Common emitter amplifier
b) Soldering practice - Inverting amplifier circuit

4
a) Study of estimation and costing of soldering –PCB: 3 phase connections
b) Domestic appliances – Wiring PCB, control, Identification of fault: Electronic Ballast, fan regulator, inverter, UPS etc.

Reference:

PH1091 PHYSICS LAB

Pre-requisites: NIL

LIST OF EXPERIMENTS

1. Magnetic Hysteresis loss - Using CRO
2. Band gap using four probe method
3. Hall effect- determination of carrier density, Hall coefficient and mobility
4. Solar cell characteristics
5. Double refraction – measurement of principle refractive indices.
7. Measurement of e/m of electron – Thomson’s experiment
8. Determination of Planck’s constant
9. Measurement of electron charge – Milliken oil drop experiment
10. Determination of Magnetic Field along the axis of the coil
11. Newton’s rings
12. Laurent’s Half shade polarimeter –determination of specific rotatory power
13. Study of P-N junction
15. Laser – measurement of angle of divergence & determination of \( \lambda \) using grating
17. Mapping of magnetic field

Reference:

Course Outcomes

CO1: To develop experimentation skills and understand importance of measurement practices in Science & Technology.
CO2: Develop analytical skills for interpreting data and drawing inferences.
CO3: Understand nature of experimental errors and practical means to estimate errors in acquired data.

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<td>End Semester Examination</td>
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</table>
CY1094: CHEMISTRY LABORATORY

Pre-requisites: Nil

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</table>

Total Hours: 28

Potentiometric and conductometric titrations, complexometric and iodimetric estimations, polarimetry, determination of pH, single step organic / inorganic preparations, colorimetry, determination of eutectic point.

References:


Course outcomes:

**CO1:** To acquire practical knowledge on the basic chemistry principles to apply in engineering.

**CO2:** To acquire practical knowledge on the techniques for the preparation and characterization of materials.

**CO3:** To acquire knowledge on electrochemical techniques.

**CO4:** To acquire training in accurate and precise data collection.
ZZ1093: Physical Education

Module 1
- Introduction, definitions, aims & objectives of Physical Education.
- Importance and scope of Physical Education.
- Health, Physical fitness and wellness.
- Importance and relevance of Physical Education in NITC curriculum.

Module 2
- Components of physical fitness.
- Types of physical fitness.
- Benefits of exercise – physical and physiological.
- Fitness balance.

Module 3
- Physical exercise.
- Principals of Physical exercise.
- Activities for developing physical fitness components – walking, jogging, running, weight training, stretching, yogasanas.
- Athletic injuries and their management.
- Nutritional balance.
- Postural deformities and their corrections.

Module 4
- Motivation and its importance in sports.
- Psychological factors affecting sports performance – stress, anxiety, tension, aggression.
- Personality, self confidence and performance.
- Team cohesion and leadership in sports.

Module 5
- Lifestyle diseases and its management
  - Diabetes
  - Hypertension
  - Obesity
  - Osteoporosis
  - Coronary heart diseases
  - Cholesterol
  - Backpain

Module 6
- Olympic Values Education.
- Event management.
Course Outcomes

II. IN TERMS OF AWARENESS INCULCATED BY STUDENTS:

a) Every participant is oriented and introduced to campus physical education-sports activities and infrastructure.
b) Everyone is made aware of the relevance of physical education in the NITC curriculum.
c) Everyone is inculcated with desired health related physical fitness awareness.
d) Every student is inculcated with Olympic Values that go to make a good citizen.
e) Every student is made aware of the scientific bases of physical education.

II. IN TERMS OF PERFORMANCE IN SPORTS ACTIVITIES BY STUDENTS:

a) Each student is made capable of selecting a game/activity of his/her choice to pursue on the campus to enjoy/entertain and thereby develop good health and fitness which he/she would carry over to post-campus life for maintaining health, fitness and wellness.
b) Students found to be more proficient in a game is spotted for special care which may lead him/her to a berth in the institute teams.
c) Higher level of exposure ensured to team members with professional training to master his/her ability.
d) Intramural and open mass participation activities ensure higher percentage of participation for students as an outcome and follow-up of i-credit course awareness.
e) The uniqueness of the course is that it identifies and places every student with a role to play in participation, organization and administration of sporting programmes whether in-campus or off-campus.
f) The most notable achievement of the course is that it calls for more and more infrastructure on the campus since the percentage of involvement by student is very high.

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<td>Involvement and overall improvement</td>
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<tr>
<td>Group projects</td>
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</tbody>
</table>
ZZ1094 Value Education

Human Values-Values in Social interactions-Social norms and sanctions-Need for value
ducation-Technology development and its impact on society-sustainability of modern
technology-Concept of holistic development-Need for inner transformations-living in tune
with nature-Professional ethics-Holistic approach in engineering design-Role and social
responsibility of an engineer.

A mini project in indentified areas/topics in groups of not more than five. The work has to be
completed and a report to be submitted at the end. The work can be done under the guidance
of the faculty advisor / any faculty member in MED, NITC and the attendance and progress
report to be obtained from concerned faculty member.

Students are required to attend and actively participate in all the value education related
lectures arranged at the institute level.

Course Outcomes:

CO1: Build an overall awareness, about one’s surroundings its needs, its dynamics and
sensitivity to its welfare and betterment.
CO2: Bring about a qualitative change in overall health of society.
ZZ1095 NSS

i. Understand the community in which one works
ii. Understand oneself in relation to his/her community
iii. Identify the needs and problems of the community and involve in problem solving process
iv. Develop among oneself a sense of social and civic responsibility
v. Utilize ones knowledge in finding practical solution to individual and community problems
vi. Develop competence required for group living and sharing of responsibilities
vii. Gain skills in mobilizing community participation
viii. Acquire leadership qualities and democratic attitude
ix. Develop capacity to meet emergencies and natural disasters and
x. Practice national integration and social harmony

Course Objectives

CO1: The students will be able to work more cohesively in a group
CO2: The student will have a broader vision on life with social dimensions
CO3: The student will be more empathetic in their attitude towards fellow beings
CO4: The student will be capable of demonstrating service mentality where it is required
CO5: The student will be more patriotic in their approach
MA1002 - MATHEMATICS II

Pre-requisites: NIL

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</table>

Module I (11 L + 3T)
**Linear Algebra I:** Systems of Linear Equations, Gauss’ elimination, Rank of a matrix, Linear independence, Solutions of linear systems: existence, uniqueness, general form. Vector spaces, Subspaces, Basis and Dimension, Inner product spaces, Gram-Schmidt orthogonalization, Linear Transformations.

Module II (11 L + 3T)
**Linear Algebra II:** Eigen values and Eigen vectors of a matrix, Some applications of Eigen value problems, Cayley-Hamilton Theorem, Quadratic forms, Complex matrices, Similarity of matrices, Basis of Eigen vectors – Diagonalization.

Module III (10L+3T)
**Vector Calculus I:** Vector and Scalar functions and fields, Derivatives, Curves, Tangents, Arc length, Curvature, Gradient of a Scalar Field, Directional derivative, Divergence of a vector field, Curl of a Vector field.

Module IV (11 L+4T)
**Vector Calculus II:** Line Integrals, Line Integrals independent of path, Double integrals, Surface integrals, Triple Integrals, Verification and simple applications of Green’s Theorem, Gauss’ Divergence Theorem and Stoke’s Theorem.

Text Book:


Reference:


Course outcomes:

**CO1:** Acquire knowledge about the ideas and techniques of linear algebra, and to illustrate some of their applications in engineering.

**CO2:** Acquire knowledge about the physical interpretation of the gradient, divergence and curl.
**CO3:** Acquire knowledge of vector calculus.
**CO4:** Prepare to evaluate multiple integrals in rectangular, polar, spherical and cylindrical coordinates.

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SEMESTER 3

MA2001 MATHEMATICS III (PROBABILITY & STATISTICS)

Prerequisite: MA 1001

Module 1: Probability distributions (15 Hours)

Random variables, Binomial distribution, Hyper-geometric distribution, Mean and variance of a probability distribution, Chebyshev’s theorem, Poisson distribution, Geometric distribution, Normal Distribution, Uniform distribution, Gamma distribution, Beta distribution, Weibull distribution. Joint distribution of two random variables.

Module 2: Sampling distributions and Inference concerning means (14 Hours)

Population and samples, The sampling distribution of the mean (σ known and σ unknown), Sampling distribution of the variance, Maximum Likelihood Estimation, Point estimation and interval estimation, point estimation and interval estimation of mean and variance, Tests of hypothesis, Hypothesis concerning one mean, Inference concerning two means.

Module 3: Inference concerning variances proportions (13 Hours)

Estimation of variances, Hypothesis concerning one variance, Hypothesis concerning two variances, Estimation of proportions, Hypothesis concerning one proportion, Hypothesis concerning several proportions, Analysis of r x c tables, Chi-square test for goodness of fit.

Module 4: Regression Analysis (14 Hours)


Text Book


References


Course Outcomes

CO1: Acquire knowledge about important probability distributions and their properties.
CO2: Acquire knowledge about statistical parameter estimation.
CO3: Acquire knowledge about statistical hypotheses tests.
CO4: Acquire knowledge about regression and correlation analysis.
CO5: Acquire knowledge about ANOVA principles and methods.
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EE2009 ELECTRICAL MEASUREMENTS AND MACHINES

Prerequisite: Nil

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Module 1 (9 hours)

Electromechanical Energy Conversion principles - Types of machines - Basics of rotating machines - Construction - Rotating magnetic field - Principles of operation - Emf and torque equation - Losses and efficiency.

Module 2 (12 hours)

DC Machines: principle of operation – generators and motors – classification – characteristics - starter - speed control - load test - Swinburne’s test - applications.


Module 3 (15 hours)

Alternators: Types, principle of operation - Synchronous motors: Principle of operation- starting- applications- Introduction to power Generation, Transmission and distribution system.


Module 4 (6 hours)


References


Course Outcomes

CO1: Acquire knowledge about the fundamental principles and classification of electromagnetic machines.
CO2: Acquire knowledge about the constructional details and principle of operation of dc machines.
CO3: Acquire knowledge about the working of dc machines as generators and motors.
CO4: Acquire knowledge about the constructional details, principle of operation, testing and applications of transformers.
CO5: Acquire knowledge about the constructional details and principle of operation of three phase and single phase induction motors.
CO6: Acquire knowledge about the starting and speed control of induction motors.
CO7: Acquire knowledge about testing and applications of induction motors.

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ME2001 MECHANICS OF FLUIDS

Pre requisite: ME1001 Introduction to Mechanical Engineering

Total hours: 42

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</table>

Module 1 (13 hours)

Module 2 (11 hours)
One dimensional flow through pipes, Non viscous equation for the flow through a stream tube and along a stream line – Euler’s equation – Bernoulli’s equation, - Energy equation, Applications of the one dimensional equations - velocity and flow measuring devices and quasi steady problems, Laminar and turbulent flow through pipes - Hagen-Poiseuille equation - Darcy-Weisbach equation - pipe friction -Moody’s chart - minor losses in pipes

Module 3 (10 hours)
Two dimensional incompressible inviscid flows –Vorticity - Vortex tube - Irrotational flow - Velocity potential, Stream function - relation between streamfunction and potential function in ideal flows -Equation of a streamline - governing equations, Fundamental flow patterns, Combination of basic patterns - Rankine half body - Rankine oval - Doublet and flow over a cylinder, Magnus effect and the calculation of lift on bodies.

Module 4 (8hours)
Plane viscous flow past bodies, The boundary layer - Prandtl’s boundary layer equations, Blasius solution for the boundary layer on a flat plate, Karman’s Momentum Integral equations - Solutions using simple profiles for the boundary layer on flat plate - calculation of skin friction drag.

Reference Books

Course Outcomes

CO1: To familiarize the concepts of continuum, properties of fluid, pressure variation and measurement, pressure on submerged and flowing bodies, RTT and its applications.
CO2: To study 1-D viscous and non-viscous flow through pipes. Bernoulli's equation, laminar and turbulent flow, Moody's chart.
CO3: To study 2-D flows, irrotational flow, stream function and velocity potential, governing equation, flow pattern.
CO4: To study about viscous and non-viscous flow over bodies, boundary layer calculation of lift and drag forces.
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</table>
ME2002 ELEMENTS OF SOLID MECHANICS

Prerequisite: ZZ1001 Engineering Mechanics

Total Hours: 42

Module 1 (12 hours)

Module 2 (10 hours)
Axial force, shear force and bending moment diagrams – sign conventions, Axial force, shear force and bending moments by direct approach, integration, Bending stresses in beams, Elastic flexure formula- bending stresses, Elastic strain energy in bending, Inelastic bending, Bending about both principal axes – Elastic bending with axial loads, Shear stresses in beams - shear flow - shearing stress formulae.

Module 3 (10 hours)
Torsion - torsion of circular elastic bars, statically indeterminate problems, torsion of inelastic circular bars, strain energy in torsion, Torsion of thin walled tubes, Deflection of beams - direct integration method, singularity functions, superposition techniques, moment area method , elementary treatment of statically indeterminate beams.

Module 4 (10 hours)
Transformation of stresses and strains (two-dimensional case only) - equations of transformation - principal stresses, Mohr's circles of stress and strain, Strain rosette, Compound stresses - superposition and its limitations - eccentrically loaded members, Columns - theory of columns - buckling theory - Euler's formula - effect of end conditions - eccentric loads and secant formula.

References


Course Outcomes

CO1: To draw the SF and BM diagrams for various beams under different loading conditions.
CO2: To be able to determine strength and deformation of members under various loading conditions.
CO3: To determine the stability of the columns under different end conditions and understand the design principles.
CO4: Learn the two dimensional stress transformation and apply it for analysis of members with combined loading.

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</table>
ME2003 ENGINEERING MECHANICS – DYNAMICS

Prerequisite: ZZ1001 Engineering Mechanics

Total Hours: 42

Module 1 (13 hours)

Module 2 (8 hours)
Kinematics of rigid bodies, Translation and rotation of rigid bodies – Chasles’ theorem – derivative of a vector fixed in a moving reference – applications of the fixed-vector concept – general relationship between time derivatives of a vector for different references – relationship between velocities of a particle for different references – acceleration of a particle for different references.

Module 3 (9 hours)

Module 4 (12 hours)
Energy and impulse momentum methods for rigid bodies, Kinetic energy of rigid body – work-energy relations – angular momentum of a rigid body about any point in the body – impulse-momentum equations – impulsive forces and torques, Eccentric impact, Dynamics of general rigid-body motion – Euler’s equations of motion and applications – necessary and sufficient conditions for equilibrium of rigid body – three-dimensional motion about a fixed point – Euler angles – equations of motion using Euler angles – torque-free motion.

References

Course Outcomes

CO1: Ability to formalize real life engineering problems using engineering fundamentals.
CO2: Ability to solve rigid body mechanics problems.
CO3: Ability to solve 3D dynamical problems related with rigid bodies
CO4: Enable the students to study higher level courses like robotics etc.

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ME2101 MATERIALS SCIENCE AND METALLURGY

Prerequisite: Nil

Total Hours: 42

Module 1 (9hours)
Engineering materials: classification, requirements, properties and selection of engineering materials, Review of fundamentals - Crystal structure, Crystal imperfections, Edge and screw dislocations, interaction between dislocations, Frank-Reed source. Experimental techniques for metallographic studies, optical microscopy, electron microscopy (SEM and TEM), X-ray diffraction, grain size, grain size measurement, ASTM grain size number.

Module 2 (10hours)
Solidification of metals- cooling curves, nucleation-homogeneous and heterogeneous nucleation, supercooling, critical radius, grain growth, dendritic pattern, equiaxed and columnar grains, grain boundary-grain boundary effects, solidification and structure of castings-coring, homogenization. Alloys-solid solutions-interstitial, substitutional ordered and disordered solid solutions, Hume-Rothery rules, intermetallic compounds, phase diagrams -construction from cooling curves, lever rule, equilibrium diagrams of binary alloys, isomorphous (Cu-Ni), Eutectic (Bi-Cd, Pb-Sn) detailed study of Fe-C systems. Diffusion: mechanisms of diffusion-Fick's laws of diffusion-applications.

Module 3 (11 hours)
Deformation of metals - cold working, hot working, annealing of a cold worked article-recovery, recrystallisation and grain growth, elastic and plastic deformations - mechanisms of plastic deformation, deformation by slip-slip systems- slip planes and slip directions, critical resolved shear stress, deformation by twinning. Strengthening mechanisms - work hardening, solid solution hardening, dispersion hardening, precipitation hardening, grain boundary strengthening. Heat treatment of steels - stress relieving, annealing, normalising, hardening. TTT diagram, tempering, hardenability, Jominy test. Surface hardening - flame hardening, induction hardening, Case hardening - carburising, nitriding, cyaniding, etc. Metallic Coatings, hard facing, metal cladding, anodising, diffusion coatings.

Module 4 (12hours)

References
Course Outcomes

CO1: To train the students to apply fundamental knowledge of basic science for selection and processing of material for engineering applications.
CO2: To expose the students to various equipment and experimental techniques used in the field of material science and metallurgy.
CO3: Understand the principles of materials science and metallurgy and to use them for practical applications like alloying, casting, heat treatment etc.
CO4: Recent developments taking place in the field of material science and metallurgy.

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ME2091 MACHINE DRAWING

Prerequisite: ZZ1002 Engineering Graphics

Total Hours: 42

Module 1 (9 hours)
Introduction to machine drawing, Principles of orthographic projections applied to machine drawing, First angle and third angle projections, Methods of dimensioning, Conversion of pictorial projections into orthographic projections, Sectional views, Rules and conventions of sectioning, Full sectional, half sectional, partial sectional and revolved sectional views of simple machine parts, Screwed fastenings – screw thread forms – vee and square headed bolts and nuts, Locking arrangements of nuts, Various types of machine screws and set screws, Foundation bolts.

Module 2 (9 hours)

Module 3 (15 hours)

Module 4 (9 hours)

References

Course Outcomes

CO1: To visualize geometric shapes and objects and to apply basic knowledge acquired in engineering graphics to a specific engineering domain.
CO2: To appreciate intricacies of machine component, assemblies and their functional aspects.
CO3: The concept of geometric dimensioning and tolerancing in order to enable the students to prepare production drawings.
CO4: To learn use of computers and software tools in machine drawing.

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List of Experiments

1. (a) Determination of V-I characteristics of a linear resistor and an incandescent lamp.
   (b) Measurement of high and low resistance using Voltmeter/Ammeter method.
5. Determination of the efficiency and regulation of single-phase transformer by direct loading.
6. Open circuit and short circuit tests on a single-phase transformer and determination of efficiency and voltage regulation at various loads conditions.
7. (a) Study of Starters for 3 phase Induction motors.
   (b) Load test on squirrel cage induction motor and determination of its performance characteristics.
8. Load test on slip ring induction motor and determination of its performance characteristics.

References


Course Outcomes

CO1: Acquire hands on experience of conducting various tests on dc machines and obtaining their performance indices using standard analytical as well as graphical methods.
CO2: Acquire hands on experience of conducting various tests on transformers and obtaining their performance indices using standard analytical as well as graphical methods.
CO3: Acquire hands on experience of conducting various experiments in electrical measurements.
CO4: Acquire hands on experience of conducting various tests on induction machines and obtaining their performance indices using standard analytical as well as graphical methods.
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# SEMESTER 4

## MA2002 MATHEMATICS IV

**Prerequisite:** MA 1001, MA 1002  
**Total Hours:** 56 Hrs

### Module 1 Series Solutions and Special Functions (15 Hours)


### Module 2 Partial differential Equations (16 Hours)


### Module 3 Complex Numbers and Functions (13 Hours)

Complex functions, Derivative, Analytic function, Cauchy-Reimann equations, Laplace's equation, Geometry of Analytic functions: Conformal mapping, Linear fractional Transformations, Schwarz - Christofell transformation, Transformation by other functions.

### Module 4 Complex Integration (12 Hours)

Line integral in the Complex plane, Cauchy’s Integral Theorem, Cauchy’s Integral formula, Derivatives of analytic functions, Power series, Functions given by power series, Taylor series and Maclaurin’s series, Laurent’s series, Singularities and Zeros, Residue integration method, Evaluation of real Integrals.

### Text Book


### Reference Books


### Course Outcomes

CO1: Acquire the knowledge to solve differential equations using power series and Frobenius method.  
CO2: Acquire knowledge about the ability to solve problems using partial differential equations.  
CO3: To know the properties of analytic and harmonic functions.  
CO4: Understanding Cauchy's integral theorem and its consequences.  
CO5: Acquire the knowledge to compute residues and integrals using the residue theorem.
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ME2011 FLUID MACHINERY

Prerequisite: ME2001 Mechanics of Fluids

Total Hours: 42

Module 1 (11 hours)
Integral form of continuity, momentum and energy equations, Dynamic action of fluids over flat plates and curved surfaces – Force, work done and efficiency, Dimensional analysis – Rayleigh’s method and Buckingham’s pi method, Principles of models and similitude as applied to turbo-machines – Non-dimensional parameters applicable to hydraulic machines like capacity coefficient, head coefficient, power coefficient and specific speed and as applicable to hydraulics like Reynolds number, Mach number, Froude’s number, Weber’s number and Euler’s number.

Module 2 (11 hours)
Euler’s equation for turbo-machines, Classification of hydraulic turbines – Constructional features of Pelton, Francis and Kaplan turbines, Speed regulation and Performance analysis of hydraulic turbines, Model studies, Theory of draft tubes and cavitations in turbines.

Module 3 (11 hours)
Classification of pumps – Features of rotodynamic and positive displacement pumps, Rotodynamic pumps – principle of working - Vortex motion – Spiral motion – Constructional features of centrifugal pumps – Performance analysis - Efficiencies – Classification of centrifugal pumps – Pump characteristics – Theoretical and actual Head- Capacity relationship – Pump selection, Model studies, Cavitations in pumps.

Module 4 (9 hours)

References:

Course Outcomes

CO1: To utilize the fundamental principles of fluid mechanics and thermodynamics, and apply laws of conservation of mass, momentum and energy in turbomachines.

CO2: To have a basic understanding of the principles of turbomachines, their construction, way of functioning and the flow processes that take place in these machines.

CO3: To develop basic skills in drawing and analysis of the velocity triangles at the tips of rotor blades, energy balance at component and system level, and calculation of the various efficiencies and losses.

CO4: Use dimensional analysis to compare homologous machines, dimensionless numbers applied to hydraulics and hydraulic machines, design and selection of appropriate hydraulic machines for appropriate operations.
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<td>End Semester Examination</td>
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</table>
ME2012 APPLIED MECHANICS OF SOLIDS

Prerequisite: ME2002 Elements of Solid Mechanics

Total Hours: 42

<table>
<thead>
<tr>
<th>Module 1 (11 hours)</th>
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<tbody>
<tr>
<td>Stress at a point, Stress tensor, Stress transformation, Principal stresses – principal planes, Mohr’s circle, Octahedral stresses, Hydrostatic and pure shear states, Strain at a point – strain tensor, Analogy with stress tensor.</td>
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</table>

<table>
<thead>
<tr>
<th>Module 2 (11 hours)</th>
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</thead>
<tbody>
<tr>
<td>Equations of elasticity - equation of equilibrium - strain-displacement equations, compatibility conditions - constitutive equations -Navier equations, Boundary conditions – traction - displacement and mixed boundary conditions. Special problems in bending - usymmetric bending - shear centre.</td>
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<tr>
<th>Module 3 (10 hours)</th>
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<tbody>
<tr>
<td>Simplification to 2-D problems - plane stress problems - plane strain problems, Axisymmetric problems - Lame’s problem - rotating disks and shrink fits. Energy Techniques - introduction to energy methods - strain energy - principle of virtual work - minimum potential energy principle.</td>
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<tr>
<th>Module 4 (10 hours)</th>
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<tbody>
<tr>
<td>Three dimensional problems, Torsion of non-circular sections - St. Venant’s theory - Prandtl’s stress function approach - elliptical and triangular cross sections, Prandtl’s membrane analogy, Torsion of thin walled open and closed sections. Introduction to plasticity - theory of plasticity - yield criteria for metals - stress strain relationships.</td>
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</table>

References


Course Outcomes

CO1: Analyze the complex stress and strain in three dimensional body.
CO2: To formulate the mathematical model using governing equations of elasticity.
CO3: To solve torsion problems of non-circular section and thin walled section.
CO4: To obtain the solution of 2D elasticity problems and to understand basic concepts of plasticity problems.

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</table>
ME2013 MECHANICS OF MACHINERY

Prerequisite: ZZ1001 Engineering Mechanics

Total Hours: 42

Module 1 (12 hours)

Module 2 (10 hours)
Analytical methods in mechanism analysis, Computer oriented methods in kinematic analysis, Cam Design, Cam and follower types, Displacement diagrams, Cam profile synthesis – graphical and analytical methods, Design of plate cam – reciprocating flat faced follower – roller follower, Advanced cam profile techniques.

Module 3 (10 hours)

Module 4 (10 hours)
Kinematic synthesis, Tasks of kinematic synthesis – type and dimensional synthesis – graphical synthesis for motion – path generation without and with prescribed timing, Function generation – overlay method, Analytical synthesis techniques, Complex number modelling – loop closure equation technique – Freudenstein’s equation, Case studies in synthesis of mechanisms.

References

Course Outcomes

CO1: To familiarize the motion of mechanism- to define a mechanism and to do kinematic construction for variety of mechanism used in application.

CO2: To introduce basic mechanisms such as slider-crank linkages, four-bar linkage, gear and cam, perform the motion analysis using both graphical and analytical methods.

CO3: To apply the knowledge gained in the earlier course engineering mechanics to a system of rigid bodies which are interconnected with constraints.

CO4: To introduce the concept of synthesis of mechanisms, which helps in the understanding of design.
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</table>
ME2014 THERMODYNAMICS

Prerequisite: Nil

Total Hours: 42

Module 1 (12 hours)

Module 2 (10 hours)

Module 3 (10 hours)

Module 4 (10 hours)

References


Course Outcomes

CO1: To provide the foundation for analysis of energy conversion systems.
CO2: To analyze the relations governing thermodynamic properties and its application.
CO3: To assess the performance of engineering systems and processes based on laws of thermodynamics.
CO4: To apply the concepts of entropy and exergy in engineering analysis.

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</table>
ME2111 ESSENTIALS OF MANAGEMENT

Prerequisite: Nil
Total Hours: 42 hours

Module 1 (9 Hours)
The management process, Schools of management thought, Kinds of managers – basic managerial roles and skills– the nature of managerial work, Contemporary management issues and challenges, Basic elements of planning – types of plans.

Module 2 (9 Hours)

Module 3 (12 Hours)

Module 4 (12 Hours)

References

Course Outcomes
CO1: To learn the fundamentals of management and the various theories of management.
CO2: To learn the functions of management and practice in real world.
CO3: To understand the functional areas of management-Marketing, Finance, HRM and Operational Management.
CO4: To prepare students to solve decision making problems and project management problems.

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ME2092 FLUID MECHANICS AND FLUID MACHINERY LABORATORY

Prerequisite: ME2001 Mechanics of Fluids

Total Hours: 42

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Course Outcomes

CO1: Impart knowledge about various flow measuring devices.
CO2: Impart knowledge about calibration of flow measuring equipment.
CO3: Familiarize students about the fluid machineries and its performance characteristics.
CO4: Impart knowledge about the testing of fluid machineries for its performance characteristics.

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CE2095 STRENGTH OF MATERIALS LABORATORY

Prerequisite: CE2001 Mechanics of Solids or equivalent.

Total Hours: 42

List of Exercises
1. Tension test on MS rod
2. Shear Test on MS rod
3. Torsion test on MS Specimen
4. Hardness tests on metals
5. Impact tests on metals
6. Bending test on steel beams
7. Spring test – open and close coil springs
8. Compression test on cubes and cylinders – determination of modulus of elasticity
9. Study of extensometers and strain gauges

Course Outcomes

CO1: Acquire hands on experience on testing tension and shear properties of materials.
CO2: Acquire hands on experience on testing torsional properties of materials.
CO3: Acquire hands on experience on testing hardness of metals using various hardness testing machines.
CO4: Acquire hands on experience on testing the impact and bending strength of materials.
CO5: To familiarize the uses of extensometer and strain gauges.

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SEMESTER 5

ME3001 DYNAMICS OF MACHINERY

Prerequisite: ME2013 Mechanics of Machinery
Total hours: 42

Module 1 (10 Hours)

Module 2 (12Hours)

Module 3 (10Hours)

Module 4 (10 Hours)
Two DOF — Forced harmonic vibration, Vibration absorber, Multi DOF systems — matrix formulation, Lagrange’s equation, Introduction to vibration of continuous systems — vibration of string, Approximate methods – Rayleigh’s energy method — Dunkerley’s equation, Holzer’s method, Geared system.

References

Course Outcomes
CO1: To learn force analysis of machines which is an essential requirement in the design of machines.
CO2: To learn the methods and nature of transmission forces using a system of interconnected bodies and to integrate this with transmission of motion.
CO3: To apply the knowledge gained in the course on Engineering dynamics and Mechanics of machinery to the area of machines.
CO4: To learn the mechanical vibration as a specialized area in dynamics.
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</table>
ME3002 PRINCIPLES OF HEAT TRANSFER

Prerequisite: Nil

Total Hours: 42

Module 1 (10 hours)
Heat transfer - basic modes of heat transfer, conduction heat transfer, energy balance - integral and differential approaches, general heat conduction equations in Cartesian, cylindrical and spherical coordinates - initial and boundary conditions - one-dimensional steady state conduction with and without heat generation, temperature dependence of thermal conductivity, introduction to two dimensional steady state conduction, unsteady state heat conduction in one dimension - lumped heat capacity system, semi infinite solids with sudden and periodic change in surface temperature

Module 2 (12 hours)
Convective heat transfer - Newton's law of cooling, Prandtl number, hydrodynamic and thermal boundary layer equations, laminar forced convection heat transfer from flat plates - similarity and integral solutions, internal flow and heat transfer - fully developed laminar flow in pipes, turbulent forced convection - Reynolds analogy, empirical relations in forced convection, natural convection - similarity and integral formulation of natural convection heat transfer from vertical plates, empirical relations in free convection, Condensation and boiling - film and drop wise condensation - film boiling and pool boiling, empirical relations for heat transfer with phase change, Introduction to mass transfer - Fick's law of diffusion - mass transfer coefficient - analogy between momentum, heat and mass transfer.

Module 3 (10 hours)
Radiation heat transfer - electromagnetic radiation spectrum, thermal radiation, black body, gray body and white body, monochromatic and total emissive power, Planck's law, Stefan-Boltzmann law, Wein's Displacement law, absorptivity, reflectivity, transmissivity, emissivity, Kirchhoff's identity, radiation exchange between surfaces - shape factors for simple configurations, heat transfer in the presence of re-radiating surfaces, radiation shields, surface and shape resistances, electrical network analogy.

Module 4 (10 hours)
Applications of heat transfer like extended surfaces, critical insulation thickness, heat exchangers, heat pipes etc. Analysis of fins with constant area of cross section, Heat Exchangers- LMTD, correction factors, heat exchanger effectiveness and number of transfer units, Design of heat exchangers - Compact heat exchangers, introduction to Heat pipes and their applications. Applications of radiative heat transfer, Multiple-mode heat transfer problems.

References
5. 

Course Outcomes

CO1: Understanding the physics involved in various heat transfer mechanisms.
CO2: Applying the knowledge of mathematics, and analyze the different situations in which heat transfer is involved.
CO3: To be able to calculate heat transfer rate, time required for heating or cooling and obtaining the temperature distribution with respect to the domain of analysis under different situations.
CO4: To gain the knowledge of applications of heat transfer and to evaluate the design and analysis of different heat exchangers.
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</table>
ME3101 MANAGEMENT OF PRODUCTION SYSTEMS

Pre-requisite: Nil

Total Hours: 42

Module 1 (12 Hours)

Module 2 (10 Hours)
Inventory control, Functions of inventors, Inventory problem classification, Relevant cost, Selective inventory control, Independent demand systems – deterministic models – sensitivity analysis – quantity discount – batch production – Introduction to probabilistic models, Basic concepts of supply chain management.

Module 3 (10 Hours)

Module 4 (10 Hours)
Quality management, Quality costs, Introduction to TQM, Introduction to six sigma, Statistical process control, Control charts for variables – X-bar and R chart, Control charts for attributes – P and C chart, Introduction to acceptance sampling.

References

Course Outcomes

CO1: To comprehend the role of operations management in the overall business strategy of the firm.
CO2: To describe the concepts and methods related for designing and managing operations in a production system.
CO3: To demonstrate the tools appropriate for analysis in demand forecasting, production planning, facility planning and quality control.
CO4: To evaluate the operations management problems using the appropriate tools.

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ME3102 MANUFACTURING SCIENCE

Prerequisite: Nil

Total Hours: 42

Module 1 (11 hours)
Foundry: foundry materials- moulding and core sand- binders - additives, sand preparation- sand control tests, pattern and pattern making, mould and core making, expendable and non expendable moulds, mould assembly, melting furnaces and melting practice, pouring and fettling, solidification of pure metals and alloys, grain growth.

Module 2 (11 hours)
Casting processes- sand casting, shell moulding, investment casting, slush casting, gravity and pressure die casting, centrifugal casting, casting design, gateway system design, riser design casting alloys, casting defects, inspection, testing- destructive and non-destructive, casting alloys, economics of casting.

Module 3 (10 hours)

Module 4 (10 hours)
Metal joining- classification, welding heat sources, arc welding machines, arc production, arc characteristics, metal transfer, welding electrode, gas welding, resistance welding, thermit welding, ultrasonic welding, electron beam welding, laser beam welding, gas and arc cutting. Welding metallurgy, weldability of ferrous and non-ferrous metals, design of weldments, joint design, residual stresses and distortion, testing of welded joints, brazing and soldering.

References

Course Outcomes

CO1: Understanding about foundry casting.
CO2: Learn about advanced casting techniques.
CO3: Understanding different welding techniques and operations.
CO4: Understanding the basic operations and metallurgical processes in soldering and brazing.

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ME3003 ENVIRONMENTAL STUDIES FOR MECHANICAL ENGINEERS

Prerequisite: Nil

Total Hours: 42

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<td>Module 4</td>
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Module 1 (9 hours)
Scope and importance of Environmental Studies, Ecosystems – Structure and function, Forest, Grassland and Desert ecosystems, diversity in ecosystems, Value of biodiversity, Threats to biodiversity – Wildlife Protection Act – Forest Conservation Act, Conservation of biodiversity, Environmental ethics, Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.

Module 2 (11 hours)
Natural resources and associated problems: Forest resources, Aquatic ecosystems, Water resources, Mineral resources, Land resources, Causes, effects and control measures of Water pollution, Soil pollution and Marine pollution, Water (Prevention and control of Pollution) Act, Water conservation, rain water harvesting, watershed management, Disaster management: floods, earthquake, cyclone and landslides, Solid Waste Management: Causes, effects and control measures of urban and industrial wastes, Wasteland reclamation – Consumerism and waste products.

Module 3 (10 hours)
Environmental Pollution – Definition – Causes, effects and control measures of: - Air Pollution, Noise pollution, Thermal pollution and nuclear hazards, Environmental Protection Act – Air (Prevention and Control of Pollution) Act – Issues involved in enforcement of environmental legislation.

Module 4 (7 hours)
Renewable and non-renewable resources, Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, From Unsustainable to Sustainable development – Urban problems related to energy, Role of an individual in conservation of natural resources, equitable use of resources for sustainable lifestyles – Role of Information Technology in Environment and human health.

Field work (Equal to 5 lecture hours)
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.

References
Course Outcomes

CO1: To understand the significance of ecosystem.
CO2: To understand the significance of natural resources.
CO3: To understand different environmental pollution control methods.
CO4: To understand the significance of renewable energy sources.

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ME3091 HEAT TRANSFER LABORATORY

Prerequisite : Nil

Total Hours: 42

Course Outcomes

CO1: To familiarize various models of study state heat transfer like conduction, convection (free of force) and radiation.
CO2: To familiarize heat transfer processes like boiling, condensation and refrigeration systems.
CO3: To familiarize the unsteady state heat transfer processes and heat transfer processes and heat exchangers.
CO4: To find various properties like thermal conductivity and also extended surfaces.

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</table>
ME3191 PRODUCTION ENGINEERING LABORATORY I

Prerequisite: Nil

Total Hours: 42

Classifications of machine tools and machining processes - Specification of machine tool, power source, Centre lathe - general features, parts and functions - Machining on Centre lathe- Cutting tools - Materials, types: Grinding, Cutting variables - Selection of speeds, feeds and depth of cut - Use of cutting fluids - Methods of holding work - Lathe operations - straight, taper and eccentric turning, thread cutting, drilling, boring, profile turning, knurling - Tolerance and surface finish.

References

Course Outcomes

CO1: To substantiate of the basic manufacturing processes learnt through workshop practice II by practical experiences.

CO2: Practice the operations- shaping, slotting, grinding, milling, and use of lathe for complex product making.

CO3: To learn the preparation of process chart, importance of reducing idling time, movement times and storage times.

CO4: Use of measuring devices, providing tolerances and allowances.

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SEMESTER 6

ME3111 MACHINING SCIENCE AND MACHINE TOOLS

Prerequisite: Nil

Total Hours: 56

Module 1 (14 hours)

Module 2 (14 hours)
Basic concepts of machine tools: Tool - work motions, machine tools for various machining processes, kinematics of machine tools and gear boxes, feed and speed mechanism, machine tool drives, machine tool dynamics, gear manufacture- milling, hobbing and shaping, special purpose machine tools, hydraulic control of machine tools, components of hydraulic circuits, control circuits and their characteristics, testing of machine tools for positioning accuracy and repeatability.

Module 3 (14 hours)
CNC machine tools, constructional features, drives and controls, stepper motors, servo motors, hydraulic systems, feed back devices, counting devices, interpolators- linear, circular interpolation and other emerging techniques, adaptive control systems for turning and milling, CNC part programming, post processors, CNC programming with interactive graphics, use of various software packages, development of CNC programmes for special problems. Introduction to robotics.

Module 4 (14 hours)
Modern machining processes: Mechanics of AJM, EDM, USM, EBM and ECM, process parameters and applications. Jigs and fixtures, basic principles of location, type and mechanics of locating and clamping elements, design of jigs and fixtures.

References
Course Outcomes

CO1: Learn basic tool geometry, mechanism of metal cutting, new tool, tool life, cutting force.
CO2: Learn kinematic of machining tools of various manufacturing methods.
CO3: Understand various modern machining process and its applications.
CO4: Learn basics of jigs and fixtures and design.

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</table>
Prerequisite: Nil

Total Hours: 42

Module 1 (12 hours)

Module 2 (10 hours)

Module 3 (10 hours)

Module 4 (10 hours)

References

Course Outcomes

CO1: Understand the terminology.
CO2: Know the available instruments.
CO3: Quantify the measurement uncertainty.
CO4: Plan experiments.

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ME3011 GAS DYNAMICS

Prerequisite: ME2001 Fluid Mechanics

Total Hours: 42

Module 1 (10 hours)

Basic equations of fluid flow, Reynolds transport equation, Integral and differential formulations - Integral form of the equations of continuity - Momentum - energy equations - use of the integral equations, Differential form of these equations. Stokes postulates and constitutive equations, Navier-Stokes equations and energy equations for Newtonian fluids.

Module 2 (11 hours)

Introduction to compressible flows, Basic concepts - equations for one-dimensional flow through stream tubes - variation of pressure - temperature - density in the atmosphere, Speed of sound, Mach number, Qualitative difference between incompressible, Subsonic and supersonic flows, Karman’s rules of supersonic flows, Characteristic velocities, The adiabatic flow ellipse, Isentropic flow through a duct - criterion for acceleration and deceleration -stagnation quantities -isentropic relations, Use of gas tables and charts, Operation of nozzles at off-design conditions.

Module 3 (11 hours)


Module 4 (10 hours)

Flow with friction - Fanno lines and Fanno flow relations, Effect of friction on properties -choking, isothermal flows, Flow with simple heat transfer - Rayleigh lines -effect of heat addition -thermal choking, Generalised on dimensional flows - One-dimensional flow with several effects like mass addition -friction and heat transfer.

References


Course Outcomes

CO1: To give the basic foundation in integral an differential formulations of equations of continuity, momentum and energy.

CO2: To understand the effect of compressibility aspects in practical applications.

CO3: To analytically solve the flow and heat problems in compressible gases.

CO4: To understand the irreversibility mechanisms of a moving compressible fluid.

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ME3012 THERMAL ENGINEERING I

Prerequisite: Nil

Total Hours: 42

Module 1 (10 Hours)
Analysis of Gas power cycles, Value of Carnot cycle in engineering, Air standard cycles - assumptions – Otto - Diesel & Dual combustion cycles, Comparison among these cycles, Miller and Stirling cycles, Real air-fuel cycles, SI engine cycle at part throttle and supercharged conditions, Four stroke and Two stroke engines, Valve timing & Port timing diagrams, Scheme of scavenging - Scavenging efficiency.

Module 2 (11 Hours)

Module 3 (11 Hours)
Normal combustion in CI engines, Diesel knock – Cetane Number, Alternate fuels for diesel engines - Multiple Port Fuel Injection (MPFI), Throttlebody fuel Injection - IC Engine performance – constant speed and variable speed characteristics - Different methods to determine Friction Power – Variation of volumetric efficiency with speed and load, Heat Balance, Engine Emission and Air pollution – Catalytic converters and EGR.

Module 4 (10 Hours)

References

Course Outcomes

CO1: To understand the significance of thermodynamic cycle w.r.t IC/EC engines
CO2: To determine the performance of engine.
CO3: To understand the working of compressor.

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<td>End Semester Examination</td>
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</table>
ME3192 METROLOGY AND INSTRUMENTATION LABORATORY

Prerequisite: Nil

Total Hours: 42

1. Calibration and determination of uncertainties of the following:
   (a) Strain gauge load cells (b) Bourdon tube pressure gauge (c) LVDT (d) Thermocouple (e) Tachometers using stroboscopes, etc.
3. Evaluation of straightness using autocollimator, spirit level
4. Measurement of tool angles of single point tool using TMM
5. Measurement of gear parameters using Profile projector
6. Study and measurement of surface finish using surface roughness tester
7. Study and measurements with CMM
8. Experiments on limits and fits
9. Study and use of ultrasonic flaw detector
10. Exercises on measurement system analysis
11. Study and making measurements with thread pitch micrometer, disc micrometer, thread pitch gauge, height gauge, slip gauges, optical flat, three pin micrometer, pyrometer, RTD, Sling psychrometer, zoom microscope, etc.

Course Outcomes

CO1: Conduct simple experiment.
CO2: Familiarize with measuring instruments.
CO3: Read instruction manuals and operate equipment.
CO4: Prepare manuals.

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<td>Laboratory Work</td>
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<td>End Semester Examination</td>
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ME3193 PRODUCTION ENGINEERING LABORATORY II

Prerequisite: Nil
Total Hours: 42


Exercises:
Shaping and slotting Exercises -Flat and bevel surfaces, grooves, Slots, guide ways, key ways etc. Exercises in horizontal and -surface, slot, key way and gear milling-Vertical milling machine. Turning Exercises-Limits and Fits. Grinding Exercises. Non – traditional Machining, NC/CNC Machining.

References
2. ASTME, Tool Engineer's Handbook.

Course Outcomes
CO1: Fabricate a kinematic linkage with the knowledge acquired through Production Engineering Lab 1.
CO2: Design a system, fabricate with proper selection of material and operations.
CO3: Present with the applications and problems faced in fabrication.
CO4: Learn the basics in costing and estimating by the analysis of: time, material cost, MHR, and other factors.

Evaluation
Component | Weightage (%) |
--- | --- |
Laboratory Work | 60 |
End Semester Examination | 40 |
SEMESTER 7

ME4001 MACHINE DESIGN – I

Prerequisite: ME2002 Elements of Solid Mechanics

Total Hours: 42

Module 1 (12 hours)
Introduction to Design – steps in design process – design factors, Principles of standardization, Selection of materials, Statistical considerations in design, Stress concentration, Theories of failure, Impact load, Fatigue loading, Consideration of creep and thermal stresses in design.

Module 2 (10 hours)

Module 3 (10 hours)

Module 4 (10 hours)

References


Data Handbooks (allowed for reference during examinations also)


Course Outcomes

CO1: To introduce general steps in design process and to familiarize mechanical design of components subjected to static, fatigue and imposed loading.

CO2: To familiarize the design principles for threaded fasteners, bolted joints and riveted joints.

CO3: To familiarize analysis and design of welded connections and springs, for static and fatigue loading.

CO4: To familiarize analysis and design of shafts subjected to static and fatigue loads.
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<td>End Semester Examination</td>
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ME4002 THERMAL ENGINEERING –II

Prerequisite: ME2014 Thermodynamics

Total hours: 42 Hrs

Module 1 (12 hours)

Module 2 (10 hours)

Module 3 (10 hours)

Module 4 (10 hours)
Power Plant Economics – load curve and load duration curve – load, Diversity, Capacity and use factors – selection of size and number of units – scheduling of operation – depreciation and replacement – environmental aspects of thermal power systems, Dust collectors.

References

Course Outcomes
CO1: To understand the significance of thermodynamic cycles w.r.t. steam power plant.
CO2: To understand the co-generation plant.
CO3: To understand working of component of power plant.
CO4: To understand working of pollution control methods.

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ME4101 OPERATIONS RESEARCH

Prerequisite: Nil

Total Hours: 42

Module 1 (12 hours)

Module 2 (9 hours)

Module 3 (9 hours)

Module 4 (12 hours)
Dynamic programming – characterization – Bellman’s principle of optimality – problems with a finite number of concentric decisions, Queuing theory – generalized Poisson queuing model – steady state solution of single server models for infinite queue size and finite queue size.

References

Course Outcomes

CO1: To solve problems in optimization techniques.

CO2: To develop mathematical skills to approach a real life industrial problems.

CO3: To inculcate ideas to solve problems on transportation and queuing theory.

CO4: To import case studies problems to solve future problems.

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ME4091 HEAT ENGINES LABORATORY

Prerequisite: Nil

Total Hours: 42

Study of spark ignition (SI) and compression ignition (CI) engine systems - fuel system - lubrication system - cooling system - starting system - ignition system - governing system - power transmission system - types of carburetors - fuel injectors - multi point fuel injection (MPFI) system - common rail direct injection (CRDI) system - gasoline direct injection (GDI) system, Study of different types of boilers and its components, Study of fuel properties measuring systems - bomb calorimeter - gas calorimeter - red-wood viscometer - flash and fire apparatus, Study of dynamometers, Constant speed performance characteristics of SI engine, Morse test at constant throttle and at constant load, Constant speed performance characteristics of SI engine, Constant speed performance characteristics of MPFI engine, Performance characteristics of constant speed CI engine, Constant speed performance characteristics of single cylinder CI engine, Determination of frictional horse power (FHP) by retardation test, Constant speed performance characteristics of reciprocating compressor, Variable speed performance characteristics of SI engine (with carburetor and MPFI system), Performance characteristics of CI variable speed engine, Determination of viscosity - flash and fire point - calorific value of the given fuel or oil, Performance characteristics of centrifugal blower and rotary type positive displacement compressor by suitable test, Performance characteristics with cooling water temperature (cooling curve experiment) by suitable test, Valve timing diagrams of single and multi cylinder engines.

Course Outcomes

CO1: Familiarize the students to automobile component.
CO2: Performance study of various types of engines.
CO3: Hands on experience on engines and blowers.
CO4: Motivate students for innovation in automobile field.

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ME4191 CAD/CAM LABORATORY

Prerequisite: Nil

Total Hours: 42


References

Course Outcomes

CO1: To familiarize with various CAD/CAM packages used in the industry.
CO2: To enable students to do geometric modeling.
CO3: To enable students to do FEM and CFD analysis.
CO4: To enable students to take up jobs in product design and related areas.

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ME4098 PROJECT

Prerequisite: Nil
Total Hours: 42

Students are required to take up a project (generally in groups) in any topic related to Mechanical Engineering under the guidance of a faculty member. The project work commenced in VII Semester (normally 5 hours/week) shall be continued in VIII Semester too. At the end of the VII semester, an interim report describing the details of the project work has to be submitted to the Department, usually in a prescribed format. Presentation of this part of the work is to be done before an evaluation committee.
SEMESTER 8

ME4011 MACHINE DESIGN – II

Prerequisite: ME2002 Elements of Solid Mechanics

Total Hours: 42

Module 1 (12 hours)
Design of clutches, brakes, belts and chain drives – friction clutches and brakes – uniform pressure and uniform wear assumptions – design of disc and cone types of clutches and brakes – design of external contracting and internal expanding elements – band type clutches and brakes – belt and chain drives of common types – design of flat and V-belt drives – selection of roller chains.

Module 2 (12 hours)

Module 3 (11 hours)

Module 4 (7 hours)

References

Data Handbooks (allowed for reference during examinations also)

Course Outcomes

CO1: To familiarize analysis and design of clutches, brakes, drives and chain drives.
CO2: To familiarize analysis and design of spur, helical, bevel and worm gears subjected to static, dynamic and wear loads.
CO3: To familiarize analysis and design of journal bearings and rolling contact bearings.
CO4: To introduce and familiarize concepts of product design for manufacturability.
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MS4004 INDUSTRIAL ECONOMICS

Prerequisite: Nil

Total Hours: 42 Hrs

Module 1 (11 hours)
General Foundations of Economics: Nature of the firm; Forms of organizations-Objectives of firms-Demand analysis and estimation-Individual, Market and Firm demand, Determinants of demand, Elasticity measures and business decision making, Demand Forecasting-Theory of the firm-Production functions in the short and long run-Cost concepts- Short run and long run costs- economies and diseconomies of scale

Module 2 (9 hours)
Product Markets-Market Structure-Competitive market-Imperfect competition (Monopoly, Monopolistic competition and Oligopoly) and barriers to entry-Pricing in different markets-Differential Pricing-Supply, Demand and Government Policies-Game Theory-Prisoner’s Dilemma

Module 3 (11 hours)
Macro Economic Aggregates-Gross Domestic Product; Economic Indicators; Models of measuring national income; Inflation ; Fiscal and Monetary Policies ; Monetary system; Money Market, Capital market; Indian stock market; Development Banks; Changing role of Reserve Bank of India

Module 4 (11 hours)
International trade - Foreign exchange market- Balance of Payments (BOP) and Trade-Effects of disequilibrium in BOP in business- Trade regulation- Tariff versus quotas- International Trade and development and role of international institutions (World Bank, IMF and WTO) in economic development.

References
1. Bo Soderston,International Economics,

PN : Supplementary materials would be suggested / supplied for select topics on Indian economy
Course Outcomes

CO1: To evaluate the economics of the management, operation, and growth and profitability of engineering firms and analyze operations of markets under varying competitive conditions.

CO2: The course equips a student to carry out and evaluate benefit/cost, life cycle and breakeven analyses on one or more economic alternatives.

CO3: To analyze cost/revenue data and carry out make economic analyses in the decision making process to justify or reject alternatives/projects on an economic basis.

CO4: Produce a constructive assessment of a social problem by drawing the importance of environmental responsibility and demonstrate knowledge of global factors influencing business and ethical issues.

CO5: Helps to use models to describe economic phenomena; analyze and make predictions about the impact of government intervention and changing market conditions on consumer and producer behavior and well-being.

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ME4097 SEMINAR

Prerequisite: Nil
Total Hours: 42

Search technical literature in the form of peer reviewed journals and conference proceedings and identify a current research topic relevant to Mechanical Engineering – Comprehend the topic and prepare a technical report on the topic of presentation in the specified format– Prepare presentation aids and deliver a technical presentation to the class – Appropriate weights will be given for communications skills (both verbal and written) as well as for capacity to impress the audience and ability to handle question and answer session.

Course Outcomes

CO1: To train the students to search technical literature.
CO2: To identify a current and relevant research topic.
CO3: To understand and deliver a presentation.
CO4: To write a technical report.
ME4098 & ME4099 PROJECT

Prerequisite: ME4098 Project
Total Hours: 70

The project work commenced in VII Semester shall be continued in VIII Semester, normally 5 hours/week. At the end of the VIII semester, the final report/thesis describing the details of the entire project work has to be submitted to the Department, usually in a prescribed format. Presentation of the entire work is to be done before an evaluation committee and a successful oral defense of the thesis before the committee is required.

Course Outcomes

CO1: Ability to work on practical problems by applying the knowledge gained from courses in Mechanical Engineering curriculum.
CO2: Practical experience gained through the in-depth study of a challenging problem in Mechanical Engineering field.
CO3: Acquire innovative problem solving skills and conceptualization of creative ideas.
CO4: Improve the team working and communication skills for a successful professional career.
ELECTIVES

ME3021 INTRODUCTION TO FINITE ELEMENT METHODS

Prerequisite: Nil

Total Hours: 42

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Module 1 (10 hours)

Module 2 (10 hours)

Module 3 (12 hours)

Module 4 (10 hours)

References
ME3022 EXPERIMENTAL STRESS ANALYSIS

Prerequisite: ME2002 Elements of Solid Mechanics or Equivalent

Total Hours: 42

Module 1 (9 hours)
Analysis of stress at a point and strain at a point, Stress-strain relations, Principal stresses and principal strains, Prediction of failures, Basic equations in elasticity theory, Formulation of problems, Plane stress and plane strain problems, Solution of problems using Airy’s stress function.

Module 2 (12 hours)

Module 3 (12 hours)

Module 4 (9 hours)
Theory of brittle coating method - coating stresses, Failure theories - brittle coating patterns - crack detection, Ceramic based brittle coatings, Resin based brittle coatings, Test procedures for brittle coating analyses - analysis of brittle coating data.

References
ME3023 THEORY OF PLASTICITY

Prerequisite: ME2012 Applied Mechanics of Solids

Total Hours: 42

Module 1 (10 hours)

Module 2 (10 hours)

Module 3 (12 hours)
Elastic-Plastic analysis – pure bending of a beam – torsion of circular bar – thick spherical shell under internal pressure – thick cylindrical shell under internal pressure – rotating cylinders – rotating disks, Plane strain problems – simple slip line fields, Bound theorems and their applications

Module 4 (10 hours)

References
ME3024 CONTROL SYSTEMS ENGINEERING

Prerequisite: Nil
Total Hours: 42

Module 1 (12 hrs)
Introduction to control system engineering, History, Representation of feedback control system by block diagrams, Physical systems and their mathematical models, Representation of linear time invariant systems, Order of the system, Classical method, Transfer function approach, Block diagram reduction, State space representation, Mathematical models of mechanical, electrical, hydraulic and pneumatic elements and systems, Conversion of state Space to transfer function and transfer function to state space, Transformation of mathematical model using MATLAB.

Module 2 (12 hrs)
Transient response analysis, Solution of first order, Second order and Higher order systems, Solution by Laplace transform, Solution of states space equation, Performance parameters of first order and second order systems, Stability of systems, Routh-Hurwitz criterion, Steady state error, Error constants, Improving time response and steady state error, Root locus techniques, Application of MATLAB in transient response.

Module 3 (8 hrs)
Frequency response of systems, Plotting the frequency response, Rectangular plots, Polar plots, Bode plots and Nichols chart, Stability analysis, Nyquist plots and Nyquist criterion, Gain margin, Phase margin, Application of MATLAB in frequency response.

Module 4 (10 hrs)
Design of control systems, The design philosophy, Design of Lead, Lag, Lead- Lag, Proportional, Integral, derivative and PID controllers using Root locus and Bode plot, Tuning of controllers and PID controller gain tuning techniques, Design of controllers via state space, Controllability and observability, Applications of MATLAB in design of controllers.

References
ME3025 NONLINEAR DYNAMICS AND CHAOS

Prerequisite: ZZ1001 Engineering Mechanics

Total Hours: 42

Module 1 (10 hours)
Introduction to dynamical systems, Discrete and continuous time systems, Autonomous and non-autonomous systems, Discrete time systems – one-dimensional map – fixed points of maps and their stability, Bifurcation of maps, Continuous time systems –phase space and flows –attracting sets, Concepts of stability.

Module 2 (10 hours)

Module 3 (10 hours)

Module 4 (12 hours)
Fractals and dynamical systems, Examples of fractals – Koch curve – Cantor set etc., Fractal dimension – measures of fractal dimension, Computational methods – shooting method, harmonic balance method, Determination of Lyapunov exponents and fractal dimensions, Applications of nonlinear dynamics.

References

ME3026 ENGINEERING FRACTURE MECHANICS

Prerequisite 1: ME2002 Elements of Solid Mechanics
Prerequisite 2: ME2012 Applied Mechanics of Solids/
ME2015 Theory of Elasticity and Plasticity

Total Hours: 42

Module 1 (10 hours)

Module 2 (10 hours)

Module 3 (10 hours)

Module 4 (12 hours)

References

ME3027 FLUID POWER CONTROLS

Prerequisite: ME2001 Fluid Mechanics

Total Hours: 42

Module 1 (10 Hours)
Introduction to oil hydraulics and pneumatics, their advantages and limitations, ISO symbols and standards in Oil Hydraulics and pneumatics. Recent developments, applications, Basic types and constructions of Hydraulic pumps and motors, Ideal pump and motor analysis, Practical pump and motor analysis, Performance curves and parameters.

Module 2 (11 Hours)

Module 3 (11 Hours)

Module 4 (10 Hours)
Components of pneumatic systems: Direction, flow and pressure control valves in pneumatics systems, Development of single and multiple actuator circuits, Valves for logic functions: Time delay valve, Exhaust and supply air throttling, Examples of typical circuits using Displacement – Time and Travel-Step diagrams. Will-dependent control, Travel-dependent control and Time-dependent control, combined control, Program Control, Electro-pneumatic control and air hydraulic control, Applications in Assembly, Feeding, Metalworking, materials handling and plastics working.

References
ME3028 ADVANCED THERMODYNAMICS

Prerequisite: ME2014 Thermodynamics

Total Hours: 42

Module 1 (10 hours)
General principles of classical thermodynamics – postulational approach – basic postulates – conditions of equilibrium – fundamental equations – equations of state, Euler equation, Gibbs-Duhem equation, Multi-component simple ideal gases.

Module 2 (10 hours)

Module 3 (10 hours)
Maxwell relations and Jacobian methods, Procedure to reduction of derivatives, applications, Stability criteria of thermodynamic systems, First-order phase transition, single component and multi-component systems, Gibbs phase rule – phase diagram for binary systems.

Module 4 (12 hours)
Critical phenomena, Liquid and solid Helium, Nernst postulate, Introduction to irreversible thermodynamics – linearised relation – Onsager’s reciprocity theorems, Special topics on advanced thermodynamics.

References

ME3029 COMPUTATIONAL METHODS IN ENGINEERING

Prerequisite: Nil
Total Hours: 42

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Module 1 (8 hours)

Module 2 (12 hours)

Module 3 (10 hours)

Module 4 (12 hours)

References
ME3121 POWDER METALLURGY

Prerequisite: Nil

Total Hours: 42

**Module 1 (10 hours)**

**Module 2 (11 hours)**
Compaction and shaping - Cold and Iso-static compaction, Die compaction, Pressing equipments and tooling: Powder Injection Moulding, Extrusion and rolling. Hot compaction techniques, Hot Iso-static Pressing (HIP), equipments, tooling and applications: Explosive compaction: Slip casting.

**Module 3 (10 hours)**

**Module 4 (11 hours)**
Powder metallurgy products, Porous parts, Sintered carbides, Cermets, Electric and magnetic parts and ceramic components, Sintered friction materials. P/M parts of the year, Research trends in Powder Metallurgy.

**References**

ME3122 INTRODUCTION TO MARKETING

Prerequisite: MA2001 Mathematics III: Probability and Statistics

Total Hours: 42

Module 1 (10 Hours)
Introduction to marketing, Evolution of marketing concept, Scope of marketing, Marketing management task, Functions of marketing, Marketing mix, Developing marketing strategies, Marketing and customer value, Corporate and division. Strategic planning in marketing, Business unit strategic planning, Contents of marketing plan.

Module 2 (10 Hours)
Identifying market segments and targets, Levels of market segmentation, Base for segmenting consumer markets, Base for segmenting business markets, Marketing Research--Marketing Research Process-Research objectives, Research Plan development, Collecting information, Analysis.

Module 3 (10 Hours)

Module 4 (12 Hours)
Product strategy, Product characterization and classification, Product and brand relationship, Packaging, Challenges in new product development, Consumer adoption process, Product lifecycle marketing strategy, Brand management, Developing pricing strategies and progress, Understanding prices, Setting the prices, Adapting the prices, Initiating and responding to price changes.

References
ME3123 DESIGN AND ANALYSIS OF MANAGEMENT INFORMATION SYSTEMS

Prerequisite: Nil
Total Hours: 42

Module 1 (11 hours)
Concepts of data and information – Producing information from data – economies of information – analysis of system – management and formal information system concepts, Building blocks in information systems – system design forces – information development life cycle – information systems for strategic planning.

Module 2 (10 hours)
General steps in Information system design – systems investigation and requirements engineering – System analysis and general system design – charting tools for system analysis and design.

Module 3 (11 hours)

Module 4 (10 hours)
System implementation – Verification and Validation of Software system – Software metric and models, introduction to capability maturity model – software testing approaches – training and post implementation audit – Recent developments in information systems, Security features in global information systems.

References

ME3124 WORK DESIGN AND MEASUREMENT

Prerequisite: Nil

Total Hours: 42 hours

Module 1 (12 Hours)

Module 2 (10 Hours)

Module 3 (10 Hours)
Ergonomics – nature of man-machine systems – characteristics – purpose, Operational functions and components – types of systems, Information input and processing, Sources and pathways of stimuli, Human information processing, Visual displays – quantitative and qualitative displays – visual codes, symbols and signs – general guidelines in design of visual displays.

Module 4 (10 Hours)

References
ME3125 COST ANALYSIS AND CONTROL

Prerequisite: Nil

Total Hours: 42

Module 1 (10 Hours)
Nature of Management Accounting, Generally accepted Accounting Principles and Accounting Standards, Accounting Cycle and Statements of Financial Information Understanding Corporate Financial Statements and Reports.

Module 2 (10 Hours)

Module 3 (10 Hours)
Activity Based Costing System, Job-Order and Batch Costing, Process, Joint and By-Product Costing, Variable Costing and Absorption (Full) Costing

Module 4 (12 Hours)
Volume-Cost-Profit Analysis, Budgeting and Profit Planning, Standard Costs and quality Costs, Cost Variance Analysis, Revenue and Profit Variance Analysis, Responsibility Accounting, Short-Run Decision Analysis, Capital Budgeting

References

ME3126 SUPPLY CHAIN MANAGEMENT

**Prerequisite:** Nil

**Total Hours:** 42

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**Module 1 (10 hours)**


**Module 2 (11 hours)**


**Module 3 (11 hours)**

Drivers of transportation decisions – modes of transportation – choices and comparison of their performance measures, Devising a strategy for transportation – distribution network design options for a transportation network – cross docking practices, Vehicle scheduling in transportation – savings algorithm, Network design and operation decisions – role of network design in the supply chain – factors influencing network design decisions – framework for network design decisions.

**Module 4 (10 hours)**

Models for facility location and capacity allocation – network optimization models – capacitated plant location models – gravity location models – network operations model, Strategic role of units in the network, Innovations in supply chains – supply chain integration – internal and external, Bullwhip effect – quantifying the bullwhip effect, Remedial strategies for coping with the bullwhip effect, Supply chain restructuring – postponement – supply chain mapping – move from make to stock (MTS) to customer to order (CTO) model, Enabling supply chain management through information technology.

**References**

ME3127 MANAGEMENT OF ORGANISATIONAL BEHAVIOUR

Prerequisite: Nil

Total Hours: 42

Module 1 (11 Hours)

Module 2 (11 Hours)
Group Process: Foundations of group behavior, understanding team, communication, leadership, power, conflict and negotiation.

Module 3 (10 Hours)
Organisational Process: Work design and technology, organisation structure and design – organisational culture.

Module 4 (10 Hours)
Special topics: Organisational change, stress management, decision making in organisations.

References
ME3128 PRODUCTION PLANNING AND CONTROL

Prerequisite: Nil
Total Hours: 42

Module 1 (12 Hours)

Module 2 (10 Hours)
Sales and operations planning – sales and operations planning process – strategic variables – relevant cost – quantitative methods, Master production scheduling (MPS)– MPS technique – final assembly schedule – freezing and time fencing.

Module 3 (10 Hours)

Module 4 (10 Hours)

References

ME3129 MANAGEMENT OF HUMAN RESOURCES

Prerequisite: Nil

Total Hours: 42

Module 1 (11 Hours)

Module 2 (11 Hours)

Module 3 (10 Hours)

Module 4 (10 Hours)

References
ME3130 QUALITY PLANNING AND ANALYSIS

Prerequisite: Nil
Total Hours: 42

Module 1 (10 hours)

Module 2 (12 hours)
Seven QC tools, Quality function deployment, ISO 9000, Benchmarking, Poka yoke, Failure mode and effect analysis, Design of experiments, Taguchi’s quality engineering, Total productive maintenance.

Module 3 (10 hours)
Statistical quality control – fundamentals – assignable causes, Rational subgrouping, Control charts for variables – average range chart, average standard deviation chart, control charts for attributes – chart for fraction non-conforming, chart for count of non-conformities, Process capability, Six sigma.

Module 4 (10 hours)
Acceptance sampling – operating characteristic curve, Types of sampling plans, Acceptance quality level, Average outgoing quality, Sampling plan design, Reliability – life-history curve, System reliability, Testing.

References

ME4021 INDUSTRIAL TRIBOLOGY

Prerequisite 1: ME2001 Fluid Mechanics/ ME2004 Fluid Mechanics and Machinery
Prerequisite 2: ME2012 Applied Mechanics of Solids/
               ME2015 Theory of Elasticity and Plasticity

Total Hours: 42

Module 1 (11 hours)
Introduction – Basic equations, Derivation of Reynolds equation, Energy equation, Idealized hydrodynamic
bearings, Mechanism of pressure development, Plane slider bearings, Idealized journal bearings, Infinitely long
and short bearings.

Module 2 (11 hours)
Finite bearings – performance characteristics – numerical solution, Hydrodynamic instability, Design of journal
bearings, Analysis of externally pressurized and gas lubricated bearings.

Module 3 (10 hours)
Costs of wear, Surface topography, Mechanics of contact, Theories of friction, Friction of metals and non-
metals, Temperature of sliding surfaces, Stick-slip, Rolling friction.

Module 4 (10 hours)
Wear of metals, Adhesive wear, Abrasive wear, Corrosion and corrosion wear, Erosion, Surface fatigue and
impact wear, Wear of elastomers, Wear of ceramics and composite materials, Measurement of friction and
wear.

References
ME4022 VEHICLE DYNAMICS

Prerequisite: ME2003 Engineering Mechanics – Dynamics

Total hours: 42

Module 1 (11 Hours)
Introduction to vehicle dynamics, Acceleration performance, Braking performance, Aerodynamics and rolling resistance, Steady-state cornering, Suspensions– steering systems, Rollover-acceleration – braking and turning forces.

Module 2 (11 Hours)
Front wheel geometry–effects of front wheel geometry on vehicle performance, Dynamic axle Loads, Transient rollover, Acceleration–Traction limited acceleration–Power limited acceleration–Road friction, Rear wheel lockup, Drag forces, Total road loads, Vibration, Roll center analysis.

Module 3 (10 Hours)
Tyre construction –Types- Types of tires–Basic Tyre modelling considerations–Tyre forces on hard surfaces–Tyre-soil interaction, Characterizing typical terrains for mobility analysis.

Module 4 (10 Hours)
Sensors, Actuators, Cruise control, Antilock braking system (ABS), Traction control, Directional control, Vehicle stability controls, Active suspension, Computer aided analysis/Simulation–Simulation with MATLAB-Simulink and ADAMS.

References
ME4023 INTRODUCTION TO ROBOTICS

Prerequisite: Nil
Total Hours: 42

Module 1 (11 hrs)
Brief History, Types and applications of robots. Present status and future trends in robotics, Overview of robot subsystems. Challenges in robotics, Characteristics of robots, Robot configurations and concept of work space, Types of actuators and sensors in robotics, Types of grippers.

Module 2 (10 hrs)
Introduction to Manipulator Kinematics, Position and orientation of rigid bodies, Planar and spatial mechanism description, Homogenous transformations, Denavit - Hartenberg (DH) notation, Forward and inverse kinematic analysis, Examples.

Module 3 (11 hrs)
Linear and rotational velocity of rigid bodies, Velocity propagation from link to link, Jacobians, Singularities, Static forces in manipulators, Jacobians in force domain, Cartesian transformation of velocities and static forces. Forward and Inverse Dynamics, Lagrangian and Newton – Euler’s formulation methods, Examples.

Module 4 (10 hrs)
Trajectory Generation, General consideration in path description and generation, Joint space schemes, Collision free path planning, Robot programming. Robot Control, Independent joint control, PD and PID feedback, Issues in nonlinear control, Examples.

References
ME4024 DESIGN FOR MANUFACTURABILITY

Prerequisite: Nil

Total Hours: 42

Module 1 (9 hours)
Introduction – Design philosophy, implementing DFM, Benefits of DFM

Module 2 (9 hours)

Module 3 (12 hours)

Module 4 (12 hours)

References

ME4025 MECHATRONICS

Prerequisite: Nil

Total Hours: 42

Module 1 (10 Hrs)
Introduction to mechatronics Systems, Key elements, Mechatronics design process, Types of design – Traditional and mechatronics designs, Information systems, Real time interfacing (Hardware-in-the loop simulation), Elements of data acquisition system.

Module 2 (11 Hrs)
Introduction to actuators, sensors and transducers, Mechanical, fluid power and electrical actuators, Actuator selection criteria, Performance characteristics of sensors, Sensors for position, motion, force and temperature, Flow sensors, Range sensors, Ultrasonic sensors, Fibre optic sensors, Selection of sensors. Special transducers - Piezoelectric transducer - Magnetostrictive transducer - Shape memory alloy (SMA) transducer.

Module 3 (11 Hrs)
Introduction to signals, system and controls, System representation, Linearisation, Time delays, Measures of system performance, Closed loop controllers – PID controller – Digital controllers, Controller tuning, Adaptive control, Supervisory control, Introduction to microprocessors, Microcontrollers and programmable logic controllers, Components, PLC programming.

Module 4 (10 Hrs)
Introduction to MEMS, Microsensors in mechatronics, Sensors for condition monitoring, Artificial intelligence in mechatronics, Introduction to fuzzy logic control and neural networks, Case studies of mechatronics systems.

References

ME4026 UNCONVENTIONAL ENERGY SYSTEMS

Prerequisite: Nil

Total Hours: 42

Module 1 (12 hours)

Module 2 (10 hours)

Module 3 (10 hours)

Module 4 (10 hours)
Economic analysis – calculation of energy cost from renewables – comparison with conventional energy systems, calculation of carbon dioxide reduction – incremental costs for renewable energy options, Introduction to integrated energy systems.

References
Prerequisite: Nil

Total Hours: 42

Module 1 (10 hours)

Module 2 (10 hours)
Model equations- Laplace’s equation – heat equation – first order wave equation – Burger’s equation (INVISCID), Computational methods for one, two, three-dimensional steady state conduction problem in Cartesian and cylindrical co-ordinates, Methods to deal Dirichlet, Neumann and Robin type boundary conditions for regular and irregular shapes, Fine, coarse, uniform and non-uniform grids, Solution of the linear algebraic equations – Gaussian elimination method – Tri-diagonal Matrix Algorithm (TDMA), Iterative methods – Gauss-Seidel point by point method – Gauss Seidel line by line methods – under and over relaxations.

Module 3 (10 hours)
Computational Methods for one, two and three-dimensional heat equations - explicit, implicit, Crank-Nicholson, ADI schemes, ADE schemes, Fractional step methods, Hopscotch scheme, Douglass scheme, Conservative form of partial differential and finite difference equations, Methods to deal interface property and non linearity, Consistency, stability and convergence of computational methods, Discrete perturbation stability analysis, Von-Neumann stability analysis, Validation of computational solution.

Module 4 (12 hours)

References

ME4028 AERODYNAMICS

Prerequisite: ME2001 Fluid Mechanics
Total Hours: 42

Module 1 (11 hours)
Equations for incompressible inviscid flows, Fluid circulation and rotation –vorticity - Kelvin’s theorem - velocity potential - stream function -equation of a stream line -complex potential, Blasius theorem for force and moment on bodies, Elementary flow patterns and their superposition.

Module 2 (11 hours)

Module 3 (10 hours)
Aerofoils -low speed flows over aerofoils - the vortex sheet, Thin aerofoil theory -symmetric aerofoil, Tear drop theory, Camber line at zero angle of attack, Characteristics of thin aerofoils, Motion in three dimensions, Flow past slender bodies.

Module 4 (10 hours)
Finite wings -downwash and induced drag - Prandtl-Lachester theory - Biot- Savart law, General series solution, Glauret method, Multhop’s method, Horseshoe effects, Ground effects, Linerased compressible flows in two dimensions -flow past a wavy wall, Similarity rules, Aerofoil in compressible flows.

References
ME4029 HEATING, VENTILATION AND AIR CONDITIONING

Prerequisite: Nil

Total Hours: 42

Module 1 (11 Hours)
Principles of refrigeration -- Carnot refrigeration cycle -- unit of refrigeration – capacity -- coefficient of performance.
Air refrigeration cycle, Vapour absorption refrigeration system.

Module 2 (11 Hours)
Psychrometry – psychrometric processes – determination of condition of air entering conditioned space.
Air conditioning systems – summer, winter and year-round-year air conditioning systems -- central and unitary systems.

Module 3 (10 Hours)
Cooling load calculations – various heat sources contributing heat load – solar load -- equipment load -- infiltration air load -- duct heat gain -- fan load -- moisture gain through permeable walls and fresh air load.
Design of air conditioning systems.

Module 4 (10 Hours)
Installation and charging of refrigeration unit, Testing for leakage, Cause for faults and rectification.

References
ME4030 FUNDAMENTALS OF COMBUSTION

Prerequisite: ME2014 Thermodynamics

Total Hours: 42

Module 1 (12 hours)

Module 2 (11 hours)
Chemical kinetics, Global and elementary reactions, Reaction rates, Rate laws and reaction orders, Temperature and pressure dependence on rate coefficients, Unimolecular and bimolecular reactions – Chain and chain-branching reactions, H₂-O₂ chemical mechanisms, Explosion limits.

Module 3 (12 hours)
Premixed laminar flames – Laminar flame structure, Flame velocity and flame thickness, Simplified analysis of laminar flame, Effect of equivalence ratio on flame speed and flame thickness, Flame quenching and ignition - Flammability limits, Laminar diffusion flames – Structure of diffusion flame from Laminar Jets.

Module 4 (7 hours)
Introduction to turbulent flames, Droplet combustion and its applications – Simple Model for evaporating and burning droplet - D² Law - Pollutant emissions - Effects of Pollutants - Emission Index.

References

ME4031 REFRIGERATION AND AIR CONDITIONING SYSTEMS

Prerequisite: Nil

Total Hours 42

Module 1 (11 Hours)

Module 2 (11 Hours)

Module 3 (10 Hours)

Module 4(10 Hours)

References
13. Carrier Design hand book
14. ASHRAE hand book
ME4032 AUTOMOBILE ENGINEERING

Prerequisite : Nil

Total Hours: 42

Module 1 (9 Hours)
Constructional details of engines - engine parts - piston - different types - piston rings cylinder block - cylinder head - gudgeon pin - connecting rod - bearing bushes - different type of bearings, Cooling system - purpose of cooling - types of cooling systems - air cooling - water cooling - radiator - types of radiators - constructional details - thermostat - temperature indicators.

Module 2 (13 Hours)
Lubrication - purpose of lubricating systems - grading of oils - oil pumps - oil filters - oil pressure indicators, Fuel systems - fuel system components - fuel tank - fuel filters and screens - fuel gauges - fuel pumps, Carburetors - idle and low speed circuits - high speed part load circuit - full power circuit - choke, Electronic fuel injection system, Gasoline Direct injection system, Air assisted fuel injection system, Diesel injection system - Common rail Direction Injection system, Ignition system - Battery and coil ignition - Electronic Ignition system - Distributor less Ignition system.

Module 3 (12 Hours)

Module 4 (8 Hours)

References
ME4033 INTRODUCTION TO COMPUTER GRAPHICS

Prerequisite: ZZ1004 Computer Programming

Total Hours: 42

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Module 1 (11 hours)
Introduction to computer graphics - Overview of computer graphics, Mathematics for computer graphics - Representing and interfacing with pictures, Description of graphic devices, Raster Scan Graphics, Algorithms for generating line, circle and ellipse – Polygon filling - Fundamentals of anti-aliasing.

Module 2 (11 hours)

Module 3 (10 hours)
Plane curves, non-parametric and parametric curves: Space curves – Representation of space curves, cubic spline, Bezier curves, B-spline curves, NURBS.

Module 4 (10 hours)
Surface description and generation- Surface of revolution, Sweep Surface, Linear Coons surface, Bezier surface, B-Spline surface, B-Spline surface filling, Introduction to solid modelling, Hidden lines and Hidden Surfaces.

References

ME4034 EXPERIMENTAL METHODS IN FLUID FLOW AND HEAT TRANSFER

Prerequisite: Nil

Total Hours: 42

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Module 1 (11 hours)

Module 2 (11 hours)

Module 3 (10 hours)

Module 4 (10 hours)

References
ME4122 MECHANICAL BEHAVIOUR AND TESTING OF MATERIALS

Prerequisite: ME2101 Materials Science and Metallurgy
Total Hours: 42

Module 1 (8 hours)
Concepts of crystals, Plastic deformation by slip and twinning, Slip systems in FCC, BCC and HCP lattices, Critical resolved shear for slip, Theoretical shear strength of solids, Stacking faults and deformation bands.

Module 2 (14 hours)
Observation of dislocations, Geometric properties of dislocations, Edge and screw dislocations, Climb and cross slip, Dislocations in FCC and HCP lattice, Partial dislocations, Stress fields and energies of dislocations, Forces between dislocations, Applications of dislocation theory, Strengthening from grain boundaries, Grain size measurements, Yield point phenomenon, Strain aging, solid solution strengthening, Strengthening from fine particles, Fiber strengthening, Cold working and strain hardening, Annealing of cold worked metal.

Module 3 (12 hours)

Module 4 (8 hours)
Tension test, Stress-strain curves, Instability in tension, Ductility measurement, Effect of strain rate, temperature and testing machine on flow properties, Stress relaxation testing. Hardness test, Brinell, Rockwell and Vickers hardness, flow of metal under the indenter, relationship between hardness and flow curve, micro hardness testing. Torsion test, Mechanical properties in torsion, Torsion stresses for large plastic strains, Types of torsion failures, and torsion testing.

References
Prerequisite: Nil

Total Hours: 42

Module 1 (12 hours)

Module 2 (10 Hours):
Critical factors in managing technology, Technology and competition – competitive consequences of technological change.

Module 3 (10 Hours):

Module 4 (10 Hours):

References
ME4125 COMPETITIVE MANUFACTURING MANAGEMENT

Pre-requisite: Nil

Total Hours: 42

Module 1 (10 hours)

Module 2 (10 hours)

Module 3 (10 hours)

Module 4 (12 hours)

References
ME4126 ENGINEERING OPTIMIZATION

Prerequisite: Nil

Total Hours: 42

Module1 (10 hours)

Module2 (10 hours)
Integer programming, Mathematical formulations, Zero-one problems – additive algorithm, Gomory’s cutting plane algorithm, Branch and bound algorithm, All integer primal algorithm, All integer dual algorithm, Mixed integer programming – cutting plane algorithm and Bender’s partitioning algorithm.

Module3 (10 hours)

Module4 (12 hours)
Non-linear programming, Formulations, General non-linear programming problem, Unconstrained optimization problem – necessary and sufficient conditions for extrema, Constrained optimization with equality constraints – Lagrangean method, Constrained optimization with inequality constraints – Kuhn-Tucker conditions, Quadratic programming – Wolfe’s modified Simplex method.

References
**ME4127 ACCOUNTING AND FINANCE FOR ENGINEERS**

Prerequisite: Nil

Total Hours: 42 hours

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**Module 1 (10 Hours)**

**Module 2 (11 Hours)**

**Module 3 (11 Hours)**
Financial statement analysis – ratio analysis, Statement of changes in financial position, Working capital basis.

**Module 4 (10 Hours)**
Financial planning – budgeting - working capital computation, Capital budgeting – traditional and discounted cash flow techniques – NPV – IRR comparisons

**References**

ME4128 SIMULATION MODELLING AND ANALYSIS

Prerequisite: Nil
Total Hours: 42

Module 1 (10 hours)
Systems and system environment, Components of a system, Discrete and continuous systems, Model of a system, Types of models, Steps in simulation study, Technique of simulation, Comparison of simulation and analytical methods, Monte Carlo simulation.

Module 2 (10 hours)
Simulation of queuing systems—simulation of inventory systems—concept in discrete event simulation, Random number generation—techniques for generating random numbers, Test for random numbers – frequency tests and tests for autocorrelation, Random variate generation—inverse transform method and acceptance rejection technique.

Module 3 (10 hours)
Input modelling for simulation—data collection, Identifying the distribution with data, Parameter estimation, Goodness of fit tests—chi square and kolmogorov smirnov tests, Verification and validation of simulation models.

Module 4 (12 hours)

References
ME4129 MODELLING OF MANUFACTURING SYSTEMS

Prerequisite: Nil

Total Hours: 42

Module 1 (8 hours)

Module 2 (12 hours)

Module 3 (10 hours)
Markov chain models, Geometric and exponential random variables, Stochastic processes – Poisson process, Discrete-time Markov chains, Continuous-time Markov chains, Markov model of a transfer line, Birth and death processes in manufacturing.

Module 4 (12 hours)
Basic queuing models – (M/M/1) – (M/M/m), Queues with breakdowns, Analysis of a flexible manufacturing center, Queuing networks – open – closed – productform, Queuing networks with blocking, Application of queuing models for manufacturing systems – simulation models for serials lines and flexible manufacturing.

References
ME4130 HUMAN FACTORS IN ENGINEERING AND DESIGN

Prerequisite: Nil

Total Hours: 42 hours

Module 1 (10 Hours)
Human factors and Systems, Nature of man-machine systems and characteristics, Information input and processing – information theory – displaying information – coding of information – mode of information processing, Perception, Attention, Mental Workload, Human Factors in information revolution

Module 2 (10 Hours)

Module 3 (12 Hours)
Human motor activity, Muscle physiology, Measure of physiological strain – physical workload – strength and endurance, Manual material handling, Recommended limits, Motor skills, Human control of systems.

Module 4 (10 Hours)
Anthropometry and work-space design – use of anthropometric data, Design of work surfaces – science of seating, General location of control and displays within work space, Interpersonal aspects of workplace design.

References
ME3114 CAD/CAM/CIM

Prerequisite: Nil
Total Hours: 42

Module 1 (9 hours)
Introduction to computer graphics, 2D and 3D transformations, Plane and space curves, surface description and generation, CAD/CAM hardware and software, CAD/CAM data exchange and integration.

Module 2 (11 hours)
CNC machine tools, fundamentals of CNC machine tools, constructional features, drives and controls, stepper motors, servo motors, hydraulic systems, feed back devices, counting devices, interpolators linear, circular interpolation and other emerging techniques, adaptive control systems for turning and milling.

Module 3 (11 hours)
CNC manual part programming and computer assisted programming, APT language, geometry, motion and auxiliary statements, macro statements, post processors, CNC programming with interactive graphics, use of various software packages, development of CNC programmes for special problems.

Module 4 (11 hours)
Computer integrated manufacturing systems, material handling and identification technologies, computer aided inspection, group technology, flexible manufacturing systems, industrial robotics and machine vision, rapid prototyping, design for manufacturability, process planning and concurrent engineering, lean production and agile manufacturing.

References