VISION AND MISSION OF THE INSTITUTE

Vision:
To provide India and the World, technical manpower of the highest academic excellence and World class by shaping our youth through holistic and integrated education of the highest quality.

Mission:
To develop Nitte Meenakshi Institute of Technology through Quality, Innovative and State-of-art educational initiatives into a centre of academic excellence that will turn out youth with well balanced personality & commitment to rich cultural heritage of India and who will successfully face the Scientific and Technological challenges in the fast-evolving Global scenario with a high degree of credibility, integrity and ethical standards.

VISION AND MISSION OF THE DEPARTMENT

Vision:
To educate and nurture students to be proficient mechanical engineers in research, entrepreneurship and professional career to fulfill the global demands of industry and society.

Mission:
• To develop Mechanical Engineers with strong theoretical and practical knowledge through effective teaching-learning process with state of the art curriculum.
• To induce critical thinking abilities, entrepreneurial skills, ethical values, leadership qualities and use of modern tools through industry institute interaction and training.
• To enable the students to be adept with innovative ideas to meet societal needs and environmental issues through interdisciplinary research.
PROGRAMME SPECIFIC OUTCOMES:

1. Graduates will have an exposure to application of various systems, processes imparted through advanced tools, internships, seminars, workshops, conferences, invited talks and specialized certification courses.

2. Graduates will possess knowledge and skill set required to synthesize and analyze the processing techniques and mechanical systems for optimum performance of materials and mechanical elements.

PROGRAMME EDUCATIONAL OBJECTIVES

Programme educational objectives refer a graduate how well he is molded for his career and his professional growth to be a competent, creative and highly valued professional after his graduation through his knowledge and competency which he attained during his graduation.

PEO 1:
Graduates of Mechanical Engineering will demonstrate leadership qualities, ethical attitude, communication skills and adopt to current technologies through engagement in lifelong learning to meet the changing societal needs.

PEO 2:
Graduates of Mechanical Engineering will pursue higher studies and excel in multi-disciplinary research activities.

PEO 3:
Graduates of Mechanical Engineering will take up responsible roles in industry, will be outstanding in their professional careers/as entrepreneurs.
PROGRAMME OUTCOMES:

Programme learning outcomes are statements that describe what learners will know and be able to do when they graduate from a programme. They are closely linked to the credential framework and program standards set by National Board Accreditation (NBA).

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work:** Function effectively as an Individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage independent and life-long learning in the broadest context of technological change.
CREDIT SYSTEM

In credit system, students are assessed in two parts

i. Continuous Internal Evaluation (CIE).

ii. Semester End Examination (SEE).

CIE will be conducted by the subject teacher all through the semester; which includes mid-term tests, weekly/ fortnightly class tests, assignments, quiz, seminar, projects etc. The breakup of CIE and SEE is as follows:

<table>
<thead>
<tr>
<th>THEORY</th>
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<tbody>
<tr>
<td><strong>Continuous Internal Evaluation (CIE)</strong></td>
<td></td>
</tr>
<tr>
<td>Mid Sem Exam (MSE) 1</td>
<td>15 Marks</td>
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<tr>
<td>Mid Sem Exam (MSE) 2</td>
<td>15 Marks</td>
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<tr>
<td>Assignment, Test Based on assignment, Mini Projects, Experimental work/ Tutorials (Submission of Drawing Sheets in case of CAED / CMD / Electrical Machine Drawing)</td>
<td>10 Marks</td>
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<tr>
<td>Surprise Test, Quiz, Seminar, Mini Projects, Experimental work</td>
<td>10 Marks</td>
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<tr>
<td><strong>Semester End Exam (SEE)</strong></td>
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<tr>
<td></td>
<td>50 Marks</td>
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<tr>
<td><strong>Grand Total</strong></td>
<td>100 Marks</td>
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<table>
<thead>
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<th>PRACTICALS</th>
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<tr>
<td><strong>Continuous Internal Evaluation (CIE)</strong></td>
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<tr>
<td>Mid Sem Exam</td>
<td>15 Marks</td>
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<tr>
<td>Records and Continuous Assessment</td>
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<td>Viva-Voce, Surprise Test, Quiz(Objective Type)</td>
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<td>50 Marks</td>
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<tr>
<td><strong>Grand Total</strong></td>
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SEE will be conducted at the end of the semester, on dates to be fixed at the college level.

A grade is basically a qualitative measure(alphabet) giving the performance of a student in a Subject such as Outstanding(S), Excellent(A), Very good(B), Good(C), Average(D), Poor(E), and Fail/Unsatisfactory (F), based on the raw marks obtained by the student(includes both CIE & SEE).

GRADE POINT SCALE:
There will be no re-examination for any course in the credit system, to take care of student who has failed. Student would require to re-register for the course when it is offered again (either in a main or supplementary sem) and fulfill the Passing Standards laid down to earn the specified credits.

PASSING STANDARDS:

- A student will not be allowed to take up the SEE, if the CIE will be less than 40%.
- A student will be put in Not Eligible (NE) status which will amount to F grade in the course in the following cases,
  1. Not allowed to take SEE for not fulfilling minimum attendance requirement.
  2. Not allowed to take SEE for not fulfilling the minimum CIE requirement
  3. Absent for SEE.
  4. There shall be no re-examination for any course in the credit system to take care of such students:
     a. Who have absented themselves from attending CIE or SEE without valid reasons; or
     b. Who have failed (secured ‘F’ grade) to meet the minimum passing standards prescribed for CIE and/or SEE; or
     c. Who have been detained for want of attendance; or
     d. Who have withdrawn (‘W’ grade)

Such students shall be required to re-register for the course(s) for study and go through CIE and SEE again and obtain a grade equal to or better than ‘E’.

Grade point average is a credit index used for calculating Semester Grade Points Average (SGPA) and the Cumulative Grade Point Average (CGPA), both of which are important performance indices. SGPA & CGPA are calculated as below:
\[ \text{SGPA} = \frac{\sum (\text{Subject Credit} \times \text{Grade Point}) \text{ for all the Subjects registered in the current semester}}{\sum (\text{Subject Credit}) \text{ for all the Subjects registered in the current semester (Excluding Transitional Grades I, X)}}. \]

\[ \text{CGPA} = \frac{\sum (\text{Subject Credit} \times \text{Grade Point}) \text{ for all the Subjects registered upto the end of the current semester}}{\sum (\text{Subject Credit}) \text{ for all the subjects registered but excluding subjects with ‘F’ Grade upto the end of the current semester (Excluding Transitional Grades I, X)}}. \]

**Vertical Progression**

It would also be necessary to lay down uniform minimum standards for the vertical progression of students from current academic year to the next academic year. This would be helpful in facilitating the mobility of students from one College to another and also in avoiding any confusion among the students. The prescribed standards for vertical progression are,

- A student can carry a maximum of 4 (four) ‘F’ grades/ four subjects of the current year of study to become eligible for admission to the next year of studying.
- Should have passed all the first and second semester courses to become eligible for the admission for fifth semester and can carry a maximum of four subjects of second year.
- Should have passed all courses of first to fourth semesters to become eligible for the admission for seventh semester and can carry a maximum of four subjects of third year.
- **Minimum standard for CGPA=5.0 at the end of each academic year.**
<table>
<thead>
<tr>
<th>CIE Components</th>
<th>Evaluation System</th>
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<tr>
<td></td>
<td>Theory</td>
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<td>Assignments / Assignment Test</td>
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<td>Case Studies</td>
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<tr>
<td>RUBRICS</td>
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Any two components of 10 Marks each will be given by the faculty.
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<th>Subject Code</th>
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<td>Smart Materials/ Tribology/ Statistical Quality Control/Cryogenics/ Renewable Energy Resources / Computational Fluid Dynamics / Gas Turbine &amp; Propulsion</td>
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<td>Computer Graphics/Nano technology/ Management Information system/ Project management/ Non-Destructive Testing/ Elements of Aeronautics/Marketing management</td>
<td>10ME76/10ME762/10ME763/10ME764/10ME765/10ME766/10ME767</td>
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<td>Experimental stress analysis/ Machine Tool design/ Foundry technology/Biomass Energy system/Aircraft Structures/Introduction to aerodynamics</td>
<td>10ME83/10ME832/10ME833/10ME834/10ME835/10ME836</td>
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<td>Project Work</td>
<td>10ME835</td>
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ELEMENTS OF MECHANICAL ENGINEERING

Sub Code : 14EME14/24  
Credits : 04

Hours/Week : 4+1+0 (L+T+P)  
CIE Marks : 50

Total hours : 52  
SEE Marks : 50

Exam Hours : 03  
Course type : Engg. Core

Course outcomes:
Students will able to
- Comprehend thermodynamic laws, steam properties, working principles of IC engines, materials/composites, joining processes, Refrigeration and air conditioning.
- Describe different forms of energy and their inter conversion through turbomachinery and IC engines.
- Comprehend machine tools and its operations, different materials, joining processes and different power transmission system.
- Solve simple problems related to the energy conversion and drives.
- Distinguish characteristics of different robot configurations and various engineering materials.

UNIT I

Thermodynamics: Basic concepts of thermodynamics, First and Second laws of thermodynamics, thermodynamic cycles (Carnot cycle, Rankine cycle, Otto cycle, Diesel cycle, Brayton cycle)

Steam: Formation, types, properties-Specific Volume, Enthalpy and Internal energy (Simple numerical on properties of steam).

10 hours

UNIT II


Internal Combustion Engines: Classification, I.C. Engines parts and terminology, principle and operation of 2 Stroke and 4 stroke Petrol engines, 4 stroke diesel engines with P-V diagrams. Performance parameters: indicated power, brake power, friction power, indicated thermal efficiency, brake thermal efficiency, mechanical efficiency, specific fuel consumption, simple numerical problems.

10 hours

UNIT III


Robotics: Introduction, classification based on robots configuration: Polar, cylindrical, Cartesian coordinate and spherical. Application, Advantages, and disadvantages

10 hours

UNIT IV


10 hours

UNIT V

Belt drives: Open & crossed belt drives, Definitions- slip, creep, velocity ratio, derivations for length of belt in open and crossed belt drive, ratio of tension in flat belt drives, advantages and disadvantages of V belts, simple numerical problems.
**Gear drives:** Types—spur, helical, bevel, worm, and rack and pinion. Velocity ratio, advantages and disadvantages over belt drives. Simple numerical problems on velocity ratio.


**Text Books:**

**Reference Books:**

**Assessment Method:**
**CIE:**
1. Three internals tests (each 30 marks) are conducted, average of best two tests marks will be considered.
2. Project evaluated through rubrics /Minimum two Assignments Average of two will be considered - for 10 marks.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

**SEE:**
1. Two Questions are to be set from each unit, carrying 20 Marks each.
2. Students have to answer 5 questions selecting one full question from each unit.

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<th>PO1</th>
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Syllabus of I to VIII Sem BE Mechanical Engg, NMIT Bangalore-64

WORKSHOP PRACTICE

Sub Code : 14WSL16/26  Credits : 1.5
Hours/Week : 0+0+3 (L+T+P)  CIE Marks : 50
Total hours : 39  SEE Marks : 50
Exam Hours : 03  Course type : Engg. Core

Course outcomes:
Students will able to
- Prepare various fitting joints
- Identify different tools and its parts and develop practical skill with workshop safety regulations.
- Develop and convert a raw sheet metal into the required shape as per the specified dimension.
- Demonstrate the process of welding through preparing various joints.
- Describe the different methods of power measurement and domestic wiring.

UNIT I
Profile Cutting: Models: Combination of straight and circular cut. (04 models).  12 hours

UNIT II
Development and sheet metal work: Models: Funnel, Tray, Transition Piece (Circular to hexagon/Pentagon, circular to square, square to a rectangle) (04 models).  09 hours

UNIT III
Welding: Butt Joint, Lap joint, T-Joint, V-Joint (with edge preparations) models have to be prepared with Calculation of electrode length required for welding.  06 hours

UNIT IV
Study Experiments (Only for CIE)
1. Domestic wiring- Control of Lamp by Two Way and Three Way
2. Measurement of power by two Watt meters method
3. Power factor improvement
4. Energy measurement
5. Star-Delta connection  12 hours

Text Book:

Assessment Method:
CIE: Day to day work and submission - 30marks, Internal Test-15 marks, Viva Voce/surprise test-5 marks
SEE Question Paper Pattern: Fitting Model - 15 Marks, Welding model - 05 Marks, Sheet Metal Model - 20 Marks, Viva Voce - 10 Marks

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Correlation Level: 3 1 1 1 2 2 2 2
COMPUTER AIDED ENGINEERING DRAWING

Sub Code : 14CED14/24
Credits : 4
Hours/Week : 2+4+0 (L+T+P)
CIE Marks : 50
Total hours : 78
SEE Marks : 50
Exam Hours : 03
Course type : Engg. Core

Course Outcomes:

Students will able to

- Apply the concept of conventions, Lettering and Dimensioning while projecting different objects
- Apply the concept of theory of orthographic projection in solving problems of points and lines.
- Demonstrate and project the planes for different positions.
- Project solids for different positions, improve their visualization skills to develop a sketch into isometric and section the solids and draw the true shape of the section.
- Demonstrate and sketch the drawings using software.

UNIT I

Introduction to Computer Aided Sketching: Introduction, Drawing instruments and their uses, BIS Conventions, Lettering, Dimensioning, geometrical constructions and freehand practicing.
Introduction to software, commands used for engineering drawing.

UNIT II

Orthographic Projections
Introduction – Planes of projection, reference line, and conventions employed.
Projection of Points- in all the four quadrants.
Projection of straight Lines (First angle projection) - True and apparent lengths, true and apparent Inclinations to reference planes, application problems (Chimney, Tripod, Flag post, Room problems) Orthographic projection of Plane surfaces (First angle projection)
Introduction, projection of triangle, square, rectangle, pentagon, hexagon and circular lamina.

UNIT III

Projections of Solids
Introduction, Projections of right regular prisms, pyramids, cylinder, cone and cube in different positions (Inclined to both HP and VP. No problems on octahedrons and combination of solids).

UNIT IV

Sections of Solids
Introduction to truncation and frustum, Section of solids like prisms, pyramids, cylinder and cone in simple vertical position by cutting planes inclined to HP and perpendicular to VP-true shapes of sections.

Isometric Projection
Introduction, Isometric scale, Isometric projection of simple plane figures, Isometric projections of Tetrahedron, hexahedron (cube), right regular prisms, Pyramids, cylinders, cones, spheres, cut spheres and combination of solids (Maximum of two solids).

Text Books:

Reference Books:
Assessment Method:
CIE:
1. Three internals tests (each 30 marks) are conducted, average of best two test marks will be considered.
2. Submission of drawing sheets/printouts will carry 10 marks.
3. Two written surprise quiz tests/worksheets/assignments conducted and evaluated for 10 marks.

SEE:
1. Q1 for 30 Marks from Unit 2.
2. Q2 for 40 Marks from Unit 3
3. Q3 for 30 Marks from Unit 4.

Evaluation: Sketching – 40%, Implementation Using Computer software – 60%

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Corelation Level | 1 | 2 |
ENGINEERING MATHEMATICS III *

Sub Code : 14MAT31
Credits : 04
Hours/Week : 4+1+0
CIEMarks : 50
Total Hours : 48
SEEMarks : 50
Exam Hours : 03
Course Type : Basic Science

1. Students understand that any periodic function can be converted to harmonic using trigonometric series and also learn to trace different periodic functions.
2. Students learn the importance of integral transforms and their applications
3. Students will be able to understand importance of probability distributions
4. Students learn the concept and applications of calculus of variations
5. Students learn the concept of sampling and testing of hypothesis

UNIT-I

Calculus of Variation: Introduction, Functional, Euler’s equation, Solution to Euler’s equation, geodesics, isoperimetric problems, Rayleigh Ritz method, Galerkin’s method, Hamilton’s principles, Lagrange’s equations 35.1, 35.2, 35.3,35.4,35.5,35.6,35.9,35.10, 35.11, 35.12. 08Hours

UNIT-II

Fourier series: Euler’s formulae, Dirichlet’s conditions for Fourier series expansion, change of interval, Even and odd function, half range series, Practical harmonic analysis.
Fourier Transforms: Definition, Complex Fourier transforms, Cosine and Sine transforms, Properties, Inverse Fourier transforms. 10.1, 10.2, 10.3, 10.5, 10.6, 10.7, 10.10, 10.11, 22.1, 22.2, 22.4, 22.5, 22.6, 22.7 (Text book 1). 10 Hours

UNIT – III

Laplace Transforms: Definition, Transforms of standard functions, Transforms of \( e^{at} f(t) \), \( t^n f(t) \), \( \frac{f(t)}{t} \), Laplace transforms of derivatives and integrals, Laplace transforms of periodic functions, unit step function, Dirac delta function. Inverse Laplace transforms, convolution theorem, solutions of 1st and 2nd order ODE using Laplace transforms. 21.1-21.15 (Text book 1). 10 Hours

UNIT – IV

Probability distributions-
(Recap of Definition of probability, addition theorem, conditional probability, Baye’s theorem) Random variables – discrete and continuous, Probability distribution – continuous and discrete, probability density function, cumulative density function, mean, Expectation, variance. Joint probability distribution function – continuous and discrete, marginal distribution, expectation, covariance and rank correlation. Binomial, Poisson, Normal, hypergeometric, t, \( \chi^2 \), F distribution. (5.1,5.2,5.4,5.5,5.6,5.7,5.8,5.9,5.11,6.1,6.2,6.3,6.4,7.1,7.2,7.3,7.4,7.5,7.7,7.9,7.10,7.15 Text book 2). 10 Hours

UNIT – V

Sampling Theory – Population and sample, sampling with and without replacement, population parameters, sample statistics, Sampling distribution of means, proportions, sample mean and variance Biased and unbiased estimates, confidence intervals for mean. Statistical hypothesis, null hypothesis, type I and type II errors, significance level, test for significance of large samples, t test for small samples, Chi square test for goodness of fit. (5.1,5.2,5.4,5.5,5.6,5.7,5.8,5.9,5.11,6.1,6.2,6.3,6.4,7.1,7.2,7.3,7.4,7.5,7.7,7.9,7.10,7.15 Text book 2). 10 Hours

Pre-requisites:
The student should have studied Maths I and Maths–II.
Course Assessment Method:

CIE – 50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments- evaluated through rubrics for 10 marks. Average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE - 50 Marks
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit.

Text Book

Reference Books

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MATERIAL SCIENCE AND METALLURGY

Sub Code : 14ME32  
Credits : 03
Hours/Week : 4+0+0  
CIE : 50
Total Hours : 38  
SEE : 50
Exam Hours : 03  
Course Type : Program Core

Course Outcomes:
Students will be able to
1. Identify the materials based on bravais lattices of metals.
2. Interpret the Binary phase diagrams of various metallurgical operations.
3. Analyze the creep and fatigue failure mechanisms in various materials.
4. Modify the properties of materials through an appropriate heat treatment operation.
5. Assess the mechanical behavior of materials by means of stress strain curves.

UNIT I

Mechanical Behavior: Tensile testing, stress-strain diagrams of brittle and ductile materials, linear and non-linear elastic behavior. Mechanical properties of materials. 08 Hours

UNIT II

UNIT III
Iron-cementite diagram. Irons, steels and cast irons. Microstructures of iron-carbon alloys. Aluminum copper system. Age hardening of aluminum alloys. 08 Hours

UNIT IV
Heat treatment of steels: T-T-T diagrams and C-C-T diagrams. Heat treatment of steels. Alloy steels and alloy steel heat treatment, surface hardening of steels. 06 Hours

UNIT V

Course Assessment Method:
CIE – 50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments- evaluated through rubrics for 10 marks. Average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE- 50 Marks
1. Two questions to be set from each unit, carrying 20 marks each.
2. Students have to answer 5 questions selecting one full question from each unit.

Text Book

Reference Books

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10
BASIC THERMODYNAMICS

Sub Code : 14ME33
Hours/Week : 4+1+0
Total Hours : 48
Exam Hours : 03
Credits : 04
CIE Marks : 50
SEE Marks : 50
Course Type : Program Core

Course Outcomes:
Students will be able to
1. Define the concepts of thermodynamic systems and state Gay laws and Laws of thermodynamics
2. Describe the meaning of thermodynamic properties and formulate heat and work expressions for various thermo mechanical systems.
3. Apply the laws of thermodynamics, concepts of entropy, availability and exergy to determine the thermal performance of different heat engines and refrigeration.
4. Differentiate the real gases from ideal gases and evaluate the work, heat transfer and properties of real, ideal gases and gas mixtures undergoing various Thermodynamic processes
5. Draw and identify the properties of pure substances on various property diagrams such as P-V, P-T, T-S, H-S diagrams and obtains the data from property tables and diagrams to compute properties.

UNIT I
Basic Concepts and Definitions:
Thermodynamics-definition and scope, engineering thermodynamics definition, applications of engineering thermodynamics, macroscopic and microscopic approaches, types of system-open, closed, isolated, homogeneous and heterogeneous systems, control volume, thermodynamic properties-definition, types-intensive and extensive properties, thermodynamic state-state point, state diagram, path and process-quasistatic process, cyclic and noncyclic processes, thermodynamic equilibrium-definition, thermal, mechanical and chemical equilibriums, adiabatic and diathermic walls,Zeroth law of thermodynamics, temperature concept, temperature measurement, international fixed points, scales, problems on temperature scales.

Work and Heat:
Definition of work in mechanics and its limitations, thermodynamic definition of work, examples, sign convention, displacement work-displacement work for various thermodynamic processes through p-v diagrams, other forms of work- shaft work, electrical work, magnetization work, surface tension work, stretching work, and flow work. Heat-definition, units, sign convention, heat and work path functions, similarities and dissimilarities, problems.

UNIT II
First Law of Thermodynamics:
Joule’s experiment, equivalence if heat and work, statement of first law of thermodynamics applied to cyclic and non-cyclic processes, PMMK-I, energy as a property, modes of energy, enthalpy, specific heat-definition, specific heat at constant pressure and constant volume, particular and universal gas constants, first law applied to thermodynamics processes, problems.
Extension of first law to control volume, steady flow energy equation-applications, unsteady processes-filling and evacuation of vessels, problems.

UNIT III
Second Law of Thermodynamics:
Limitations of first law of thermodynamics, thermodynamic cycle, mechanical cycle, devices converting heat to work in thermodynamic and mechanical cycles, heat engine, devices converting work into heat in thermodynamic cycle, heat pump, COP, reversed heat engine, Kelvin-Planck and Clausius statements of II law of thermodynamics, PMMK-II, equivalence of two statements, reversible and irreversible processes, factors that make processes irreversible, Carnot cycle, corollaries of Carnot theorem, thermodynamic and absolute temperature scales, problems.

Entropy:
Clausius inequality, Clausius theorem, entropy-definition, a property, principle of increase of entropy, change in
entropy for various thermodynamics, problems. 09 Hours

UNIT IV

Availability and Irreversibility:
Available and unavailable energy, maximum work, maximum useful work for a system and control volume, availability of a system and steady flow system, irreversibility, second law efficiency, problems. 09 Hours

Ideal and Real Gases:
Equation of state, perfect and semi perfect gases, evaluation of heat, work, dE, dH, dS for various thermodynamic processes, ideal gas mixture, Dalton’s law of partial pressures, Amagat’s law of additive volumes, evaluation of properties, analysis of various processes
Real gases-Vander Waal’s equation and its constants in critical properties, law of corresponding states, compressibility factor, compressibility chart, problems 09 Hours

UNIT V

Pure Substances:
Pure substance; definition, two property rule, vapour formation-P-V, P-T, P-V-T diagrams, critical and triple points, T-S and H-S diagrams, steam tables, dryness fraction, problems.
Vapour processes-evaluation of W, dE, Q, dH for various processes, problems.
Steam calorimeters-separating, throttling and combined calorimeters, problems. 10 Hours

Course Assessment Method:
CIE –50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments- evaluated through rubrics for 10 marks. Average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE- 50 Marks
1. Two questions to be set from each unit, carrying 20 marks each.
2. Students have to answer 5 questions selecting one full question from each unit.

Text Book:
1. Basic and applied thermodynamics by P K Nag, Tata McGraw Hill.
2. Thermodynamics an engineering approach by Yunus A Cenegal, Tata McGraw Hill.

Reference Books:
3. Basic applied thermodynamics by Omakar Singh.

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MECHANICS OF MATERIALS

Sub Code : 14ME34
Hours/Week : 4+1+0
Total Hours : 48
Exam Hrs : 03
Credits : 04
CIE Marks : 50
SEE Marks : 50
Course Type : Program Core

Course Outcomes:
Students will be able to
1. Define the properties and response of the materials under different loading conditions.
2. Select different geometric parameters of structures based on its application.
3. Apply the analytical or graphical methods to determine the forces, stresses, bending moment, buckling and torsion with respect to bars, beams, columns and struts.
4. Formulate and analyse the effect of load on geometry and material.
5. Evaluate the structural members and specify suitable materials based on application.

UNIT I

Stresses and Strains:
Definition of Stress, types of stress, strain, types of strain, modulus of elasticity, true stress, true strain, simple problems, stress strain diagram of ductile, brittle, visco-elastic, linear & non-linear elastic materials, bars with varying sections, bars of composite sections, simple problems, thermal stresses, simple problems, elastic constants and its relation, volumetric strains, simple problems.

Compound Stresses:
Methods of determining stresses in oblique sections, principal planes and stresses, simple problems, construction of Mohr’s circle, simple problems.

UNIT II

Shear Force and Bending Moment Diagram:
Definition of shear force, bending moment, types of beams and loads, sign convention for shear force and bending moment, shear force and bending moment diagram for various beams. Relation between shear force and bending moment.

UNIT III

Bending Stresses and Shear Stress in Beams:
Definition of bend, pure bending and simple bending, expression of bending stress, neutral axis and moment of resistance, bending stress in symmetrical sections, section modulus, section modulus for various shapes of the beam section. Introduction to shear stress, shear stress distribution for different section.

UNIT IV

Deflection of Beams:
Definition of deflection and slope, finding deflection and slope of a beam subjected to various loads, relation between slope, deflection and radius of curvature, simple problems to be solved for the beams experiencing various loads.

Torsion of Shafts:
Definition of torsion, derivation of shear stress produced in a circular shaft subjected to torsion, expression of torque in terms of polar moment of inertia, power transmitted by shaft, simple problem.

UNIT V

Column and struts:
Definition of columns and struts, failure of a column, expression of crippling load when (a) both ends are hinged (b) one end of the column is fixed and the other end is free (c) both ends are fixed (d) one end is fixed and the other end is hinged. Simple problems to be solved used Euler’s formula and Rankine formula.

Thick and Thin cylinders:
Definition of thin and thick cylinders, thin cylinders subjected to internal pressure. Stresses in a thin cylinder
subjected to internal pressure, expression of circumferential stress and hoop stress, simple problems.
Thick Cylinder: Lame’s theorem, stresses in a thick cylinder, simple problems to be solved.  

10 Hours

Pre-requisites:
The student should have studied Engineering Mechanics.

Course Assessment Method:
CIE – 50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments - evaluated through rubrics for 10 marks. Average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE – 50 Marks
1. Two questions to be set from each unit, carrying 20 marks each.
2. Students have to answer 5 questions selecting one full question from each unit.

Text Book:

Reference Books:
MANUFACTURING TECHNOLOGY

Course Outcomes:
Students will be able to
1. Recognize the various manufacturing principles and techniques.
2. Interpret the cutting tool parameters in various machining processes.
3. Differentiate the conventional and non-traditional machining processes.
4. Determine the appropriate parameters for different manufacturing processes.
5. Justify the most appropriate manufacturing process for a given product.

UNIT I
Patterns: Definition, functions, materials used for pattern, various pattern allowances and their importance, classification of patterns, BIS colour coding of patterns.
Binder: Definition, types of binder used in sand moulding.
Additives: Need, types of additives used and their properties.
Sand Moulding: Types of base sand, requirement of base sand. Moulding sand mixture ingredients for different sand mixtures. Method used for sand moulding, such as green sand, dry sand and skin dried moulds.
Cores: Definition, need, types. Method of making cores, binders used, core sand moulding.
Concept of Gating & Risers: Principle and types.

UNIT II
Fettling and Cleaning of Castings: Basic steps, casting defects, causes, features and remedies.
Moulding Machines: Jolt type, squeeze type, jolt & squeeze type and sand slinger.
Special Moulding Process: Study of important molding processes, no bake moulds, flask less moulds, sweep mould, CO₂ mould, shell mould, investment mould.
Metal Moulds: Gravity die-casting, pressure die casting, centrifugal casting, squeeze casting, slush casting, thixo-casting and continuous casting processes.
Melting Furnaces: Classification of furnaces. Constructional features & working principle of coke fired, oil fired and gas fired pit furnace, resistance furnace, coreless induction furnace, electric arc furnace and cupola furnace.

UNIT III
Cutting Tool Materials: Desired properties and types of cutting tool materials-HSS carbides, coated carbides, and ceramics.

UNIT IV
Turret and Capstan Lathe, Shaping and Planing Machines: Classification, constructional features of shaping machine, planing machine, driving mechanisms of lathe, shaping and planing machines, different operations on lathe, shaping and planing machines. Simple problems on machining time calculations.
Finishing and other Processes: Lapping and Honing operations–principles, arrangement of set up and
application. Super finishing process, polishing, buffing operation and application.  

UNIT V

**Welding:** Arc welding-Metal Arc Welding (MAW), Flux Shield Arc Welding (FSMAW), Inert Gas Welding (TIG & MIG), Submerged Arc Welding (SAW), Friction Stir Welding (FSW) and Atomic Hydrogen Welding Processes (AHW).  

**Non-traditional Machining Processes:** Need for non-traditional machining, principle, equipment & operation of laser beam, plasma arc machining, electro chemical machining, ultrasonic machining, abrasive jet machining, water jet machining, electron beam machining, and electron discharge machining.

Course Assessment Method:

**CIE – 50 Marks**
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments-evaluated through rubrics for 10 marks. Average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

**SEE- 50 Marks**
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit.

**TEXT BOOKS:**
2. *A Textbook Manufacturing Technology-I & II* by Dr P C Sharma, S CHAND & Company publications, 2008

**REFERENCE BOOKS:**

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COMPUTER AIDED MACHINE DRAWING

Subject Code: 14ME36  
Credits: 04
Hours/Week : 2+0+4  
CIE Marks: 50
Total Hours : 78  
SEE Marks: 50
Exam Hours : 03  
Course Type: Program Core

Course Outcomes:
Students will be able to
1. Understand the concept and importance of limits fits and tolerance in the manufacturing drawing.
2. Understand the thread terminologies, different types of fasteners, keys and joints and couplings used in machine parts.
3. Perform both 2d to 3d drawings of any components using the commercial software.
4. Visualize and model different parts of a machine.
5. Construct assemblies of various machines like screw jack, machine vice, tail stock of lathe from the concepts learnt using the Commercial software.

UNIT I
Introduction to GD&T:
12 Hours

UNIT II
Introduction to Riveted and Welded Joints:
Definitions of rivets, riveting and rivet heads. Classification of riveted joints.
Welded joints and symbols, dimensioning of welds, edge preparation of welds, welding.
Blueprint Reading:
Introduction, blueprint reading of component drawings and assembly drawings.  
12 Hours

UNIT III
Orthographic Projections and Sectional Views:
Conversion of 2D drawings to 3D parts (software only) of simple machine components. Full and half section of machine components.  
16 Hours

UNIT IV
Thread Forms and Fasteners:
Thread terminology, sectional views of threads, ISO metric (Internal & External), BSW (Internal & External), square and ACME sellers thread, American standard thread.
Hexagonal threaded bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly), simple assembly using stud bolts with nut and lock nut. Flanged nut, slotted nut, taper and split pin for locking, counter sunk head screw, grub screw, Allen screw.  
12 Hours

UNIT V
Assembly Drawings (Part drawings should be given)
1. Drill Jig
2. Crane Hook
3. Screw Jack (Only Demo)
4. Clapper Block
5. Machine Vice (Only Demo)
6. Universal Coupling
7. Piston Of Petrol Engine
8. Milling Machine Tail Stock
9. Non-Return Valve
10. Plummer Block (Only Demo).  
26 Hours
Pre-requisites:
The student should have knowledge of Computer Aided Engineering Drawing.

Course Assessment Method:
CIE –50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Drawing sheets from each chapter has to be submitted and it will be evaluated for 10 marks.
3. Minimum two assignments or surprise test to be given and evaluated through rubrics for 10 marks. Average of two will be considered.

SEE- 50 Marks
1. Two questions to be set from each unit (Unit-I carries 10 marks and Unit-II, Unit-III, Unit-IV & Unit-V carrying 10 marks each).
2. Students have to answer 4 questions selecting one full question from each unit.

TEXT BOOKS:

REFERENCE BOOKS:

All the sheets should be drawn in the class using software. Sheet sizes should be A3/A4. All sheets must be submitted at the end of the class by taking printouts.

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MANUFACTURING LAB

Sub Code : 14ME3L77
Credits : 1.5
Hours/Week : 0+0+3
CIE Marks : 50
Total Hours : 39
SEE Marks : 50
Exam Hours : 03
Course Type : Program Core

Course Outcomes:
Students will be able to
1. Select the proper moulding process for various rate of productions.
2. Estimate the size of the raw material for the forging product.
3. Apply foundry and forging processes in different industrial applications.
4. Analyze the properties of moulding sand and core sand by conducting different test.
5. Recognize the feasibility of casting, foundry and forging process.

UNIT I
Testing of Molding Sand and Core Sand:
1. Preparation of sand specimens and conduction of the following tests.
2. Compression, shear and tensile tests on universal sand testing machine.
3. Permeability test
4. Core hardness & mould hardness tests.
5. Grain fineness number test (Sieve Analysis test)
6. Clay content tests.
7. Moisture content tests.

UNIT II
Foundry Practice:
Use of foundry tools and other equipments. Preparation of molds using two molding boxes using patterns or without patterns.
Preparation of casting (Aluminum or cast iron) using sand mold, permanent mold, centrifugal casting, centrifuge casting.
Forging Operations:
Preparing minimum three forged models involving upsetting, drawing and bending operations.

Pre-requisites:
The student should have theoretical knowledge of manufacturing process

Course Assessment Method:
Record: 30 marks
Test: 15 marks
Study project/Viva voce: 05 marks
SEE - Final Exam: 50 Marks

Text Books:

Scheme of Examination:
Student will be asked to conduct one experiment from each unit.

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METALLOGRAPHY AND MATERIAL TESTING LAB

Sub Code : 14MEL38
Hours/Week : 0+0+3
Total Hours : 39
Exam Hours : 03
Credits : 1.5
CIE Marks : 50
SEE Marks : 50
Course Type : Program Core

Course Outcomes:
Students will be able to
1. Describe the microstructures of ferrous and non-ferrous materials.
2. Operate physical testing machines in the shop floor.
3. Diagnose internal defect by non-destructive testing.
4. Modify the wear resistance of ferrous and non-ferrous material by varying parameters like microstructures etc.
5. Estimate the strength of ferrous and non-ferrous metals.

UNIT I
2. To study the wear characteristics of ferrous and non-ferrous materials for different parameters.
3. Non-destructive test experiment.

UNIT II
2. Torsion tests.
3. Bending test on metallic and nonmetallic specimens.
4. Izod and Charpy tests on MS Specimen.

Pre-requisites:
The student should have basic theoretical knowledge of Material Science & Metallurgy

Course Assessment Method:
Record: 30 marks
Test: 15 marks
Study project/Viva: 05 marks
SEE - Final Exam: 50 Marks

Text Books:

Scheme of Examination:
Student will be asked to conduct one experiment from each unit.

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Course outcome:
1. Students learn the basics and method of obtaining solution of nonlinear equations and system of linear equations.
2. Students understand essentials of methods to obtain eigenvalues and Eigenvectors.
3. Students will be able understand the importance and limitations of numerical differentiation and integration
4. Students learn to obtain solutions of ordinary and partial differential equations numerically
5. Students learn to interpolate and extrapolate the given set of data

UNIT I

Errors and approximations – Introduction, Sources of errors, fixed and floating point numbers, Rounding off of numbers, Absolute and relative errors, approximation of series. (Chapter 2-1, 2.5, 11, 12, 13, 19, text book 3).

Solution of algebraic and transcendental equations- Secant or regula falsi method, Newton Raphson method for simple root, multiple root and complex roots, iteration method, Aitken’s $\Delta^2$ method for acceleration of convergence. (2.3, 2.4, 2.5 Text Book 2).

Solution of system of equations- Gauss-Seidel method, LU decomposition method, Cholesky method, Thomas algorithm for tridiagonal system (3.2, page 120-127, 3.4- page 150-152 Text book 12, 6.3.6, 6.3.8 text book 2).

UNIT II

Finite differences and interpolation – Forward, backward and central difference operators, construction of difference table, relation between differences and derivatives, Newton’s forward and backward difference interpolation, Sterling and Bessel central difference formulae, Newton’s divided difference and Lagrange’s interpolation formula, Bivariate interpolation using Lagrange’s and Newton’s interpolation, Spline interpolation (cubic splines only), Numerical differentiation with Newton’s forward and backward difference interpolation (3.3.1-3.3.3, 3.6, 3.7.2, 3.7.3, 3.9.1, 3.10.1, 5.2.1 Text book 1), (4.2, 4.4, 4.6, 4.7, 5.2, Text book 2).

UNIT III

Solution of ODE- Taylor series method, 4th order Runge-Kutta method, Milnè’s predictor corrector method, shooting method and finite difference method for boundary value problems. (7.2, 7.5, 7.6, 7.10 Text Book 1) (6.4, 7.2, 7.3 Text book 2)


UNIT IV

Numerical integration- Newton Cotes formula, Trapezoidal, Simpson’s 1/3rd and 3/8th rule, Weddle’s rule, Gaussian Quadrature method, Double integration by Trapezoidal and Simpson’s formula (5.4.1, 5.4.2, 5.4.3, 5.4.4, 5.4.7, 5.6, 5.10 Text book 2).

Integral equations- Volterra and Fredholm equations, Kernel of an integral equation, Solution of integral equation using successive approximation method, Simpson’s 1/3rd rule. (9.2 text book 2), (9.1.9.2.1 Text Book 1).

UNIT V

Calculus of Variation:
Eigen values and Eigen vectors- Largest eigen value by Power method, Rutishauser’s method, Jacobi method for symmetric matrices, Given’s method to reduce symmetric matrix to tridiagonal matrix, QR algorithm. (3.7, 3.8, 3.9, 3.10, 3.11 Text Book 1).

10 hours
Pre-requisites:
The student should have studied Maths –I, Maths-II and Maths-III.

Course Assessment Method:
CIE –50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments- evaluated through rubrics for 10 marks. Average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE- 50 Marks
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit.

Text Book:
2. Introductory methods of numerical analysis by S Sastry, PHI India.

Reference Book:
ENGINEERING METROLOGY & MEASUREMENTS

Sub Code :14ME42 Credits :03
Hours/Week :4+0+0 CIE Marks :50
Total Hours :38 SEE Marks :50
Exam Hours :03 Course Type : Program Core

Course Outcomes:
Students will be able to
1. Recognize the need of measurements.
2. Select suitable instruments for specific measurement.
3. Apply the knowledge of limits, fits & tolerance in the assembly.
4. Design gauges by applying taylors principles.
5. Assess the use of comparators.

UNIT I
Introduction to Measurement System:
Definition, requirements and significance of measurement system, methods of measurements, generalized measurement systems, definition and basic concepts of accuracy, precision, calibration, threshold, sensitivity, hysteresis, repeatability, linearity, system response, delay, errors in measuring instruments, classification of errors.

Transducers:
Definition, classifications of transducers, mechanical transducers, electrical transducers, piezoelectric transducers, electronic transducers, advantages and disadvantages of each type of transducers. 06 Hours

UNIT II
Measurement of Force, Torque and Pressure:
Introduction, analytical balance, platform balance, proving ring, types of dynamometers, mechanical dynamometers, hydraulic dynamometers, fan brake dynamometers, electric dynamometers – eddy current and dc dynamometers, advantages of hydraulic dynamometers over mechanical dynamometers.

Use of elastic members in pressure measurement, Mc Leod gauge, the Bridgeman gauge, thermal conductivity gauges - Pirani thermal conductivity gauge, thermocouple vacuum gauge. 08 Hours

UNIT III
Temperature Measurements and Strain Gauge:
Introduction, electrical resistance thermometer, thermoelectric effects, thermocouple, laws of thermocouples, thermocouple materials and construction, advantages and disadvantages of thermocouples, optical pyrometers and radiation pyrometers.

Mechanical strain gauges, optical strain gauges, and electrical resistance strain gauges – bonded type, unbonded type and piezoresistive strain gauges preparation and mounting of strain gauges, gauge factor, strain measurement using wheat stone bridge, calibration of strain gauges. 08 Hours

UNIT IV
Metrology Standards and Systems of Limits, Fits and Tolerances:
Introduction, objectives of metrology, standards of length – International proto type meter, imperial standard yard, wavelength standard, subdivision of standards – line standard and end standard, calibration of end bars (numerical), slip gauges, wringing phenomena, Indian standards (m-81, m-112), numerical problems on building of slip gauges.

Need for limit system, definition of limits, concept of limits of size and tolerance, definition of fit, types of fit and their designation, special types of fit. Definition of tolerance, unilateral and bilateral tolerance, concept of interchangeability and selective assembly, hole basis system and shaft basis system, brief concept of design of gauges (Taylor’s principles), types of gauges and gauge materials. 08 Hours
UNIT V
Comparators and Screw Thread Measurement:
Introduction, characteristics, classifications of comparators, mechanical comparators – Johansson microkator comparators, sigma comparators, dial indicator, optical comparators – Zeiss ultra-comparators, LVDT, pneumatic comparators, back pressure comparators, solex gauges.

Screw thread terminology, measurement of major diameter, minor diameter, pitch, angle and effective diameter of screw threads by 2 wire method and 3 wire method, best size wire, autocollimator and optical flat. **08 Hours**

Course Assessment Method:
CIE – 50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments- evaluated through rubrics for 10 marks. Average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE- 50 Marks
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit.

Text Book

Reference Books
2. Mechanical measurements by R K Jain.
3. Industrial Instrumentation Alsutko, Jerry D Faulk, Thompson Asia Pvt. Ltd. 2002

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APPLIED THERMODYAMICS

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Course Outcomes:
Students will be able to
1. Describe the working principle and thermodynamic cycles of various power generating and absorbing systems using property diagrams.
2. Formulate and correlate the mathematical expressions for energy transfer and thermal efficiency of different thermodynamic cycles.
3. Compute the performance parameters of IC engines, air compressors, turbines, refrigerators at different operating conditions.
4. Design the size of the IC engine and compressor cylinder for optimal energy conversion.
5. Interpret and apply the methods to improve the performance of various energy conversion systems.

UNIT I
Gas Power Cycles
Air standard cycles: Carnot, Otto, Diesel, Dual and Stirling cycles, P-V and T-S diagrams, description, efficiencies and mean effective pressures, comparison of Otto, Diesel and Dual combustion cycles, problems.

Gas Turbines and Jet Propulsion
Classification of gas turbines, Joule’s cycle, thermal efficiency, optimum pressure ratio, analysis of open cycle and closed cycle gas turbines, advantages and disadvantages of closed cycle gas turbine, methods to improve thermal efficiency, jet propulsion and rocket propulsion, problems.

UNIT II
Combustion thermodynamics: Theoretical (Stoichiometric) air and excess air for combustion of fuels, Mass balance, actual combustion, exhaust gas analysis, A/F ratio, energy balance for a chemical reaction, enthalpy of formation, enthalpy and internal energy of combustion, combustion efficiency, adiabatic flame temperature.

Reciprocating Air Compressors
Working of single stage air compressor; work done, efficiencies, volumetric efficiency, effect of clearance on volumetric efficiency, multi-stage compressor; advantages, condition for optimum pressure ratio, work done, methods used to achieve isothermal compression, problems.

UNIT III
Vapour Power Cycles
Carnot cycle-working, draw backs, simple Rankine cycle-description, performance parameters, comparison of Carnot and Rankine cycles, actual vapour cycles, ideal and practical regenerative cycles, open and closed feed water heaters, reheat Rankine cycle, problems.

UNIT IV
Internal Combustion Engines
Testing of two stroke and four stroke SI and CI engines for performance related numerical problems, heat balance, motoring method, Willian’s line method, swinging field dynamometer, Morse test. Alternate Engine fuels and emissions and introduction to MFIS (multi-fuel injection system).

UNIT V
Refrigeration
Definition-TOR, COP, relative COP, refrigerant, properties. Classification, Description and working of Carnot, Air cycle, vapor compression and vapor absorption refrigeration systems, working of steam jet refrigeration, problem. Electrolux refrigeration system.

Psychometry and Air Conditioning
Definition, psychometric properties, dry bulb temperature, wet bulb temperature, dew point temperature, partial
pressures, specific, absolute and relative humidity's, degree of saturation, adiabatic saturation temperature, enthalpy of moist air, psychrometric relations, psychrometric processes, summer and winter air conditioning, problems.  

10 Hours

Pre-requisites:
The student must have an extensive overview of Basic thermodynamics.

Course Assessment Method:
CIE –50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments- evaluated through rubrics for 10 marks. Average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE- 50 Marks
1. Two questions to be set from each unit, carrying 20 marks each.
2. Students have to answer 5 questions selecting one full question from each unit.

Text Book:
1. Basic and applied thermodynamics by P K Nag, Tata McGraw Hill.
2. Thermal Engineering by R K Rajput

Reference Books:
1. Engineering Thermodynamics by J B Jones, G A Hawkins, John Wiley and Sons
3. Basic and applied thermodynamics by Omakar Singh.

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THEORY OF MACHINES I

Sub Code : 14ME44
Hours/Week : 4+1+0
Total Hours : 48
Exam Hours : 03
Credits : 04
CIE Marks : 50
SEE Marks : 50
Course Type : Program Core

Course Outcomes:
Students will be able to
1. Analyze and select appropriate mechanisms for different applications.
2. Develop inversions of mechanisms for various kinematic applications.
3. Analyze and choose performance parameters and terminology of various gears and gear trains.
4. Evaluate functional parameters of various kinematic mechanisms using different methods.
5. Develop profile of higher pair based on varied motion of mating part.

UNIT I
Fundamentals
Fundamentals of mechanisms: Kinematic, link, pair, constraint motion-definition and its classification, types of joints, kinematic chain, Grubpler’s criteria, mechanisms, machines and structures, degrees of freedom, simple problems. 10 Hours

UNIT II
Mechanisms
Inversions: Inversions of 4 bar chain, single slider and double slider crank chain, Pantograph, Geneva, Ratchet and Pawl mechanisms.
Steering Gear mechanism: Fundamental equation of correct gearing, Davis and Acramenn mechanisms.
Gear: Introduction, types of gears, terminology of gears, fundamental law of gearing, gear tooth forms. Involutionary, interference, determination of minimum number of teeth to avoid interference, simple problems. 10 Hours

UNIT III
Velocity and Acceleration Diagram
Velocity Diagram: Determination of link velocities by relative method, instantaneous method.
Acceleration Diagram: Determination of link acceleration by relative methods, Aoriolis method. 12 Hours

UNIT IV
Gear Train
Introduction, types of gear trains, sun and planet gear trains, epicyclic gear train, torques in gear train, simple problems. 08 Hours

UNIT V
CAMs:
Introduction, types of cams and followers, procedure for drawing cam profile. Follower motion: uniform velocity, uniform acceleration and deceleration, SHM and cycloidal motions, problems to be solved using the above said types of motions. 08 Hours
Syllabus of I to VIII Sem BE Mechanical Engg. NMIT Bangalore-64

Course Assessment Method:
CIE –50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments- evaluated through rubrics for 10 marks. Average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE- 50 Marks
1. Two questions to be set from each unit, carrying 20 marks each.
2. Students have to answer 5 questions selecting one full question from each unit.

Text Book

Reference Books:
1. Theory of Machines by J K Guptha, S Chand Pvt Ltd.
2. Theory of Machines by Sadhu Singh, Pearson Education.

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Syllabus of I to VIII Sem BE Mechanical Engg., NMIT Bangalore-64

**FLUID MECHANICS**

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**Course Outcomes:**

*Students will be able to*

1. Cite the fundamental concepts of fluid mechanics including viscosity, surface tension, Pascal's law, total pressure and center of pressure, etc.
2. Illustrate the concepts of buoyancy, metacenter, Lagrangian and Eulerian concepts for fluid motion. They will also be able to differentiate between stream lines, path lines, and streak lines in a fluid, viscous, inviscid and irrotational flows.
3. Interpret general equations of motion, Euler’s equation of motion and Bernoulli’s equation for viscous and inviscid fluid flows. They will also be able to compute measurement of fluid flow using venturimeter, pitot tube and orificemeter.
5. Describe the concepts of boundary layer, displacement, momentum and energy thickness, laminar vs turbulent flow, compressibility, entrance length, critical Reynolds number, Mach number, Mach cone and aerodynamics terminologies like coefficient of lift and drag.

**UNIT I**

**Fluid Statics:** Introduction, types of fluid, properties of fluid- viscosity, thermodynamic properties, surface tension, capillarity, vapour pressure. the fluid pressure at a point, Pascal’s law, pressure variation in a static fluid; absolute, gauge, atmospheric and vacuum pressures; measurement of pressure using simple and differential manometers. Total pressure and center of pressure on submerged horizontal, vertical, inclined plane surfaces and curved surfaces.

10 Hours

**UNIT II**

**Buoyancy:** Archimedes principle, center of buoyancy, metacenter and metacentric height; conditions of equilibrium of floating and submerged bodies-determination of metacentric height by experimental and theoretical methods.

**Fluid Kinematics:** Introduction, scalar and vector variables, fluid motion –Lagrangian vs Eulerian Concept, steady vs unsteady and uniform vs. non uniform flow, continuity equation in Cartesian 2D and 3D coordinates, velocity and acceleration in fluid motion; distinction between stream lines, path lines and streak lines in a fluid, distinction amongst viscous, inviscid and irrotational flow, definition of velocity potential function, stream function – both satisfy laplace equation for irrotational flows.

09 Hours

**UNIT III**

**Fluid Dynamics:** Introduction, general equations of motion representing conservation of mass, momentum and energy for a viscous fluid flow, Euler’s equation of motion for inviscid flow Bernoulli’s equation from first principles and also deduced from Euler’s equation, limitations of Bernoulli’s equation. The impulse momentum principle- forces on pipe bends

**Measurement of Fluid Flow:** Venturimeter, orifice-meter, Pitot - static tube, V-Notch and rectangular weirs.

09 Hours

**UNIT IV**

**Flow through pipes:** Major loss due to friction in flow through pipes – computing head loss due to skin friction using Darcy’s and Chezy’s equation for head loss due to friction in pipes. HGL (Hydraulic Grade Line) and TEL (Total Energy Line).

**Dimensional Analysis:** Introduction, fundamental units, dimensions of physical quantities, dimensional homogeneity, Rayleigh’s method, Buckingham-π theorem, dimensionless numbers, similitude-geometric, kinematic and dynamic.

08 Hours
UNIT V

External Flow past Immersed Bodies:
Reynolds Number – definition and physical importance, concept of boundary layer, laminar flow past a flat plate, concept of displacement, momentum and energy thickness, laminar vs turbulent flow, phenomenon of transition and turbulence, expression for lift and drag coefficients, concept of compressibility, importance of pressure wave propagation and velocity of sound in a compressible fluid, Mach number, Mach cone, wind tunnels – applications in measurement of fluid-body interaction for flow past immersed bodies, introduction to aerodynamics terminologies like coefficient of lift and drag.

Internal Flow in Ducts: Concept of critical Reynolds number, entrance length, fully developed laminar flow through a circular pipe - HagenPoiseuille’s equation, laminar flow between parallel and stationary plates (Couette flow).

Course Assessment Method:
CIE – 50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments - evaluated through rubrics for 10 marks. Average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE- 50 Marks
1. Two questions to be set from each unit, carrying 20 marks each.
2. Students have to answer 5 questions selecting one full question from each unit.

TEXT BOOKS:

REFERENCE BOOKS:
ADvanced Manufacturing Technology

Course Code: 14ME46  
Hours/week: 4+0+0  
Total Hours: 48  
Exam Hours: 03

Credits : 04  
CIE Marks : 50  
SEE Marks : 50  
Course Type: Program Core

Course Outcomes:
Students will be able to
1. Select appropriate forming processes for various mechanical applications.
2. Compute different process parameters used during forming processes.
3. Analyze friction losses and power requirement during forging, rolling, drawing, extrusion and sheet metal forming.
4. Ascertaining high energy rate forming techniques based on real-time applications.
5. Distinguish powder metallurgy and rapid prototyping methods.

UNIT I

Effects Of Parameters: Temperature, strain rate, friction and lubrication, hydrostatic pressure in metalworking, deformation zone geometry and workability of materials, residual stresses in wrought products. 10 Hours

UNIT II

UNIT III
Drawing: Drawing equipment & dies, expression for drawing load by slab analysis, power requirement. Redundant work and its estimation, optimal cone angle & dead zone formation, drawing variables, tube drawing and classification of tube drawing, simple problems.
Extrusion: Types of extrusion processes, extrusion equipment & dies, deformation, lubrication & defects in extrusion. Extrusion dies, extrusion of seamless tubes. Extrusion variables, simple problem 10 Hours

UNIT IV
High Energy Rate Forming Methods: Principles, advantages and applications, explosive forming, electro hydraulic forming, electromagnetic forming. 10 Hours

UNIT V
Powder Metallurgy: Basic steps in powder metallurgy brief description of methods of production of metal powders, conditioning and blending powders, compaction and sintering application of powder metallurgy components, advantages and limitations.
Introduction to Rapid Prototyping: Brief discussion on rapid tooling and manufacturing. 08 Hours

Pre-requisites:
The student must have studied the concepts of manufacturing technology.

Course Assessment Method:
CIE – 50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments- evaluated through rubrics for 10 marks. Average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE – 50 Marks
1. Two questions to be set from each unit, carrying 20 marks each.
2. Students have to answer 5 questions selecting one full question from each unit.

TEXT BOOKS:

REFERENCE BOOKS:

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HEAT POWER LAB

Sub Code: 14MEL47
Credits: 1.5
Hours/Week: 0+0+3
CIE Marks: 50
Total Hours: 39
SEE Marks: 50
Exam Hours: 3
Course Type: Program Core

Course Outcomes:
Students will be able to
1. Operate instruments and measurement systems to calculate various parameters like BP, FP, IP, AF ratio, etc.
2. Write reports describing experimental setups, data collection, data analysis and data presentation.
3. Examine the input power, output power and efficiency of internal combustion engines.
4. Predict the flash point, fire point and viscosity for given lubricating oil.
5. Estimate the calorific value for a given fuel and compare different types of fuels based on their calorific values.

UNIT I
1. Determination of flash point and fire point of lubricating oil using Abel Pensky and Pensky apparatus.
2. Determination of caloric value of solid, liquid and gaseous fuels.
3. Determination of viscosity of lubricating oil using redwoods, Saybolts and torsion viscometers.
5. Use of planimeter.

UNIT II
Performance Tests on I.C. Engines, Calculations of IP, BP, thermal efficiencies, SFC, FP, heat balance sheet for
(a) Four stroke diesel engine.
(b) Four stroke petrol engine.
(c) Multi cylinder diesel/petrol engine (Morse test).
(d) Two stroke petrol engine.
(e) Variable compression ratio I.C. Engine.

Pre-requisites:
The student should have studied Applied Thermodynamics.

Course Assessment Method:
CIE - Record: 30 marks
Test: 15 marks
Study project/Viva:05 marks
SEE - Final Exam: 50 Marks

Text Books:

Scheme of Examination:
Student will be asked to conduct one experiment from each unit.
METROLOGY & MEASUREMENTS LAB

Sub Code : 14MEL48
Credits : 1.5
Hours/Week : 0+0+3
CIE Marks : 50
Total Hours : 39
SEE Marks : 50
Exam Hours : 03
Course Type : Program Core

Course Outcomes:

Students will be able to

1. Quote the applications of various measuring instruments.
2. Select a suitable measuring instrument for specific measurement.
3. Operate & calibrate measuring instruments in the shop floor.
4. Use lathe tool dynamometers to measure the cutting tool force.
5. Determine the moduli of elasticity of materials, pressure, temperature, gear and thread parameters and surface roughness.

UNIT I

MECHANICAL MEASUREMENTS

1. Calibration of pressure gauge.
2. Calibration of thermocouple
3. Calibration of LVDT.
5. Determination of modulus of elasticity of a mild steel specimen using strain gauges.

UNIT II

METROLOGY

1. Measurements using optical projector / toolmaker microscope.
5. Measurements of Screw thread Parameters using two wires or three-wire method.
7. Measurements of gear tooth profile using gear tooth vernier / gear tooth micrometer.

Pre-requisites:

Knowledge of metrology and measurements is a must.

Course Assessment Method:

CIE - Record: 30 marks
Test: 15 marks
Study project/Viva:05 marks
SEE - Final Exam: 50 Marks

Text Books:
2. Mechanical Measurements, 6/E 01-Sep-2007 by Beckwith, Pearson Education India,

Scheme of Examination: Student will be asked to conduct one experiment from each unit.
Syllabus of I to VIII Sem BE Mechanical Engg. NMIT Bangalore-64

DESIGN OF MACHINE ELEMENTS I

Sub Code : 14ME51
Hours/Week : 4+1+0
Total Hours : 48
Credits : 04
CIE Marks : 50
SEE Marks : 50
Course Type : Program Core

Course Outcomes:

Students will be able to
1. Recognize the design considerations for various mechanical metal forming processes and machine elements.
2. Apply theories of failure in design of machine components.
3. Analyze strength of various machine components subjected to static and variable loading.
4. Apply specific methodology in design of various machine elements.
5. Compute the strength parameters of machine elements subjected to impact loads.

UNIT I

Basics:
Engineering Materials and their Mechanical properties Use, types of codes & standards in Design. Design considerations in castings, Forgings & welded assemblies. Selection of preferred sizes.
Behaviour of Ductile & Brittle material, Stress-Strain Diagram for various materials. Factor of safety.

Design for Static Loading:
Introduction: Stresses in members subjected to axial, shear, Bending, Torsional & Eccentric loading. Stress tensor, Uniaxial, Biaxial & Triaxial stress state, Principal Stresses in members subjected to combination of static loads.

Theories of Failure & Stress Concentration:
Failure Criterion & problems - Maximum Normal Stress theory, Maximum Shear stress theory, Distortion energy theory

UNIT II

Stress Concentration:
Definition, Reason for occurrence, Methods to reduce, Stress concentration factor. Design of stress concentrated members subjected to various loads.

Design for Variable Loading:
Types of variable/Cyclic loads Mean & amplitude Stresses, Fatigue Failure, Endurance Limit & Strength, S-N Diagram. Goodman and Soderberg criterion, Modifying factors: Size effect, surface effect, Reliability, stress concentration effects etc. Problems on design of members for finite & infinite life in members subjected to individual & combined loading. Cumulative damage in fatigue.

UNIT III

Shafts:
Types, Design of solid & hollow shaft on strength and rigidity basis with steady loading subjected to pure torsion. Design of shafts carrying pulleys & gears (Combined loading). ASME Code for shaft design.

Cotter & Knuckle Joints: Design procedure

UNIT IV

Couplings:
Types, Design of Flange, Bush & Pin type flexible coupling.

Riveted Joints: Types, Design of longitudinal & circumferential joint for various types, Simple Riveted Brackets.

UNIT V

Impact Strength:
Introduction, Impact stress due to axial, Bending and Torsional loads

Power screws:
Forms of threads, terminology, Torque in lifting & lowering the load, self-locking screw, efficiency of screw (Square, ACME, self-locking), Design of screw & Nut for power screw.

Welded joints:
Types, Strength of Butt, parallel, transverse welds, eccentrically loaded welded joint subjected to torsion & Bending moment.

08 Hours

Pre-requisites:
The student would have to be well-versed with mechanics of materials and engineering mechanics

Course Assessment Method:
Test : 30 marks
Assignment : 10 marks
Study project/Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book

Design Data Hand Books:
3. PSG Design Data hand Book by PSG College of Technology, Coimbatore.

Reference Books
4. Engineering Design by G.E. Dieter

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THEORY OF MACHINE II

Course Outcomes:
Students will be able to
1. Ascertain the reaction forces on 2D bodies subjected to static and dynamic loads.
2. Demonstrate the suitability of Belt drive, flywheel, governor and gyroscope for various industrial applications.
3. Develop a methodology for balancing the rotating masses under static and dynamic loading.
4. Comprehend and predict the gyroscopic effect on automobiles, aircrafts and ships.
5. Analyze the performance of different types of governors, belt drives and gyroscopes subjected to various loading.

UNIT I
Static & Dynamic Force Analysis:
Dynamic Force Analysis:
D’Alembert’s principle, Inertia force, inertia torque, Dynamic force analysis of four-bar mechanism and slider crank mechanism.

UNIT II
Friction and Belt Drives:
Definitions: Types of friction: laws of friction, Belt drives: Flat belt drives, ratio of belt tensions, centrifugal tension power transmitted.
Flywheel
Turning moment diagrams Fluctuation of Energy. Determination of size of flywheels.

UNIT III
Balancing of Rotating Masses:
Static and dynamic balancing, Balancing of single rotating mass by balancing masses in same plane and in different planes. Balancing of several rotating masses by balancing masses in same plane and in different planes.

UNIT IV
Governors:
Types of governors; force analysis of Watt, Proell, Porter and Hartnell governors. Controlling force, stability, sensitiveness, isochronism, effort and power. (Only definitions).

UNIT V
Gyroscope:
Vectorial representation of angular motion, basic definitions, Gyroscopic couple. Effect of gyroscopic couple on a plane disc, a boat, an aero plane, a naval ship, stability of two wheelers and four wheelers.

Pre-requisites:
The student needs to possess knowledge of theory of machines-I

Course Assessment Method:
Test : 30 marks
Case study/Assignment: 10 marks
Surprise : 10 marks
SEE - Final Exam: 50 Marks
Text Book


Reference Books:
3. **Mechanisms and Dynamics of Machinery** by J. Srinivas, Scitech Publications, Chennai, 2002

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FINITE ELEMENT METHODS

Sub Code: ME53
Credits: 04
Hours/Week: 4+1+0
Total Hours: 48
Exam Hours: 03
CIE Marks: 50
SEE Marks: 50
Course Type: Program Core

Course Outcomes:
Students will be able to
1. Recognize the importance of FEM and its application in solid mechanics.
2. Interpret the various methods in assembling the stiffness equations.
3. Classify the coordinate systems and will be able to indicate the shape functions for different family of elements.
4. Calculate the stress, strain and reaction forces and infer the temperature effects on structural and thermal problems.
5. Assess the mechanical system with appropriate considerations for public health and safety.

UNIT I
Overview of Finite Element Method: Basic Concept, Historical background, General and Engineering applications of the FEM, Finite Element Method vs Classical Method, FEM vs FDM, Force Vs Displacement method in FEM
Discontinuity: Geometry, Load, Boundary, Material, Types of Symmetry, Aspect Ratio, Banded Matrix.
Interpolation Models: Introduction, Polynomial form of interpolation function, Simplex, Complex, and Multiplex elements, Interpolation polynomial in terms of nodal DOF, Selection of the order of the interpolation polynomial, Convergence requirements, coordinate systems.
Basic Equations in Elasticity (No questions will be asked for MSE or SEE): Introduction, Stresses in a Typical Element, Equations of Equilibrium, Strains, Strain Displacement Equations, Linear Constitutive Law.

UNIT II
Techniques of saving memory: Use of symmetry and banded nature, Partitioning of matrix (Frontal solution), Skyline storage.
Coordinate Systems: Local, Global, Area.
Shape Functions: Derivation of Shape Functions Using Polynomials, Finding Shape Functions Using Lagrange Polynomials, Shape Functions for Serendipity Family Elements, Hermite Polynomials as Shape Functions.

UNIT III
UNIT IV

Beams: 2-noded beam element: Finite element formulation, load vector-point load, UDL, shear force and bending moment, Problems

1D-Steady state Heat Transfer: Straight uniform fin analysis, convection loss from end surface of fin. Problems on composite wall and thin fins. 08 Hours

UNIT V

Isoparametric formulation: Basic theorems of Isoparametric concept, Uniqueness of mapping, isoparametric sub and super parametric elements, Numerical Integration-Gauss quadrature formula-1D: One, two and three point formula, 2D:two point

2D-CST: Area coordinates Isoparametric representation, Jacobian matrix, Strain-displacement matrix, Element stiffness, force term. Problems

2D-Quadrilateral element: Isoparametric representation, Jacobian matrix, Strain-displacement matrix, Element stiffness, forces term. Problems. 10 Hours

Pre-requisites:
The student should have studied Matrices and Mechanics of materials.

Course Assessment Method:
CIE –50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments- evaluated through rubrics for 10 marks. Average of two will be considered.
3. Case Study / Seminar / Mat lab programing / C programming for 10 marks.

SEE –50 Marks
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit

Text Book:
2. Finite Element Analysis by Bhavikatti S S New age International, 3rd Edition 2015,

Reference Book:

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FLUID MACHINERY

Subject Code: 14ME54
Credits: 04
Hours/Week: 4+1+0
CIE Marks: 50
Total Hours: 48
SEE Marks: 50
Exam Hours: 03
Course Type: Program Core

Course Outcomes:
Students will be able to
1. Describe the working principle of various turbo machines and energy transfer between fluid and rotor using governing equations.
2. Interpret the performance curves of various turbines, pumps and compressors.
3. Compute the Energy transfer and maximum efficiency in different stages of various turbo machines.
4. Design and analyze the performance of various turbo machines with dimensional analysis, velocity triangles and steady flow energy equations.
5. Modify the conditions of working fluid for various turbo machines, for effective performance.

UNIT I
Introduction: Definition of turbomachine, parts of turbomachines, Comparison with positive displacement machines, Classification, Dimensionless parameters and their significance, Effect of Reynold’s number, Unit and specific quantities, model studies on Turbomachines. Efficiencies of turbomachines. Problems.
Thermodynamics of fluid flow: Static and Stagnation states-Incompressible fluids and perfect gases, overall isentropic efficiency, stage efficiency (their comparison) and polytropic efficiency for both compression and expansion processes. Reheat factor for expansion process. 08 Hours

UNIT II
Energy exchange in Turbomachines: Euler’s turbine equation, Alternate form of Euler’s turbine equation, Velocity triangles for different values of degree of reaction, Components of energy transfer, Degree of Reaction, utilization factor, Relation between degree of reaction and Utilization factor, Problems.
General Analysis of Turbomachines: Radial flow compressors and pumps – general analysis, Expression for degree of reaction, velocity triangles, Effect of blade discharge angle on energy transfer and degree of reaction, Effect of blade discharge angle on performance, Theoretical head – capacity relationship, General analysis of axial flow pumps and compressors, degree of reaction, velocity triangles, Problems. 10 Hours

UNIT III
Steam Turbines: Classification, Single stage impulse turbine, condition for maximum blade efficiency, stage efficiency, Need and methods of compounding, Multi-stage impulse turbine, expression for maximum utilization factor, Reaction turbine – Parsons’s turbine, condition for maximum utilization factor, reaction staging. Problems. 10 Hours

UNIT IV
Centrifugal Pumps: Classification and parts of centrifugal pump, different heads and efficiencies of centrifugal pump, Minimum speed for starting the flow, Maximum suction lift, Net positive suction head, Cavitation, Need for priming. Problems. 10 Hours
UNIT V

Centrifugal Compressors: Stage velocity triangles, slip factor, power input factor, Stage work, Pressure developed, stage efficiency and surging and problems.

Axial flow Compressors: Expression for pressure ratio developed in a stage, work done factor, efficiencies and stalling. Problems.

(Note: Since dimensional analysis is covered in Fluid Mechanics subject, questions on dimensional analysis may not be given. However, dimensional parameters and model studies may be given more weightage.

10 Hours

Pre-requisites:
The student should have in-depth understanding of fluid mechanics, applied thermodynamics and basic thermodynamics.

Course Assessment Method:
CIE – 50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments- evaluated through rubrics for 10 marks. Average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE – 50 Marks
1. Two questions to be set from each unit, carrying 20 marks each.
2. Students have to answer 5 questions selecting one full question from each unit

TEXT BOOKS:

REFERENCE BOOKS:
5. Turbo machinery by ValanAr asu, A., vikas publishing house, New delhi, 2001

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Syllabus of I to VIII Sem BE Mechanical Engg. NMIT Bangalore-64

CAD/CAM/CIM

Sub Code : 14ME55
Credits : 04
Hours/Week : 4+0+0
CIE Marks : 50
Total Hours : 48
SEE Marks : 50
Exam Hours : 03
Course Type: Program Core

Course Outcomes:

Students will be able to

1. Recognize the techniques for minimizing the production time and cost.
2. Interpret the cycle, lead, mean time to repair, mean time between failures and total utilization of various machining centers in a shop floor production.
3. Implement the suitable automation Identification techniques in shop floor control.
4. Develop the effective automation systems for various industrial applications.
5. Compare the material handling & storage system with flexible manufacturing systems.

UNIT I

Introduction to CAD/CAM: Computers in Industrial Manufacturing, Product cycle
Computer Graphics: Raster scans graphics coordinate system, database structure for graphics modeling, transformation of geometry, 2D transformations, mathematics of projections, clipping, hidden surface removal.
Geometric modeling: Requirements, geometric models, geometric construction models, curve representation methods, surface representation methods, modeling facilities desired Drafting and Modeling systems: Basic geometric commands, layers, display control commands, editing, dimensioning, solid modeling, constraint based modeling.

UNIT II

Fundamentals of Manufacturing and Automation:
Automation, Reasons for automation, Manufacturing Industries, Types of production, Functions in Manufacturing, Organization and information processing in manufacturing, Plant layout, Production concepts and Mathematical models, Automation strategies Detroit type Automation: Automated flow lines, Methods of work part transport, transfer mechanisms, Buffer storage, Automation for machining operations

UNIT III

Analysis of automated flow lines:
General terminology and analysis, Analysis of transfer line without storage, with storage, partial automation.
Assembly Systems and Line Balancing:
The assembly process, Assembly systems, manual assembly systems, Line balancing, design of automated assembly, types, parts feeding devices, analysis of multistation assembly machines and single station assembly machine.

UNIT IV

Material Handling and Storage:
Functions, types of material handling, analysis of material handling, design of system, AGVs, storage system performance, AS/RS, Carousel storage system, work-in-process storage, interfacing handling and storage with manufacturing.
Group Technology and Flexible Manufacturing Systems:
Part families, Parts classification and coding, production flow lines, machine cell design, Benefits of Group technology, FMS workstation, Material handling and storage system, computer control systems, Planning the FMS.
Computerized Manufacturing planning systems:
CAPP, types, Computer integrated production planning systems, MRP, capacity planning.
UNIT V

Shop Floor control and automation Identification techniques:  
shop floor control, factory data collection system, automation identification systems, bar code technology, automated data collection system

Quality control and Automated Inspection:  
Inspection and testing, SQC, Automated inspection principles and methods, coordinate measuring machines, other contact inspection methods, Machine vision, other optical inspection methods, non contact inspection methods.

10 Hours

Course Assessment Method:  
Test: 30 marks
Assignment: 10 marks
Case study/Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Books:  
1. CAD/CAM by Zeid, Tata McGraw Hill.
THEORY OF ELASTICITY

Course Outcomes:
Students will be able to
1. Analyze stress and strain tensors at a point in structures subjected to normal, shear and torsional loads in both Cartesian and Cylindrical Co-ordinates.
2. Identify and correlate the relationships between elastic constants of different types of materials and its respective stress-strain relations and check for Airy’s stress function compatibility for simple beam problems.
3. Compute for critical loads that a component can withstand by applying suitable energy evaluation methods and to distinguish between various theorems.
4. Analyze asymmetrical bending problems, compute for shear centre and shear stresses in thin walled hollow sections.
5. Compute types of crack, crack lengths for suitable different modes of fracture, fracture toughness, SIF and illustrate the capability to design a component for a specified fatigue life, providing innovative solutions to elastic structural engineering problems to meet stress engineer capacities.

UNIT I
Analysis of Stress in Cartesian Co-ordinates:
Introduction - Body, surface force and stress vector, State of stress at a point, Normal shear stress components, rectangular stress components, stress components on an arbitrary plane, Equality of cross shears, Principal stress, invariants, State of stress referred to principal axes, Mohr’s circles for the 3D state of stress, Mohr’s stress plane, Planes of max. shear, Octahedral stress, State of pure shear, Decomposition into hydro static and pure shear state, plane state of stress, differential equations of equilibrium, equilibrium equations for plane stress state, boundary conditions. 12 Hours

UNIT II
Analysis of Stress in Cylindrical Co-ordinates: Equations of equilibrium in cylindrical coordinates, Axis symmetric case and plane stress case.
Analysis of Strain: Introduction, deformation, change of length, strain at a point, interpretation of shear strain components, change in direction of linear element, cubical dilation, principal axis of strain, principal strains, plane state of strain, compatibility conditions, strain deviators and its invariants. 10 Hours

UNIT III
Stress strain relationship: Generalized statement of Hooke’s law, isotropic materials, modulus of rigidity, bulk modulus, young’s modulus and Poisson’s ratio. Relationship between elastic constants, displacement equation of equilibrium.
Airy’s function: Investigation of Airy’s stress function for simple Beam Problems. 08 Hours

UNIT IV
Bending of beams: Introduction, Asymmetrical bending, Euler Bernoulli hypothesis, shear centre, shear stresses in thin walled open sections: shear centre. 10 Hours

UNIT V
Torsion: Introduction, generalized prismatic bar of solid section- circular and elliptical bar, equilateral triangular, rectangular bar, membrane analogy, torsion of thin walled tubes, torsion of thin walled multiple
cell closed sections.

**Fracture Mechanics:** Brittle fracture, stress intensity factor, fracture toughness, fracture conditions, fracture modes. **08 Hours**

**Pre-requisites:**
The student should have studied Material Science, Mechanics of Materials and Design of Machine Elements -1.

**Course Assessment Method:**

**CIE – 50 Marks**
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Two assignments / one course project- evaluated through rubrics for 10 marks. For assignments average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

**SEE – 50 Marks**
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit

**Text Books:**

**Reference Books:**

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Syllabus of I to VIII Sem BE Mechanical Engg. NMIT Bangalore-64

INTERNAL COMBUSTION ENGINES

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Exam Hours | 03 |

Course Outcomes:

**Students will be able to**

1. Define the various thermodynamic cycles for fuel-air and actual air standard cycles by applying the principles of thermodynamics.
2. Classify different types of fuels, cooling systems and various inlet boosting devices.
3. Interpret the suitable systems for the optimum engine performance.
4. Determine the effects of various engine variables and their performance in spark-ignition and compression-ignition engines.
5. Analyze the engine performance of internal combustion engines by studying the engine exhaust emissions and their control methods.

UNIT I

**Fuel–Air Cycles and their Analysis:**

UNIT II

**Carburetion and Combustion Process in SI engines:**

UNIT III

**Combustion in CI Engines:**

**Combustion Chambers:**
Introduction, Requirements of good Combustion chambers. Types of combustion chambers system for SI Engine – I-Head, F-head combustion chambers. CI Engines combustion chambers – Swirl generation methods, types of combustion chambers for CI engine- Turbulent type, air cell chamber, M- combustion chambers. Comparison of SI and CI combustion chambers. Modern combustion chambers. **12 Hours**

UNIT IV


**Fuel Injection:** Requirements of fuel injection systems. Types of fuel injection systems. Fuel pump, fuel atomizer and Injector. Electronic injection systems for CI engines for ECU-system (Electronic Central Unit), Injector system, injection pump, fuel injection system, multi-sparking in SI engines.

Cooling System: Necessity of engine cooling, Air Cooling, water cooling-Thermo Syphon cooling, forced circulation system. **10 Hours**

UNIT V


08 Hours

Pre-requisites:
The student should have studied the concepts of basic thermodynamics and applied thermodynamics.

Course Assessment Method:
CIE – 50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Two assignments / one course project- evaluated through rubrics for 10 marks. For assignments average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE – 50 Marks
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit

Text Books:

Reference Books:

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Syllabus of I to VIII Sem BE Mechanical Engg. NMIT Bangalore-64

NON – TRADITIONAL MACHINING

Sub Code: 14MEE563  Credits: 04
Hours/Week: 4+0+0  CIE Marks: 50
Total Hours: 48  SEE Marks: 50
Exam Hours: 03  Course Type: Program Elective

Course Outcomes:
Students will be able to
1. Recognize a process suitable for a particular application and infer the same
2. To indicate the merits, demerits and applications of various non-traditional machining processes
3. Analyze the concept, mechanism of material removal and their influence on the machining processes.
4. Set up the non-traditional machines
5. Compare the non-traditional machining processes with traditional machining processes with respect to the different process parameters

UNIT I

Mechanical Process:
Abrasive Jet Machining (AJM): Introduction, Equipment, Variables in AJM: Carrier Gas, Type of abrasive, size of abrasive grain, velocity of the abrasive jet, mean No. abrasive particles per unit volume of the carrier gas, work material, standoff distance. Applications, advantages & Disadvantages of AJM.

10 Hours

UNIT II


08 Hours

UNIT III

Chemical Machining (CHM):
Introduction, elements of process, chemical blanking process: Preparation of work piece, preparation of masters, masking with photo resists, etching for blanking, accuracy of chemical blanking, applications of chemical blanking, chemical milling (contour machining): process steps –masking, Etching, process characteristics of CHM: material removal rate accuracy, surface finish, Hydrogen embrittlement, advantages & application of CHM.

10 Hours

UNIT IV

Thermal Metal Removal Processes:
Electrical discharge machining (EDM) introduction, machine, mechanism of metal removal, dielectric fluid, spark generator, EDM tools (electrodes) Electrode feed control, Electrode manufacture, Electrode wear, EDM tool design choice of machining operation electrode material selection, under sizing and length of electrode, machining time. Flushing pressure flushing suction flushing, side flushing, pulsed flushing synchronized with electrode movement, EDM process characteristics: metal removal rate, accuracy surface finish, Heat affected Zone. Machine tool selection, Application EDM accessories / applications, electrical discharge grinding, Traveling wire EDM.

10 Hours
UNIT V

Plasma Arc Machining (PAM):

Laser Beam Machining (LBM):
Introduction, equipment of LBM mechanism at metal removal, LBM parameters, Process characteristics, Applications, Advantages Limitations.

Electron Beam Machinery (EBM):
Principles, equipment, operations, applications, advantages and limitation of EBM. 10 Hours

Pre-requisites:
The student should have studied Manufacturing Technology and Advanced Manufacturing Technology.

Course Assessment Method:

CIE –50 Marks
1. Three internal tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments- evaluated through rubrics for 10 marks. Average of two will be considered. (or) Students have to give seminar on the selected topic and have to submit a report, which can be considered for 10 marks. (or) Students have to submit a mini project with report, which can be considered for 10 marks.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE –50 Marks
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit

Text Book
1. New Technology by BHATTACHARAYA 2000
2. Modern Machining Process”, P.C Pandy & H.S. Shan

Reference Book
1. Production Technology, by HMT TATA McGraw Hill. 2001
2. Modern Machining Process by ADITYA. 2002
4. “Modern Machining Processes”, K. Mishra

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ENERGY ENGINEERING

Sub Code : 14MEE564
Credits : 04
Hours/Week : 4+0+0
CIE Marks : 50
Total Hours : 48
SEE Marks : 50
Exam Hours : 03
Course Type : Program Elective

Course Outcomes:
Student will be able to
1. Identify the different components and explain the working principles of power plant and its process.
2. Categorize the types of power plants and recognize the engineering challenges in using each of the sources of energy efficiently and environmentally friendly.
3. Grasp the economics in the use and application of various forms of energy.
4. Analyze the estimation of power plant based on factors such as number and size.
5. Design the draught systems and evaluate various performance parameters of power plant.

UNIT I
Steam Power Plant:
Different types of fuels used for steam generation, Equipment for burning coal in lump form, stokers, different types, Advantages and Disadvantages of using pulverized fuel, Equipment for preparation and burning of pulverized coal, unit system and bin system. Pulverized fuel furnaces, cyclone furnace, Coal and ash handling, Generation of steam using forced circulation, high and supercritical pressures, A brief account of Benson, Velox, Schmidt steam generators.

Chimneys:
Natural, forced, induced and balanced draft, Calculations involving height of to produce a given draft.

Cooling towers and Ponds: Classification and working principles of various towers and ponds. 10 Hours

UNIT II
Diesel Engine Power Plant:
Applications of Diesel Engines in Power field. Method of starting diesel engines, cooling and lubrication system for the diesel engine. Filters, centrifuges, Oil heaters, Intake and exhaust system, Layout of diesel power plant.

Gas Turbine Power Plant:
Advantages and disadvantages of the gas turbine plant, open and closed turbine plants with the accessories. 10 Hours

UNIT III
Hydro-Electric Plants:
Storage and pondage, flow duration and mass curves, hydrographs, low, medium and high head plants, pumped storage plants, Penstock, water hammer, surge tanks, gates and valves, power house general layout. A brief description of some of the important Hydel Installations in India. 08 Hours

UNIT IV
Nuclear power Plant:
Principles of release of nuclear energy Fusion and fission reactions. Nuclear fuels used in the reactors. Multiplication and thermal utilization factors. Elements of the nuclear reactor: moderator, control rod, fuel rods, coolants. Brief description of reactors of the following types-Pressurized water reactor, Boiling water reactor, Sodium graphite reactor, Fast Breeder reactor, Homogenous graphite reactor and gas cooled reactor. Radiation hazards, Shieldings, Radioactive waste disposal. 10 Hours

UNIT V
Power station estimation:
Choice of site for power station, load estimation, load duration curve, load factor, capacity factor, use
factor, diversity factor, demand factor, effect of variable load on power plant, selection of the number and size of units.

**Economics:**
Cost of energy production, selection of plant and generating equipment and operating characteristics of power plants, tariffs for electrical energy.  

10 Hours

**Pre-requisites:**
The student should have studied Elements of Mechanical Engineering, Basic thermodynamics, Applied thermodynamics.

**Course Assessment Method:**
**CIE –50 Marks**
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments- evaluated through rubrics for 10 marks. Average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

**SEE –50 Marks**
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit

**Text Book**

**Reference Book**

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WELDING TECHNOLOGY

Sub Code: 14MEE565  Credits: 4
Hours/Week: 4+0+0  CIE Marks: 50
Total Hours: 48  SEE Marks: 50
Exam Hours: 03  Course Type: Program Elective

Course Outcomes:
Students will be able to
1. Select a particular method of welding for different joining processes and select an appropriate technique according to a specific requirement.
2. Apply the various welding parameters and their effects on various welding processes related to the quality of weldment.
3. Determine the various weld defects and its causes on weld quality and remedies to reduce the defects to greater extent.
4. Inspect and Test of weldments through various destructive and Non destructive tests and also able predict the life of welds through residual life assessment.
5. Design different welded joints and to understand importance of computer systems and Software’s in various welding techniques.

UNIT I

Introduction:

Arc Welding:
Types, Working, advantages, disadvantages and applications of Shielded Metal Arc Welding (SMAW), Submerged Arc Welding (SAW), Metal Inert Gas Welding (MIG), Tungsten Inert Gas welding (TIG), Plasma Arc Welding (PAW), Electro stage and Electro gas welding. 10 Hours

UNIT II

Resistance Welding:
Working, advantages, disadvantages and application of spot welding, projection, seam flash, butt, percussion welding.

Solid Phase Welding:
Working, advantages, disadvantages and applications of friction welding, pressure welding, ultrasonic and explosive welding.

Radiant Energy Welding Processes: Electron Beam Welding and Laser Beam Welding. 08 Hours

UNIT III

Defects in Welds:
Introduction, Cracks, Distortion and types of distortion, Incomplete Penetration, Inclusions, Porosity and blow holes or gas pockets, Poor Fusion, Poor Weld bead appearance, spatter, Undercutting and over lapping, Causes and remedies of defects.

Inspection and Testing of Welds: Stages of Weld inspection and testing, Inspection before, during and after Welding.

Testing and impaction of welds: tensile test, Hardness tests and Bend tests, Non destructive inspection of welds: X-ray and Gamma ray radiography, Magnetic Particle Inspection, Dye Penetrant test. 10 Hours

UNIT IV

Life Prediction and Residual Life Assessment:
Life predictions of welding Structures, Residual life assessment, Nature of damage in service, Involvement of External agencies in FES and RLA, Weld failure.

Welding Symbols: Need for representing the Welds, Basic Weld symbols, Local of Weld, Supplementary Symbols, Dimensions of Welds, and Examples.

UNIT V
Under Water Welding:
Introduction, Problems encountered in underwater welding, Types of underwater welding, Characteristics of a good underwater welding processes, Underwater welding processes, salinity of sea water, Applications of underwater welding.

New developments and Computers in welding:
Computers systems, Software for Welding engineers, Programming language, Magdata, Preheat, Weldcost, Weldselector, Weldbest and Turbo-IX.

Pre-requisites:
The student should have studied Manufacturing Technology.

Course Assessment Method:
Test : 30 marks
Assignment : 10 marks
Seminar/Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book
1. Welding Technology by O P Khanna, Dhanpat Rai Publications

Reference Book
2. Advanced Welding Technology, Dr. S P Tewari, WATSON Press.
3. Welding Technology for Engineers, Dr. Baldev Raj, ASM Publishers

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MECHATRONICS

Sub Code : 14MEE566
Credits : 04
Hours/Week : 4+0+0
CIE Marks : 50
Total Hours : 48
SEE Marks : 50
Exam Hours : 03
Course Type : Program Elective

Course Outcomes:
Students will be able to
1. Define & outline the development of Mechatronic systems, concept of concurrent & sequential engineering, Sensors, Actuators and Signal conditioners.
2. Illustrate & summarize the working principle of Microprocessor & Microcontrollers Based Mechatronics Systems.
3. Interpret the fundamentals of signal processing for electrical systems.
4. Analyze the importance of data conversions, processing and storage in the microprocessor.
5. Compile an assembly language program to perform various arithmetic operations using 8085A microprocessor.

UNIT I
Introduction of Mechatronics:
Introduction of Mechatronic systems, Evolution on Mechatronics, Measurement system, control systems, microprocessor based controllers, Mechatronics system design approach Automatic washing machine, automatic camera and Engine management system, Mechatronics approach and their associated problems. Examples and discussion on typical systems.

UNIT II
Transducers & Sensors:
Introduction of Transducers, Classifications, Potentiometer, Capacitive Sensor, Eddy current proximity sensor, Hall effect sensor, Temperature sensor, light sensors, selection of sensors, inputting data by switches, Strain gauge & Wheat Stone Bridge.

UNIT III
Electrical actuation systems:
Electrical systems, Mechanical switches, solid-state switches, solenoids, DC & AC motors, Stepper motors and their merits and demerits.
Signal Conditioning:
Introduction to signal conditioning. The operational amplifier, Protection, Filtering, Wheatstone bridge, and Digital signals Multiplexers, Data acquisition, Introduction to Digital system processing Pulse-modulation.

UNIT IV
Introduction to Microprocessors:
Organization of Microprocessors (Preliminary concepts), basic concepts of programming of microprocessors. Review of concepts – Boolean algebra, Logic Gates and Gate Networks, Binary &Decimal number systems, memory representation of positive and negative integers, maximum and minimum integers. Conversion of real numbers, floating point notation, representation of floating point numbers, accuracy and range in floating point representation, overflow and underflow, addition of floating point numbers, character representation.
Logic function, Data word representation:
Basic elements of control systems 8085A processor architecture terminology such as CPU, memory and address, ALU, assembler data registers, Fetch cycle, write cycle, state, bus, interrupts. Micro Controllers. Difference between microprocessor and micro controllers. Requirements for control and their implementation in microcontrollers. Classification of micro controllers.
UNIT V
Organization & Programming of Microprocessors:
Introduction to organization of INTEL 8085-Data and Address buses, Instruction set of 8085, programming the 8085, assembly language programming.

Central Processing Unit of Microprocessors:
Introduction, timing and control unit basic concepts, Instruction and data flow, system timing, examples of INTEL 8085.

Pre-requisites:
Prior knowledge of Basic Electronics is required.

Course Assessment Method:
CIE - Test: 30 marks
Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book:

Reference Book:

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Course Outcomes:

Students will be able to

1. Demonstrate problem solving and decision making process based on economic concepts like law of returns, interest factors, cash flow diagrams etc.
2. Evaluate alternative proposals for investment based on economic methods.
3. Apply the methods to find rate of return, depreciation of capital items for decision making.
4. Utilize the process of estimating and costing for analyzing the economic feasibility.
5. Evaluate financial healthiness of a company by calculating and analyzing various financial ratios and assess the budgets for future activities.

UNIT I

Introduction:

09 Hours

UNIT II

Equivalent Annual Worth Comparisons: Equivalent Annual Worth Comparison methods, Situations for Equivalent Annual Worth Comparisons, Consideration of asset life, Comparison of assets with equal and unequal lives, Use of shrinking fund method, Annuity contract for guaranteed income, difference between tangible and intangible assets, Exercises Problems.

10 Hours

UNIT III

Rate of Return Calculations and Deprecation: Rate of return, Minimum acceptable rate of return, IRR, IRR misconceptions, Cost of capital concepts. Causes of Depreciation, Basic methods of computing depreciation charges, Tax concepts, and corporate income tax.

10 Hours

UNIT IV

Introduction, Scope of finance, Finance functions:

09 Hours

UNIT V

Financial and Profit Planning: Introduction, Financial planning, Profit planning, Objectives of profit planning, Essentials of profit planning, Budget administration, type of budgets, preparation of budgets, advantages, problems and dangers of budgeting.

10 Hours
Course Assessment Method:
CIE – 50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments - to familiarize students with the use of Compound interest tables as directed towards interest calculations, Present and future worth comparisons. - evaluated through rubrics for 10 marks. Average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE – 50 Marks
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit

Text Book

Reference Book

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SOLAR ENERGY

Sub Code : 14MEE568
Credits : 04
Hours/Week : 4+0+0
CIE Marks : 50
Total Hours : 48
SEE Marks : 50
Exam Hours : 03
Course Type : Program Elective

Course Outcomes:
Students will be able to
1. Identify the different types of energy sources and define the same with special reference to the Indian context.
2. To classify the different solar measuring devices, solar radiation devices and concentrators.
3. Interpret the various systems and power generation methods for the optimum performance.
5. Evaluate the effect of various parameters on the performance of photo-voltaic systems, liquid flat plate collectors and concentrators.

UNIT I

Introduction:
Energy source, renewable energy sources, renewable energy potential and achievements in India, Sustainable energy: The engine of sustainable development Solar energy: General characteristics of solar energy; the Sun, solar spectrum, spectral solar impedance.

Solar Radiation at the Earth Surface:

UNIT II

Solar radiation geometry:
Flux on a plane surface, Sun earth angles-latitude, declination, hour angle, zenith, solar altitude angle, surface azimuth angle, solar azimuth angle, Local apparent time, solar time, apparent motion of sun, day length, some numerical examples. Solar radiation on a inclined surface - Beam, diffuse, reflected radiation on a tilted surface, expression for flux on a tilted surface, monthly average daily radiation on slopped surface, numerical examples.

Solar Thermal Radiation Devices:
Liquid flat plate collectors, solar air heaters, concentrating collectors like cylindrical, parabolic, evacuated tubular collectors. Storage devices: Sensible heat storage, latent heat storage. Application of solar energy: water heating, space heating, space cooling, active and passive cooling, systems, power generation various methods, Refrigeration, Distillation, solar ponds, theory, working principle, operational problems (Sketches, principle of working).

UNIT III

Solar Photovoltaic System:
Introduction, Description, principles of working of solar cell: Doping, Fermi level, p-n junction, photovoltaic effect. Photovoltaic Material: Single crystal solar cell, Poly crystal solar cell, thin film solar cell, I-V characteristic, limits to cell efficiency, Cell temperature, Current status and Future potential of P.V.

Performance Analysis of Liquid Flat Plate Collectors:
General description, collector geometry, selective surface (qualitative discussion), basic energy – balance equation, stagnation temperature, transmissivity of the cover system, transmissivity-absorptivity product, numerical examples. The overall loss coefficient, correlation for the top loss coefficient, bottom and side loss-coefficient, problems (all correlations to be provided).

Temperature Distribution:
Between the collector tubes, collector heat removal factor, collector efficiency factor and collector flow
factor mean plate temperature, instantaneous efficiency (all expression to be provided). Effect of various parameters on the collector performance: Collector orientation, selective surface, fluid inlet temperature, number covers, dust.

**Solar Concentrators:**
Introduction, characteristic parameters:- Aperture area, Acceptance angle, absorber area, geometric concentration ratio. Local concentration ration or brightness concentration ratio, Intercept factor, optical efficiency, thermal efficiency. Concentration ratio.

**UNIT V**

**Concentrators, Types, Classification, Tracking:**

**Course Assessment Method:**
Test: 30 marks
Case study/Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks

**Text Book**

**Reference Book**
INDUSTRIAL ENGINEERING & MANAGEMENT

Sub Code: 14MEE569
Credits: 04
Hours/Week: 4+0+0
CIE Marks: 50
Total Hours: 48
SEE Marks: 50
Exam Hours: 03
Course Type: Program Elective

Course Outcomes:
Students will be able to
1. Recognize the motivational behavior of employees in an organization.
2. Identify various methods of improving overall productivity in an organization.
3. Improve the processes to help the industries to compete in global market.
4. Apply techniques of decision making, customer involvement, work-study, incentive schemes and process improvement.
5. Relate role of technology in management.

UNIT I

Introduction:
Historical perspective, contribution of Taylor, Henry Fayol, Gilbert, Charles Babbage, HL Gantt and others to the evolution of management science in the Indian context. Ownership of Industries Proprietorship, partnership, joint stock companies, public and private undertakings, co-operative organizations.

Management Functions:
Planning: corporate objectives, policies, strategies need for planning, responsibilities and types of plans, modern type of planning, selection of alternatives and process of decision making, case studies.
Organization: Basic requirement, types, structures and merits, Departmentation, vertical and horizontal growth, span of control, authority and responsibility, centralization and decentralization, formal and informal organizations, case studies.

UNIT II

Staffing:
Appraisal of needs, executive development schemes, performance appraisal and managerial mobility.
Directing: Types of instructions and characteristics of good order, communication flow of instructions motivation and leadership. Controlling: process of control, requirements of effective controlling, controlling techniques.

Work study, Incentives, Health and Safety:
Method study and time study, Foundations of work study, Job evaluation systems, Multi skilling, Incentive schemes, Training and Development, Safety Regulations and safe practices.

UNIT III

Management and Behavioral Approach:
Contribution of Elton Mayo and skinner and others to behavior sciences. Skills of a manager at various levels in an organization and inter-related systems, understanding past behavior, predicting future behavior, directing, changing And controlling behavior.

Motivation and Behavior:
Maslow’s hierarchy of needs, pretence of needs and satisfaction of needs, goal oriented behavior, integration of organizational goals and needs of employee. Hawthorn’s studies and its findings theory X and theory Y, immaturity theory, motivation hygiene theory.

UNIT IV

Process Management:
Definition of process management. Major process decisions-process choice, vertical integration, resource flexibility, customer involvement, capital intensity, relationships between decisions, service operation
relationships between decisions, service operation relationships, economics of scale and gaining focus. Designing process-process rearranging and process improvement.  

10 Hours

UNIT V

Management of Technology:

08 Hours

Course Assessment Method:
CIE –50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Case Study evaluated through rubrics for 10 marks.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE –50 Marks
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit.

Text Book

Reference Book

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AUTOMOTIVE ENGINEERING-I

Course Outcomes:
Students will be able to

1. Students can enroll the importance of the components in an engine with its ignition and fuel supply system.
2. Students will have the knowledge about different parts involved in increasing the performance of the engine.
3. Enable the students to understand the concepts involved gear box, clutch mechanism, power trains, steering in driving an automotive.
4. Students can understand the criticality in function and mounting of shock absorbers, steering and wheels on to the chassis.
5. Students will study the different parts of automobile including tyres and pressure to be maintained as a hassle free vehicle.

UNIT I
Engines Components and Fuel Supply systems
Ignition Systems: Battery Ignition systems, magneto Ignition system, Transistor assist contacts. Electronic Ignition, Automatic Ignition advance systems.
Superchargers and Turbochargers: Naturally aspirated engines, Forced Induction, Types pf superchargers, Roots supercharger, Spiral (Scroll) supercharger, Turbocharger construction and operation, Intercooler, Turbocharger lag.

UNIT II
Auxiliary systems of automotive engines
Cooling system: Necessity, variation of gas temperature, Areas oh heat flow, heat transfer, piston and cylinder temperature, Heat rejected to coolant, quantity of water required, cooling system, air cooling, water cooling, thermodynamics of forced circulation, thermostats, pressurized water cooling, regenerative cooling, comparison of air and water cooling, radiators – types, cooling fan – power requirement, antifreeze solution, types of coolant
Lubrication system: Lubricants, lubricating systems, Lubrication of piston rings, bearings, oil consumption, Oil cooling. Heat transfer coefficients, liquid and air cooled engines, coolants, additives and lubricity improvers, concept of adiabatic engines, oil filters, pumps, and crankcase ventilation – types.

UNIT III
Power Trains and steering systems
Steering System: center point steering, correct steering angle, steering mechanisms, cornering force, self-righting torque, under steer and over steer, Steering linkages, steering gears, special steering columns, power steering, trouble shooting, Numerical problems.

UNIT IV
Automotive Brakes and Suspension System
Brakes: Types of brakes, mechanical compressed air, vacuum and hydraulic braking systems, construction and working of master and wheel cylinder, brake shoe arrangements, Disk brakes, drum brakes, Antilock Braking systems, purpose and operation of antilock braking system, ABS Hydraulic Unit, Rear-wheel antilock.

Suspension system: basic considerations, Types of suspension springs, construction, operation & materials, leaf springs, coil springs, torsion bar, rubber springs, plastic springs, air bellows or pneumatic suspension, hydraulic suspension, constructional details of telescopic shock absorbers, independent suspension, front wheel independent suspension, rear wheel independent suspension, types, stabilizer, trouble shooting. Numerical problems.

UNIT V

Automotive Chassis and Wheels, Tyres
Frames: Types of frames – Two, Three, four wheelers & HV, general form & dimensions, materials, frame stresses, frame sections, proportions of channel sections, constructional details, loading points, sub frames, passenger car frames, X member type frame, Box section type frame, testing of frames, bending and torsion test, effect of brake application of frame stresses, truck frames, defects, Numerical problems.

Wheels and Tyres: Types of wheels, construction, structure and function, wheel dimensions, structure and function of tyres, static and dynamic properties of pneumatic tyres, types of tyres, materials, tyre section & designation, factors affecting tyre life, quick change wheels, special wheels, trouble shooting.

10 Hours

08 Hours

Course Assessment Method:
CIE – 50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Case Study/Mini project evaluated through rubrics for 10 marks.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE – 50 Marks
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit.

Text Book
3. Automotive Engineering, Powertrain by Chassis System and Vehicle Body, Edited by David A. Crolla, Edited by David A. Crolla

Reference Book

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FLOW MEASUREMENT AND FLUID MACHINERY LAB

Sub Code: 14MEL57
Hours/Week: 0+0+3
Total Hours: 39
Exam Hours: 03
Credits: 1.5
CIE Marks: 50
SEE Marks: 50
Course Type: Program Core

Course Outcomes:

Students should be able to

1. Obtain the necessary practical skills & real time knowledge that helps them in long run to gain the abilities necessary to tackle the fluid machinery problems.
2. Apply scientific method for analyzing the qualitatively & quantitatively to solve the problem situations.
3. Interpret general equations of motion, Euler’s equation of motion and Bernoulli’s equation for viscous and in viscid fluid flows. They will also be able to compute measurement of fluid flow using venturimeter, pitot tube and orifice meter.
5. Describe the concepts of boundary layer, displacement, momentum and energy thickness, laminar vs. turbulent flow, compressibility, entrance length, critical Reynolds number, Mach number, Mach cone and aerodynamics terminologies like coefficient of lift and drag.

UNIT I

1. Determination of Coefficient of Friction of flow in a pipe.
2. Determination of Minor Losses in Flow through pipes.
3. Determination of Force developed by impact on jets on Vanes.
4. Calibration of Flow measuring devices
   a. Orifice Plate
   b. Venturimeter
   c. Rotameter
   d. Nozzle

UNIT II

1. Performance testing of Turbines.
   a. Pelton wheel
   b. Francis turbine
2. Performance testing of pumps.
   a. Single stage & multi stage centrifugal pumps
   b. Double acting Reciprocating pump.
3. Performance test on a two stage Reciprocating Air compressor.

Pre-requisites:
Basic knowledge of Fluid Mechanics needed.

Course Assessment Method:
Record : 30 marks
Test : 15 marks
Study project/Viva : 05 marks
SEE - Final Exam: 50 Marks

Scheme of Examination: Student will be asked to conduct one experiment from each unit.
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MACHINE SHOP

Sub Code : 14MEL58
Hours/Week  : 0+0+3
Total Hours : 39
Exam Hours  : 03
Credits     : 1.5
CIE Marks   : 50
SEE Marks   : 50
Course Type : Program Core

Course Outcomes:

Student will be able to
1. Identify the different machine tools.
2. Demonstrate the operations of lathe, shaping and milling machines.
3. Determine the various process parameters for machining operations.
4. Formulate the process chart for the job.
5. Estimate the machining rate of the job.

UNIT I

Plain Turning, Taper turning, step turning, Thread cutting, facing, knurling, Eccentric turning using lathe.
(Minimum 3 models involving all the above processes)

UNIT II

1. Cutting of gear teeth using milling machine.
2. Cutting of V-Groove, Dovetail, Rectangular groove using shaping machine.

Pre-requisites:
Basic knowledge of Manufacturing Technology needed.

Course Assessment Method:
Record : 30 marks
Test : 15 marks
Study project/Viva : 05 marks
SEE - Final Exam : 50 Marks

Scheme of Examination:
Student will be asked to conduct one experiment from each unit.

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DESIGN OF MACHINE ELEMENTS II

Sub Code : 14ME61
Credits : 04
Hours/Week : 4+1+0
CIE Marks : 50
Total Hours : 48
SEE Marks : 50
Exam Hours : 03
Course Type : Program Core

Course Outcomes:
Students will be able to
1. Identify the design considerations for machine elements such as gears, bearings, brakes, clutches and springs.
2. Formulate and evaluate static and dynamic strengths of clutch, brakes, springs and gears for different operating conditions.
3. Design the machine elements for its functionality at design and off-design conditions.
4. Apply specific methodology in synthesis and analysis of components.
5. Propose appropriate materials and optimize design parameters for the machine elements.

UNIT I

Spur Gears:
Terminology, Forces analysis, Beam strength of spur gear tooth. Lewis Equation and form factor, Design for strength, Dynamic Load and wear load

Helical Gears:
Terminology, Forces analysis, formative/virtual number of teeth, Beam strength of helical gear tooth. Lewis Equation and form factor, Design for strength, Dynamic Load and wear load. 10 Hours

UNIT II

Worm Gears:
Terminology, Forces analysis, efficiency of worm and worm gear, worm gear strength, Thermal capacity of worm gear sets.

Bevel Gears:
Terminology, Forces analysis, formative/virtual number of teeth, Beam strength of straight tooth Bevel gear, Design for strength, Dynamic Load and wear load. 10 Hours

UNIT III

Brakes:
Types, Thermal considerations in Brakes, Design of Block shoe (Single & Double), Band Brakes (Simple & differential): Self Locking of brakes

Springs:
Types of Springs, terminology – Stresses in Helical coil springs of circular and non-circular cross sections. Concentric springs, springs under fluctuating loads, - Energy stored in springs, torsion, Belleville springs. Leaf Springs: Stresses in leaf springs, Nipping. Equalized stresses. 10 Hours

UNIT IV

Lubrication:
Lubricants and their properties, Modes of Lubrication (Hydrodynamic & Hydrostatic).

Sliding Contact bearings:

Rolling contact bearings:
Types & classification, Terminology- Life, Static & dynamic load capacity, equivalent load, Load-life relationship, Design – finding Life, selection from manufacturer’s catalogue. 10 Hours
UNIT V

Curved Beams:
Differences between Straight & curved beam, Derivation of bending Stress equation for a curved beam subjected to pure bending. Stresses in curved Beams subjected to Direct and Bending loading of Standard cross sections (Circular, Rectangular, Trapezium, Triangle, I & T Sections) used in crane hook, punching presses & clamps , Closed rings & chain links.

Clutches:
Types, friction materials & properties, Torque transmitting capacity- Uniform pressure & wear theory. Design of Single plate, multi plate and cone clutch.

08 Hours

Pre-requisites:
The student should possess good knowledge of Mechanics of Materials.

Course Assessment Method:
CIE –50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Mini Project/Case study is evaluated through rubrics for 10 marks.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE –50 Marks
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit.

Text Book
1. Design of Machine Elements by V.B.Bhandari, 2nd Edn 2007,TataMcgrawhill

Design Data Handbook
3. PSG Design Data Hand Book by PSG College of Technology.

Reference Book
Sub Code: 14ME62  Credits: 04
Hours/Week: 4+1+0  CIE Marks: 50
Total Hours: 48  SEE Marks: 50
Exam Hours: 03  Course Type: Program Core

Course Outcomes:

Students will be able to
1. Formulate the mathematical models for undamped and damped mechanical vibrations systems.
2. Determine and interpret the characteristics of linear vibration mechanical systems.
3. Predict the frequency response for mechanical vibration systems under loading conditions.
4. Analyze the critical speed of shaft, determine the principle mode of vibration for two DOF systems.
5. Evaluate the natural frequencies of different DOF systems using various numerical techniques.

UNIT I
Fundamentals of Vibrations:
Concept of Vibration, Definitions, Vector method of representing Harmonic Motions, Addition of the two Simple Harmonic Motion of the same frequency, Beats Phenomenon, Fourier Series and Harmonic Analysis.

Undamped Free Vibrations of Single DOF systems:
Derivation of Differential equation for spring mass system, Solution of Differential equation, Equivalent Stiffness of spring combinations, Energy Method, Raleigh method, Torsional Vibration, Problems on Single DOF to find the frequency of the system such as simple pendulum, compound pendulum, spring controlled simple pendulum, Beams, A cylinder oscillating on another cylindrical surface, a half cylinder oscillating on a flat surface, vibrating liquid column in U tube, effect of mass of the spring on natural frequency, cylinder floating in a liquid, frequency for small oscillations of the fluid between the two tanks, spring mass pulley system.

UNIT II
Damped Free Vibrations of Single DOF systems:
Different types of Damping, Dry Friction, Solid damping, Interfacial Viscous Dampers. Free vibrations with Viscous damping for spring mass damper system, solutions for different amount of damping in the system: Over damped, Critically Damped, Under Damped. Logarithmic Decrement.

UNIT III
Forced Vibrations of Single DOF systems:

UNIT IV
Critical Speeds of Shafts:
Critical speed of a light shaft having a single disc, with and without damping.
Two Degrees of Freedom systems:
Principal modes of vibration for a two DOF spring mass system, two masses fixed on a tightly stretched string, double pendulum, two rotor system, combined pendulum and spring mass system. Combined rectilinear and angular modes. Systems with damping. Coordinate coupling. Torsionally equivalent shaft.
UNIT V

Multi-degree-of-Freedom Systems
Introduction, Influence Coefficients, Newton’s method, Maxwell’s reciprocity theorem, Dunkerley’s Formula, Holzer’s Method, Orthogonality of principal modes, Stodola method. 10 Hours

Pre-requisites:
Knowledge of Engg Mechanics, MOM and Maths I, II, III and IV is required.

Course Assessment Method:
CIE – 50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments – to be given on dynamic analysis as directed toward vibration problems. - evaluated through rubrics for 10 marks. Average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE – 50 Marks
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit

Text Book

Reference Book

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Syllabus of I to VIII Sem BE Mechanical Engg, NMIT Bangalore-64

OPERATIONS RESEARCH

Sub Code : 14MEH63
Credits : 04
Hours/Week : 4+1+0
CIE Marks : 50
Total Hours : 48
SEE Marks : 50
Exam Hours : 03
Course Type : Program Core

Course Outcomes:
Students will be able to
1. Able to understand and reproduce the concept and scope of operations research in managerial problems to use the scarce resources (capitals, materials, staffing, and machines) more effectively.
2. Apply the knowledge of formulating mathematical models for quantitative analysis of managerial problems in industry;
3. Create computer programmes to solve mathematical models for practical problems.
4. Evaluate the decision variables for mathematical formulations using various methods
5. Extend the skills in the use of Operations Research approaches in formulating and solving real time problems like transportation, assignment, game theory, Queue theory and Project analysis.

UNIT I

Introduction:
Introduction: Evolution of OR, definition of OR, scope of OR, application areas of OR, steps (phases) in OR study, characteristics and limitations of OR, models used in OR, linear programming (LP) problem formulation and solution by graphical method.

UNIT II

The simplex method

UNIT III

Transportation Problem:
Assignment Problem:
Mathematical Formulation, Hungarian method, Minimal, Maximal & unbalanced assignment problem, traveling salesman (Routing) problem.

UNIT IV

Sequencing:
Terminology & notations, Johnson’s algorithm, processing of : n-jobs to 2 machines, n jobs 3 machines, n jobs m machines without passing sequence. 2 jobs n machines with passing. Graphical solution.
Game Theory:
Formulation of games, types, solution of games with saddle point, graphical method of solving mixed strategy games, dominance rule for solving mixed strategy games.

UNIT V

PERT-CPM Techniques:

Queueing Theory:
Queueing system and their characteristics. The M/M/1 queueing system, steady state performance and analysis of M/M/1 & M/M/C queueing model.

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**Course Assessment Method:**

*CIE* - Test: 30 marks  
Assignment: 10 marks  
Surprise: 10 marks  
*SEE* - Final Exam: 50 Marks

**Text Book**

**Reference Book**

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Course Outcomes:

1. **Knowledge**: Given an English language problem description &/or a schematic representation of the problem, define the problem precisely, identify the input/output requirements, examine the simplicity/complexity of the problem and develop a generic initial solutions using MATLAB/SIMULINK software & finally to interpret & justify the correctness of the result.

2. **Application**: Given a problem definition involving mechanical engineering or mechatronic system (Multi-discipline), apply various analytical modeling techniques to obtain the differential equation describing the system and to solve the same using MATLAB/SIMULINK environment.

3. **Analysis**: Examine the given problem, break down the given system into sub systems & analyze boundary conditions & the various process/system parameters associated with it.

4. **Synthesis**: Design a SIMULINK Model of the system by connecting all the sub systems together to obtain a unified system response solution for various values of the given input parameters and constraints.

5. **Create**: Develop a system describing the real world application problems in MATLAB/SIMULINK and solve them individually or in a group with effective project management skills (Communication, Documentation).

**UNIT I**

**Fundamentals of MATLAB**
Introduction to MATLAB, Graphic User Interface (GUI), Basic programming involving arithmetic operations, workspace variables, strings, calling functions, matrix & array operations, linear algebra, basic plotting functions, control flow.  

**10 Hours**

**UNIT II**

**Modeling, Simulation and Analysis**
1. Dynamics & Vibrations of Mechanical Systems using MATLAB
   a) Spring Mass Damper System (Forced & Unforced System Response)- 1 DOF & Multi DOF.
   b) Simple & Double Pendulum
   c) Inverted Pendulum on Cart
   d) Three bar linkage

2. System Response Simulation using SIMULINK
   a) Spring Mass Damper
   b) Electro-Mechanical System
   c) Quarter Car Model
   d) Simple Electrical System

3. Overview of various SIMULINK tools with Case Studies SimScape, SimMechanics, SimDriveline, SimHydraulics.  

**20 Hours**

**UNIT III**

**Course Project-Max 2 Students per group**
Students have to take up a case study or a mini project on real world application driven problem & Solve them using MATLAB/SIMULINK. Each Group is required to give a brief report & presentation on their project at the end of completion of their project.  

**09 Hours**
Course Assessment (CIE+SEE)
CIE:
- Engineering Journal/Record: 10 Marks
- Mid Sem Exam (MSE)- 20 Marks
- Course Project: 10 Marks
- Viva/Voce: 10 marks

SEE:
- Final Exam: 50 Marks

Scheme of Examination:
- Students would be given a minor problem from Unit I & a major problem from Unit II.

Text Book & References
1. “MATLAB Primer” by MathWorks Inc (Open Source available over Internet)

Course Pre-Requisites:
1. Computer Concepts & ‘C’ Programming
2. Mechatronics, Mechanical Vibrations & Control Engineering

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TOOL DESIGN

Course Outcomes:
Students will be able to
1. An ability to define modern tools like Jigs & Fixtures Press tools, die casting dies and Injection moulding tools.
2. An ability to select the proper tool to increase the rate of production.
3. An ability to apply the knowledge in the shop-floor.
4. An ability to reduce the wastage of raw materials.
5. An ability to choose the proper die casting dies for almost defect free castings.

UNIT I
Introduction to tool design: Tooling requirement of a tool designer, General tool designing procedure.
Design of Single Point Cutting Tool: Design of single point lathe tool, Design of shank dimension using strength and rigidity considerations for rectangular, square and round cross section and selection of tool geometry. Solid type tool, brazed tip tool, long indexable insert, thruway indexable insert types and chip breakers.
Design of Multi Point cutting Tool: Drill bit design of elements like back taper, Web thickness, land width, Margin, flute length, Cross section and selection of tool geometry.
Design of milling cutter: Design elements like Number of teeth and Height circular pitch, Body thickness, Chamfer width, fillet radius and Selection of tool geometry. Design of Flat and Circular form tools.

UNIT II
Design of Fixtures: Fixture design, Turning fixtures, Milling fixtures, Grinding and Broaching fixtures, Indexing fixtures, Design of fixtures for simple components.

UNIT III

UNIT IV
Bending & Drawing: Bending dies: Introduction, Bend allowances, Spring back, Edge bending die design, Drawing dies: Single action, Double action and triple action dies, Factors affecting drawing, Drawing die design.
UNIT V


Injection Moulding: Injection moulding machine and its elements, general configuration of a mould, 2 plate & 3 plate mould. Introduction to Gate, Runner, parting surface ejection system, Core & cooling system, Introduction to compression, Transfer Blow moulding, Extrusion, forming and Calendaring.

09 Hours

Pre-requisites:
The student must have undergone a course on Mechanics of Materials, Finite Element Methods and Mechanical Vibrations.

Course Assessment Method:
MSE –50 Marks
4. Three Mid Semester Examination (MSE) tests (each 30 marks) are conducted, average of best two marks will be considered.
5. Minimum two assignments - to familiarize students with the use of Compound interest tables as directed towards interest calculations, Present and future worth comparisons. - evaluated through rubrics for 10 marks. Average of two will be considered.
6. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE –50 Marks
3. Two questions to be set from each unit, carrying 20 mark each.
4. Students have to answer 5 questions selecting one full question from each unit

Text Book

Reference Book
2. Typical example and problems in metal Cutting theory and cutting tool design by N. Nefdov, K. Osipov, Mir Pub. Edn. 1987
5. Fundamentals of tools design, ASTME prentice hall India. 2000.

Course outcomes
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THEORY OF PLASTICITY AND METAL FORMING PROCESSES

Course Code: 14MEE652
Credits: 04
Hours/Week: 4+0+0
CIE Marks: 50
Total Hours: 48
SEE Marks: 50
Exam Hours: 03
Course Type: Program Elective

Course Outcomes:

Students will be able to
1. Understand the stress-strain relations under plastic deformation of metals manufactured under different conditions.
2. Analyze plastic deformation under bending and torsion based on application.
3. Interpret the plastic deformation with various criteria through appropriate field theories.
4. Compute the effect process parameter on the surface integrity aspects during various manufacturing process.
5. Predict the specific metal forming operations for a particular plastic deformation.

UNIT I

Plastic Deformation of Metals: Crystalline structure in metals, mechanism of plastic deformation, factors affecting plastic deformation, strain hardening, recovery, recrystallization and grain growth, flow figures or luder’s cubes.
Stress Strain Relations: Introduction, types of materials, empirical equations, theories of plastic flow, experimental verification of St. Venant’s theory of plastic flow, the concept of plastic potential, the maximum work hypothesis, mechanical work for deforming a plastic substance.  

UNIT II

Yield Criteria: Introduction, yield or plasticity conditions, Von-Mises and Tresca criteria, Geometrical representation, yield surface, yield locus (two dimensional stress space), energy required to change the shape with basic principle problems.
Slip Line Field Theory: Introduction, basic equations for incompressible two dimensional flows, continuity equations, stresses in conditions of plain strain, convention for slip lines, solutions of plastic deformation problem, Geometry of slip line field, Properties of the slip lines, construction of slip line nets.

UNIT III

Bending of Beams: Analysis for stresses, nonlinear stress strain curve, shear stress distribution, residual stresses in plastic bending, problems.
Torsion of Bars: Introduction, plastic torsion of a circular bar, elastic perfectly plastic material, elastic work hardening of material, residual stresses and problems.

UNIT IV

Metal Forming Process: Introduction, Cold working, warm working, hot working, flow stress, Coefficient of friction, work of deformation, methods of analysis of metal forming.
Drawing & Extrusion Process: Introduction, zero-friction case, wire drawing and extruding considering friction, defects in extrusion, extrusion equipment.

UNIT V

Forging: Introduction, forging operations, forging processes, design of forging dies, drop forging die design, upset forging die design, forgeability, strip forging, upsetting under axial symmetry, closed die forging with overlapping dies, closed die press forging with axial symmetry and overlapping dies, forces in impression die forging.


Course Assessment Method:
CIE – 50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Two assignments / one course project- evaluated through rubrics for 10 marks. For assignments average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

**SEE – 50 Marks**
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit

**Text Books:**

**Reference Books:**
2. *Theory of Plasticity*, L.S. Srinath, TMH.

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Syllabus of I to VIII Sem BE Mechanical Engg. NMIT Bangalore-64

REFRIGERATION AND AIR CONDITIONING

Sub Code: 14MEE653
Credits: 04
Hours/Week: 4+0+0
CIE Marks: 50
Total Hours: 48
SEE Marks: 50
Exam Hours: 03
Course Type: Program Elective

Course Outcomes:
Students will be able to
1. Describe the fundamental principles of refrigeration and air-conditioning systems through various refrigeration cycles.
2. Illustrate the functions of various components of refrigeration and air-conditioning systems with suitable refrigerants.
3. Compute the performance parameters of vapor compression refrigeration system using analytical and graphical approach.
4. Apply the concept of refrigeration in the use of air-conditioning systems through psychrometric relations and charts.
5. Design the various components of air-conditioning systems for optimum performance.

UNIT I
Brief Review of Various Methods of Refrigeration:
Refrigerants:
Survey of Refrigerants, Comparative study of Ethane and Methane derivatives, selection of Refrigerants, Requirements of Refrigerants, Effects of lubricants in Refrigerants, substitutes of CFC Refrigerants, Mixture Refrigerants-azeotropic mixtures.

UNIT II
Multi Pressure Vapour Compression Systems:
Multi evaporator systems, Cascade systems, calculation, production of solid carbon dioxide, System practices for multistage system.

UNIT III
Vapour Absorption System:
Psychometry of Air Conditioning Process-Review:
Summer Air conditioning, Apparatus Dew point, winter air conditioning.

UNIT IV
Design Conditions:
Outside design conditions, choice of inside conditions, comfort chart. Choice of supply design condition.
Load Calculations and Applied Psychometrics:
Internal heat gains, system heat gains, break up of ventilation load and effective sensible heat factor, cooling load estimate. Psychometric calculations for cooling. Selection of Air conditioning apparatus for cooling and dehumidification, evaporative cooling.
UNIT V

Transmission and Distribution of Air:
Room Air Distribution, Friction loss in ducts, dynamic losses in ducts, Air flow through simple Duct system, Duct design.

Controls in Refrigeration and Air Conditioning Equipments:
High pressure and low pressure cut out, thermostats, pilot operated solenoid valve, motor controls, by pass control-Damper motor. VAV controls. 08 Hours

Pre-requisites:
The student should have in-depth knowledge of subjects such as basic thermodynamics and applied thermodynamics.

Course Assessment Method:
CIE - Test: 30 marks
Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book

Reference Book

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OPERATIONS MANAGEMENT

Course Outcomes:
Students will be able to:
1. Gain an understanding and appreciation of principles and applications relevant to planning, design and operation of manufacturing/ service firms.
2. Develop necessary skills to effectively analyze and synthesize many inter-relationship in production systems.
3. Gain ability to recognize the situations in production systems environment that suggests use of quantitative methods to assist in decision making.
4. Understand aggregate planning and master scheduling techniques.
5. Choose a frame work of inventory control and enterprise resource planning through MRP-II.

UNIT I
Operations Management Concepts and Decision Making:

UNIT II
System Design & Capacity Planning, Forecasting:
Design capacity, System capacity, and Determination of Equipment requirement. Facility Location and Facility Layout Location Planning for Goods and Services, foreign locations and facility layout. Forecasting Objectives and Uses, Forecasting Variables, Opinion and Judgmental methods, Time Series methods, Exponential smoothing, Regression and Correlation methods, Application and Control of Forecasts.

UNIT III
Aggregate Planning and Master Scheduling:
Introduction, Planning and Scheduling, Objectives of Aggregate Planning, Aggregate Planning Methods, Master Scheduling Objectives, Master Scheduling Methods.

UNIT IV
Supply chain, Inventory Control, Material and Capacity Requirements:
Planning Components and model of supply chain, inventory control, inventory cost, order quantities and inventory classification. MRP and CRP, MRP: Underlying Concepts, System Parameters, MRP Logic, System refinements, Capacity Management, CRP activities. Concept of continuous improvement of process.

UNIT V
Scheduling and Controlling Production Activities:
Introduction, PAC objectives and data requirements, Scheduling strategy and guidelines, Scheduling Methodology, Priority Control, Capacity Control. Single Machine Scheduling:
Concept, Measures of Performance, SPT Rule, Weighted SPT Rule, EDD Rule, Minimizing the number of tardy jobs. Flow Shop Scheduling:
Introduction, Johnson's rule for 'n' jobs on 2 and 3 machines, CDS Heuristic. Job Shop Scheduling:
Types of schedules, Heuristic Procedure, Scheduling 2 Jobs on 'm' machines.
### Course Assessment Method:

**CIE** - Test: 30 marks  
Assignment: 10 marks  
Surprise: 10 marks  
**SEE** - Final Exam: 50 Marks

### Text Book


### Reference Book

1. **Modern Production/Operations Management** by Buffa, Wiley Eastern Ltd., 2001  
2. **Production and Operations Management** by Pannerselvam, R., PHI, 2002  
3. **Productions & operations management** by Adam & Ebert, 2002  

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Syllabus of I to VIII Sem BE Mechanical Engg. NMIT Bangalore-64

ALTERNATIVE FUELS

Sub Code : 14MEE655
Credits : 04
Hours/Week : 4+0+0
CIE Marks : 50
Total Hours : 48
SEE Marks : 50
Exam Hours : 03
Course Type : Program Elective

Course outcomes

Students will be able to

1. Describe the properties of solid, liquid and gaseous forms of alternate fuels and their effective utilisation.
2. Acquire the concepts on emerging technologies of alternative fuels and drive trains.
3. Illustrate the production, handling, merits, demerits and environmental effects of alternate fuels.
4. Analyse the benefits of alternative fuels to manage global fossil fuel crisis.
5. Compute the exhaust emissions of various alternative fuels and compare with fossil fuel.

UNIT I
Overview of an Alternative fuels: Introduction, Classification of alternative fuels, Technological up gradation and inspection required for alternative fuel vehicles, need for alternative fuels, impelling causes for alternative fuels, implementation barriers.


UNIT II
Bio Fuel: Introduction, properties, production, applications, advantages, disadvantages, Health and Environmental effects and storage of Ethanol, Methanol and Butanol and Numerical problem

UNIT III
CNG, LNG and LPG
CNG: Storage, production, advantages and disadvantages
LNG: Storage, properties, production, advantages and disadvantages, LNG to CNG conversion system
LPG: Storage, properties, production, advantages and disadvantages safety system for LPG.

UNIT IV

UNIT V
Duel Fuel technology: Operations, Conversion of a CI engine to Duel fuel engine.

Course Assessment Method:
CIE - Test: 30 marks
Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks
Text book

Reference book

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TOTAL QUALITY MANAGEMENT

Course Outcomes:
Students will be able to
1. Understand the philosophy and core value to TQM and to determine the voice of customers and its impact on quality.
2. Apply and evaluate best practices for attainment of total quality.
3. Understand the methodologies to enhance the management process such as benchmarking, business process reengineering.
4. Choose the framework to evaluate the performance excellence of organization, human resource and to determine the set of performance indicators.
5. Identify the areas for quality improvement through QFD and FMEA.

UNIT I
Overview of TQM:
Leadership, Customer Satisfaction and Employee Involvement:

UNIT II
Human Resource Practices:
Scope of Human Resources Management, leading practices, designing high performance work systems-work and job design, Recruitment and career development, Training and education, Compensation and recognition, Health, safety and employee well-being, performance appraisal.

UNIT III
Tools and Techniques in TQM:
7 basic tools of quality control, Kaizen, Re-engineering, 6 sigma, Benchmarking, Definition, Process of benchmarking, 5S, Poke yoke, 3M, Pareto diagram, Process flow diagram.

UNIT IV
Building and Sustaining Total Quality Organizations:
Making the commitment to TQ, Organizational culture and Total Quality, Change management, sustaining the quality organization, quality assurance, concepts and objectives of quality assurance.
Quality Management Systems:
Quality management systems through ISO standards.

UNIT V
Quality Function Deployment and Failure Modes Effects Analysis:
Introduction to QFD and QFD process, Quality by design, Rationale for implementation of quality by design, FMEA, Design FMEA and process FMEA.

Course Assessment Method:
CIE – 50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Seminar will be conducted for a group of 5 students- evaluated through rubrics for 10 marks.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

**SEE – 50 Marks**

1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit

**Text Book**

2. **Total Quality Management**: Dale H. Besterfield, Publisher - Pearson Education India, Edition 03/e Paperback (Special Indian Edition).

**Reference Book**


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STATISTICAL QUALITY CONTROL

Sub Code : 14MEE657
Hours/Week : 4+0+0
Total Hours : 48
Exam Hours : 03
Credits : 04
CIE Marks : 50
SEE Marks : 50
Course Type : Program Elective

Course Outcomes:
Students would be able to
1. Understand the quality improvement and control technique.
2. Formulate the different problems and analysis quality control technique.
3. Analyze the problems by the help of controls chart.
4. Analyze the problems by the help of controls chart of conformities and nonconformities.
5. Evaluate the graphical method of sampling problems to confirm whether the problems are in statistical control.

UNIT I
Introduction:
The Meaning of Quality and Quality Improvement; Brief History of Quality Methodology; Statistical Methods for Quality Control and Improvement; Total Quality Management (quality philosophy, links between quality and productivity, quality costs legal aspects of quality implementing quality improvement).

UNIT II
Modeling Process Quality:
Mean, Median, Mode, Standard deviation, Calculating area, The Deming funnel experiment, Normal distribution tables, Finding the Z score, Central limit theorem.
Methods and Philosophy of Statistical Process Control:
Chance and assignable causes, Statistical Basis of the Control Charts (basic principles, choices of control limits, significance of control limits, sample size and sampling frequency, rational subgroups, analysis of pattern on control charts, warning limits, Average Run Length-ARL)

UNIT III
Control Charts for Variables:
Control Charts for X-Bar and R charts, Type I and Type II errors.
Process Capability:
The foundation of process capability, Natural Tolerance limits, $C_p$ – process capability index, $C_{pk}$, $pp$ – process performance index, summary of process measures.

UNIT IV
Control Charts For Attributes:
Binomial distribution, Poisson distribution (from the point of view of Quality control) Control Chart for Fraction Nonconforming, Control Chart for number Nonconforming, Control Charts for Nonconformities or Defects, Control Chart for Number of non-conformities per unit.

UNIT V
Lot-By-Lot Acceptance Sampling For Attributes:
The accepting sampling problem, single sampling plan for attributes, Double, Multiple, and sequential sampling, AOQL, LTPD, OC curves
Cumulative-Sum (CUSUM) & Exponentially Weighted Moving Average (EWMA) Control Charts:
CUSUM Control Chart (basic principles of the chart for monitoring the process mean); EWMA control chart (EWMA control chart for monitoring process mean), design of a EWMA control chart.

Pre-requisites:
The student should have studied Maths I and Maths-II.

Course Assessment Method:
CIE – 50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments evaluated through rubrics for 10 marks. Average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE – 50 Marks
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit.

Text Book

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RENEWABLE ENERGY RESOURCES

Sub Code : 14MEE658  
Credits : 04  
Hours/Week : 4+0+0  
CIE Marks : 50  
Total Hours : 48  
SEE Marks : 50  
Exam Hours : 03  
Course Type : Program Elective

Course Outcomes:  
 Students will be able to

1. Identify the various renewable energy forms to fulfil the energy demand globally.
2. Describe the main components of different renewable energy systems and explain the technological basis for harnessing renewable energy sources.
3. Outline the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels.
4. Recognize the effects that current energy systems based on fossil fuels have over the environment and the society.
5. Judge the best combination of technological solutions to minimize the emissions and increase the sustainability of the energy system.

UNIT I
Energy Sources and their Availability:
Introduction, commercial or conventional energy sources, Non-conventional energy sources, new energy techniques.

Solar Radiation and its Measurement:
Solar constant, solar radiation at the earth’s surface, solar radiation geometry, solar radiation measurements, solar radiation data, estimation of average solar radiation, solar radiation on tilted surfaces. 09 Hours

UNIT II
Solar Energy collectors:
Introduction, physical principles of the conversion of solar radiation into heat, flat plate collectors, thermal analysis of flat plate collector and useful heat gained by the fluid, concentrating collector: focusing type, advantages and disadvantages of concentrating collectors over flat plate type collectors. 08 Hours

UNIT III
Applications of Solar Energy System:
Solar energy storage system, solar water heating, space heating, space cooling, solar thermal electric conversion, solar photo voltaics, solar distillation, pumping, furnace, cooking, greenhouse, solar production of hydrogen. 09 Hours

UNIT IV
Wind Energy:
Introduction, Basic principles: nature of the wind, power in the wind, forces on the blade, wind energy conversion, wind data and energy estimation, basic components of wind energy conversion system (WECS), classification of WECS, advantages and disadvantages of WECS, Type of wind machines, energy storage, applications.

Energy from Biomass:
Introduction, biomass conversion technologies, photosynthesis, biogas generation, factors affecting biodigestion, classification of biogas plants, advantages and disadvantages of floating drum plant advantages, advantages and disadvantages of fixed dome type plant, constructional details of some main digesters, bio gas from plant wastes, materials used for bio gas generation, utilization of bio gas. 11 Hours

UNIT V
Geothermal Energy:
Introduction, geothermal sources, hot dry rock resources, magma resources, comparison of flashed steam and total flow concept, interconnection of geothermal fossil systems, applications, material selection for geothermal power plants.

Tidal Power:
Introduction, basic principle of tidal power, components of tidal power plants, operation methods, estimation of
energy and power in simple single basin tidal system, storage, advantages and limitations.  

11 Hours

Course Assessment Method:
CIE – 50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments- evaluated through rubrics for 10 marks. Average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE – 50 Marks
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit

Text Book

Reference Book

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AUTOMOTIVE ENGINEERING-II

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Course Outcomes:
1. Students can understand the functions and importance of electrical and electronics based systems in a vehicle.
2. Students will have the knowledge in developing an automotive structure based on the type of the vehicle considering the vehicle safety.
3. Enable the students to understand the ethical standards of emission in consideration with environmental safety during the exhaust of an automobile.
4. Students can understand the importance of vehicle stability at high speed cruise and digitalization of engine control.
5. Students will study the different types of automobiles and importance of the parts based on the type of the vehicle.

UNIT I
Automotive electrical and electronic systems
Battery: Principle of lead acid cells, plates and their characteristics containers and separators, electrolyte and their preparation, voltmeter, effect of temperature on electrolyte, its specific gravity, capacity and efficiency.
Starter Motor & Drives: Battery motor starting system, condition at starting, behavior of starter during starting series motor and its characteristics.
Automotive Electronic systems: Modern automotive Instrumentation, Input and output signal conversion, Sampling, Fuel quantity measurement, Coolant temperature measurement, Oil pressure measurement, Vehicle speed measurement, Display devices, LED, LCD, CRT etc.

UNIT II
Automotive Structural design and Material
Terminology and overview of vehicle structure types, Strength, Stiffness, vibration behavior, Selection of vehicle type and concept, manufacturer’s approach to current design, Panel dent resistance and stiffness testing, fatigue, Integration of materials into designs, Engineering requirements for plastic and composite components, Cost analysis.

UNIT III
Vehicle Control System
Vehicle motion control system: Introduction, Typical cruise control system, Cruise control electronics, Antilock braking system, Electronic suspension system, Electronic steering control.

UNIT IV
Vehicle safety, Air Pollution and Control
Vehicle safety: Crash testing, Structural safety and airbags, Side impacts, Smart air bags, Seat belts, Seating, The pedal controls, Tyres, suspension and steering, Suspension control, Automatic braking and traction control, Ergonomic considerations and safety.
Emission Control Systems: Automotive emission controls, controlling crankcase emissions, Controlling evaporative emissions, Cleaning the exhaust gas, Controlling the air-fuel mixture, Controlling the combustion process, Exhaust gas recirculation, Treating the exhaust gas, Air-injection system, Air-aspirator
Syllabus of I to VIII Sem BE Mechanical Engg, NMIT Bangalore-64

system, Catalytic converter, Emission standards-Euro I, II, III and IV norms, Bharat Stage II, III norms.

09 Hours

UNIT V

Alternative Vehicles:


Hybrid Electric Vehicles: Introduction, Hybrid-drive prospects, Hybrid technology case Studies, Hybrid passenger and goods Vehicles, Dual Hybrid Systems.

Earth Moving, equipment’s and Maintenance: Different types of earth moving equipment’s and their applications (Dozers, Loaders, Shovels, Excavators, Scrapers, Motor graders, Rollers, Compactors, Tractors and Attachments). Basic types of transmissions, constructional and its working principles. Types of maintenance schedules purpose and advantages, organization set ups, documentation. Safety methods for earth moving equipment’s.

10 Hours

Course Assessment Method:
Test: 30 marks
Seminar/Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Books:
3. Automotive Engineering, Powertrain, Chassis System and Vehicle Body Edited by David A. Crolla, Edited by David A. Crolla

Reference Books:

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INDUSTRIAL ROBOTICS

Course Outcomes:
1. Will have the knowledge of fundamentals of robotics, graphics, and configurations of serial manipulators, workspace, frames, 3D transformations and Robot programming.
2. Describe the concepts of Euler’s angles, Differential velocities, D-H Representation, Forward and Inverse kinematics, fuzzy logic and robot vision.
3. Application of Calculus & Linear algebra, for kinematics, dynamics & trajectory planning respectively.
5. Development of generic algorithms to perform various robot tasks and obtain the robot program using AML and VAL.

UNIT I
Introduction and Mathematical Representation of Robots:

UNIT II
Kinematics of serial manipulators:
Velocity and Statics of Manipulators:
Differential relationships, Jacobian, Differential motions of a frame (translation and rotation), Linear and angular velocity of a rigid body, Linear and angular velocities of links in serial manipulators, 2R manipulators, Jacobian of serial manipulator, Velocity ellipse of 2R manipulator, Singularities of 2R manipulator, Statics of serial manipulators.

UNIT III
Dynamics of Manipulators:
Kinetic energy, Potential energy, Equation of motion using Lagrangian, Equation of motions of one and two degree freedom spring mass damper systems using Lagrangian formulation, Inertia of a link, Recursive formulation of Dynamics using Newton Euler equation, Equation of motion of 2R manipulator using Lagrangian, Newton- Euler formulation.
Trajectory Planning:
Joint space schemes, cubic trajectory, Joint space schemes with via points, Cubic trajectory with a via point, Third order polynomial trajectory planning, Linear segments with parabolic blends, Cartesian space schemes, Cartesian straight line and circular motion planning.

UNIT IV
Robot Programming:
Introduction, Manual teaching, lead through teaching, programming languages, AML and VAL simple example, programming with graphics, storing and operating, Task programs.
Fuzzy logic control:
Introduction, fuzzy control, fuzzy sets, fuzzification, fuzzy interference rule base, defuzzification, center of gravity method.
gravity method, mamdani’s inference method, applications. 08 Hours

UNIT V

Robot Vision:
Image Representation, Template Matching, Polyhedral Objects, Edge Detection, Corner Points, Run-Length Encoding, Shape Analysis, Line Description, Principle Angle, Segmentation, Thresholding, Region Labeling, Iterative Processing, Shrink Operators, Swell Operations, Euler Number, Perspective Transformation, Structured Illumination, Camera Calibration and Applications. 10 Hours

Pre-requisites:
Knowledge of Theory of Machines-I is essential.

Course Assessment Method:

CIE –50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments - Average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE –50 Marks
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit

Text Book

Reference Book

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SMART MATERIALS

Sub Code: 14MEO661
Credits: 03

Hours/Week: 4+0+0
CIE Marks: 50

Total Hours: 38
SEE Marks: 50

Exam Hours: 03
Course Type: Open Elective

Course Outcomes:
1. Students will be able to describe the characteristics of materials such as Metals, Polymers and Ceramics.
2. Students will be able to indicate the Electro, Magneto Rheological fluids and Chromic materials for various mechanical systems.
3. Students will be able to exploit Electrostrictive and Magnetostrictive materials in the design of different actuators.
4. Students will be able to distinguish the properties of shape memory alloys with other class of materials and propose its suitability for a range of applications.
5. Students will be able to implement the smart materials in the development of smart composites.

UNIT I
Introduction:
Sensing and actuation:
Principles of electromagnetic, acoustics, chemical and mechanical sensing and actuation. Types of sensors and their applications. Compatibility with conventional and advanced materials.

UNIT II
Shape Memory Alloys:
History of shape memory alloys. Classification of shape memory alloys. NITINOLS – melting, casting and forming of NITINOLS, shape memory and pseudoelasticity. Mechanical and biomedical applications of NITINOL. Vibration control through shape memory alloys.

UNIT III
Piezoelectric Materials:

UNIT IV
Electro rheological (ER) and magneto rheological (MR) fluids:
Mechanisms and properties, fluid composition and behavior. Applications to clutches, vibration dampers and others. Chromic materials – thermochromic, photochromic, piezochromic materials and their applications.

UNIT V
Composite Materials:
**Pre-requisites:**
The student should have basic knowledge of Materials Science & Metallurgy.

**Course Assessment Method:**
Test: 30 marks
Assignment: 10 marks
Case study/Surprise: 10 marks
SEE - Final Exam: 50 Marks

**Text Book**

**Reference Book**

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SOLAR ENERGY

Sub Code : 14MEO662  
Credits : 03

Hours/Week : 4+0+0  
CIE Marks : 50

Total Hours : 38  
SEE Marks : 50

Exam Hours : 03  
Course Type : Open Elective

Course Outcomes:
Students will be able to

1. Identify the different types of energy sources and define the same with special reference to the Indian context.
2. To classify the different solar measuring devices, solar radiation devices and concentrators.
3. Interpret the various systems and power generation methods for the optimum performance.
5. Evaluate the effect of various parameters on the performance of photo-voltaic systems, liquid flat plate collectors and concentrators.

UNIT I

Introduction:
Energy source, renewable energy sources, renewable energy potential and achievements in India, Sustainable energy: The engine of sustainable development Solar energy: General characteristics of solar energy: the Sun, solar spectrum, spectral solar impedance.

Solar Radiation at the Earth Surface:
Solar constant beam, diffuse and global radiation. Solar radiation data of India. Measurement of solar radiation: Pyrometer, pyrheliometer, sunshine recorder (schematic diagram and working principles of the devices.) 06 Hours

UNIT II

Solar radiation geometry:
Flux on a plane surface, Sun earth angles-latitude, declination, hour angle, zenith, solar altitude angle, surface azimuth angle, solar azimuth angle, Local apparent time, solar time, apparent motion of sun, day length, some numerical examples. Solar radiation on an inclined surface-Beam, diffuse, reflected radiation on a tilted surface, expression for flux on a tilted surface, monthly average daily radiation on slopped surface, numerical examples.

Solar Thermal Radiation Devices:
Liquid flat plate collectors, solar air heaters, concentrating collectors like cylindrical, parabolic, evacuated tubular collectors. Storage devices: Sensible heat storage, latent heat storage. Application of solar energy: water heating, space heating, space cooling, active and passive cooling, systems, power generation various methods, Refrigeration, Distillation, solar ponds, theory, working principle, operational problems (Sketches, principle of working). 08 Hours

UNIT III

Solar Photovoltaic System:
Introduction, Description, principles of working of solar cell: Doping, Fermi level, p-n junction, photovoltaic effect. Photovoltaic Material: Single crystal solar cell, Poly crystal solar cell, thin film solar cell, I-V characteristic and limits to cell efficiency, Cell temperature, Current status and Future potential of P.V.

Performance Analysis of Liquid Flat Plate Collectors:
General description, collector geometry, selective surface (qualitative discussion), basic energy – balance equation, stagnation temperature, transmissivity of the cover system, transmissivity-absorptivity product, numerical examples. The overall loss coefficient, correlation for the top loss coefficient, bottom and side loss-coefficient, problems (all correlations to be provided). 08 Hours

Temperature Distribution:
Between the collector tubes, collector heat removal factor, collector efficiency factor and collector flow
factor mean plate temperature, instantaneous efficiency (all expression to be provided). Effect of various parameters on the collector performance: Collector orientation, selective surface, fluid inlet temperature, number covers, dust.

**Solar Concentrators:**
Introduction, characteristic parameters:- Aperture area, Acceptance angle, absorber area, geometric concentration ratio. Local concentration ratio or brightness concentration ratio, Intercept factor, optical efficiency, thermal efficiency. Concentration ratio. **08 Hours**

**UNIT V**

**Concentrators, Types, Classification, Tracking:**

**Course Assessment Method:**
Test: 30 marks
Case study/Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks

**Text Book**

**Reference Book**

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INDUSTRIAL ENGINEERING & MANAGEMENT

Sub Code: 14ME06

Credits: 03

Hours/Week: 4+0+0

CIE Marks: 50

Total Hours: 38

SEE Marks: 50

Course Type: Open Elective

Course Outcomes:

Students will be able to

1. Recognize the motivational behavior of employees in an organization.
2. Identify various methods of improving overall productivity in an organization.
3. Improve the processes to help the industries to compete in global market.
4. Apply techniques of decision making, customer involvement, work-study, incentive schemes and process improvement.
5. Relate role of technology in management.

UNIT I

Introduction:

Historical perspective, contribution of Taylor, Henry Fayol, Gilbert, Charles Babbage, HL Gantt and others to the evolution of management science in the Indian context. Ownership of Industries: Proprietorship, partnership, joint stock companies, public and private undertakings, co-operative organizations.

Management Functions:

Planning: corporate objectives, policies, strategies need for planning, responsibilities and types of plans, modern type of planning, selection of alternatives and process of decision making, case studies.

Organization: Basic requirement, types, structures and merits, Departmentation, vertical and horizontal growth, span of control, authority and responsibility, centralization and decentralization, formal and informal organizations, case studies.

UNIT II

Staffing:

Appraisal of needs, executive development schemes, performance appraisal and managerial mobility.

Directing: Types of instructions and characteristics of good order, communication flow of instructions, motivation and leadership. Controlling: process of control, requirements of effective controlling, controlling techniques.

Work study, Incentives, Health and Safety :

Method study and time study, Foundations of work study, Job evaluation systems, Multi skilling, Incentive schemes, Training and Development, Safety Regulations and safe practices.

UNIT III

Management and Behavioral Approach:

Contribution of Elton Mayo and skinner and others to behavior sciences. Skills of a manager at various levels in an organization and inter-related systems, understanding past behavior, predicting future behavior, directing, changing and controlling behavior.

Motivation and Behavior:

Maslow’s hierarchy of needs, pretence of needs and satisfaction of needs, goal oriented behavior, integration of organizational goals and needs of employee. Hawthorn’s studies and its findings theory X and theory Y, immaturity theory, motivation hygiene theory.

UNIT IV

Process Management:

Definition of process management. Major process decisions-process choice, vertical integration, resource flexibility, customer involvement, capital intensity, relationships between decisions, service operation
relationships between decisions, service operation relationships, economics of scale and gaining focus. Designing process-process rearranging and process improvement.  

08 Hours

UNIT V

Management of Technology:

06 Hours

Course Assessment Method:
CIE –50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Case Study evaluated through rubrics for 10 marks.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE –50 Marks
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit.

Text Book

Reference Book

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NON DESTRUCTIVE TESTING

Sub Code: 14MEO664  Credits: 03
Hours/Week: 4+0+0  CIE Marks: 50
Total Hours: 38  SEE Marks: 50
Exam Hours: 03  Course Type: Program Open Elective

Course Outcomes:
Students will be able to
1. Describe the basic concepts and principles of NDT methods.
2. Analyze characteristics of NDT techniques.
3. Collect the data for NDT project work.
4. Predict the viewing, interpretation and protection against radiographs.
5. Apply NDT techniques in different industrial applications.

UNIT I

Liquid penetrant Inspection:
Introduction, principles of penetrant inspection, Characteristics of a penetrant, Water washable system, Post emulsification system, solvent removable system, surface preparation and cleaning, penetrant application, development, advantages and disadvantages, range of applications.

Magnetic Particle Inspection:
Introduction, magnetization, methods, continuous and residual methods, sensitivities, demagnetization, Magnetic particles, applications, advantages and disadvantages

UNIT II

Electrical Test Methods (Eddy Current Testing):
Introduction, principle, conductivity of a material, Magnetic properties, coil impedance, lift off factor and edge effects, skin effect, inspection frequency, coil arrangements, inspection probes, types of circuit, display methods, application of eddy current techniques.

UNIT III

Ultrasonic Testing:
Introduction, Nature of sound, wave velocity and length. Generation of ultrasound, characteristics of an ultrasonic beam, sound waves at interfaces, sound attenuation, Inspection techniques identification of defects, immersion testing, surface conditioning, application of ultrasonic testing.

UNIT IV

Radiography:
Introduction, uses, limitation. Principle, radiation sources, production od X rays, ray spectra, radiation sources, shadow formation Exposure factor, Viewing and interpretation of radiographs, radiation hazard, protection against radiation, measurement of radiation received by personnel.

UNIT V

Other NDT techniques:
Optical inspection probes, Neutron radiography, laser induces ultrasonic, acoustic emission inspection, Thermography, surface texture analysis, Multi phase flow analysis.

Course Assessment Method:
Test: 30 marks
Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks
Text Book

Reference Book

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AUTOMOTIVE TECHNOLOGY

Course Outcomes:
Students should be able to
1. Students can understand the functions and importance of automotive subsystems and their performance.
2. Students will have the knowledge of fuel supply and critical components of an engine.
3. Students will be exposed to the platform of electrical and electronics based systems and its automation.
4. Students can understand the importance of vehicle stability, safety and improvisation of the components for new introduction in any automotive sectors.
5. Students will be given clear idea of the challenges of an engineer at different levels of manufacturing an automotive parts and also follow the standards of developing and manufacturing.

UNIT I

Automotive subsystems and its function
Fuel supply system: carburetors, multi point and single point fuel injection systems, fuel transfer pumps, Fuel filters, fuel injection pumps and injectors.
Engine cooling system: methods of cooling, thermostat valves, different lubrication arrangements,
Engine Lubrication system: types of lubrications, different lubrication arrangements,
Suspension system: Requirements, air suspension system, independent and dependent suspension system,
Clutch and Gear box: General arrangement of clutch, Principle of friction clutches, Torque transmitted, Constructional details, Necessity for gear ratios in transmission, synchromesh gear boxes, 3,4 and 5 speed gear boxes.
Drive to wheels: Propeller shaft and universal joints, Hotchkiss and torque tube drives, differential, rear axle. Power trains, brakes, exhaust and introduction to super charges and turbo charges. 10 Hours

UNIT II

Engines Components and Fuel Supply systems
Ignition Systems: Battery Ignition systems, magneto Ignition system, Transistor assist contacts.
Electronic Ignition, Automatic Ignition advance systems. 07 Hours

UNIT III

Electrical and electronic systems
Battery: Principle of lead acid cells, plates and their characteristics containers and separators, electrolyte and their preparation, voltmeter, effect of temperature on electrolyte, its specific gravity, capacity and efficiency.
Starter Motor & Drives: Battery motor starting system, condition at starting, behavior of starter during starting series motor and its characteristics.
Automotive Electronic systems: Modern automotive Instrumentation, Input and output signal.
Conversion, Sampling, Fuel quantity measurement, Coolant temperature measurement, Oil pressure measurement, Vehicle speed measurement, Display devices, LED, LCD, CRT etc.  

UNIT IV

Vehicle safety and Vehicle motion control
Vehicle Safety: Crash testing, Protection of occupants, Testing for occupant safety, Protection of pedestrians from serious injury, Active safety, Structural safety and air bags, Smart air bags, Seat belts, Improvement of active safety, Ergonomic considerations and safety, Seating.
Vehicle Motion Control: Introduction, Typical cruise control system, Cruise control electronics, Anti-lock braking system, Electronic suspension system, Automatic braking and traction control, Electronic steering control, Suspension control.

UNIT V

The manufacturing challenges in automotive
Introduction, Lean product development and lean production, Design to manufacture as a single process and IPPD (Integrated Product and Process Development), Manufacturing analysis, tools and methods: Design for manufacture and assembly, Quality function deployment, Design for dimensional control, Value engineering/analysis, Failure modes and effects analysis, Quality engineering, Materials processing and technology: Hydroforming, Adhesive bonding and Rapid prototyping.

Course Assessment Method:
Test: 30 marks  
Seminar/Assignment: 10 marks  
Study project/Surprise: 10 marks  
SEE - Final Exam: 50 Marks

Text Book
3. Automotive Engineering, Powertrain, Chassis System and Vehicle Body, Edited by David A. Crolla, Edited by David A. Crolla

Reference Book
1. An Introduction to Modern Vehicle Design, Edited by Julian Happian-Smith, Oxford Auckland Boston Johannesburg Melbourne New Delhi,

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PROJECT MANAGEMENT

Syllabus of I to VIII Sem BE Mechanical Engg, NMIT Bangalore

Sub Code : 14MEO666
Credits : 03
Hours/Week : 4+0+0
CIE Marks : 50
Total Hours : 38
SEE Marks : 50
Exam Hours : 03
Course Type : Open Elective

Course Outcomes:
Students will be able to
1. Identify the specific management needs in the execution of projects at tactical and strategic level.
2. Estimate the Project proposals for scope, time and cost to conclude its feasibility.
3. Synthesis the strategies to evolve suitable approach to accomplish the project with effective usage of the resources.
4. Illustrate team-building and leadership skills in planning and implementation of the project.
5. Apply the effective management techniques in the project execution to fulfill the desired objectives.

UNIT I
Concepts of Project Management:
Concepts of a Project, Categories of projects, Phases of project life cycle, Roles and responsibilities of project leader, tools and techniques for project management. 08 Hours

UNIT II
Project Planning and Estimating:
Feasibility report, phased Planning, Project planning steps, Objectives and goals of the project, preparation of cost estimation, evaluation of the project profitability. 07 Hours

UNIT III
Organizing And Staffing:
The Project Team: Skills / abilities required for project manager, Authorities and responsibilities of project manager, Project organization and types accountability in project execution and controls. 08 Hours

UNIT IV
Project Scheduling, Co-Ordination And Control:
Project implementation scheduling, different scheduling techniques bar (GANTT) charts, Bar charts for combined activities. Project evaluation and review techniques, PERT planning. Project direction communication in a project, Role of MIS in project control, performance control, schedule control, cost control cases. 08 Hours

UNIT V
Performance Measures in Project Management and Project inventory management:
Performance indicators, Performance improvement for the CM & DM companies for better project management. Nature of project inventory, supply and transportation of materials. 07 Hours

Course Assessment Method:
Test: 30 marks
Case study/Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book
2. Project Execution Plan: Chaudhry S., plan for project Execution Interaction.2001
Reference Book

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MECHATRONICS

Sub Code : 14MEO667
Credits : 03
Hours/Week : 4+0+0
CIE Marks : 50
Total Hours : 38
SEE Marks : 50
Exam Hours : 03
Course Type : Program Elective

Course Outcomes:

Students will be able to
1. Define & outline the development of Mechatronic systems, concept of concurrent & sequential engineering, Sensors, Actuators and Signal conditioners.
2. Illustrate & summarize the working principle of Microprocessor & Microcontrollers Based Mechatronics Systems.
3. Interpret the fundamentals of signal processing for electrical systems.
4. Analyze the importance of data conversions, processing and storage in the microprocessor.
5. Compile an assembly language program to perform various arithmetic operations using 8085A microprocessor.

UNIT I
Introduction of Mechatronics:
Introduction of Mechatronic systems, Evolution on Mechatronics, Measurement system, control systems, microprocessor based controllers, Mechatronics system design approach Automatic washing machine, automatic camera and Engine management system, Mechatronics approach and their associated problems. Examples and discussion on typical systems.

UNIT II
Transducers & Sensors:
Introduction of Transducers, Classifications, Potentiometer, Capacitive Sensor, Eddy current proximity sensor, Hall effect sensor, Temperature sensor, light sensors, selection of sensors, inputting data by switches, Strain gauge & Wheat Stone Bridge.

UNIT III
Electrical actuation systems:
Electrical systems, Mechanical switches, solid-state switches, solenoids, DC & AC motors, Stepper motors and their merits and demerits.
Signal Conditioning:
Introduction to signal conditioning. The operational amplifier, Protection, Filtering, Wheatstone bridge, and Digital signals Multiplexers, Data acquisition, Introduction to Digital system processing Pulse-modulation.

UNIT IV
Introduction to Microprocessors:
Organization of Microprocessors (Preliminary concepts), basic concepts of programming of microprocessors. Review of concepts – Boolean algebra, Logic Gates and Gate Networks, Binary &Decimal number systems, memory representation of positive and negative integers, maximum and minimum integers. Conversion of real numbers, floating point notation, representation of floating point numbers, accuracy and range in floating point representation, overflow and underflow, addition of floating point numbers, character representation.
Logic function, Data word representation:
Basic elements of control systems 8085A processor architecture terminology such as CPU, memory and address, ALU, assembler data registers, Fetch cycle, write cycle, state, bus, interrupts. Micro Controllers. Difference between microprocessor and micro controllers. Requirements for control and their implementation in microcontrollers. Classification of micro controllers.
UNIT V

Organization & Programming of Microprocessors:
Introduction to organization of INTEL 8085-Data and Address buses, Instruction set of 8085, programming the 8085, assembly language programming.

Central Processing Unit of Microprocessors:
Introduction, timing and control unit basic concepts, Instruction and data flow, system timing, examples of INTEL 8085.

08 Hours

Pre-requisites:
Prior knowledge of Basic Electronics is required.

Course Assessment Method:
CIE - Test: 30 marks
Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book:

Reference Book:

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Syllabus of I to VIII Sem BE Mechanical Engg. NMIT Bangalore-64

FINITE ELEMENT METHODS

Sub Code: 14MEO668  Credits: 03
Hours/Week: 4+0+0  CIE Marks: 50
Total Hours: 38  SEE Marks: 50
Exam Hours: 03  Course Type: Open Elective

Course Outcomes:
Students will be able to
1. Recognize the importance of FEM and its application in solid mechanics.
2. Interpret the various methods in assembling the stiffness equations.
3. Classify the coordinate systems and will be able to indicate the shape functions for different family of elements.
4. Calculate the stress, strain and reaction forces and infer the temperature effects on structural and thermal problems.
5. Assess the mechanical system with appropriate considerations for public health and safety.

UNIT I

Overview of Finite Element Method: Basic Concept, Historical background, General and Engineering applications of the FEM, Finite Element Method vs Classical Method, FEM vs FDM, Force Vs Displacement method in FEM


Discontinuity: Geometry, Load, Boundary, Material, Types of Symmetry, Aspect Ratio, Banded Matrix.

Interpolation Models: Introduction, Polynomial form of interpolation function, Simplex, Complex, and Multiplex elements, Interpolation polynomial in terms of nodal DOF, Selection of the order of the interpolation polynomial, Convergence requirements, coordinate systems.

07 Hours

UNIT II


Basic Equations in Elasticity (No questions will be asked for MSE or SEE): Introduction, Stresses in a Typical Element, Equations of Equilibrium, Strains, Strain Displacement Equations, Linear Constitutive Law.


Techniques of saving memory: Use of symmetry and banded nature, Partitioning of matrix (Frontal solution), Skyline storage.

Coordinate Systems: Local, Global, Area.

08 Hours

UNIT III

Shape Functions: Derivation of Shape Functions Using Polynomials, Finding Shape Functions Using Lagrange Polynomials, Shape Functions for Serendipity Family Elements, Hermite Polynomials as Shape Functions.


08 Hours

UNIT IV

Plane Trusses: Transformation matrix, Element stiffness matrix, stress calculations. Problems

08 Hours
UNIT V

1D-Steady state Heat Transfer: Straight uniform fin analysis, convection loss from end surface of fin. Problems on composite wall and thin fins.

Isoparametric formulation: Basic theorems of Isoparametric concept, Uniqueness of mapping, isoparametric sub and super parametric elements, 2D-CST: Area coordinates Isoparametric representation, Jacobian matrix, Strain-displacement matrix, Element stiffness, force term. Problems. 07 Hours

Pre-requisites:
The student should have studied Eng. Mechanics and Matrices.

Course Assessment Method:
CIE – 50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments evaluated through rubrics for 10 marks. Average of two will be considered.
3. Case Study / Seminar / Mat lab programing / C programming for 10 marks.

SEE – 50 Marks
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit

Text Book:
2. Finite Element Analysis by Bhavikatti, S S New age International, 3rd Edition 2015,

Reference Book:

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NANO TECHNOLOGY

Sub Code : 14MEO669 Credits : 03
Hours/Week : 4+0+0 CIE Marks : 50
Total Hours : 38 SEE Marks : 50
Exam Hours : 03 Course Type: Open Elective

Course Outcomes:

Students will be able to

1. Analyze and classify Nanomaterials based on their structures.
2. Compare and contrast between different methods of synthesizing the Nanomaterials.
3. Prepare and characterize Nanomaterials for an specified applications.
4. Identify the difference between bulk and nano materials properties.
5. Relate the application of mechanical engineering with nanotechnology

UNIT I

Overview of Materials:
Introduction to materials; classification of materials: metallic, polymeric and ceramic materials; modification of properties of conventional materials by different methods: top-down and bottom-up approaches. 08 Hours

UNIT II

Nano materials and Nanostructures.
Difference between micro and nano materials; Structure and defects in crystalline nanomaterials; Hybrid nanomaterials; Synthesis of Nanomaterials; Nanomaterials in Nature.

Nanostructures:
Dimensionality of nanomaterials: 3D, 2D, 1D and 0D structures-bulk nano structures (nanocomposites and alloys), thin films, Nanotubes(carbon and others) and nanorods, Fullerenes, Nanowires, Quantum Dots. Cell's response to Surfaces and interfaces in nanostructures. Ceramic interfaces, Superhydrophobic surfaces, Grain boundaries in Nano crystalline materials, Defects associated with interfaces. 08 Hours

UNIT III

Synthesis of nanomaterials and nanostructures:
Chemical methods: Sol gel method, solution combustion method, chemical vapor deposition.
Physical methods: Evaporation - thermal and e-beam; Sputtering (DC, RF, Magnetron, Ion-assisted); MBE; ALD; Lithography. 08 Hours

UNIT IV

Properties and Characterization of nanomaterials
Properties of nanomaterials: Deformation behaviour of nanomaterials. Fracture and creep. Electrical, Magnetic and Optical properties
Characterization:Overview of characterization of nanostructures and nanomaterials. SEM, TEM, STM, AFM, XRD, FTIR, UV spectroscopy, XPS, ResistivityNano metrology. 06 Hours

UNIT V

Applications
Bio-Nanotechnology; Nano-electronics; Nano-photronics; Micro and Nano Fluidics; Polymer and Nanocomposites; Thin Film Technology; Spintronics; Nanotechnology for Energy Systems; MEMS; datastorage and retrieval. 08 Hours

Course Assessment Method:
Test: 30 marks
Assignment: 10 marks
Case study/Surprise: 10 marks
SEE - Final Exam: 50 Marks
Text Book

Reference Book

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INNOVATIVE PRODUCT DESIGN AND DEVELOPMENT

Sub Code : 14MEO660  Credits : 03
Hours/Week : 3+0+0  CIE Marks : 50
Total Hours : 38  SEE Marks : 50
Exam Hours : 03  Course Type : Open Elective

Course Outcomes:
1. Students will be able to apply the concepts of product design in the development of products to meet the societal needs.
2. Students will understand the importance of morphology in the design of a product with identification of need in functional aspect.
3. Enable the students to apply high ethical standards in terms of team work to be a good design engineer.
4. Students will understand and design the importance of man machine interface with design of display and control.
5. The students would have a good understanding of using special techniques such as SQC, work study etc. in improving the quality of any product before it is sent for manufacturing.

UNIT I
Introduction to Product Design:
Introduction to PDD, Applications, Relevance, Product Definition, Scope, Terminology, Challenges in product development. Design definitions, the role and nature of design, old and new design methods, Design by evolution.
Examples such evolution of bicycle, safety razor etc. Need based development, technology based developments. Physical reliability & Economic feasibility of design concepts.

UNIT II
Morphology of Design:
Identification of customer needs analysis of need, Product specifications, Concept generation concept selection and concept testing. Conceptual type of design by divergent, transformation and convergent phases of product design.

UNIT III
Transformations:

UNIT IV
Reliability:

UNIT V
Product Appraisal:
Information and literature search, patents and Intellectual Property, standards and codes, environment and safety considerations, existing techniques such as work-study, SQC etc to improve method and quality of product, Product Economics, Innovation versus Invention, technological forecasting and Managing Project.
Course Assessment Method:
Test: 30 marks
Seminar/Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Books:
1. **Product Design and Manufacturing** by A. K. Chitab and R.C. Gupta, PHI (EEE).

Reference Books:

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DESIGN LAB

Sub Code: 14MEL67
Credits: 1.5
Hours/Week: 0+0+3
CIE Marks: 50
Total Hours: 39
SEE Marks: 50
Exam Hours: 03
Course Type: Program Core

Course Outcomes:
Students will be able to
1. Project the contemporary concepts of kinematics and dynamics through experiments.
2. Develop an in-depth perceptive of the design principles of single dof vibrating systems.
3. Determine the stress concentration on various photo elastic materials of different cross sections.
4. Compute pressure distribution curve of a journal bearing.
5. Speed as a critical parameter, students will be able to relate the working condition of a governor and shafts.

UNIT I
1. Determination of natural frequency, logarithmic decrement, damping ratio and damping coefficient in a single degree of freedom vibrating systems (longitudinal and torsional)
2. Balancing of rotating masses.
3. Determination of critical speed of a rotating shaft.
4. Determination of Fringe constant of Photoelastic material using a) Circular disc subjected to diametral compression, Pure bending specimen (four point bending)
5. Determination of stress concentration using Photoelasticity for simple components like plate with a hole under tension or bending, circular disk with circular hole under compression, 2D Crane hook.

UNIT II
1. Determination of equilibrium speed, sensitivity, power and effort of porter / proell Governor.
3. Determination of Principal Stresses and strains in a member subjected to combined loading using strain rosettes.
4. Determination of stresses in Curved beam using strain gauge.
5. Experiments on Gyroscope (Demonstration only).

Pre-requisites:
The student should have in-depth knowledge of TOM-I, TOM-II and Mechanical Vibrations.

Course Assessment Method:
Record: 30 marks
Test: 15 marks
Study project/Viva: 05 marks
SEE - Final Exam: 50 Marks

Scheme of Examination:
Student will be asked to conduct one experiment from each unit.

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FINITE ELEMENT ANALYSIS LAB

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Course Outcomes:
1. Reproduce results for stress analysis using software and compare these results obtained with the theoretically calculated values.
2. Associate the basic principle of finite element methods and match with FEA. Use of different type of elements in analysis as well as technical knowhow on elements shape and size to be considered for particular analysis.
3. Analysis types based on change in area (plate with a hole), type of element (1D, 2D), materials (isotropic, composite laminate) and load type.
4. Ability to interpret and solve problems in real life applications.
5. Developing software (ANSYS) knowledge learnt during the course also utilizing, analyzing and enhancing it further from simple to application based situations.

UNIT I

Study of a FEA package and modeling, stress analysis of:
1. Bars of constant cross section area, tapered cross section area and stepped bar
2. Trusses – (Minimum 2 exercises)
3. Beams – Simply supported, cantilever, beams with UDL, beams with varying load etc (Minimum 4 exercises)
5. Dynamic Analysis – to find the natural frequency of beams, bars (Minimum 2 exercises).

UNIT II

1. Composite laminate/ply lay-up analysis (minimum 1 exercise).
2. Thermal Analysis – 2D problem with conduction and convection boundary conditions (Minimum 2 exercises).
3. Fluid flow Analysis (Minimum 1 exercise : Y-duct)
4. Modal analysis of Spring Mass system.
5. Buckling Analysis of a given structure

Pre-requisites:
The student needs to possess knowledge of FEM theory, SOM theory, Vibration theory, Basics of thermal conduction and fluid flow.

Course Assessment Method:

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**CONTROL ENGINEERING**

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**Course Outcomes:**

Students should be able to

1. Identify various test signals, compensators and control systems.
2. Develop mathematical models for simulation of mechanical, electrical and hydraulic control systems in order to obtain system response for given input test signals.
3. Integrate each sub system for a desired control system and obtain the relevant transfer functions.
4. Predict the stability of a control system employing nyquist, polar, bode and root locus plots as stability criteria.
5. Develop block diagrams and signal flow graphs for different applications of control system.

---

**UNIT I**

**Introduction:**

Concept of automatic controls, open and closed loop systems, concepts of feedback, requirement of an ideal control system. Types of controllers – Proportional, Integral, Proportional Integral, Proportional Integral Differential controllers.

10 Hours

**UNIT II**

**Mathematical Models:**

Transfer function models, models of mechanical systems, models of electrical circuits, DC and AC motors in control systems, models of thermal systems, models of hydraulic systems. Analogous Systems: Force-voltage analogy and force-current analogy.

**Transient and Steady State Response Analysis:**

Introduction, first order and second order system response to step, ramp and impulse inputs, concepts of time constant and its importance in speed of response.

10 Hours

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**UNIT III**

**Block Diagrams and Signal Flow Graphs:**

Transfer Functions definition, function, block representation of system elements, reduction of block diagrams, Signal flow graphs: Manson’s gain formula.

09 Hours

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**UNIT IV**

**Frequency Response Analysis:**


**Frequency Response Analysis using Bode Plots:**


10 Hours

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**UNIT V**

**Root Locus Plots:**

Definition of root loci, general rules for constructing root loci, Analysis using root locus plots.

**Control Action and System Compensation:** Series and feedback compensation, Physical devices for system compensation.

09 Hours

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**Course Assessment Method:**

Test: 30 marks
Case study/Assignment: 10 marks
Mini project/Surprise: 10 marks
SEE - Final Exam: 50 Marks
Text Book

2. Control Systems Principles and Design: M. Goal, TMH, 2000

Reference Book


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HEAT AND MASS TRANSFER

Course Outcomes:
Students will be able to

1. Explain the physical origins of heat transfer and identify important modes of heat transfer in a given situation, and make appropriate assumptions.
2. Formulate mathematical model for one and two dimensional heat transfer processes and solve using analytical and numerical methods.
3. Compute the Natural and Forced convection heat transfer parameters for internal and external flows using Boundary layer methods and Dimensional analysis.
4. Evaluate the radiation heat transfer rate and shape factor of black and grey bodies.
5. Design and analyze the performance of various heat exchangers by using the LMTD and NTU methods.

UNIT I
Introductory Concepts and Definitions:
Modes of heat transfer: Basic laws governing conduction, convection, and radiation heat transfer; Thermal Conductivity; Convective Heat Transfer coefficient; Stefan Boltzmann constant; combined heat transfer mechanism; boundary conditions of 1st, 2nd and 3rd kind.

Conductive Heat Transfer I:

UNIT II
Conductive Heat Transfer II:
Heat transfer in extended surfaces (Fins) - infinitely long fin, fin with insulated tip and fin with convective heat transfer at the tip, Fin Efficiency or Effectiveness. Numerical problems on Fin Heat Transfer. Transient Conduction:- Conduction in solids with negligible internal temperature gradient (Lumped System Analysis), Use of Transient Temperature and Heat Transfer Charts (Heisler’s Charts) for Transient Conduction in Slab, Long Cylinder and Sphere; Numerical Computation of Transient Conduction problems; Graphical Analysis(Schmidt Plot); Numerical Problems.

UNIT III
Convective Heat Transfer I:
UNIT IV
Convective Heat Transfer II:
Dimensional analysis for Forced Convection problems: Physical significance of Reynolds, Prandtl, Nusselt and Stanton numbers. Use of various experimental correlations for hydro dynamically and thermally developed flows; use of empirical correlations for flow over a flat plate, over a cylinder and across a tube bundle. Numerical problems;
Radiation Heat Transfer:
Thermal Radiation; definitions of various terms; Stefan-Boltzman law, Kirchoff’s law, Planck’s law and Wein’s Displacement law. Radiation heat exchange between two parallel infinite black surfaces, between two parallel infinite gray surfaces; effect of Radiation Shield; Intensity of Radiation and Solid Angle; Lambert’s law; Radiation Heat exchange between two finite surfaces - Configuration Factor or View factor; properties of and determination of View Factors; View Factor Algebra; Hottel’s Cross String formula; Network Method for Radiation Heat Exchange in an Enclosure: Numerical Problems. 09 Hours

UNIT V
Mass Transfer:
Heat Transfer with Phase Change:
Types of Condensation; Nusselt’s theory for Laminar Condensation on a Vertical Flat Surface; Film Thickness and Heat Transfer Coefficient; Correlations for Condensation on Inclined Flat surfaces, Horizontal Tube and Horizontal Tube Banks; Regimes of Pool Boiling, Pool Boiling Correlations. Numerical problems
Heat Exchangers:
Classification of Heat Exchangers; Overall Heat Transfer coefficient, Fouling and Fouling factor; LMTD, Effectiveness-NTU methods of analysis of Heat Exchangers: Numerical problems. 10 Hours

Pre-requisites:
The student should have studied ATD and BTD

Course Assessment Method:
Test: 30 marks
Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book

Reference Book
CAD/CAM/CIM

Sub Code : 10ME73
Hours/Week : 4+0+0
Total Hours : 48
Exam Hours : 03
Credits : 04
CIE Marks : 50
SEE Marks : 50
Course Type: Program Core

Course Outcomes: 
Students will be able to
6. Recognize the techniques for minimizing the production time and cost.
7. Interpret the cycle, lead, mean time to repair, mean time between failures and total utilization of various machining centers in a shop floor production.
8. Implement the suitable automation Identification techniques in shop floor control.
9. Develop the effective automation systems for various industrial applications.
10. Compare the material handling & storage system with flexible manufacturing systems.

UNIT I
Introduction to CAD/CAM: Computers in Industrial Manufacturing, Product cycle
Computer Graphics: Raster scans graphics coordinate system, database structure for graphics modeling, transformation of geometry, 2D transformations, mathematics of projections, clipping, hidden surface removal.
Geometric modeling: Requirements, geometric models, geometric construction models, curve representation methods, surface representation methods, modeling facilities desired Drafting and Modeling systems: Basic geometric commands, layers, display control commands, editing, dimensioning, solid modeling, constraint based modeling

UNIT II
Fundamentals of Manufacturing and Automation:
Automation, Reasons for automation, Manufacturing Industries, Types of production, Functions in Manufacturing, Organization and information processing in manufacturing, Plant layout, Production concepts and Mathematical models, Automation strategies Detroit type Automation: Automated flow lines, Methods of work part transport, transfer mechanisms, Buffer storage, Automation for machining operations.

UNIT III
Analysis of automated flow lines:
General terminology and analysis, Analysis of transfer line without storage, with storage, partial automation.
Assembly Systems and Line Balancing:
The assembly process, Assembly systems, manual assembly systems, Line balancing, design of automated assembly, types, parts feeding devices, analysis of multistation assembly machines and single station assembly machine.

UNIT IV
Material Handling and Storage:
Functions, types of material handling, analysis of material handling, design of system, AGVs, storage system performance, AS/RS, Carousel storage system, work-in-process storage, interfacing handling and storage with manufacturing.
Group Technology and Flexible Manufacturing Systems:
Part families, Parts classification and coding, production flow lines, machine cell design, Benefits of Group technology, FMS workstation, Material handling and storage system, computer control systems, Planning the FMS.
Computerized Manufacturing planning systems:
CAPP, types, Computer integrated production planning systems, MRP, capacity planning.
UNIT V

Shop Floor control and automation Identification techniques:
shop floor control, factory data collection system, automation identification systems, bar code technology, automated data collection system

Quality control and Automated Inspection:
Inspection and testing, SQC, Automated inspection principles and methods, coordinate measuring machines, other contact inspection methods, Machine vision, other optical inspection methods, non contact inspection methods. 10 Hours

Course Assessment Method:
Test: 30 marks
Assignment: 10 marks
Case study/Surprise: 10 marks
SEE - Final Exam: 50 Marks

2. CAD/CAM by Zeid, Tata McGraw Hill.

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ENTEPRNEURSHIP DEVELOPMENT/MANAGEMENT AND IPR

Sub Code: 10MEH74
Credits: 03
Hours/Week: 3+0+0
CIE Marks: 50
Total Hours: 38
SEE Marks: 50
Exam Hours: 03
Course Type: Program core

Course Outcomes:
Students will be able to
1. Recognize the importance of entrepreneurship and its role in economic development of the Country.
2. Identify various schemes of Central and State Governments and their agencies available to promote MSME and process of setting up the same.
3. Identify & select various projects to become entrepreneur by conducting feasibility studies in respect of market, finance, technical & social.
4. Prepare project report for starting an enterprise in line with guidelines proposed by planning commission for appraising to various statutory authorities and financial institutions.
5. Appraise of IP rights like patents, industrial design, trademark, copyrights for effective protection and utilization of their innovations.

UNIT I
Introduction-meaning and importance of entrepreneurship, entrepreneur, types, characteristics, entrepreneur process, role of entrepreneurs in economic development, problems faced by entrepreneurs, scope in India

UNIT II
Micro, Small and medium enterprises, Definition of MSMEs as per MSME act, characteristics of small enterprises, need and advantages of small enterprises, Steps in setting up of small enterprises, Institutional support to MSMEs-State supporting agencies-TECSOK, KIADB, KSSIDC, KSFC, National Schemes-MSME-DI, NSIC, SIDBI

UNIT III
Preparation of Project reports, control variables in project, project lifecycle, project report, need, project identification, project selection, components of project report, formulation of report, planning commission guidelines, project appraisal, feasibility study-market, financial, technical and economic, PERT and CPM, errors in report.

UNIT IV
Introduction to IP, What is Intellectual Property (IP)?, Historical background of IP, Economic value of IP, Motivation to IP development, IP system strategy, Emerging issues, IPR governance, Institutions for administering the IP system, IP rights and marketing regulations, IPR protection, protecting consumers and protecting competition, IP management framework, Drivers of IP management, IP value chain, IP management framework, IP strategies, Strategic considerations, managing trademarks.

UNIT V
Intellectual Property Rights-What are IPRs?, Types of IPRs, Indian IPR scenario, Legal use of IP, Global Vs Indian IPR landscape, TRIPS and its implications
Patents-What is a patent, history of patent, Criteria for patent, types of patents, Indian patent act, patents for computer software, business models, incremental innovation, patent infringement
Trademarks-role, as a marketing tool, trademark rights, types, use of trademarks, trademark act, trademark registration in India
Copyrights-meaning, copyright protection in India, enforcement measures, copyright act

Course Assessment Method:
Test: 30 marks
Assignment: 10 marks
Case study/Surprise: 10 marks  
*SEE* - Final Exam: 50 Marks

**Text Book**
1. Dynamics of Entrepreneurial Development and Management- Vasanth Desai, Himalaya Publishing House  
2. Entrepreneurship and Management, S Nagendra and Manjunath VS, Pearson Publications  

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SMART MATERIALS

Course Outcomes:

Students will be able to

1. Describe the characteristics of materials such as Metals, Polymers and Ceramics.
2. Indicate the Electro, Magneto Rheological fluids and chromic materials for various mechanical systems.
3. Exploit Electrostrictive and Magnetostrictive materials in the design of different actuators.
4. Distinguish the properties of shape memory alloys with other class of materials and propose its suitability for a range of applications.
5. Implement the smart materials in the development of smart composites.

UNIT I

Introduction:
Characteristics of composites and ceramics materials, Dynamics and controls, concepts, Electro-magnetic materials and shape memory alloys-processing and characteristics

Sensing and Actuation:
Principals of electromagnetic, acoustics, chemical and mechanical sensing and actuation, Types of sensors and their applications, their compatibility writer conventional and advanced materials, signal processing, principals and characterization.

UNIT II

Control Design:
Design of shape memory alloys, Types of MR fluids, Characteristics and application, principals of MR fluid value designs, Magnetic circuit design, MR Dumpers, Design issues.

UNIT III

Optics and Electromagnetic:
Principals of optical fiber technology, characteristics of active and adaptive optical system and components Design and manufacturing principles.

Structures:
Principles of drag and turbulence control through smart skins, applications in environment such as aerospace and transportation vehicles, manufacturing, repair and maintainability aspects.

UNIT IV

Controls:
Principles of structural acoustic control, distributed, analog and digital feed back controls, Dimensional implications for structural control.

Principles of Vibration and Modal Analysis:
PZT Actuators, MEMS, Magnetic shape Memory Alloys, Characteristics and Applications.

UNIT V

Information Processing:
Neural Network, Data Processing, Data Visualization and Reliability–Principals and Application domains.

Pre-requisites:
The student should have basic knowledge of Materials Science & Metallurgy.

Course Assessment Method:
Test: 30 marks
Assignment: 10 marks
Case study/Surprise: 10 marks
Syllabus of I to VIII Sem BE Mechanical Engg. NMIT Bangalore-64

_SEE_ - Final Exam: 50 Marks

Text Book

Reference Book

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TRIBOLOGY

Sub Code : 10MEE752  
Credits : 03  
Hours/Week : 3+0+0  
CIE Marks : 50  
Total Hours : 38  
SEE Marks : 50  
Exam Hours : 03  
Course Type: Program Elective

Course Outcomes:  
students will be able to

1. Realize and describe the mechanisms of lubrication in bearings.
2. Compute load carrying capacity in light and heavy loaded journal bearings.
3. Analyze the friction force and power loss in hydrodynamic and hydrostatic lubrication.
4. Identify the appropriate material for bearings based on the application.
5. Recognize the different wear regimes in tribological components.

UNIT I

Introduction to Tribiology:  
07 Hours

UNIT II

Hydrodynamic Lubrication:  
Friction forces and power loss in lightly loaded bearing, Petroff’s law, Tower’s experiments, idealized full journal bearings.  
Mechanism of Pressure Development in an Oil Film:  
Reynold’s investigations, Reynold’s equation in two dimensions. Partial journal bearings, end leakages in journal bearing, numerical problems.  
08 Hours

UNIT III

Slider / Pad Bearing with a Fixed and Pivoted Shoe:  
Pressure distribution, Load carrying capacity, coefficient of friction, frictional resistance in a pivoted shoe bearing, influence of end leakage, numerical examples.  
08 Hours

UNIT IV

Hydrostatic Lubrication:  
Introduction to hydrostatic lubrication, hydrostatic step bearings, load carrying capacity and oil flow through the hydrostatic step bearing.  
Bearing Materials:  
Commonly used bearings materials, properties of typical bearing materials.  
08 Hours

UNIT V

Wear:  
Classification of wear, wear of polymers, wear of ceramic materials, wear measurements, effect of speed, temperature and pressure.  
Behavior of Tribological Components:  
Selection, friction, Wear of ceramic materials, wear measurements, effects of speed, temperature and pressure. Tribological measures, Material selection, improved design, surface engineering.  
07 Hours

Course Assessment Method:  
Test: 30 marks  
Seminar/Assignment: 10 marks  
Surprise: 10 marks  
SEE - Final Exam: 50 Marks

Text Book  

Reference Book
2. **Introduction to Tribology Bearings**, Mujumdar B. C., S. Chand company pvt. Ltd 2008

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# STATISTICAL QUALITY CONTROL

**Sub Code:** 10MEE753  
**Credits:** 03  
**Hours/Week:** 3+0+0  
**CIE Marks:** 50  
**Total Hours:** 38  
**SEE Marks:** 50  
**Exam Hours:** 03  
**Course Type:** Program Elective

## Course Outcomes:

*Students would be able to*

1. Students will be able to understand the quality improvement and control technique.
2. Student will be able to formulate the different problems and analysis quality control technique.
3. Students will be able to analyze the problems by the help of controls chart.
4. Students will be able to analyze the problems by the help of controls chart of conformities and nonconformities.
5. Students will be able to evaluate the graphical method of sampling problems to confirm whether the problems are in statistical control.

## UNIT I

**Introduction:**
The Meaning of Quality and Quality Improvement; Brief History of Quality Methodology; Statistical Methods for Quality Control and Improvement; Total Quality Management (quality philosophy, links between quality and productivity, quality costs legal aspects of quality implementing quality improvement).

- **07 Hours**

## UNIT II

**Modeling Process Quality:**
Mean, Median, Mode, Standard deviation, Calculating area, The Deming funnel experiment, Normal distribution tables, Finding the Z score, Central limit theorem.

**Methods and Philosophy of Statistical Process Control:**
Chance and assignable causes, Statistical Basis of the Control Charts (basic principles, choices of control limits, significance of control limits, sample size and sampling frequency, rational subgroups, analysis of pattern on control charts, warning limits, Average Run Length-ARL)

- **08 Hours**

## UNIT III

**Control Charts for Variables:**
Control Charts for X-Bar and R charts, Type I and Type II errors.

**Process Capability:**
The foundation of process capability, Natural Tolerance limits, cp – process capability index, cpk, pp – process performance index, summary of process measures

- **08 Hours**

## UNIT IV

**Control Charts For Attributes:**
Binomial distribution, Poisson distribution (from the point of view of Quality control) Control Chart for Fraction Nonconforming, Control Chart for number Nonconforming, Control Charts for Nonconformities or Defects, Control Chart for Number of non-conformities per unit

- **08 Hours**

## UNIT V

**Lot-By-Lot Acceptance Sampling For Attributes:**
The accepting sampling problem, single sampling plan for attributes, Double, Multiple, and sequential sampling, AOQL, LTPD, OC curves

**Cumulative-Sum (CUSUM) & Exponentially Weighted Moving Average (EWMA) Control Charts:**
CUSUM Control Chart (basic principles of the chart for monitoring the process mean); EWMA control chart (EWMA control chart for monitoring process mean), design of an EWMA control chart

- **07 Hours**

## Pre-requisites:
Knowledge of Maths-IV is essential.
Course Assessment Method:
Test: 30 marks
Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book

Reference Book

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Syllabus of I to VIII Sem BE Mechanical Engg. NMIT Bangalore-64

CRYOGENICS

Sub Code : 10ME754
Credits : 03
Hours/Week : 3+0+0
CIE Marks : 50
Total Hours : 38
SEE Marks : 50
Exam Hours : 03
Course Type: Program Elective

Course Outcomes:

Students will be able to
1. Reproduce the various mechanical, electrical and thermal properties of cryogenic fluids, applications and creation of low temperature.
2. Illustrate the classification and working principles of various refrigeration cycle, gas liquefaction, gas separation systems, low temperature measurement involved in cryogenic system.
3. Design and analyze the various cryogenic fluid storage systems and transfer systems.
4. Relate the cryogenic system to food preservation, medical and space technology by creating low temperature and high vacuum using mechanical vacuum pumps and diffusion pumps.
5. Select among different technologies to achieve different stages of cryogenics.

UNIT I

Introduction to Cryogenic system:
Applications areas of cryogenic engineering. Low temperature properties of engineering materials: Mechanical properties, Thermal properties, Electrical properties. Introduction The Thermodynamically Ideal system Production of low temperatures: Joule Thompson Effect, Adiabatic expansion.


UNIT II

Gas cycle Cryogenic Refrigeration Systems:
Classification of Cryo coolers Stirling cycle cryo – refrigerators Ideal cycle – working principle Schmidt’s analysis of Stirling cycle Various configurations of Stirling cycle refrigerators Integral piston Stirling cryo-cooler Free displacer split type Stirling Cryo coolers Gifford Mcmahon Cryorefrigerator Pulse tube refrigerator Solvay cycle refrigerator Vuillimier refrigerator Cryogenic regenerators. 08 Hours

UNIT III

Gas Separation and Gas Purification Systems:

Ultra Low Temperature Cryo – Refrigerators: Magneto Caloric Refrigerator $^3\text{He}-^4\text{He}$ Dilution refrigerator. Pomeranchuk cooling. Measurement systems for low temperatures Temperature measurement at low temperatures Resistance thermometers Thermocouples Thermistors Gas Thermometry. Liquid level sensors. 08 Hours

UNIT IV

Vacuum Technology:
Fundamental principles. Production of high vacuum Mechanical vacuum pumps Diffusion pumps Cryopumping Measurement of high vacuum level. Cryogenic Insulation: Heat transfer due to conduction Evacuated porous insulation Powder & Fibers Opacified powder insulation Gas filled powders & Fibrous materials Multilayer super-insulation Composite insulation. 08 Hours
**UNIT V**

**Cryogenic Fluid Storage and Transfer Systems:**
Design of cryogenic fluid storage vessels Inner vessel Outer Insulation Suspension system Fill and drain lines. Cryogenic fluid transfer External pressurization Self pressurization Transfer pump.

**Application of Cryogenic Systems:**
Cryogenic application for food preservation – Instant Quick Freezing techniques 11.2 Super conductive devices, Cryogenic applications for space technology. **07 Hours**

**Pre-requisites:**
Knowledge of Basic thermodynamics & fluid mechanics is essential.

**Course Assessment Method:**
Test: 30 marks
Case study/Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks

**Text Book**
2. **Cryogenic Engineering** – Thomas M. Flynn, Marcel Dekker, Inc N.Y. Basal 1997

**Reference Book**

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Knowledge of Basic thermodynamics & fluid mechanics is essential.
RENEWABLE ENERGY RESOURCES

Course Outcomes:
Students will be able to

1. Identify the various renewable energy forms to fulfill the energy demand globally.
2. Describe the main components of different renewable energy systems and explain the technological basis for harnessing renewable energy sources.
3. Outline the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels.
4. Recognize the effects that current energy systems based on fossil fuels have over the environment and the society.
5. Judge the best combination of technological solutions to minimize the emissions and increase the sustainability of the energy system.

UNIT I

Energy Sources and their Availability:
Introduction, commercial or conventional energy sources, Non conventional energy sources, new energy techniques.

Solar Radiation and its Measurement:

07 Hours

UNIT II

Solar Energy collectors:
Introduction, physical principles of the conversion of solar radiation into heat, flat plate collectors, thermal analysis of flat plate collector and usefull heat gained by the fluid, concentrating collector: focusing type, advantages and disadvantages of concentrating collectors over flat plate type collectors.

08 Hours

UNIT III

Applications of Solar Energy System:
Solar energy storage system, solar water heating, space heating, space cooling, solar thermal electric conversion, solar photo voltaics, solar distillation, pumping, furnace, cooking, green house, solar production of hydrogen.

08 Hours

UNIT IV

Wind Energy:
Introduction, Basic principles: nature of the wind, power in the wind, forces on the blade, wind energy conversion, wind data and energy estimation, basic components of wind energy conversion system(WECS), classification of WECS, advantages and disadvantages of WECS, Type of wind machines, energy storage, applications.

Energy from Biomass:
Introduction, biomass conversion technologies, photosynthesis, biogas generation, factors affecting biodigestion, classification of biogas plants, advantages and disadvantages of floating drum plant advantages, advantages and disadvantages of fixed dome type plant, constructional details of some main digesters, bio gas from plant wastes, materials used for bio gas generation, utilization of bio gas.

08 Hours

UNIT V

Geothermal Energy:
Introduction, geothermal sources, hot dry rock resources, magma resources, comparision of flashed steam and total flow concept, interconnection of geothermal fossil systems, applications, material selection for geothermal power plants.
Tidal Power:
Introduction, basic principle of tidal power, components of tidal power plants, operation methods, estimation of energy and power in simple single basin tidal system, storage, advantages and limitations.

07 Hours

Course Assessment Method:
Test: 30 marks
Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book
1. Non-conventional Energy resources, G D Rai, Khanna Publishers

Reference Book

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COMPUTATIONAL FLUID DYNAMICS

Sub Code: 10MEE756  
Credits : 03  
Hours/Week: 3 +0+0  
CIE Marks : 50  
Total Hours: 38  
SEE Marks : 50  
Exam Hours: 03  
Course Type: Program Elective

Course Outcomes:  
Students will be able to

1. Recall the knowledge and mathematical description of Fluid Mechanics and recognize how to discretize the conservation equations for mass, momenta and energy and define the truncation, round-off and discretization errors
2. Recognize and use different Grid Generation procedures for discretization of space around complex configuration to be analyzed; distinguish between differential and algebraic procedures of grid generation
3. Analyze Finite Difference and Finite Volume schemes to solve non-linear fluid-flow problems using appropriate numerical discretization of the relevant mass, momenta and energy fluxes; emphasize on the concept and merit of Upwind Differencing of different accuracy levels to discretize convective fluxes for problems of engineering interest
4. Recognize and employ Turbulence Models of different levels of accuracy for computing different real life fluid flow and heat transfer problems
5. Compute flow situations of simple geometry using the current best practice for selection of numerical grid, turbulence model and flux discretization scheme, followed by validation against experimental data.

UNIT I

Introduction to CFD:
Relative merits with respect to Experimental and Theoretical Fluid Dynamics, Concept of Transport process – Importance in design, major elements of a CFD Code; Preprocessor, Flow Equation Solver and Postprocessor- Conservation Equations in coordinate-free form and Solution Errors

Grid Generation:
Importance, Structured Vs Unstructured Grids, Major Tasks of generation, Analytical Transformation, Algebraic and Differential (Poisson Equation) methods for Structured Grid Generation, Grid Quality, Concept of Multiblocking

UNIT II

Governing Equations for CFD:
Brief introduction to Vectors & Tensors, Mathematical behaviour of partial differential equations relevant to CFD, Conservation Equations for mass, momentum and energy in cartesian coordinates, Conservation equations in dimensionless form, Importance of different dimensionless numbers, Approximation of Navier Stokes to Euler and Potential Flow equation, Different ways of handling Continuity equation, Pressure Poisson Equation, Generic Form of Governing Equations for flow

UNIT III

Discretisation of Conservation Equations:

UNIT IV

Simulation of Turbulence:
Phenomenon of Turbulence, Reynolds Averaging, Reynolds Stress, Closure Problem, Linear Eddy Viscosity Hypothesis, Mixing Length Model, Turbulence Energy ($k$), Turbulence Dissipation($\epsilon$), $k-\epsilon$ model, $k-\omega$ model, Boundary Conditions
UNIT V
Solution of Linear Equation System and Application Examples of CFD:
Direct solver – Gauss Elimination, LU Decomposition, Iterative Solver - Point Jacobi, Gauss Siedel, Thoma’s Algorithm for Tri-Diagonal matrix, Alternate Direction Implicit (ADI) method for 2D and 3D problems, Simple FORTRAN Programs, Formulation of 1D and 2D Fluid Flow and Heat Transfer problems with proper Boundary Conditions
10 Hours

Pre-requisites:
The student should have studied Fluid Mechanics.

Course Assessment Method:
Test: 30 marks
Case study/Assignment: 10 marks
Study project/Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book

Reference Book

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GAS TURBINE AND JET PROPULSION

Course Outcomes:
1. Clear concepts of Gas Dynamic processes - the effect of compressibility on fluid flow and hence the definition of Shock Wave, Mach Number and their effect on flow in a convergent-divergent nozzle with and without friction and heat transfer
2. Good understanding of the relative merits of Gas Turbines over conventional reciprocating IC Engines and the ideal thermodynamic cycles of Gas Turbine system – understanding how the heat exchangers, reheat burners and inter-stage cooling during compression process enhance the thermal efficiency and network output
3. Good understanding of the basic principle of Jet Propulsion and computation of thrust and power developed – for air-breathing Aircraft Engines employing principles of Ramjet, Pulsejet, Turbojet, Turboprop and Turbofan systems and also for non-air breathing Rocket Engines
4. Understanding mainly the components and principle of operation of both Centrifugal and Multistage Axial Flow Compressors and Turbines, the important role of Degree of Reaction in blade design and also with special emphasis on the phenomena of Surging and Chocking limits affecting the performance of turbomachines
5. Understanding of the physicochemical process of high speed combustion and flame in Gas Turbine Combustion Chambers with special emphasis on thrust augmentation systems, mechanism of flame stabilisation, ignition and droplet combustion and the special design requirements of high speed combustion systems

UNIT I
Introduction to CFD:
Gas Dynamics Fundamentals: Conservation Laws and governing equations for Mass, Momentum and Energy for Compressible flows; Basic definitions for Static and Stagnation Pressure, Temperature, Enthalpy, Mach Number, Subsonic, Transonic, Supersonic and Hypersonic Flow, Mach Wave, Mach Angle and Over expanding Nozzle, Adiabatic Flow through Converging-Diverging Nozzle, Adiabatic Flow through a constant area duct, Phenomenon of Shock, Rayleigh Lines, Fanno Lines in duct flow. 06 Hours

UNIT II
Gas Turbines: Relative merits over conventional IC Engines, Introduction to Brayton and Atkinson cycle for Gas turbines, Pressure Ratio, Thermal Efficiency, Specific Output, optimum pressure ratio, Enhancement of Thermal Efficiency and/or specific power output using inter cooling, heat exchangers, reheat burners. 06 Hours

UNIT III
Centrifugal Compressor:
Major components – Inducer, Impeller, Vaneless Diffuser, Vaned Diffuser, Volute Casing, Velocity & Pressure variation in a stage, Pressure Rise for Radial Tipped Vanes, Degree of Reaction, Prewhirl and Surging.
Axial Flow Compressor:
Stage consisting of a Rotor and a Stator, Pressure Rise in a Stage, Polytropic Efficiency, Losses in a compressor stage, Phenomenon of Blade Stall & Surging, and Performance Curves
Axial Flow Turbine:
Stage consisting of a Rotor and a Stator, Pressure Rise in a Stage, Polytropic Efficiency, Losses in a Compressor stage, Phenomenon of Chocking, Performance Curves. 08 Hours
UNIT IV

Jet Propulsion :
Concept of Propulsion and Thrust, Variety of Propulsion systems for flying vehicles – Turboprop, Turbomachinery, Ram Jet, Pulse Jet, SCRAM Jets with supersonic combustion. Definition & derivation for Pressure Thust Momentum Thrust, Propulsive Power, Propulsive Efficiency, Thermal and Overall Efficiency

Thrust Augmentation:
Water Injection, Liquid Injection, Afterburning, Bleed Air system

Rocket Propulsion : Distinction between Turbojets and Rockets, Rocket Thrust, Specific Impulse, Total Impulse, Thermal Efficiency, Rocket Equation and applications

UNIT V

Combustion Systems :

Pre-requisites:
The student should have studied Fluid Machinery.

Course Assessment Method:
Test: 30 marks
Case study/Assignment: 10 marks
Study project/Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book


Reference Book
COMPUTER GRAPHICS

Sub Code : 10MEO761
Credits : 03
Hours/Week : 3+0+0
CIE Marks : 50
Total Hours : 38
SEE Marks : 50
Exam Hours : 03
Course Type: Open Elective

Course Outcomes:
1. Students are able to write the different algorithms used in graphics.
2. Students are able to transform 2-D geometries and mathematical representations with different entities.
3. Students are able to analyze the techniques of implementation/adaptation of CG to software and hardware.

UNIT I
Scan Conversion and Clipping Representation of points, lines,

Line Drawing Algorithms: DDA algorithm, Bresenham’s integer line algorithm, Bresenham’s circle algorithm,
Polygon filling algorithms: Scan conversion, seed filling, scan line algorithm.
Viewing transformation, Clipping –points, lines, text, polygon, Cohen-Sutherland line clipping, Sutherland-Hodgmen algorithm.

UNIT II
Two Dimensional Transformations:
Representation of points, Transformations: Rotation, Reflection, Scaling, Combined Transformations, Translations and Homogeneous Coordinates, A geometric interpretation of homogeneous coordinates, Over all scaling, Points at infinity, rotation about an arbitrary point, Reflection through an arbitrary line.

UNIT III
Plane and Space Curves:
representation, Nonparametric curves, parametric curves, parametric representation and generation of line, circle, ellipse, parabola, hyperbola, generation of circle, ellipse, parabola, hyperbola, Cubic spline, normalized cubic splines, Bezier curves: blending function, properties, generation, B-spline curves- Cox-deBoor recursive formula, properties, open uniform basis functions, Non-uniform basis functions, periodic B-spline curve.

UNIT IV
Types and Mathematical Representation:

UNIT V
Computer animation:
Introduction, Conventional animation-key frame, Inbetweening, Line testing, Painting, Filming, Computer animation entertainment and engineering animation, Animation system hardware, software architecture, Animation types- frame buffer, colour table, zoompan- scroll, cross bar, real time play back, Animation techniques- key frame, skeleton. Path of motion and p-curves.

Course Assessment Method:
Test: 30 marks
Case study/Assignment: 10 marks
Study project/Surprise: 10 marks
SEE - Final Exam: 50 Marks
Text Book

Reference Book

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Syllabus of I to VIII Sem BE Mechanical Engg, NMIT Bangalore-64

NANO TECHNOLOGY

Sub Code: 10MEO762
Credits: 03
Hours/Week: 3+0+0
CIE Marks: 50
Total Hours: 38
SEE Marks: 50
Exam Hours: 03
Course Type: Open Elective

Course Outcomes:
1. Students will be able to analyze and classify Nano materials based on their structures.
2. Students will be able to compare and contrast between different methods of synthesizing the Nano materials.
3. Students will be able to prepare and characterize Nano materials for an specified applications.
4. Students could identify the difference between bulk and Nano materials properties.
5. Students could relate the application of mechanical engineering with nanotechnology.

UNIT I
An overview of Nanoscience & Nanotechnology:
Historical background – nature, scope and content of the subject – multidisciplinary aspects – industrial, economic and societal implications.

Experimental Techniques and Methods:
Investigating and manipulating materials in the nano scale – electron microscope – scanning probe microscope – optical and other microscopes – light scattering – x-ray diffraction. 08 Hours

UNIT II
Fullereness:
Discovery, synthesis and purification – chemistry of fullerenes in the condensed phase – orientational ordering – pressure effects – conductivity and superconductivity – ferromagnetism – optical properties.

Carbon Nanotubes:
Synthesis and purification – filling of nanotubes – mechanism of growth – electronic structure – transport properties – mechanical and physical properties – applications. 08 Hours

UNIT III
Self-Assembled Monolayers:

Gas Phase Clusters:
History of cluster science – formation and growth – detection and analysis – type and properties of clusters – bonding in clusters. 08 Hours

UNIT IV
Monolayer-Protected Metal Nanoparticles:

Core-Shell Nanoparticles:
Types – characterization – properties – applications.

Nanoshells:
Types – characterization – properties – applications. 06 Hours

UNIT V
Molecular Nanomachines:

Nanotribology:
Studying tribology on the nanoscale – applications. 08 Hours
Course Assessment Method:
Test: 30 marks
Assignment: 10 marks
Case study/Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book

Reference Book

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MANAGEMENT INFORMATION SYSTEM

Sub Code: 10MEO763  
Credits: 03

Hours/Week: 3+0+0  
CIE Marks: 50

Total Hours: 38  
SEE Marks: 50

Exam Hours: 03  
Course Type: Open Elective

Course Outcomes:

Student will be able to

1. Outline the requirements of Information systems in the management of resources in an organizational environment.
2. Classify and define the different Information systems of various divisions of the organization.
3. Analyze the organizational functional requirements and apply appropriate models and tools.
4. Develop the effective Supply chain and Customer relationship structure in the enterprise management.
5. Demonstrate the acquaintance in various functional heads suitable for a range of service firms.

UNIT I

Organisation and Information Systems:

UNIT II

Kinds of Information Systems:
Transaction Processing System (TPS) - Office Automation System (OAS) - Management Information System (MIS) - Decision Support System (DSS) and Group Decision Support System (GDSS) - Expert System (ES) - Executive Support System (EIS or ESS).

UNIT III

System Analysis and Development and Models:

UNIT IV

Enterprise System Enterprise Resources Planning (ERP):

UNIT V

Manufacturing and Service Systems:
Information systems for Accounting, Finance, Production and Manufacturing, Marketing and HRM functions - IS in hospital, hotel, bank.

Course Assessment Method:

Test: 30 marks  
Assignment: 10 marks  
Surprise: 10 marks  
SEE - Final Exam: 50 Marks
Text Book:

Reference Book

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PROJECT MANAGEMENT

Course Outcomes:

Students will be able to

6. Identify the specific management needs in the execution of projects at tactical and strategic level.
7. Estimate the Project proposals for scope, time and cost to conclude its feasibility.
8. Synthesis the strategies to evolve suitable approach to accomplish the project with effective usage of the resources.
9. Illustrate team-building and leadership skills in planning and implementation of the project.
10. Apply the effective management techniques in the project execution to fulfill the desired objectives.

UNIT I

Concepts of Project Management:
Concepts of a Project, Categories of projects, Phases of project life cycle, Roles and responsibilities of project leader, tools and techniques for project management.

UNIT II

Project Planning and Estimating:
Feasibility report, phased Planning, Project planning steps, Objectives and goals of the project, preparation of cost estimation, evaluation of the project profitability.

UNIT III

Organizing And Staffing:
The Project Team: Skills / abilities required for project manager, Authorities and responsibilities of project manager, Project organization and types accountability in project execution and controls

UNIT IV

Project Scheduling, Co-Ordination And Control:
Project implementation scheduling, different scheduling techniques bar (GANTT) charts, Bar charts for combined activities. Project evaluation and review techniques, PERT planning. Project direction communication in a project, Role of MIS in project control, performance control, schedule control, cost control cases.

UNIT V

Performance Measures in Project Management and Project inventory management:
Performance indicators, Performance improvement for the CM & DM companies for better project management. Nature of project inventory, supply and transportation of materials.

Course Assessment Method:
Test: 30 marks
Case study/Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book
2. Project Execution Plan: Chaudhry S., plan for project Execution Interaction.2001

Reference Book

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NON DESTRUCTIVE TESTING

Sub Code : 10MEO765
Credits : 03
Hours/Week : 3+0+0
Total Hours : 38
Exam Hours : 03
CIE Marks : 50
SEE Marks : 50
Course Type: Open Elective

Course Outcomes:
Students will be able to
6. Describe the basic concepts and principles of NDT methods.
7. Analyze characteristics of NDT techniques.
8. Collect the data for NDT project work.
9. Predict the viewing, interpretation and protection against radiographs.
10. Apply NDT techniques in different industrial applications.

UNIT I
Liquid penetrant Inspection:
Introduction, principles of penetrant inspection, Characteristics of a penetrant, Water washable system, Post emulsification system, solvent removable system, surface preparation and cleaning, penetrant application, development, advantages and disadvantages, range of applications.

Magnetic Particle Inspection:
Introduction, magnetization, methods, continuous and residual methods, sensitivities, demagnetization, Magnetic particles, applications, advantages and disadvantages

UNIT II
Electrical Test Methods (Eddy Current Testing):
Introduction, principle, conductivity of a material, Magnetic properties, coil impedance, lift off factor and edge effects, skin effect, inspection frequency, coil arrangements, inspection probes, types of circuit, display methods, application of eddy current techniques.

UNIT III
Ultrasonic Testing:
Introduction, Nature of sound, wave velocity and length. Generation of ultrasound, characteristics of an ultrasonic beam, sound waves at interfaces, sound attenuation, Inspection techniques identification of defects, immersion testing, surface conditioning, application of ultrasonic testing.

UNIT IV
Radiography:
Introduction, uses, limitation. Principle, radiation sources, production of X rays, ray spectra, radiation sources, shadow formation Exposure factor, Viewing and interpretation of radiographs, radiation hazard, protection against radiation, measurement of radiation received by personnel.

UNIT V
Other NDT techniques:
Optical inspection probes, Neutron radiography, laser induces ultrasonic, acoustic emission inspection, Thermography, surface texture analysis, Multi phase flow analysis.

Course Assessment Method:
Test: 30 marks
Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks
Text Book
1. **Non Destructive Testing**, Barry Hull & Vernon John, ELBS, 1988
2. **Metals Handbook** Vol.II, Nondestructive inspection and quality control

Reference Book
1. **Practical Non-Destructive Testing** by Baldev Raj, Jayakumar, Thavasimuthu, Wood Head Publishing Ltd. 2nd edition
2. **Non-Destructive Testing** by P. Halmshaw

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ELEMENTS OF AERONAUTICS

Sub Code : 10MEO766
Credits : 03

Hours/Week : 3+0+0

CIE Marks : 50

Total Hours : 38
SEE Marks : 50

Exam Hours : 03
Course Type: Open Elective

Course Outcomes:
Students will be able to

1. Cite the developments in an aircraft and discover the recent trends in aerospace industry.
2. Recognize various systems and the components of an aircraft.
3. Analyze the basic principles of flight mechanics.
4. Analyze the effects of operational parameters and its response in aircraft systems with respect to stability and control.
5. Ascertain the critical parameters needed to perform the aircraft maneuvers.

UNIT I
Aircraft Industry Overview
Evolution and History of flight, types of aerospace Industry, key players in aerospace Industry, Aerospace manufacturing, Mergers and acquisitions, Aerospace industry trends, advances in Engineering. Global and Indian Aircraft scenario.

Introduction to Aircrafts
Basic components of an aircraft, structural members, Aircraft Axis system, Aircraft Motions, Control surfaces and high lift devices.
Types of Aircrafts- Lighter than Air/ Heavier than Air aircrafts Conventional Design configurations based on power plant location, Wing vertical location, intake location, tail unit arrangements, landing gear arrangements. Unconventional configurations- Biplane, variable sweep, canard layout, twin boom layouts, span loaders, blended body wing layout, STOL and STOVL Aircraft, stealth Aircraft. Advantages and disadvantages of these configurations.

UNIT II & III
Introduction to Aircraft Systems

UNIT IV
Basic Principles of Flight
Significance of speed of Sound, Air speed and ground speed, Properties of Atmosphere, Bernoulli’s Equation, Forces on the airplane, Airflow over wing section, Pressure Distribution over a wing section, Generation of Lift, Drag, Pitching Moments, Types of Drag, Lift curve, Drag Curve, Lift/ Drag Ration Curve, Factors affecting lift and drag, Center of pressure and its effects. Aerofoil Nomenclature, Types of Aerofoil, Wing section- Aerodynamic Center, Aspect Ratio, Effects of lift, drag speed, air density on drag.

UNIT V
Basics of Flight Mechanics
Mach waves, Mach angles, sonic and Supersonic Flight and its effects
Stability and Control
Degree of stability- Lateral, Longitudinal and Directional stability and controls of Aircraft. Effects of flaps and Slats on Lift Coefficients, Control tabs, stalling, Landing, Gliding, Turning, Speed of Sound, Mach Numbers, Shock Waves
**Aircraft Performance and Maneuvers**

Power Curves, Maximum and minimum speeds of horizontal flight, effects of changes of Engine Power, Effects of Altitude on Power Curves, Forces acting on a Aeroplane during a turn, loads during a Turn, correct and incorrect angles of Bank, Aerobatics, Inverted Maneuvers, Maneuverability

**06 Hours**

**Course Assessment Method:**
- Test: 30 marks
- Assignment: 10 marks
- Study project/Surprise: 10 marks
- SEE - Final Exam: 50 Marks

**Resources**

**Text Books**

**Reference**
2. Introduction to Flight by Dave Anderson
3. Aircraft systems: Mechanical, Electrical and Avionics subsystems integration by lan moir, Allen Seabridge

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HEAT TRANSFER LAB

Sub Code: 10MEL77  Credits: 1.5
Hours/Week: 0+0+3  CIE Marks: 50
Total Hours: 39  SEE Marks: 50
Exam Hours: 3  Course Type: Program Core

Course Outcomes:

Students will be able to

1. Determine the thermal conductivity of different metallic materials.
2. Examine the rate of heat transfer between fluids and solid boundaries.
3. Select the appropriate dimensional and functional parameters for heat transfer devices.
4. Apply the basic heat transfer mechanisms for various heat transfer phenomenon.
5. Analyze the design and performance of vapor compression refrigeration and air conditioning system.

UNIT I

1. Determination of Thermal Conductivity of a Metal Rod.
3. Determination of Effectiveness on a Metallic fin.

UNIT II

1. Determination of Stefan Boltzman Constant.
2. Determination of LMDT and Effectiveness in a Parallel Flow and Counter Flow Heat Exchangers
3. Experiments on Boiling of Liquid and Condensation of Vapour
4. Performance Test on a Vapour Compression Refrigeration.
5. Performance Test on a Vapour Compression Air – Conditioner

Pre-requisites:
The student should have theoretical knowledge of Heat and Mass transfer theory.

Course Assessment Method:
Record: 30 marks
Test: 15 marks
Study project/Viva: 05 marks
SEE - Final Exam: 50 Marks

Scheme of Examination:
Student will be asked to conduct one experiment from each unit.

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CIM & AUTOMATION LAB

Sub Code: 10MEL78  Credits: 1.5
Hours/Week: 0+0+3  CIE Marks: 50
Total Hours: 39  SEE Marks: 50
Exam Hours: 03  Course Type: Program Core

Course Outcomes:

Students will be able to

1. Given a English language description of the problem &/or a schematic representation of the problem, Identify the various Manufacturing process associated with the problem & develop an initial generic solution using the G & M codes.
2. Identify & virtually simulate various concepts of CIM such as CNC, FMS, Automation, Industrial Robots, ASRS and Hydraulics & Pneumatics.
3. Apply the manufacturing specific G & M codes to the given problem & to simulate the same using the FANUC Package.
4. Analyse the simplicity/complexity of the problem. Breakdown the sequence of manufacturing process & task involved.
5. Develop a Program for the Robot & CNC to execute various tasks and manufacturing process respectively considering the manufacturing & task precedence constraints.

UNIT I

CNC part programming using CAM packages. Simulation of Turning, Drilling, Milling operations. 3 typical simulations to be carried out using simulation packages like Master – CAM, or any equivalent software.

UNIT II

(Only for Demo/Viva voce)

1. FMS (Flexible manufacturing System) : Programming of Automatic storage and Retrieval system (ASRS) and liner shuttle conveyor Interfacing CNC lathe, milling with loading unloading arm and ASRS to be carried out on simple components.
2. Robot programming: Using Teach Pendent & Offline programming to perform pick and place, stacking of objects, 2 programs.
3. Pneumatics and Hydraulics, Electro-Pneumatics: 3 typical experiments on Basics of these topics to be conducted.

Pre-requisites:
The student should have theoretical knowledge of CAD/CAM /CIM theory.

Course Assessment Method:

Record: 30 marks
Test: 15 marks
Study project/Viva: 05 marks
SEE - Final Exam: 50 Marks

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COMPOSITE MATERIALS

Sub Code : 10ME81
Credits : 04
Hours/Week : 4+0+0
CIE Marks : 50
Total Hours : 48
SEE Marks : 50
Exam Hours : 03
Course Type: Program Core

Course Outcomes:
Students will be able to
1. Identify the significance and suitability of composite materials for various engineering applications.
2. Analyze laminates using constitutive matrices.
3. Synthesize the various processing techniques in the development of PMC’S and MMC’S.
4. Improve the properties of composites through secondary and special fabrication techniques.
5. Determine the influence of size, shape and particle distribution in MMC’S.

UNIT I
Introduction To Composite Materials: Definition, classification and characteristics of composite Materials – fibrous composites, laminated composites, particulate composites.
Fiber Reinforced Plastic Processing: Layup and curing, fabricating process, open and closed mould process, hand layup techniques; structural laminate bag molding, production procedures for bag molding; filament winding, pultrusion, pulforming, thermo-forming, injection molding, blow molding.

UNIT II
Characteristics of Fiber Reinforced Lamina:
Fundamentals, Elastic properties of a Lamina, Unidirectional Continous fibre zero degree and angle-ply lamina.
Introduction to properties of Laminate and failure theories.

UNIT III
Applications of PMCs: Automobile, Aircrafts, missiles, Space hardware, Electrical and electronics, Marine, recreational and sports equipment, future potential of composites.

UNIT IV
Metal Matrix Composites: Reinforcement materials, types, characteristics and selection base metals selection. Need for production MMC’s and its application.
Fabrication Process For MMC’s: Powder metallurgy technique, liquid metallurgy technique and secondary processing, special fabrication techniques.

UNIT V
Study Properties of MMC’s: Physical Mechanical, Wear, machinability and Other Properties. Effect of size, shape and distribution of particulate on properties

Pre-requisites:
The student should have studied Material Science & Metallurgy theory.

Course Assessment Method:
Test: 30 marks
Seminar/Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks
TEXT BOOKS:

REFERENCE BOOKS:
1. Fiber Reinforced Composites, P. K. Mallick, Marcel Dekker,Inc

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Syllabus of I to VIII Sem BE Mechanical Engg, NMIT Bangalore-64

DESIGN FOR MANUFACTURE

Sub Code : 10ME82 Credits :03
Hours/Week : 3+0+0 CIE Marks :50
Total Hours : 38 SEE Marks :50
Exam Hours : 03 Course Type: Program Core

Course Outcomes:
Students will be able to

1. List & Define the process of design and basic guidelines of Design for Manufacture encompassing the selection of materials & manufacturing processes.
2. Identify & illustrate various GD&T symbols, explain the concepts of Tolerance, Datums, True Positional Theory, Selective Assembly and Quantitative material selection process.
3. Apply the design for manufacture guidelines for a given component to meet the technical & economical feasibility. Also compute the tolerances for gauges & selective assembly components.
4. Analyse the design and effect of tolerance on a given component &/or a pattern, examine the design flaws associated with it & identify its parting line, Datum features & sequence of Manufacturing processes.
5. Re-design the given component by rearranging the sequence of manufacturing processes or by redesigning the pattern to obviate the sand cores for a sustainable economic feasibility.

UNIT I


UNIT II

Selective Assembly: Interchangeable part manufacture and selective assembly, Deciding the number of groups -Model-1 : Group tolerance of mating parts equal, Model total and group tolerances of shaft equal. Control of axial play-Introducing secondary machining operations, Laminated shims, examples.

UNIT III


UNIT IV

Component Design : Component design with machining consideraions link design for turning components-milling, Drilling and other related processes including finish- machining operations.
Design of Gauges: Design of gauges for checking components in assemble with emphasis on various types of limit gauges for both hole and shaft.

UNIT V

Course Assessment Method:
Test: 30 marks  
Seminar/Assignment: 10 marks  
Surprise: 10 marks  
SEE - Final Exam: 50 Marks

TEXT BOOKS:

REFERENCE BOOKS:

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EXPERIMENTAL STRESS ANALYSIS

Sub Code     : 10MEE831  
Hours/Week   : 3+0+0  
Total Hours  : 38  
Exam Hours   : 03  

Course Type: Program Elective

Course Outcomes:
Students will be able to

1. Define various phenomenon and properties associated with light and photo elastic materials.
2. Identify different strain gauges and rosette.
3. Explain and illustrate the principles for measuring strain.
4. Apply the concept of photo elasticity, strain gauge circuit and rosette for the calculation of stress in the given component under different loading conditions.
5. Investigate different methods of calibration and compensation techniques to improve the accuracy of strains being measured

UNIT I
Nature of Light:
Nature of light, Harmonic wave, phase amplitude, polarization, passage of light through isotropic material, total internal reflection, normal incidence and oblique incidence, passage of light through crystalline medium. Absolute and relative phase difference, quarter wave plate and half wave plate. Production of plane polarized light.  
07 Hours

UNIT II
Two Dimensional Photoelasticity:
08 Hours

UNIT III
Two Dimensional Photo Elastic Analysis:
Isoclinics and isochromatics fringe order at a point, methods of compensation, calibration methods, separation techniques.

Application of Photoelasticity:
Types of application, properties of an ideal photoelastic material, casting techniques, stress relieving, two dimensional applications.  
08 Hours

UNIT IV
Strain Measurement:
Mechanical, optical, Pneumatics, Acoustic strain gauges. Electrical strain gauges – Induction, capacitance and electrical resistance strain gauges.

Electrical Resistance Strain Gauges:
07 Hours

UNIT V
Strain gauge Circuit and Rosette:
Wheat stone bridge, error due to input impedance of the measuring instrument, bridge balancing, temperature compensation. Strain gauge transducers, calibration of strain measuring system. Two, Three and four element rosette problems  
08 Hours
Pre-requisites:
The student should have studied Mechanics of Materials.

Course Assessment Method:
Test: 30 marks
Study Project/Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book

Reference Book
1. Experimental Stress Analysis, Sadhu Singh, Khanna Publishers

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MACHINE TOOL DESIGN

Sub Code : 10MEE832
Credits : 03

Hours/Week : 3+0+0
CIE Marks : 50

Total Hours : 38
SEE Marks : 50

Exam Hours : 03
Course Type: Program Elective

Course Outcomes:

Students will be able to
1. Describe general requirements of machine tools.
2. Use control systems for forming and auxiliary motions in machine tools.
3. Analyze types of design problems such as gear box design, guide way design, shaft loading and its associated parts.
4. Design machine tool parts.
5. Evaluate the forces generated by cutting tools.

UNIT I

Principles of Machine Tools Design:
General requirements of machine tool design-design process machine tool layout

Machine Tool Drives and Mechanisms:

07 Hours

UNIT II

Cutting Force Analysis and Power Requirement:
In Turning, milling, Drilling shaping and broaching operations- simple problems. General requirements of machine tools -centre lathe, milling machine.

Design of Guide Ways and Power Screws:
Function and types of guide ways-design and lubrication of slide ways-aerostatic slide ways-antifriction guideways-protecting devices, design of power screws.

08 Hours

UNIT III

Design of Machine Tool Structures:
Functions-requirements –design criteria material used-static and dynamic stiffness-profile and basic design procedure for machine tools structures. Design of beds, columns, housing, bases, tables, cross rail, arms saddle, carriages.

08 Hours

UNIT IV

Design of Spindle and Spindle Bearings:
Function-requirements and materials for compliance and matching accuracy-design of spindles bearings, hydrodynamic and hydrostatic bearings, and air lubricated bearing.

Dynamics of Machines Tools:
Concept of dynamic cutting process, physical causes of chatter and vibration, types of chatter. Stability chart, chatter vibration in lathe, drilling machine, grinding machine and milling machine. Different methods of avoiding machine tools chatter and vibrator.

08 Hours

UNIT V

Control Systems in Machine Tools:
Functions, requirements and classification. Control systems for speed and feeds centralized control, Preselective control, control systems for forming and auxiliary motions-mechanical control –ergonomic consideration and compatibility-automatic control system-electric hydraulic and pneumatic systems.

07 Hours

Pre-requisites:
The student must have undergone a course on Mechanics of Materials, Finite Element Methods and Mechanical Vibrations.
Course Assessment Method:
Test: 30 marks
Case study/Study Project/Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book

Reference Book

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FOUNDARY TECHNOLOGY

Course Outcomes:

Students will be able to
1. Identify different types of melting methods that are employed in different casting process.
2. Illustrate the design of defect-free castings considering proper gating and risering.
3. Analyze the structure of casting and its influence on mold characteristics.
4. Compare ferrous and non-ferrous castings that are used in special molding techniques.
5. Identify the need of modernization and mechanization of foundry molding process considering pollution control norms that is appropriate for public health and safety.

UNIT I

**Foundry Metallurgy:** Oxidation of liquid metals, gas dissolution in liquid metals, methods of degassing, fluidity, factors affecting fluidity, fluidity tests, hot tearing, shrinkage of liquid metals.

**Casting Design:** Introduction to casting design, redesign considerations, design for minimum casting stresses, design for directional solidification, design for metal flow, safety factors, design for low pattern cost and model making as an aid in design.

08 Hours

UNIT II

**Solidification Of Castings:** Crystallization and development of cast structure - nucleation, growth and dendritic growth. Structure of castings – significance and practical control of cast structure, grain shape and orientation, grain size, refinement and modification of cast structure. Concept of progressive and directional solidification, solidification time and derivation of Chvorinov’s equation, influence on mold characteristics and cast metal.

08 Hours

UNIT III


08 Hours

UNIT IV

**Special Molding Techniques:** Principles, materials used, process details and application of no-bake sand systems, vacuum molding, flask less molding, and high pressure molding.

**Cupola Melting:** Developments in cupola melting – hot blast cupola, water cooled cupola, balanced blast cupola, coke less cupola, cupola charge calculations.

**Ferrous Foundry:** Melting procedures, casting characteristics, production, specification, and properties of some typical steels, grey cast iron, malleable iron, and spheroidal graphite cast iron castings.

**Non-Ferrous Foundry:** Melting procedures, casting characteristics, production, specification, and properties of some typical aluminum, copper, and magnesium based alloy castings.

08 Hours

UNIT V

**Modernization And Mechanization Of Foundry:** Need for modernization, and mechanization, molding and core making, melting, pouring, shake out equipment and fettling, dust and fume control, material handling equipments for sand moulds and cores, molten metal and castings, reclamation of sands. Pollution control – norms, and agencies.

06 Hours
Pre-requisites:
The student should have studied Manufacturing Process

Course Assessment Method:
Test: 30 marks
Seminar/Assignment: 10 marks
Case study/Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book
1. Principles of metal casting, Heine Loper & Rosenthal TMH - 2005

Reference Book
2. Foundry Technology, P. N. Rao

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Syllabus of I to VIII Sem BE Mechanical Engg. NMIT Bangalore-64

BIO MASS ENERGY SYSTEM

Sub Code : 10MEE834                Credits : 03
Hours/Week : 3+0+0                  CIE Marks : 50
Total Hours : 38                    SEE Marks : 50
Exam Hours : 03                     Course Type: Program Elective

Course Outcomes:
Students will be able to
1. Identify different types of melting methods that are employed in different casting process.
2. Illustrate the design of defect-free castings considering proper gating and risering.
3. Analyze the structure of casting and its influence on mold characteristics.
4. Compare ferrous and non-ferrous castings that are used in special molding techniques.
5. Identify the need of modernization and mechanization of foundry molding process considering pollution control norms that is appropriate for public health and safety.

UNIT I
Biomass Energy:

Biomass Conversion Methods:
Physical, Agrochemical, Thermo chemical, Biochemical (flowchart) & Explanation. 07 Hours

UNIT II
Physical & Agrochemical Conversion:
Briquetting, Pellatigation, Agrochemical, fuel Extraction, Thermo chemical Conversion: Direct combustion for heat, domestic cooking & heating.
Biomass Gasification:
Chemical reaction in gasification, Producer gas& the constituents, Types of gasifiers: Fixed bed gasifiers, Fluidized bed gasifiers. 07 Hours

UNIT III
Liquefaction & Bio Methanization:
Liquefaction through pyrolysis & Methanol synthesis, Anaerobic digestion, Basic principles, factors influencing Biogas yield, classification of Biogas digester: floating gasholder & fixed dome type (Working Principle with diagram). 08 Hours

UNIT IV

UNIT V
Bio Power Plants:
Bio Power generation routes, Basic Thermodynamic cycles in Bio power generation, Brayton cycle, Sterling cycle, Rankine cycle, Cogeneration cycle, Biomass Based steam power plant. Calculations for sizing the Biogas plant. 08 Hours

Course Assessment Method:
Test: 30 marks
Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks
Text Book

Reference Book

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AIRCRAFT STRUCTURES

Sub Code : 10MEE835
Credits : 03

Hours/Week : 3+0+0
CIE Marks : 50

Total Hours : 38
SEE Marks : 50

Exam Hours : 03
Course Type: Program Elective

Course Outcomes:
1. Students will obtain a preliminary understanding of the aircraft design methodologies and structure analysis.
2. Students will obtain detailed knowledge about the types of materials of an aircraft its importance type of load acting on them and its analysis.
3. Students will obtain clear understanding of the types of certifications of an aircraft and also the procedure to obtain a type certificate for a new aircraft.
4. Students will able to design and analyze various structural members of aircraft.
5. Students will able to apply the necessary repairing and reworking techniques for various structural damage of parts

UNIT I
Overview of the Aircraft Design Process

Fundamentals of Structural Analysis
Review of Hooke’s Law, Principal Stresses, Equilibrium and Compatibility, Determinate structures, St Venant’s Principle, Conservation of Energy, Stress Transformation, Stress strain Relations.

Introduction to Aircraft structures
Types of Structural members of Fuselage and wing section Ribs, Spars, Frames, Stringers, Longeron, Splices, Sectional Properties of structural members and their loads, types of structural joints, types of loads on structural joints

UNIT II
Aircraft loads
Aerodynamic loads, Inertial loads, loads due to engine, actuator loads, Maneuver Loads, VN diagrams, Gust Loads, Grounds Loads, Ground conditions, Miscellaneous loads.

Aircraft Materials and Manufacturing Processes

UNIT III
Structural Analysis of Aircraft Structures
Analysis of Trusses. Theory of Beams – Symmetric Beams in pure Bending, Unsymmetrical Beams in Bending. Shear Centre

UNIT IV
Deflection of Beams. , Theory of Torsion – Shafts of Non-Circular sections- triangular, rectangular section and, Membrane analogy, Multi cell closed sections, Simple Exercises.

UNIT V
Airworthiness and Aircraft Certification

Aircraft Structural Repair
Types of Structural damage, Nonconformance, Rework, Repair, Allowable damage Limit, Repairable Damage Limit, Overview of ADL Analysis, Types of Repair, Repair Considerations and best practices.  

**Pre-requisites:**
The student should have a good understanding of Mechanics of Materials, Engg Mechanics and Elements of Aeronautics.

**Course Assessment Method:**
Test: 30 marks
Study Project/Assignment: 10 marks
Case study/Surprise: 10 marks
SEE - Final Exam: 50 Marks

**Resources**

**Text Books**

**Reference**
5. *An Introduction to Aircraft Certification*; A guide to understanding Jaa, Easa and FAA by Filippo De Florio, Butterworth – Heinemann

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INTRODUCTION TO AERODYNAMICS

Sub Code : 10MEE836
Credits : 03
Hours/Week : 3+0+0
CIE Marks : 50
Total Hours : 38
SEE Marks : 50
Exam Hours : 03
Course Type: Program Elective

Course Outcomes:
Students will be able to

1. Define the geometrical details of an Aircraft wing; recognize the performance coefficients like Lift, Drag and Pitching Moment as function of operating parameters like the Wing geometry, Angle of Attack, Mach number, Reynolds number; distinguish between the deformation of a solid and a fluid element using unambiguous definitions of substantial derivatives of flow variables, Shear Strain Rate, Normal Strain Rate and Vorticity

2. Recognise the distinction between irrotational, inviscid and viscous flow, their relative importance and complexity in simulation of real-life turbulent flow past a full aircraft configuration; to apply basic flow singularities like Sources, Vortices, Doublets & Uniform flow and their multiple combinations to compute potential flow around different complex shaped configuration

3. Employ the Potential flow based Singularity, Panel and Vortex Lattice methods to analyse the flow field around simple aerodynamic configuration; appreciate the important role of Bernoulli’s Equation to calculate the relevant forces and moments on a 2D Aerofoil and a Circular Cylinder

4. Analyse the Biot Saver’s Law and Helmholtz Theorem for Vortices leading to Prandtl’s Lifting Line theory for computing Induced Drag and Downwash of Finite Wings

5. Ascertain the effect of fluid viscosity on flow past Flat Plates, Aerofoils or Finite Wings; differentiate between Laminar and Turbulent flow situations for attached and separated flow over wing surface; explain the formation of Wing Tip Vortices and Wake Vortices for aircrafts

UNIT I

Aerodynamics: Fundamental principles
Models of the fluid: control volumes and fluid elements, continuity and momentum equation, application of momentum equation: drag of a 2D body, Energy equation, angular velocity, vorticity, and strain, circulation, stream function, velocity potential, relationship between the stream function and velocity potential. 07 Hours

UNIT II

Fundamentals of Inviscid, incompressible flow
Bernoulli equation, Incompressible flow in a duct: the venturi and low speed wind tunnel, pitot tube: measurement of airspeed, pressure coefficient, condition of velocity for incompressible flow, governing equation for incompressible flow: laplace’s equation, uniform flow, source flow, doublet flow, non lifting flow over a circular cylinder, vortex flow, lifting flow over a cylinder. 08 Hours

UNIT III

Incompressible flow over aerofoils
Introduction, aerofoil nomenclature and characteristics, vortex sheet, kutta condition, kelvin’s theorem and the starting vortex, airfoil theory: symmetric and cambered, circulation theory of lift, lifting flow over arbitrary bodies. 07 Hours

UNIT IV

Incompressible flow over finite wings
Downwash and induced drag, vortex filament, biot savart law, helmboltz vortex theorem, prandtl’s classical lifting theory-line theory, numerical nonlinear lifting-line method, lifting surface theory-vortex lattice method, lanchester and prandtl - development of finite wing theory 08 Hours

UNIT V

Viscous flow
Introduction, qualitative aspects of viscous flow, viscosity and thermal conduction, navier stokes equation, Incompressible flow over flat plate-blasius solution, compressible flow over flat plate, results for turbulent boundary layers. 08 Hours
Pre-requisites:
The student should have a good understanding of Fluid Mechanics

Course Assessment Method:
Test: 30 marks
Study Project/Assignment: 10 marks
Case study/Surprise: 10 marks
SEE - Final Exam: 50 Marks

Resources
Text Books
Reference
2. L.M. Milne-Thomson, Theoretical aerodynamics, Dover Publications

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PROJECT WORK

Sub Code: 10MEP84
Credits: 13
Hours/Week: 0+0+30
CIE Marks: 50
Total Hours: 216
SEE Marks: 50
Exam Hours: 1.5Hr/Batch
Course Type: Program Core

Course outcomes:
1. Apply the relevant knowledge and skills, which are acquired within the technical area, to a given problem
2. Analyse complex mechanical engineering problems and apply appropriate engineering techniques and design processes
3. Acquire and evaluate research regarding new knowledge development within the mechanical engineering discipline and its social, cultural, environmental and legal context
4. Develop creative solutions to problems and conceive innovative approaches in developing and designing of mechanical systems and machines
5. Demonstrate a responsible, ethical and professional attitude regarding the role of engineers in society, including situations involving potentially adverse environmental and cultural impacts

The Project work shall be on a topic in the area of specialization specified by the guide and opted by the candidate. The project batch should contain 2 to 4 members only. The students shall seek the guidance of the internal guide on a continuous basis, and the guide shall give a certificate to the effect that the candidate has worked satisfactorily under his/her guidance on completion of the project work. On completion of the project work, students shall prepare a report according to the guidelines and submit it to the concerned authority.

The students are supposed to finalize the topic of the project work at the beginning of the 7th semester. 3 seminars have to be given,
1. Start of the 8th semester about the literature survey.
2. Progress of the project.
3. Final Presentation.

The seminars will be assessed by a project committee who will make suitable recommendations at each stage.

Course Assessment Method:
CIE – 50 Marks
SEE - Final Exam: 50 Marks

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