DEPARTMENT OF MECHANICAL ENGINEERING

VISION

The Mechanical Engineering Department endeavors to be recognized globally for outstanding education and research leading to well qualified engineers, who are innovative, entrepreneurial and successful in advanced fields of mechanical engineering to cater the ever changing industrial demands and social needs.

MISSION

The Mechanical Engineering program makes available a high quality, relevant engineering education. The Program dedicates itself to providing students with a set of skills, knowledge and attitudes that will permit its graduates to succeed and thrive as engineers and leaders. The Program strives to:

- Prepare its graduates to pursue life-long learning, serve the profession and meet intellectual, ethical and career challenges.
- Maintain a vital, state-of-the-art research enterprise to provide its students and faculty with opportunities to create, interpret, apply and disseminate knowledge.

Programme Educational Objectives (PEO)

1. To equip the students with necessary foundation for effectively analyzing and solving the problems associated in thermal engineering field.
2. To deliver comprehensive education in thermal Engineering to ensure that the students have core competency to be successful in industry/ research laboratory and motivate them to pursue higher studies and research in interrelated areas.
3. To encourage the students to take up real life and/or research related problems and to create innovative solutions of these problems through comprehensive analysis and designing.
4. Graduates will have inculcated the ability to maintain high professionalism and ethical standards, effective technical presentation and writing skill and to work as a part of team on research projects
Program Outcomes (PO)

PO 1: An ability to acquire, apply and share in-depth knowledge in the area of thermal engineering.

PO 2: An ability to conduct independent research and generate new knowledge for the benefit of mankind.

PO 3: Graduates will demonstrate an ability to identify, formulate and solve thermal engineering problems.

PO 4: Graduates will demonstrate research skills to critically analyze complex thermal engineering problems for synthesizing new and existing information for their solutions.

PO 5: An ability to maintain a high level of professional and intellectual integrity, ethics of research and scholarly standards.

PO 6: Graduates will demonstrate skills to use modern engineering tools, software and equipment to analyze and solve complex engineering problems.

PO 7: Graduates will demonstrate and ability to work on laboratory and multidisciplinary tasks.

PO 8: Students will be able to convey thoughts effectively on the basis of acquired soft skills and self confidence with peers, subordinates and higher authority for the consistent and effective knowledge sharing process.

PO 9: Graduates will be able to understand the need for, and an ability to engage in life-long learning and continual updating of professional skills.

PO 10: Graduate will acquire knowledge about current issues/advances in engineering practices.

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
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1. **Condition for Admission**
Candidates for admission to the first year of the four-semester M.E / M.Tech Degree programme in Engineering shall be required to have passed B.E / B.Tech degree of Annamalai University or any other authority accepted by the syndicate of this University as equivalent thereto. They shall satisfy the condition regarding qualifying marks and physical fitness as may be prescribed by the syndicate of the Annamalai University from time to time. The admission for part time programme is restricted to those working or residing within a radius of 90 km from Annamalainagar. The application should be sent through their employers.

2. **Branches of Study in M.E / M.Tech**
The Branch and Eligibility criteria of programmes are given in Annexure 1

3. **Courses of study**
The courses of study and the respective syllabi for each of the M.E / M. Tech programmes offered by the different Departments of study are given separately.

4. **Scheme of Examinations**
The scheme of Examinations is given separately.

5. **Choice Based Credit System (CBCS)**
The curriculum includes three components namely Professional Core, Professional Electives and Open Electives in addition to Thesis. Each semester curriculum shall normally have a blend of theory and practical courses.

6. **Assignment of Credits for Courses**
Each course is normally assigned one credit per hour of lecture / tutorial per week and one credit for two hours or part thereof for laboratory or practical per week. The total credits for the programme will be 65.

7. **Duration of the programme**
A student of M.E / M.Tech programme is normally expected to complete in four semesters for full-time / six semesters for part-time but in any case not more than four years for full-time / six years for part-time from the date of admission.

8. **Registration for courses**
A newly admitted student will automatically be registered for all the courses prescribed for the first semester, without any option. Every other student shall submit a completed registration form indicating the list of courses intended to be credited during the next semester. This registration
will be done a week before the last working day of the current semester. Late registration with the approval of the Dean on the recommendation of the Head of the Department along with a late fee will be done up to the last working day. Registration for the Thesis Phase - I and II shall be done at the appropriate semesters.

9. Electives
The student has to select two electives in first semester and another two electives in the second semester from the list of Professional Electives. The student has to select two electives in third semester from the list of Open Electives offered by the department/ allied department. A student may be allowed to take up the open elective courses of third semester (Full Time program) in the first and second semester, one course in each of the semesters to enable them to carry out thesis in an industry during the entire second year of study provided they should register those courses in the first semester itself. Such students should meet the teachers offering those elective courses themselves for clarifications. No specific slots will be allotted in the time table for such courses. Further, the two open elective courses to be studied in III semester (Full Time programme) may also be credited through the SWAYAM portal of UGC with the approval of Head of the Department concerned. In such a case, the courses must be credited before the end of III Semester.

10. Assessment
The break-up of continuous assessment and examination marks for theory courses is as follows:

<table>
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<tr>
<th>Assessment</th>
<th>Marks</th>
</tr>
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<tr>
<td>First assessment (Mid-Semester Test-I)</td>
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<tr>
<td>Second assessment (Mid-Semester Test-II)</td>
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</tr>
<tr>
<td>Third Assessment</td>
<td>5</td>
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<tr>
<td>End Semester Examination</td>
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The break-up of continuous assessment and examination marks for Practical courses is as follows:

<table>
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<th>Assessment</th>
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<tr>
<td>First assessment (Test-I)</td>
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<tr>
<td>Second assessment (Test-II)</td>
<td>15</td>
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<tr>
<td>Maintenance of record book</td>
<td>10</td>
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<tr>
<td>End Semester Examination</td>
<td>60</td>
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</table>

The thesis Phase I will be assessed for 40 marks by a committee consisting of the Head of the Department, the guide and a minimum of two members nominated by the Head of the Department. The Head of the Department will be the chairman. The number of reviews must be a minimum of three per semester. 60 marks are allotted for the thesis work and viva voce examination at the end of the third semester. The same procedure will be adopted for thesis Phase II in the fourth semester.

11. Student Counsellors (Mentors)
To help the students in planning their course of study and for general advice on the academic programme, the Head of the Department will attach a certain number of students to a member of the faculty who shall function as student counsellor for those students throughout their period of study. Such student counsellors shall advise the students, give preliminary approval for the courses to be taken by the students during each semester, monitor their progress in
SWAYAM courses / open elective courses and obtain the final approval of the Head of the Department.

12. Class Committee
For each of the semesters of M.E / M.Tech programmes, separate class committees will be constituted by the respective Head of the Departments. The composition of the class committees from first to fourth semesters for Full time and first to sixth semesters for Part-time will be as follows:

- Teachers of the individual courses.
- A Thesis coordinator (for Thesis Phase I and II) shall be appointed by the Head of the Department from among the Thesis supervisors.
- A thesis review committee chairman shall be appointed by the Head of the Department.
- One Professor or Associate Professor, preferably not teaching the concerned class, appointed as Chairman by the Head of the Department.
- The Head of the Department may opt to be a member or the Chairman.
- All counselors of the class and the Head of the Department (if not already a member) or any staff member nominated by the Head of the Department may opt to be special invitees.

The class committee shall meet three times during the semester. The first meeting will be held within two weeks from the date of class commencement in which the type of assessment like test, assignment etc. for the third assessment and the dates of completion of the assessments will be decided.

The second meeting will be held within a week after the completion of the first assessment to review the performance and for follow-up action.

The third meeting will be held after all the assessments but before the University semester examinations are completed for all the courses, and at least one week before the commencement of the examinations. During this meeting the assessment on a maximum of 25 marks for theory / 40 marks for practical and project work will be finalized for every student and tabulated and submitted to the Head of the Department for approval and transmission to the Controller of Examinations.

13. Temporary Break Of Study
A student can take a one-time temporary break of study covering the current semester and / or the next semester with the approval of the Dean on the recommendation of the Head of the Department, not later than seven days after the completion of the mid-semester test. However, the student must complete the entire programme within the maximum period of four years for Full time / six years for Part time.

14. Substitute Assessments
A student who has missed, for genuine reasons accepted by the Head of the Department, one or more of the assessments of a course other than the end of semester examination may take a
substitute assessment for any one of the missed assessments. The substitute assessment must be completed before the date of the third meeting of the respective class committees. A student who wishes to have a substitute assessment for a missed assessment must apply to the Head of the Department within a week from the date of the missed assessment.

15. Attendance Requirements
The students with 75% attendance and above are permitted to appear for the University examinations. However, the Vice Chancellor may give a rebate / concession not exceeding 10% in attendance for exceptional cases only on Medical Grounds. A student who withdraws from or does not meet the minimum attendance requirement in a semester must re-register and repeat the same semester in the subsequent academic years.

16. Passing and declaration of Examination Results
All assessments of all the courses on an absolute marks basis will be considered and passed by the respective results passing boards in accordance with the rules of the University. Thereafter, the controller of examinations shall convert the marks for each course to the corresponding letter grade as follows, compute the grade point average (GPA) and cumulative grade point average (CGPA) and prepare the mark sheets.

<table>
<thead>
<tr>
<th>Marks</th>
<th>Grade</th>
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<tbody>
<tr>
<td>90 to 100</td>
<td>S</td>
</tr>
<tr>
<td>80 to 89</td>
<td>A</td>
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<td>70 to 79</td>
<td>B</td>
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<td>60 to 69</td>
<td>C</td>
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<td>55 to 59</td>
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<td>50 to 54</td>
<td>E</td>
</tr>
<tr>
<td>Less than 50</td>
<td>RA</td>
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<td>Withdrawn from the Examination</td>
<td>W</td>
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</table>

A student who obtains less than 30 / 24 marks out of 75 / 60 in the theory / practical examinations respectively or is absent for the examination will be awarded grade RA.
A student who earns a grade of S, A, B, C, D or E for a course is declared to have successfully completed that course and earned the credits for that course. Such a course cannot be repeated by the student.
A student who obtains letter grade RA / W in the mark sheet must reappear for the examination of the courses.
The following grade points are associated with each letter grade for calculating the grade point average and cumulative grade point average.
S - 10; A - 9; B - 8; C - 7; D - 6; E - 5; RA - 0
Courses with grade RA / W are not considered for calculation of grade point average or cumulative grade point average.
A student can apply for re-totaling of one or more of his examination answer papers within a week from the date of issue of mark sheet to the student on payment of the prescribed fee per paper. The application must be made to the Controller of Examinations with the recommendation of the Head of the Department.
After the results are declared, mark sheets will be issued to the students. The mark sheet will contain the list of courses registered during the semester, the grades scored and the grade point average for the semester. GPA is the sum of the products of the number of credits of a course with the grade point scored in that course, taken over all the courses for the semester, divided by the sum of the number of credits for all courses taken in that semester. CGPA is similarly calculated considering all the courses taken from the time of admission.

17. Awarding Degree
After successful completion of the programme, the degree will be awarded with the following classifications based on CGPA.
For First Class with Distinction the student must earn a minimum of 65 credits within four semesters for full-time / six semesters for Part time from the time of admission, pass all the courses in the first attempt and obtain a CGPA of 8.25 or above.
For First Class, the student must earn a minimum of 65 credits within two years and six months for full-time / three years and six months for Part time from the time of admission and obtain a CGPA of 6.75 or above.
For Second class, the student must earn a minimum of 65 credits within four years for full-time / six years for Part time from the time of admission.

18. Ranking Of Candidates
The candidates who are eligible to get the M.E /M.Tech degree in First Class with Distinction will be ranked on the basis of CGPA for all the courses of study from I to IV semester for M.E / M.Tech full-time / I to VI semester for M.E / M.Tech part-time.
The candidates passing with First Class and without failing in any subject from the time of admission will be ranked next to those with distinction on the basis of CGPA for all the courses of study from I to IV semester for full-time / I to VI semester for M.E / M.Tech part-time.

19. Transitory Regulations
If a candidate studying under the old regulations M.E. / M.Tech could not attend any of the courses in his/her courses, shall be permitted to attend equal number of courses, under the new regulation and will be examined on those subjects. The choice of courses will be decided by the concerned Head of the department. However he/she will be permitted to submit the thesis as per the old regulations. The results of such candidates will be passed as per old regulations.
The University shall have powers to revise or change or amend the regulations, the scheme of examinations, the courses of study and the syllabi from time to time.
## ANNEXURE -1

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Department</th>
<th>Programme (Full Time &amp; Part time)</th>
<th>Eligible B.E./B.Tech Programme *</th>
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<tr>
<td></td>
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<td>ii. Environmental Engineering &amp; Management</td>
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<tr>
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<td>ii. Construction Engg. and Management</td>
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<td>iii. Geotechnical Engineering</td>
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<tr>
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<td>iv. Disaster Management &amp; Engg.</td>
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<tr>
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<td>ii. Welding Engineering</td>
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<tr>
<td></td>
<td></td>
<td>ii. Smart Energy Systems</td>
<td>B.E. / B.Tech – Electrical and</td>
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<td>Electronics &amp; Instrumentation Engineering</td>
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<td>iii.</td>
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* AMIE in the relevant discipline is considered equivalent to B.E
## DEPARTMENT OF MECHANICAL ENGINEERING

### Curriculum for M.E. Thermal Power Engineering (Full Time)

#### FIRST SEMESTER

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### THIRD SEMESTER

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<td>Thesis</td>
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*Note: * - Four weeks during the summer vacation at the end of II\textsuperscript{nd} Semester.*

### FOURTH SEMESTER

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**L- Lecture ; P- Practical; T- Thesis; CA- Continuous Assessment; FE- Final Examination**
## DEPARTMENT OF MECHANICAL ENGINEERING

### Curriculum for M.E. Thermal Power Engineering (Part Time)

#### First Semester

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*Note: * - Four weeks during the summer vacation at the end of IVth Semester.*

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**L- Lecture ; P- Practical; T- Thesis; CA- Continuous Assessment; FE- Final Examination**
LIST OF ELECTIVES

PROFESSIONAL ELECTIVES

1. Analysis and Design of Turbo Machines
2. Mechanical Design of Rotodynamic Machines
3. Design of Heat Exchangers
4. Fluidized Bed Systems
5. Bio Energy Conversion Technologies
6. Cogeneration and Waste Heat Recovery Systems
7. Computational Heat Transfer
8. Computational Fluid Dynamics
9. Advanced Engines and Emission Systems
10. Finite Element Methods in Thermal Engineering
11. Thermal System Analysis
12. Energy Conservation in HVAC Systems
13. IC Engine Combustion and Measurement Techniques
14. Power Plant Management
15. Process Instrumentation
16. Nuclear Engineering
17. Alternate Fuels for Internal Combustion Engine

OPEN ELECTIVES

1. Numerical Analysis
2. Microprocessor and Applications
3. Waste Management and Energy Generation Techniques
4. Power Plant Instrumentation and Controls
5. Mechanical Behavior of Materials
6. Metal Joining Technology
7. Optimization Techniques
8. Impact Engineering
9. Composite Materials
COURSE OBJECTIVES

- To impart knowledge on numerical methods that will come in handy to solve numerically the problems that arise in engineering and technology. This will also serve as a precursor for future research.

Algebraic Equations


Ordinary Differential Equations

Runge Kutta Methods for system of IVPs, numerical stability, Adams-Bashforth multistep method, solution of stiff ODEs, shooting method, BVP: Finite difference method, orthogonal collocation method, orthogonal collocation with finite element method, Galerkin finite element method.

Finite Difference Method for Time Dependent Partial Differential Equation


Finite Difference Methods for Elliptic Equations

Laplace and Poisson’s equations in a rectangular region: Five point finite difference schemes, Leibmann’s iterative methods, Dirichlet and Neumann conditions – Laplace equation in polar coordinates: finite difference schemes – approximation of derivatives near a curved boundary while using a square mesh.

Finite Element Method


REFERENCES


COURSE OUTCOMES

Upon completion of this course, the students will be able to

1. Solve engineering problems numerically.

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TPEC102 | ADVANCED THERMODYNAMICS |
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COURSE OBJECTIVES

- To achieve an understanding of basic principle and scope of thermodynamics.
- To predict the availability and irreversibility associated with the thermodynamic processes.
- To analyse the properties of ideal and real gas mixtures. Also to achieve an understanding of Statistical thermodynamics and Irreversible thermodynamics.

**Availability Analysis and Thermodynamic Property Relations**


**Real Gas Behaviour and Multi-Component Systems**

Different Equations of State, Fugacity, Compressibility, Principle of Corresponding States, Use of generalised charts for enthalpy and entropy departure, fugacity coefficient, Lee-Kesler generalized three parameter tables.

Fundamental property relations for systems of variable composition, partial molar properties, Real gas mixtures, Ideal solution of real gases and liquids, Activity, Equilibrium in multi phase systems, Gibbs phase rule for non-reactive components.

**Statistical Thermodynamics**

Microstates and Macrostates, Thermodynamic probability, Degeneracy of energy levels, Microscopic Interpretation of heat and work, Evaluation of entropy, Partition function, Calculation of the Macroscopic properties from partition functions, Equilibrium constant statistical thermodynamics approach.

18
Irreversible Thermodynamics

Conjugate Fluxes and Forces, Entropy Production Onsager's Reciprocity relations, Thermo-electric phenomena.

REFERENCES


COURSE OUTCOMES:

On successful completion of this course the student will be able to

1. Apply the law of thermodynamics to thermal systems.
2. Calculate the availability of the systems and cycles
3. Analyse the engineering systems to improve and optimize its performance

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COURSE OBJECTIVES

- Learn and Understand the Concepts of fluid flow problems
- Acquiring the computational Knowledge in Fluid flow models
- Application of differential equations in fluids applications

Fundamentals of fluid flow

Isentropic flow, Compressible flow, adiabatic Flow, Flow in constant area ducts – with friction - without friction – problems. Fanno line-Rayleigh’s line. CFD Models of flow, continuity, momentum and energy equations, Navier- Stokes equation, Euler equation, physical boundary conditions-Applications

Physical significance of irrotational motion

Kelvins theorem- Connection between the rotation and the thermodynamic properties of flow - Crocco’s theorem – Equation of continuity (3d).

Differentials equations in terms of Velocity potential and Stream function

Relation between stream function and velocity potential.

Two dimensional Subsonic flow


Two dimensional supersonic flow


REFERENCES

COURSE OUTCOMES

1. Concepts of fluid flow problems will make the engineering graduate to apply the knowledge in real time applications.
2. Graduate may become an researcher, entrepreneur or an employer in fluid flow industry
3. Development of software Fluid models incorporating the mathematical knowledge for real time applications

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TPEC104 ADVANCED HEAT TRANSFER

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COURSE OBJECTIVES

- To develop the ability to use the heat transfer concepts for various applications like finned systems, turbulence flows, high speed flows.
- To develop the numerical approach to solve the heat transfer problem
- To carry out the thermal analysis and design of heat exchangers.

Review on mechanism of heat and mass transfer – balance laws and constitutive equations.

Conduction


Convection


Radiation

Two phase flows and boiling and condensation heat transfer

Fundamentals of 2-phase flows: Homogenous, separated and drift flux models – Two phase flow pressure drop.

Heat Exchange Equipments


REFERENCES


COURSE OUTCOMES

1. On successful completion of this course the student will be able to apply the law of thermodynamics and heat transfer to real life heat transfer problems.

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Mapping with Programme Outcomes
COURSE OBJECTIVES

- To conduct the load test, speed test and Heat Balance Test of a single and double cylinder diesel engine
- To evaluate the performance of steam boiler, turbine and condenser.
- To make the students understand the working principle of various types of governors, balancing systems, Cam analyzer, Torsional vibration of single rotor system, whirling speed concept, action of forces in gyroscope.

List of Experiments

1. Study and Performance test on Kaeser air compressor test rig.
2. Heat balance test and air fuel determination on a Diesel Engine.
4. Determination of Damping coefficient in damping torsional oscillation.
5. Experimentation of pressure processes station by PID control.
6. Demonstrate the gyroscopic effects and determination of gyroscopic couple.
7. Performance evaluation of loco type boiler.

COURSE OUTCOMES

Upon completing this course, students should be able to:

1. Gain knowledge about the combustion principles.
2. Analyze the performance of steam boiler, turbine and condenser.
3. Supplement the principles learnt in kinematics and Dynamics of Machinery.

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COURSE OBJECTIVES

- To understand the principle of operation and design aspects of refrigeration and air conditioning system and its components with multistage.
- To learn the selection procedure and design of duct system with pipe lines
- To learn the concept of cooling load calculation and comfort design of air conditioning systems


Thermal design of compressor, condenser, evaporator and expansion devices - selection of condensers and evaporators-design of pipe lines-selection and matching of components.

Review of psychrometric processes - Cooling load calculations, selection of standard comfort design of air-conditioning system. Critical loading conditions, selection of cooling unit, air cleaning systems and air filters.

Passive heating and cooling of Building, Selection of duct arrangements, duct layout, duct design, duct installation - duct maintenance- sheet metal standards- duct materials – pressure balancing of ducts, duct sizing- Friction and dynamic losses in duct, static regain method-problems.


REFERENCES

2. V.K.Jain - Refrigeration and Air-conditioning - S. Chand & Co, New Delhi,

COURSE OUTCOMES

Upon completion of this course the students will be able to,

1. Appreciate the principle of operation of multistage and different refrigeration and air conditioning system
2. Understand the design and selection procedure of air conditioning components with its thermal behaviors
3. Learn the design of duct system, charging of refrigeration, trouble shooting procedure and its applications in air conditioning system

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**TPEC202 DESIGN OF THERMAL POWER EQUIPMENTS**

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**COURSE OBJECTIVES**

The course should enable the students to

- Provide knowledge of various components and its types used in thermal power plants.
- Provide knowledge of design principles of various components in thermal power plants.
- Understand the limitations, advantages and disadvantages of various components.

**Design considerations**


**Condenser Design**

Types of condensers – Design of condensers – Surface area calculation – Air leakage and its effects – methods of removal of air leakage – Condenser water cooling system – Air pump – Wet and Dry capacity and dimensions.

**Super heater Design**


**Evaporator Design**

Air Heaters


REFERENCES


COURSE OUTCOMES

Upon completion of the course the students will be able to
1. Design a system or components required to meet desired needs.
2. Select the capacity of various components based on design requirements.
3. Work effectively as team members in thermal power plant projects.

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COURSE OBJECTIVES

- To understand and analyze the present and future energy demand of world and nation and techniques to exploit the available renewable energy resources such as, solar, bio-fuels, wind power, tidal and geothermal effectively

Direct Energy Conversion


Power Plants


Solar Energy


Other Non-Conventional Energy Systems


Tidal Power Plants


REFERENCES

COURSE OUTCOMES

Upon the completion of the course, the students will be able to
1. Acquire fundamental knowledge in energy generation, heat transfer and to utilisation-renewable energy-conversion technology
2. Ability to use modern engineering tools, software and equipment to analyze and solve complex engineering problems.
3. Solve real world problems and reduce the impact global warming for betterment of living things to serve healthy life.

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COURSE OBJECTIVES

- To understand the working principles of various instruments used in thermal power plants
- To acquire the knowledge of working of modern equipment.

Concept of Generalized Measurement System

System configurations - Errors Problem analyses - Basic characteristics of measuring devices – Calibration – introduction to data acquisition and processing systems – compact data loggers.

Temperature

Thermo electric sensors – Thermocouple & electrical resistance- Radiation & optical thermometers – Quartz crystal Thermometers – High speed Temperature probe.

Gas analysis

Measurement of CO₂, NO₂, CO, hydrocarbon and SO₂ – use of chromatography – smoke Measurement. NOₓ and particulate measurement – Concentration measurement.

Pressure

Variable reluctance & LVDT Type pressure sensors – Knudsen gauge – Thermal conductivity ionization gauge High pressure measurement – Piezo-electric and vibrating elements pressure sensors.
Flow


REFERENCES

4. 

COURSE OUTCOMES

Upon completion of this course, the students will be able to:
1. Understand the advances in the field of instrumentation.
2. Learn the various instrumentation terminologies in thermal engineering.
3. Acquire the principle and working of modern equipments.

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COURSE OBJECTIVES

- To make the students understand the modes of heat transfer and to conduct the trails on various experiments to analyze the heat transfer parameters.
- To understand the working of refrigeration trainer and air conditioners.
- To study the basics of solar energy.

List of Experiments

1. Natural convection from vertical cylinder
2. Experiments on finned tube heat exchanger
3. Experiments on unsteady state heat transfer apparatus.
4. Determination of thermal conductivity of metal rod.
5. Experiments on composite wall apparatus
6. Performance test on central A/C plant
7. Performance test on vapor absorption refrigeration system
8. Performance test on Solar still

COURSE OUTCOMES

Upon completing this course, students should be able to:

1. Understand the behavior of a system at different operating conditions
2. Understand the usage of different refrigeration tools.
3. Learn the basics of solar energy, how to determine solar intensity, and how to estimate daily and annual solar energy potential at each location

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COURSE OBJECTIVES

- To enhance the research and development activities of the students.

COURSE OUTCOMES

1. The students’ would apply the knowledge gained from theoretical and practical courses in solving problems, so as to give confidence to be creative, well planned, organized, coordinated in their project work phase–II.

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COURSE OBJECTIVES:

- To train the students in the field work related the Mechanical Engineering and to have a practical knowledge in carrying out Structural field related works.
- To train and develop skills in solving problems during execution of certain works related to Manufacturing Engineering.

The students individually undergo a training program in reputed concerns in the field of Manufacturing Engineering during the summer vacation (at the end of second semester for full – time / fourth semester for part – time) for a minimum stipulated period of four weeks. At the end of the training, the student has to submit a detailed report on the training he had, within ten days from the commencement of the third semester for Full-time / fifth semester for part-time. The students will be evaluated by a team of staff members nominated by head of the department through a viva-voce examination.

COURSE OUTCOMES:

1. The students can face the challenges in the practice with confidence.
2. The student will be benefited by the training with managing the situation arises during the execution of works related to Manufacturing Engineering.
Mapping of Course Outcomes with Programme Outcomes

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FOURTH SEMESTER

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COURSE OBJECTIVES

- To improve the student research and development activities.
- To improve presentation and report preparation skills.

COURSE OUTCOMES

1. The students would apply the knowledge in solving problems, so as to give confidence to be creative, well planned, organized, coordinated project outcome of the aimed work.

Mapping with Programme Outcomes

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PROFESSIONAL ELECTIVE SUBJECTS

TPEEX0X  ANALYSIS AND DESIGN OF TURBO MACHINES  L  T  P
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COURSE OBJECTIVES

- To equip the students with necessary foundation for effective analyzing and solving the problem.
- To enlighten the thermodynamics aspects of energy transfer.
- To study the flow characteristics of Turbo machines.

Theory of Turbo machines


Flow of fluid through rotor blades – One and two dimensional incompressible flow analysis – Calculation of velocity and pressure – Radial pressure gradient – Free vortex flow – Forced vortex flow (Theory only). Two dimensional cascades – Experimental study – Correlations, Ainley, Soderberg, and Howell’s (Theory only).

Fans, Blowers and Pumps


Steam Turbines


REFERENCES

COURSE OUTCOMES

Upon completion of the course, the students will be able to
1. Gain the knowledge for all forms of turbo machines.
2. Study the fluid flow analysis through turbine blades.
3. Analyze design characteristics of fan, blower and pumps.

Mapping with Programme Outcomes

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TPEEX0X MECHANICAL DESIGN OF ROTODYNAMIC MACHINES

COURSE OBJECTIVES

- Knowledge of Rotodynamic machine and to perform design, operation, performance evaluation and research in the area.
- To educate the students with knowledge of experimental techniques and instruments required.
- To impart knowledge on conceptual design of different components of thermal and hydro turbo machines.

Introduction to Mechanical Design Aspects


Bearings


Eigen Value Problems

Torsional, Longitudinal and lateral vibration problems.

Jacobi Givens and Householder’s transformations – Forward and inverse iteration schemes – Gram Schmidt deflation technique to find the natural frequencies – Simultaneous iteration method – Standard eigen value form – non-standard eigen value form – Subspace iteration – Lanczo’s method.

Industrial applications – Determination of critical speeds – including gyroscopic effect – eigen pairs of boiler frame – Eigen values of compressor disc.
REFERENCES


COURSE OUTCOMES

Upon completion of the course, the students will be able to
1. Equip fundamental knowledge on principle of operation, component details and performance evaluation.
2. Carry out research and development in the area of rotodynamic machines.
3. Comprehend concepts and develop academic skills to disseminate knowledge to others.

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COURSE OBJECTIVES

- To expose the student to perform the energy transfer analysis on the all types of heat exchangers.
- To impart the knowledge about phase changes-Special application to Condensers and Evaporators.
- To understand and solve the real life industrial problems for heat exchanger design and optimization.

Constructional Details and Heat Transfer

Types - Shell and Tube Heat Exchangers - Regenerators and Recuperators - Industrial Applications Temperature Distribution and its Implications - LMTD - Effectiveness

Flow Distribution and Stress Analysis

Effect of Turbulence - Friction Factor - Pressure Loss - Channel Divergence Stresses in Tubes - Heater Sheets and Pressure Vessels - Thermal Stresses - Shear Stresses - Types of Failures
Design Aspects


Condensers and Evaporators Design

Design of Surface and Evaporative Condensors - Design of Shell and Tube - Plate Type Evaporators

Cooling Towers

Packings - Spray Design - Selection of Pumps - Fans and Pipes - Testing and Maintenance - Experimental Methods

REFERENCES


WEBSITES

2. http://www.tata.com

COURSE OUTCOMES

Upon completion of the course, students will be able to
1. Perform the energy transfer in the all types of heat exchangers.
2. Perform heat exchanger design using engineering equation solver.
3. Perform energy transfer analysis for research and develop energy effective systems.

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COURSE OBJECTIVES

- To understand the design principles and applications of fluidized bed systems.
- To introduce the concepts of fluidization and heat transfer in fluidized beds.

Fluidized Bed Behaviour


Heat Transfer


Combustion and Gasification


System Design


Industrial Applications

Sulphur Retention - Nitrogen Emission Control - Furnaces, Dryers, Heat Treatment, etc. Pollution Control and Environmental Effects - Cost Analysis

REFERENCES

COURSE OUTCOMES

Upon completion of the course, the students will be able to
1. Understand the working principles, merits and limitations of fluidized bed systems
2. Apply fluidized bed systems for a specific engineering application.
3. Analyze the fluidized bed system to improve and optimize its performance

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TPEEX0X BIO ENERGY CONVERSION TECHNOLOGIES

COURSE OBJECTIVES

- To pursue the various technologies for utilizing the bio-energy and its availability and conversion of bio-energy in the useful forms.
- Analyze elaborately the technologies available for conversion of biomass to energy in the technical update.
- Analyze the bio-energy conversion with respect to economical aspect and also in the environmental aspect.

Introduction of Biomass

Availability merits and demerits-Indian scenario-conversion mechanism- utilization of photo synthesis comparison with other energy.

Thermal Biomass Conversion

Combustion, pyrolysis, Gasification and Liquefaction-Biological Conversion-Methanol, Ethanol Production - Fermentation-Anaerobic Digestion Biodegradation and Biodegradability of Substrate.

Combustion

Perfect, complete and incomplete combustion-stoichiometric air requirement for biofuels - equivalence ratio-fixed bed and fluid Bed combustion-fuel and ash handling systems-steam cost comparison with conventional fuels.

Power Generation Techniques

Through Fermentation and Gasification-Biomass Production from different Organic Wastes- Effect of Additives on Biogas Yield-Biogas production from Dry Dung Cakes-Industrial

**Economics and Environmental Aspects**


**REFERENCES**

1. David Boyles, Bio Energy Technologies Thermodynamics and Costs, Ellis Hoknood, Chichester, 1984
6. Tom B Reed, Biomass Gasification-Principles and Technology, Noyce Data Corporation, 1981

**COURSE OUTCOMES**

Upon completion of the course, the students will be able to

1. Gain idea about the various forms of biomass.
2. Understand the various biomass energy conversion technologies and its importance.
3. Understand the economical and environmental aspect towards the present energy crisis.

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COURSE OBJECTIVES

- To gain fundamental knowledge in energy generation, heat transfer in thermal engineering.
- To reduce the impact global warming for betterment of living things to serve healthy life.

Cogeneration


Application & Techno Economics of Cogeneration


Waste Heat Recovery

Introduction - Principles of Thermodynamics and Second Law - Sources of Waste Heat Recovery - Diesel Engines and Power Plant etc.

Waste Heat Recovery Systems, Applications & Techno Economics


Environmental Considerations

Environmental Considerations for Cogeneration and Waste Heat Recovery - Pollution

REFERENCES

COURSE OUTCOMES

1. The students will acquire fundamental knowledge in energy generation, heat transfer in thermal engineering.
2. Students will get the ability solve problems using mathematical concepts and to use modern engineering tools, software and equipment to analyze and solve complex engineering problems.
3. The students will be able to solve real world problems and reduce the impact global warming for betterment of living things to serve healthy life.

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COURSE OBJECTIVES

- To impart fundamental mathematical concepts related to computational heat transfer.
- To impart fundamental mathematical concepts about fluid flow and heat transfer.
- To train students in the usage of computational codes and develop new ones.

Mathematical Description of Physical Phenomena


Finite Difference Methods in Partial Differential Equations


Applications in Heat Condition and Convection

Control Volume Approach - Steady and Unsteady One Dimensional Conduction - Two and Three Dimensional Situations - Solution Methodology.

Convection and Diffusion

Upwind Scheme - Exponential Scheme. Hybrid Scheme - Power Law Scheme : Calculation of the Flow Field - Simpler Algorithm.

Finite Element Method Concept


REFERENCES


COURSE OUTCOMES

1. The students will acquire fundamental knowledge in mathematical related to computational heat transfer in thermal engineering.
2. Students will get the ability solve problems using mathematical concepts.
3. The students will be able to solve real world problems using numerical methods.

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COURSE OBJECTIVES

Graduates are able to:

- Learn the physical significance of computational fluid dynamics as a design and research tool through derivation of governing equations.
- Understand to linearization of given mathematical behavior of flow field by finite difference method and obtain solution by numerical methods.
- Learn the implementation of FDM and numerical techniques in simple field behavior problems.
Philosophy of computational fluid dynamics

CFD as a research tool, CFD as a design tool, applications. Governing equations, their derivation, physical meaning and presentation of forms suitable to CFD.

Models of flow, continuity, momentum and energy equations, Navier-Stokes equation, Euler equation, physical boundary conditions. Mathematical behavior of partial differential equations, discrimination, finite differences, explicit and implicit approaches.

Grids with appropriate transformation

Transformation of equations, stretched grids, adaptive grids, mesh generation.

Simple CFD techniques

The Lax-Wendroff Technique, MacCormack's technique, relaxation technique, the alternating direction implicit technique, pressure correction method Leap frog and Crank Nicolsan method, upwind schemes

Some applications

Numerical solution of Quasi one-dimensional nozzle flows, incompressible coutte flow.

REFERENCES


COURSE OUTCOMES

At the end of course, the graduates have ability to:
1. Describe the signification of flow field in energy engineering which imparts the knowledge of design and research as tool.
2. Formulate the linear equation of complex field behavior of mathematical governing equations through finite difference method which solves by numerical techniques.
3. Handle multidisciplinary task of work and used as modern engineering tools by the application of software which continues the updating of professional skills.

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COURSE OBJECTIVES

- To explore recent trends, combustion modes and add on devices of automotive engines persisting in transportation system
- To reveal formation of pollution strategies of emission and control in in-cylinder combustion and after burn conditions.
- To understand measurement of exhaust emission using chassis dynamometer and trends in vehicle emission standards.

Advanced Engines


SI and CI Engine Combustion


Pollutant Formation

Pollutant formation in SI Engine - Unburned HC formation - HC oxidation in the cylinder and exhaust - exodus of HC contribution of different sources - Flame quenching in SI engines kinetics of NO and NO2 formation – CO and CO2 – Pollutant formation in CI Engines Formation of HC in CI engines – effect of nozzle design and other variable - NO and NO2 formation in premixed and diffusion combustion periods. Formation of CO and kinetic effects - effect of engine variables - Composition of particulates - soot formation - soot structure - stoichiometric considerations, nucleation, growth and oxidation

Emission Control Systems

Strategies for emission control - emissions control inside the engine - EGR, crankcase and evaporative emission control - Exhaust gas after treatment - thermal and catalytic reactors - elements of reactors, catalysts and substrates – oxidation and reduction – Three way catalytic reactors - closed loop feedback control - catalyst deactivation mechanism - cold start HC control - Lean deNOx catalysts - NOx traps and SCR- Diesel particulate filters (DPF) - DPF regeneration
Measurement of Emissions

Measurement of emissions - instrumentation for CO, HC, NOx, PM and smoke emissions - chassis dynamometer – isokinetic sampling - constant volume sampling (CVS) system – development of driving cycles – driving cycle tests procedures – European, US and Japan driving cycles - trends in vehicle emission standards - emission limits - national and international emission norms

REFERENCES


COURSE OUTCOMES

1. Acquire knowledge on evolution of recent technologies for enhancement of internal combustion engines.
2. Understand the occurrence of combustion phenomena and their characterization in internal combustion engines.
3. Obtain knowledge of emission measurement test procedures and vehicle emission norms.

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TPEEX0X | FINITE ELEMENT METHODS IN THERMAL ENGINEERING | L | T | P
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COURSE OBJECTIVES:

- To train students to acquire in depth mathematical knowledge related to finite element methods.
- To acquire knowledge to solve simple 1-dimensional and 2-dimensional problems related to fluid flow and heat transfer.
- To train students to develop codes to solve real world problems in heat transfer equipments using finite element codes.
Overview of numerical methods – Discretised representation of physical systems – thermal
resistance, flow resistance networks, thermal capacitance – Governing equations and Boundary
conditions for thermal and flow systems.

Principles of variations calculus – applications of variational approach to one dimensional
heat conduction – element matrix contribution and assembly.

Weighted residual methods – Galerkin’s approach – Shape functions and interpolations –
Application of Galerkin’s weighted residual approach to one dimensional heat conduction – Three
nodded triangular elements, 2 D steady state conduction using triangular elements – Radiation and
natural convective boundary conditions – incorporation of variations in thermal properties.

Higher order elements and numerical integration solution of heat conduction and creeping
flow using higher order element – Solution of convective heat transfer.

Incompressible laminar flow simulation – Stream function/Vorticity methods, Velocity
Pressure formulation, mixed order interpolation for incompressible flow, modifications for turbulent
flow. Application to heat exchanger. Description of programs for heat conduction, fluid flow,
Assignment problems using these codes.

REFERENCES

6. Introduction to Finite Elements in Engg., T.R.Chandrapatla and Belegundu, Prentice Hall of
   India, New Delhi, 1985.

COURSE OUTCOMES

1. The students will gain knowledge to identify the problems in thermal engineering, formulate
   solutions through computational approaches.
2. The students will get the ability to analyze and solve convective heat transfer problems using
   numerical techniques.
3. Students will acquire ability to solve real world problems in the field of thermal engineering.

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Mapping with Programme Outcomes
COURSE OBJECTIVES

The curriculum is supposed to facilitate the students to:
- Develop the awareness of thermodynamics, heat transfer and fluid mechanics in the design of integrated thermal systems.
- Design thermal systems to meet desired need within realistic limitations such as economic, environmental, social, safety, manufacturability and sustainability.
- Gain knowledge about current issues and advances in engineering practices.

Design of Thermal System

- Design Principles, Workable systems, Optimal systems, Matching of system components, Economic analysis, Depreciation, Gradient present worth factor.

Mathematical Modelling

- Equation fitting, Nomography, Empirical equation, Regression analysis, Different modes of mathematical models, selection, computer programmes for models.

Modeling Thermal Equipments

- Modelling heat exchangers, evaporators, condensers, absorption and rectification columns, compressor, pumps, simulation studies, information flow diagram, solution procedures.

Systems Optimization

- Objective function formulation, Constraint equations, Mathematical formulation, Calculus method, Dynamic programming, Geometric programming, Linear programming methods, solution procedures

Dynamic Behavior of Thermal System

- Steady state simulation, Laplace transformation, Feedback control loops, Stability analysis, Non-linearities.

REFERENCES

COURSE OUTCOMES

The students should be able to
1. Intend and pertain knowledge of mathematics, science and engineering
2. Propose a system, component or process to meet desired needs
3. Realize the professional and ethical conscientiousness

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TPEEX0X ENERGY CONSERVATION IN HVAC SYSTEMS

COURSE OBJECTIVES

- To understand the basic principles and latest developments in HVAC systems
- To understand the components and design principles used in air distribution systems.


Heating and Ventilating systems - Energy conservation feasibility analysis – conventional ventilating systems, constant volume induction system, Multizone unit system, Variable volume induction system, constant temperature systems. Heat Pipe Applications in Air-conditioning systems.


REFERENCES

5. Energy conservation in Heating, Cooling and Ventilating Buildings, Proceedings
7. Edward Hartmann, Maintenance Management, Productivity And Quality Publishing Pvt. Ltd.

COURSE OUTCOMES

1. Students will have a good understanding, knowledge, and comprehension of the theory and principals of HVAC equipment and their use.
2. Students will demonstrate a solid foundation of required technical skills for HVAC Installers and/or Serviced Techs.
3. Students will be able to identify and apply the principles and strategies necessary for hands-on installation, trouble-shooting, and servicing HVAC systems.

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COURSE OBJECTIVES

- To understand thermodynamics of combustion and stages of combustion process in SI and CI engines
- To learn formation of pollutants with respect to engine operating variables and their effects on environment
- To understand instrumentation for engine emission and driving cycle test procedures.

Combustion Basics

Air pollution from IC engines - primary and secondary pollutants- photochemical smog - Thermodynamics of combustion - Stoichiometry of combustion - heats of reaction and formation - adiabatic flame temperature - Chemical equilibrium - properties of equilibrium- combustion products of air-fuel mixtures -Introduction to chemical kinetics - order of reaction and reaction rates - Premixed combustion - flammability limits, SIT, flame structure - laminar and turbulent flames, flame speeds.

Combustion in SI Engines

**Combustion in CI Engines**


**Pollutant Formation**


**Measurement Techniques**


**REFERENCES**


**COURSE OUTCOMES**

1. Acquire knowledge of combustion phenomena related to engine variables of SI and CI engine.
2. Obtain knowledge of pollutant formation mechanism on various reasons.
3. Obtain knowledge of measurement techniques of combustion process and exhaust emission using various devices.
COURSE OBJECTIVES

1. The course aims to equip the students with the analytical tools of economics and apply the skills for managerial decision making.
2. It seeks to develop economic way of thinking in dealing with practical problems and challenges.
3. To provide an idea of modern approaches to manage the power plant.

Managerial Economics


Replacement Studies

Types of replacement studies – annual cost present worth - rate of return – MAPT approach to replacement studies.

Budgetary Control

Various steps in budgetary control – basic concepts – break even charts – setting targets for profits, sales – manufacturing – variable cost budgeting.

Power Plant Economics


Personnel Management

REFERENCES


COURSE OUTCOMES

1. To gather the knowledge of budgetary control and economics of power plant
2. To gain the managerial skills
3. Understand the training techniques of power plants.

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COURSE OBJECTIVES

- To educate students on different measurement systems and on common types of errors.
- To introduce different types of sensors, transducers, strain gauges, thermocouples, thermometers and flow meters used for measurement.
- To introduce control equipments and combined modes of control systems.

Fundamentals of process measurements, measurements of temperature

The air thermometer, thermodynamic viewpoints of temperature, the international practical temperature scale (IPTS) and ITS-90 scale- an overview. Introduction to instruments and their representation-application-functional elements or sensors-classification- microprocessor based instrumentation- standards and calibration; Static and dynamic performance of instruments, errors and uncertainties, propagation of measurement error into result.

Temperature and its measurement

Liquid-in-glass thermometers, principles and definitions, stem corrections, stability and accuracy; resistance thermometer, principles, sensors, circuits and bridges, resistance thermometer characteristics, circuit connection of PRT, thermistor; thermoelectric thermometry, historical development of basic relation, laws of thermoelectric circuits, thermoelectric circuit analysis; optical pyrometry, history, principles and calibration; temperature measurements in moving fluids, installation effects on temperature sensors; transient temperature measurements, first and second order response.
Pressure and its measurement

Concepts of pressure, pressure standards, mechanical and electrical pressure transducers, high and low pressure measurements, pressure measurement in moving fluids, transient pressure measurement

Flow and its measurements

Primary and secondary meters, positive displacement meters, invasive and non-invasive type flow meters.

Data analysis

An overview of basic statistical concepts, graphical representation and curve fitting of data, empirical correlation-linear fit, method of least square fit, error and uncertainty analysis.

REFERENCES


COURSE OUTCOMES

Upon completion of the course, the students will be able to
1. Gain knowledge about various instrumentation techniques
2. Perform dynamic modeling and study the system behavior
3. Apply control systems in various processes

Mapping with Programme Outcomes

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COURSE OBJECTIVES

- To acquire knowledge of technical competency combined with research to generate innovative solutions in Energy engineering
- To be acquainted with a variety of options in energy sources.
- To prepare the students to exhibit a high level of professionalism, integrity, environmental and social responsibility, and life-long independent learning ability

Review of nuclear physics


Reactor Materials:


Boiling water reactor


Liquid metal cooled reactors


Separation of Reactor Products


REFERENCES

COURSE OUTCOMES

1. An ability to acquire, apply and share in depth knowledge in the area of Nuclear physics and reactor materials.
2. An ability to have generate knowledge about different types of reactors and ore materials of uranium and thorium.
3. An ability to apply knowledge about Nuclear reprocessing, Waste Disposal and Radiation Protection methods.

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COURSE OBJECTIVES

- Learn various biofuel production methods and their characterization using various equipments.
- Describe the technique of reformation of biofuel fuel and alcohol fuel and its utilization in internal combustion engines.
- Understand the scenario of gaseous fuel utilization and their performance features in internal combustion engine

Biofuel production and characterization

Vegetable oil – biofuel production methods – pyrolysis, fermentation, catalytic cracking and transesterification process – characterization of fuel – physical and chemical properties, Gas Chromatograph and Mass Spectroscopy (GC-MS) analysis, Fourier Transformation Infrared (FTIR) analysis, Thermo Gravimetric (TG) analysis and elemental analysis – suitability – merits and demerits

Reformation of liquid fuel

Alcohol fuel and fuel additives


Biogas utilization


Gaseous fuel


REFERENCES

2. Duffy Smith, Auto fuel systems, the Good Heart Willcox Company Inc. Publishers, 1987

COURSE OUTCOMES

1. Identify biofuel preparation methods and their characterization procedures using various devices.
2. Obtain knowledge of reforming liquid fuel and preparation of nano fuel blend.
3. Understand prospects of various gaseous fuels utilization in the transportation system.

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OPEN ELECTIVES

TPEEX0X | NUMERICAL ANALYSIS | L | T | P
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COURSE OBJECTIVES

- To understand the significance of numerical analysis in solving engineering problems
- To understand the basic concepts of mathematical modeling

Functional Approximation

Interpolation - divided difference, finite difference, Lagrangian, Chebychev, Hermite, Spline interpolations. Least squares methods - Orthogonal polynomial approximations, fourier approximations, fast fourier transforms. Types of errors - introduction to error analysis.

Numerical Calculus


Eigen value problems - Power and inverse power methods, Householder method, simultaneous iteration method, Lanczo's method.

Solution of Differential Equations


Unconstrained optimization - single variable minimization, multivariate minimization - direct search methods- Introduction to constrained optimization.

REFERENCES


COURSE OUTCOMES

Upon completion of the course, the students will be able to

1. Understand the common numerical methods used in engineering analysis
2. Estimate the amount of error inherent in different numerical methods.
3. Assess the efficiency of a selected numerical method when more than one option is available to solve a certain class of problem.
### COURSE OBJECTIVES

- To learn and understand the development of microprocessor and microprocessor based system.
- To provide solid foundation on interfacing the external devices to the processor according to the user requirements to create novel products and solutions for the real time problems.
- To assist the students with an academic environment aware of excellence guidelines and lifelong learning needed for a successful professional carrier.

### Digital Technology overview


### Microprocessor architecture

- RAM, ROM, EPROM – memory mapping – INTEL 8085 Architecture – ALU, Registers, address bus, data bus, control buses, tristate devices – overview of 8086 16-bit microprocessor (Instruction set not included)

### Microprocessor Programming

- INTEL 8085 mnemonics – data transfer, arithmetic, logic, branching instructions – Subroutines – simple programs.

### Interfacing and Peripheral devices


### Applications

- Control of pressure, temperature, speed – stepper motor control – automotive applications – Microprocessor based monitoring and control of power plants (Concepts only)
REFERENCES


COURSE OUTCOMES

Upon completion of the course, the students will be able to

1. Perform an in-depth knowledge of applying the concepts on real-time applications
2. Understand and capable of interfacing the microprocessor to the I/O devices.
3. Develop skill in writing simple arithmetic programmes for microprocessor.

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COURSE OBJECTIVES

- To familiarize students with recent energy generation techniques
- To provide information on various methods of waste management
- To detail on the recent technologies of waste disposal and
- To make student realize on the importance of healthy environment

Solid Waste

Definitions - Sources, Types, Compositions, Properties of Solid Waste - Municipal Solid Waste - Physical, Chemical and Biological Property - Collection - Transfer Stations - Waste Minimization and Recycling of Municipal Waste

Waste Treatment

Size Reduction - Aerobic Composting - Incineration - Furnace Type & Design, Medical / Pharmaceutical waste Incineration - Environmental Impacts - Measures to Mitigate Environmental effects due to Incineration.
Waste Disposal

Land Fill Method of Solid Waste Disposal - Land Fill Classification, Types, Methods & Siting Consideration - Layout & Preliminary Design of Land Fills - Composition, Characteristics, generation, Movement and Control of Landfill Leachate & Gases- Environmental Monitoring System for Land Fill Gases

Hazardous Waste Management


Anaerobic Digestion

Biogas Production - Types of Biogas Plant - Thermochemical Conversion - Sources of Energy Generation - Gasification - Types of Gasifiers - Briquetting - Industrial Applications of Gasifiers - Utilization and Advantages of Briquetting - Environmental Benefits of Biochemical and Thermochemical Conversion

REFERENCES

5. Bhide AD., Sundaresan BB, Solid Waste Management in Developing Countries, INSDOC New Delhi, 1983

COURSE OUTCOMES

Upon completion of the course, the students will be able to
1. Understand the waste characterization, segregation and disposal
2. Familiarize the technologies that are available for effective waste disposal
3. Understand the problem in a sensible and realistic manner

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Mapping with Programme Outcomes
COURSE OBJECTIVES

- To gain fundamental knowledge about instrumentation and control devices used in thermal power plant.
- To understand the various energy, thermal and mass flow measurement techniques.

Flow Measurement

Different types flow measurement for water flow, steam flow, furnace oil flow.

Pressure and Temperature Measurement


Boiler Control


Turbine Control

Governor – over speed cut off – controls in combined cycle plants and PLC application – controls in cogeneration plants.

Data Acquisition Systems

Overview of A/D converter, types and characteristics – Sampling, Errors. Objective – Building blocks of Automation systems - Calibration, Resolution, Data acquisition interface requirements.

REFERENCES

COURSE OUTCOMES

1. The students will acquire fundamental knowledge about instrumentation and control devices used in thermal power plant.
2. Students will get the ability to measure energy, thermal and mass flow using direct measurement, indirect measurement and use of modern engineering tools, software and equipment to analyze and solve complex engineering problems.
3. The students will be able to solve real world problems and reduce the impact of global warming for betterment of living things to serve healthy life.

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COURSE OBJECTIVES

- To provide an understanding of the stress and strain distribution of metals during loading conditions and fracture of metals and also to introduce different test procedures.

Tensile behavior


Hardness & toughness behavior

Fatigue behavior


Fracture behavior


Time dependant mechanical behavior

Creep curve - Stress rupture Test - Structural changes during creep - Mechanisms of creep deformation - Deformation mechanisms maps - Activation energy for steady state creep - Fracture at elevated temperature - Introduction to high temperature alloys - Prediction of long time properties - Creep under combined stresses - Creep-Fatigue Interaction.

REFERENCES


COURSE OUTCOMES

1. Understand the mechanical behaviour of metals.
2. Understand the environmental factors affecting the mechanical behaviour of materials.
3. Design the metals for specific applications.

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COURSE OBJECTIVES

- To provide fundamental knowledge on welding metallurgy and weldability aspects of carbon steels, stainless steels, aluminum and titanium alloys, with an emphasis on various weldability testing methods and techniques.

Basic characteristics of fusion welds


Weldability of ferrous metals

Weldability of Carbon Steels, HSLA steels, Q&T steels, Cr-Mo steels, Significance of carbon equivalent, important problems encountered in welding of above steels and remedial steps - Weldability of Stainless Steels: stainless steel classification, Schaffler diagram, Delong diagram, WRC diagram problems associated with welding of austenitic stainless steel, ferritic stainless steel, martensitic stainless steel and duplex stainless steels.

Weldability of non-ferrous metals

Weldability of Aluminum alloys: Classification of aluminum alloys, various processes used for aluminum welding, problems involved in aluminum welding, precaution and welding procedure requirements, Weldability of Titanium alloys: classifications of titanium alloys, various welding processes and procedures involved in titanium welding problems involved and remedial steps - welding of nickel base alloys. and magnesium alloys.

Welding defects


Weldability testing

REFERENCES


COURSE OUTCOMES

Upon completing this course, students should be able to:
1. Understand the basics of Physical Metallurgy, Welding Metallurgy and heat flow equations;
2. Understand and inspect welding defects using Non-destructive testing methods;
3. Understand the Weldability testing, Weldability Service tests and Corrosion tests.

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TPEEX0X OPTIMIZATION TECHNIQUES

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COURSE OBJECTIVES

- To introduce methods of optimization
- To maintain a balance between theory, numerical computation, problem setup for solution by optimization software, and applications to engineering systems

Classical Optimization techniques

Unconstrained optimization – calculus of variations – Linear programming - Graphical and simplex methods – Duality

Non-linear Programming

Integer linear programming

Gomory’s cutting plane method – Stochastic linear programming – Geometric programming – Constrained and Unconstrained minimization problems.

Dynamic programming

Multi stage decision processes – Principle of optimality- tabular method – computational procedure.

Non traditional optimization algorithms


REFERENCES


COURSE OUTCOMES

Upon successful completion of this course, the student will be able to understand:
1. Basic Theoretical Principles in Optimization;
2. Solution Methods in Optimization;
3. Applications to a Wide Range of Engineering Problems

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 Mapping with Programme Outcomes
COURSE OBJECTIVES

- To impart an in-depth study of impact engineering with a focus on the current status of explosive metal working.

Explosives - Types - Propagation of ideal detonation - reaction zone. Shock waves - general considerations - Pressure, Impulses and energies of shocks generated by explosions in air and water Mechanics of energy transfer - ecometrical method - bubble phenomenon.

Stand-off and contact operations - parameters and applications. Interaction between explosion and work Piece in contact operation - Pressure time relation in metal- explosive system.Stress waves in solids - Microstructural changes - Hugoniot curves for iron and brass - changes in physical properties - fracturing under impulsive loads


Explosive forming - strain energy of deformation - effect of explosive standoff and strain distribution in the explosive forming of flat circular blanks - Simple problems - Multiple shot explosive forming - Use of scale models in explosive Conning -explosive Conning dies- Effect of explosive forming on materials properties

Shock consolidation ceramics and composites - shock waves. The jump-relations- Equation (Hugoniot) – Compaction mechanism static versus shock compaction - different shock compaction techniques - (Cylindrical, Converged, Underwater and high temperature) - Temperature measurements - shock consolidation of bio-compatibles - ceramics - melt - infiltration of shock compacted ceramics - Metallurgy of shock consolidation

REFERENCES

2. Explosive working of metals, Jolm Rineheart and John Pearson, Pergamon, London, 1985

COURSE OUTCOMES

Upon successful completion of this course, the student will be able to

1. Understand the processes variables generated by explosions
2. Understand the environmental factors affecting the atmospheric contaminations
3. Study the metallurgical properties of explosive cladded process
Mapping with Programme Outcomes

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**COURSE OBJECTIVES**

To impart an in-depth knowledge on composite materials, types, production processing and the structural development in composite materials.


Classification of Polymers - properties and applications of selective engineering polymers - Polymer Matrix Composites: Polymer matrix resins - Thermosetting resins, thermoplastic resins - Reinforcement fibres - Rovings - Woven fabrics - Non Woven random mats - various types of fibres. PMC processes - Hand lay up processes - Spray lay up processes - Compression moulding - Reinforced reaction injection moulding - Resin transfer moulding Pultrusion - Filament winding - Injection moulding. Fibre reinforced plastics (FRP), (Glass fibre reinforced plastics (GRP)).


**REFERENCES**

7. Hand Book of Plastic processing, Brydson,

**COURSE OUTCOMES**

Upon completing this course, students should be able to:

1. Obtain knowledge on classification of composite materials used in the modern world
2. Obtain knowledge on different types of production technique of composite materials
3. Acquire knowledge on production of light weight composites that are used in aerospace industries

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