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)

This program imbibes excellent technical capabilities in the area of energy engineering and allied systems, effective communication skill in students, ensuring successful career and continuing their professional advancement through life-long learning. The programme educational objectives of Master in Energy Engineering and Management are

1. Have high level of technical competency combined with research and problem solving ability to generate innovative solutions in energy engineering or related areas using the acquired analytical, computational and experimental skills.

2. 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.

3. To prepare the students to exhibit a high level of professionalism, integrity, environmental and social responsibility, and life-long independent learning ability

Programme Outcomes (PO)

PO1: An ability to acquire, apply and share in-depth knowledge in the area of Energy Engineering and Management

PO2: An ability to analyze real life problems in the field of Energy Engineering and arrive at sustainable solutions
PO3: An ability to conduct independent research and generate knowledge for the benefit of mankind.

PO4: An ability to effectively communicate through technical reports, presentations and scientific publications in general and, use the modern computer/software tools to model and analyze energy engineering problems in particular.

PO5: An ability to work effectively in interdisciplinary teams to develop energy efficient systems for the society

PO6: An ability to apply engineering and scientific principles for effective management of energy systems

PO7: Graduates will demonstrate an ability to visualize and work on laboratory and multidisciplinary tasks.

PO8: An ability to engage in life-long independent learning with high level of enthusiasm and commitment

PO9: An ability to maintain a high level of professional and intellectual integrity, ethics of research and scholarly standards

PO10: An ability to examine critically the outcomes of one’s actions and make corrective measures subsequently

<table>
<thead>
<tr>
<th>Mapping PO with PEO</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEs</td>
</tr>
<tr>
<td>PEO1</td>
</tr>
<tr>
<td>PEO2</td>
</tr>
<tr>
<td>PEO3</td>
</tr>
</tbody>
</table>
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>
<thead>
<tr>
<th>Assessment</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>First assessment (Mid-Semester Test-I)</td>
<td>10</td>
</tr>
<tr>
<td>Second assessment (Mid-Semester Test-II)</td>
<td>10</td>
</tr>
<tr>
<td>Third Assessment</td>
<td>5</td>
</tr>
<tr>
<td>End Semester Examination</td>
<td>75</td>
</tr>
</tbody>
</table>

The break-up of continuous assessment and examination marks for Practical courses is as follows:

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

- 90 to 100 marks Grade ‘S’
- 80 to 89 marks Grade ‘A’
- 70 to 79 marks Grade ‘B’
- 60 to 69 marks Grade ‘C’
- 55 to 59 marks Grade ‘D’
- 50 to 54 marks Grade ‘E’
- Less than 50 marks Grade ‘RA’
- Withdrawn from the Examination Grade ‘W’

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>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>ii. Environmental Engineering &amp; Management</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>iii. Water Resources Engineering &amp; Management</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>ii. Construction Engg. and Management</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>iii. Geotechnical Engineering</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>iv. Disaster Management &amp; Engg.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>ii. Welding Engineering</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>iii. Nano Materials and Surface Engineering</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>ii. Smart Energy Systems</td>
<td>B.E. / B.Tech – Electrical and Electronics Engg, Control and</td>
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<tr>
<td></td>
<td></td>
<td>iii. Power System</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Chemical Engineering</td>
<td>i. Chemical Engineering</td>
<td>B.E. / B.Tech – Chemical Engg, Petroleum Engg, Petrochemical Technology</td>
</tr>
<tr>
<td>9</td>
<td>Information Technology</td>
<td>i</td>
<td>Information Technology</td>
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</table>

* AMIE in the relevant discipline is considered equivalent to B.E.*
# DEPARTMENT OF MECHANICAL ENGINEERING

## Curriculum for M.E. Energy Engineering and Management (Full Time)

### First Semester

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Category</th>
<th>Course Code</th>
<th>Course</th>
<th>L</th>
<th>P</th>
<th>T</th>
<th>CA</th>
<th>FE</th>
<th>Total Credits</th>
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<tbody>
<tr>
<td>1</td>
<td>PC-I</td>
<td>EEMC101</td>
<td>Advanced Numerical Methods</td>
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<tr>
<td>2</td>
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<td>EEMC102</td>
<td>Advanced Thermodynamics</td>
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<tr>
<td>3</td>
<td>PC-III</td>
<td>EEMC103</td>
<td>Fluid Mechanics and Heat Transfer</td>
<td>4</td>
<td></td>
<td>-</td>
<td>25</td>
<td>75</td>
<td>100</td>
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<tr>
<td>4</td>
<td>PC-IV</td>
<td>EEMC104</td>
<td>Waste Management and Energy Generation Techniques</td>
<td>4</td>
<td></td>
<td>-</td>
<td>25</td>
<td>75</td>
<td>100</td>
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<tr>
<td>5</td>
<td>PE-I</td>
<td>EEME105</td>
<td>Professional Elective - I</td>
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<td>EEME106</td>
<td>Professional Elective – II</td>
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<td>Energy Laboratory - I</td>
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<td>3</td>
<td></td>
<td>190</td>
<td>510</td>
<td>700</td>
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### Second Semester

<table>
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<tr>
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<th>Category</th>
<th>Course Code</th>
<th>Course</th>
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<th>P</th>
<th>T</th>
<th>CA</th>
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<th>Total Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PC-V</td>
<td>EEMC201</td>
<td>Energy Conservation and Management</td>
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<td>2</td>
<td>PC-VI</td>
<td>EEMC202</td>
<td>Energy Modeling, Economics and Project Management</td>
<td>4</td>
<td></td>
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<tr>
<td>3</td>
<td>PC-VII</td>
<td>EEMC203</td>
<td>Environmental Engineering and Pollution control</td>
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<td>Co-Generation and Waste Heat Recovery Systems</td>
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<td>5</td>
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<td>Professional Elective – III</td>
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### Third Semester

<table>
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<th>Category</th>
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<th>CA</th>
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<th>Total</th>
<th>Credits</th>
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<tbody>
<tr>
<td>1</td>
<td>OE-I</td>
<td>EEME301</td>
<td>Open Elective I</td>
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<tr>
<td>2</td>
<td>OE-II</td>
<td>EEME302</td>
<td>Open Elective II</td>
<td>4</td>
<td></td>
<td></td>
<td>25</td>
<td>75</td>
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</tr>
<tr>
<td>3</td>
<td>Thesis</td>
<td>EEMT303</td>
<td>Thesis Phase I and Viva Voce</td>
<td></td>
<td>4</td>
<td></td>
<td>40</td>
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<tr>
<td>4</td>
<td>Ind. Train</td>
<td>EEMI304</td>
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<td>190</td>
<td>210</td>
<td>400</td>
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</tbody>
</table>

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

### Fourth Semester

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Category</th>
<th>Course Code</th>
<th>Course</th>
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<tbody>
<tr>
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<td>Thesis Phase II and Viva Voce</td>
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<td>-</td>
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<td>40</td>
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</table>

**L-** Lecture ; **P-** Practical; **T-** Thesis; **CA-** Continuous Assessment; **FE-** Final Examination
### First Semester

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Category</th>
<th>Course Code</th>
<th>Course</th>
<th>L</th>
<th>P</th>
<th>T</th>
<th>CA</th>
<th>FE</th>
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<tr>
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<td>EEMC101</td>
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<td>PC-II</td>
<td>PEEMC102</td>
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<td>PC-III</td>
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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. Measurements and Controls in Thermal Engineering
2. Energy Conversion Techniques
4. Bio Energy Conversion Technologies
5. Boiler Technology
6. Fluidized Bed Systems
7. Design of Heat Exchangers
8. Computational Heat Transfer
9. Energy Storage Technologies
10. Renewable Energy Systems
12. Biomass Gasification- Technology and Utilization

OPEN ELECTIVES

1. Nuclear Engineering
2. Fuels And Combustion
3. Hydropower Systems
4. I.T In Energy Management
5. Computational Fluid Dynamics
6. Numerical Analysis In Engineering
7. Biocomposite Materials
8. Nano Materials Technology
9. Applied Probability and Statistical Inferences
10. Neural Networks and Fuzzy Systems
11. Energy Management In Buildings
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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EEMC102 ADVANCED THERMODYNAMICS

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 co efficiency, 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, Maxwell-Boltzman, Fermi-Dirac and Bose-Einstein Statistics, Microscopic Interpretation of heat and
work, Evaluation of entropy, Partition function, Calculation of the Macroscopic properties from partition functions, Equilibrium constant statistical thermodynamics approach.

**Irreversible Thermodynamics**

Conjugate Fluxes and Forces, Entropy Production Onsager’s Reciprocity relations, Thermo-electric phenomena, formulations, Power Generation, Refrigeration.

**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

- To develop the skills to correlate the Physics with applications.
- To understand the laws of fluid flow and Heat transfer.

Basic Equation, Potential Flow Theory and Boundary Layer Concept


Incompressible and Compressible Flows


Conduction and Radiation Heat Transfer

Governing Equation and Boundary conditions, Extended surface Heat Transfer, Transient conduction – Use of Heisler’s charts, Conduction with moving boundaries, Radiation Heat Transfer, Gas Radiation

Turbulent Forced Convective Heat Transfer


Phase Change Heat Transfer and Heat Exchanger

Condensation on bank of tubes – boiling – pool and flow boiling, Heat exchanger – € – NTU approach and design procedure – compact heat exchangers

REFERENCES

COURSE OUTCOMES

1. Student will be able to use the concepts of Heat Transfer and fluid flow in the field of energy applications.

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EEMC104 WASTE MANAGEMENT AND ENERGY GENERATION TECHNIQUES

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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


Hazardous Waste Management

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.

Mapping with Programme Outcomes

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EEMP107 ENERGY LABORATORY - I

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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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EEMC201 ENERGY CONSERVATION AND MANAGEMENT

COURSE OBJECTIVES

- Familiarizing with management, especially with management in energy sector engineering.
- Fundamentals of product strategy management. Studying methods of energy accounting and energy auditing in energy sector, industry and final consumption.
- Finding opportunities to increase the rational use of energy.

Introduction


Role of Instrumentation in Energy Conservation

Electrical Energy Auditing


Energy Management


REFERENCES


COURSE OUTCOMES

The theory should be taught in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

1. Identify the demand supply gap of energy in Indian scenario.
2. Carry out energy audit of an industry/Organization.
3. Draw the energy flow diagram of an industry and identify the energy wasted or a waste stream.

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EEMC202 ENERGY MODELLING, ECONOMICS AND PROJECT MANAGEMENT

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COURSE OBJECTIVES

- To impart greater understanding of energy modeling in renewable energy technology.
- To throw light on the economic aspects involved in renewable energy technology.
- To enlighten the students on the various techniques involved in project management.
Models and Modeling Approaches


Input-Output Analysis


Energy Demand Analysis and Forecasting

Methodology of Energy Demand Analysis - Methodology for Energy Technology Forecasting -Methodology for Energy Forecasting - Sectoral Energy Demand Forecasting.

Economics of Stand-alone Power Systems


Project Management – Financial Accounting


REFERENCES


COURSE OUTCOMES

At the end of this course, the students will be able to
1. Gain clear perspective on energy economy.
2. Forecast the energy demand and plan wisely.
3. Become excellent managers of the energy resources.
COURSE OBJECTIVES

To provide the engineering graduates with technical expertise in Environmental Engineering which enable to have a career and professional accomplishment in the public or private sector to

- Address the complexities of real life environmental engineering problems related to water supply, sewerage, sewage treatment, waste management, environmental impact assessment, industrial pollution prevention and control.
- Identify, formulate, analyze, and develop processes and technologies to meet desired environmental protection needs of society and formulate solutions that are technically sound, economically feasible, and socially acceptable.
- To impart knowledge on the principles and design of control of indoor/particulate/gaseous air pollutant and its emerging trends and also application of Industrial pollution prevention, cleaner technologies, industrial wastewater treatment and residue management.

Air Pollution

Sources and Effect - Acid Rain - Air Sampling and Measurement - Analysis of Air Pollutants - Air Pollution Control Methods and Equipments - Issues in Air Pollution Control.

Solid Waste Management

Water Pollution


Other Types of Pollution

Noise Pollution and its Impact - Oil Pollution - Pesticides - Radioactivity Pollution - Prevention and Control.

Pollution from Thermal Power Plants and Control Methods

Instrumentation for Pollution Control - Water Pollution from Tanneries and Other Industries and their Control.

REFERENCES


COURSE OUTCOMES

By the time of their graduation, the students are expected to be able to:

1. Have basic knowledge about environmental protection and operation of pollution control devices – design and conduct experiments, as well as interpreted data and communicate effectively.
2. Identify, formulate, and solve environmental engineering problems using the techniques, skills, and modern engineering tools necessary for environmental engineering practice.
3. Design systems, processes, and equipment for the control and remediation of water, air, and soil quality environment within realistic constraints of economic affordability and social acceptability.

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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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COURSES 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.
### 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.

### 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.

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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.

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COURSE OBJECTIVES

- To equip the students with necessary foundation for effectively analyzing and solving the problems associated in thermal engineering field.
- 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.
- 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.

Measurement Characteristics


Concepts of Instrumentation

Basic instruments for the measurement of temperature- torque-strain gauges- pressure- velocity-current-flow and level.

Measurements of Surface Temperature

Measurements of conductivity remote sensing of temperature- coefficient of conduction- insulating materials –convection and radiation - measurements of conduction in porus insulating material- measurement of pH value- Oxygen Concentration.

Gas Analysis

Measurements of Co₂, No₂, Co and hydrocarbons and So₂, Use of gas Chromatography- fuel analysis- Measurements of Smoke- Dust and Moisture.

Microprocessor Based Instrumentation and Data Logging System

Controllers and displays in power plants- pneumatic and electronic controls- typical control system in power plant control- loop interaction- nuclear reactor control systems.

REFERENCES

COURSE OUTCOMES

1. Ability to acquire, apply and share in-depth knowledge in the area of thermal engineering.
2. Graduates will demonstrate skills to use modern engineering tools, software and equipment to analyze and solve complex engineering problems.
3. Graduate will acquire knowledge about current issues/advances in engineering practices.

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EEMEX0X ENERGY CONVERSION TECHNIQUES

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COURSE OBJECTIVES

- To analyze the pros and cons of conventional energy and direct energy conversion techniques for converting one form of energy to another.
- To study the various forms of energy conversion techniques and production of electrical energy.
- To understand the necessity of energy storage systems and the thermodynamic and kinetic principles of fuel cells.

Introduction


Production of Thermal Energy and Mechanical Energy

Conversion of mechanical, electrical, electromagnetic and chemical energy-conversion of thermal energy – turbines – Electromechanical conversion.

Production of Electrical Energy

Conversion of Thermal energy into electricity - Chemical energy into Electricity – Electromagnetic energy into Electricity – Mechanical energy into Electricity.

Energy Storage Systems

Thermal Biomass Conversion

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

REFERENCES

7. www.alternativepower.com

COURSE OUTCOMES

1. Awareness on the existence of various mechanisms for conversion of energy from one form to another and their merits, constraints.
2. Understand the production of electrical energy from different conversion methods.
3. Understand the working of various fuel cells, their relative advantages/disadvantages.

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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

Solar Radiation

Availability - Measurement and Estimation - Isotropic and an Isotropic Models - Introduction to Solar Collectors (Liquid Flat - Plate Collector, Air Heater and Concentrating Collector) and Thermal Storage - Steady State and Transient Analysis - Solar Pond - Solar Refrigeration.
Modeling of Solar Thermal Systems and Simulations in Process Design


Photovoltaic Solar Cell


Wind


Wind Energy Conversion System (WECS)


REFERENCES

8. www.solarpv.com

COURSE OUTCOMES

Upon completion of the course, the students will be able to
1. Know about the exploration of nonconventional energy resources and their effective tapping technologies.
2. Effective utilization of available renewable energy resources.
3. To acquire the knowledge of modern 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

Economics and Environmental Aspects


REFERENCES


COURSE OUTCOMES

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

1. Gain vast idea of the various form of biomass availability in the earth.
2. Get complete understanding of the various biomass energy conversion technologies, and its importance of these energies in the economical and environmental aspect towards and environmental aspect towards the present energy crisis.

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COURSE OBJECTIVES

The course content should be taught with the aim to develop different types of skills so that students are able to acquire following competency:

- To apply basic concepts, laws and principles of Boiler design.
- To impart greater understanding of heat balance in Boiler for modern power plant.
- To throw light on the heat transfer aspects involved in boiler technology.
- To enlighten the students on the various techniques involved in the boiler code.
Introduction


Boiler Design

Design of Boiler Drum - Steam Generator Configurations for Industrial Power and Recovery Boilers - Pressure Loss and Circulation in Boilers

Design of Accessories

Design of Air Preheaters - Economisers and Superheater for High Pressure Steam Generators - Design Features of Fuel Firing Systems and Ash Removing Systems

Emission Aspects


Boiler code


REFERENCES


COURSE OUTCOMES

At the end of this course, the students will be able to
1. Gain the ability of engineering design calculations in boiler technology.
2. Attain knowledge of modern technology in boiler accessories design and heat balance calculation.
3. Become excellent managers of the boiler code.

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**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.

Mapping with Programme Outcomes

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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 Condensers - 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

7. http://www.tata.com

COURSE OUTCOMES

1. The student will be able to perform the energy transfer in the all types of heat exchangers.
2. The student with engineering equation solver and its use in heat exchanger design.
3. The student to do energy transfer analysis for research and develop energy effective systems.

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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

General Applicability of the Method using one dimensional heat transfer equation - Approximate Analytical Solution - Raleigh’s Method. Galerikin Method, Solution Methods

Finite Element Method Packages


REFERENCES

6. www.fluent.com
7. http://chtol.mech.unsw.edu.au
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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EEMEX0X ENERGY STORAGE TECHNOLOGIES

COURSE OBJECTIVES

- Student will be able to demonstrate and apply in depth technical knowledge of engineering in design and operation of various thermal systems.
- Develop the students to enrich their wise through their cognitive skill.
- Student will be able to understand the need for, and an ability to engage in life-long learning and continual updating of professional skills.

Energy Storage Need of energy storage


Electrochemical Energy Storage Systems Batteries

Primary, Secondary, Lithium, Solid-state and molten solvent batteries; Lead Lead acid batteries; Nickel Cadmium Batteries; Advanced Batteries. Role of carbon nano-tubes in electrodes.

Magnetic and Electric Energy Storage Systems

Superconducting Magnet Energy Storage(SMES) systems; Capacitor and Batteries: Comparison and application; Super capacitor: Electrochemical Double Layer Capacitor (EDLC), principle of working, structure, performance and application, role of activated carbon and carbon nano-tube.
Sensible Heat Storage

SHS mediums; Stratified storage systems; Rock-bed storage systems; Thermal storage in buildings; Earth storage; Energy storage in aquifers; Heat storage in SHS systems; Aquifers storage. Solar Ponds for energy storage. Green house heating.

Latent Heat Thermal Energy Storage

Phase Change Materials (PCMs); Selection criteria of PCMs; Stefan problem; Solar thermal LHTES systems; Energy conservation through LHTES systems; LHTES systems in central air-conditioning systems; Energy Storage Food preservation; Waste heat recovery; Solar energy storage;

REFERENCES

7. http ://www.tata.com

COURSE OUTCOMES

1. Able to understanding of principles and technologies for thermal storage system, application and utilization.
2. Able to identify, formulate and solve simple to complex troubles of thermal storage systems, conversion and storage.
3. Able to identify and understand components and their function.

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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.

Introduction

World energy use-reserves of energy resources-energy cycle of the earth-environmental aspects of energy utilisation-renewable energy resources and their importance.

Solar Energy

Introduction -extraterrestrial solar radiation -radiation at ground level-collectors-solar cells-applications of solar energy- Biomass Energy-Introduction-Biomass Conversion-Biogas Production- Ethanol Production-Pyrolysis and Gasification-Direct Combustion-

Applications


Tidal Energy

Introduction-origin of tides-power generation schemes-Wave Energy-Introduction-basic theory-wave power devices.

Other Renewable Energy Sources: Introduction-Open and Closed OTEC cycles-biophotolysis-Ocean Currents-Salinity Gradient Devices-Environmental Aspects-Potential impacts of harnessing the different renewable energy resources.

REFERENCES

6. www.mnes.mic.in
7. www.ireada.org
COURSE OUTCOMES

1. An ability to acquire, apply and share in depth knowledge in the area of Energy Engineering and Management.
2. An ability to conduct independent research and generate knowledge for the benefit of mankind.
3. An ability to apply engineering and scientific principles for the effective management of energy systems.

Mapping with Programme Outcomes

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COURSE OBJECTIVES

- To learn the present biomass energy scenario and the importance of energy conversion.
- To learn the biomass, biomethanation, gasification, pyrolysis and carbonization.
- To analysis different routes of biomass conversion and methods of characterization.

Origin of Biomass


Biomass Production and Conversion


Biomethanation and Combustion


Gasification


Pyrolysis and Carbonization


REFERENCES


COURSE OUTCOMES

After successful completion of this course, the students should be able to
1. To understand the generation and utilization of various biomass.
2. To gain knowledge in the concept of biomass – proximate and ultimate analysis.
3. To study the various biomass conversion - biomethanation, gasification and pyrolysis.

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COURSE OBJECTIVES

- To learn about the different types biomass technology.
- To study the origin and developments of gasification system.
- To learn the various types of gasifier, purification, cooling system and impact on environment.
- To learn the properties of gaseous fuel from woody biomass and application as engine fuel.

Introduction


Biomass Technology


Gasifiers, Gas Cleaning and Cooling


Impact of Fuel Properties on Gasification and Drive Engines

Gasification fuels-Need for selection of the right gasifier for each fuel-Energy content of the fuel- Moisture content of the fuel- Voltaile matter content of the fuel-ash content and ash chemical composition-Reactivity of the fuel-Particle size and distribution-Bulk density of the fuel- Charring properties of the fuel- Assessment of the suitability of various types of biomass as gasifier fuel. Producer gas drive engines- Performance of gasifier- engine system- Operational difference between diesel and gasoline engine- Conversion of gasoline engine to produce gas-Conversion of diesel engine to producer gas- Conditions of producer gas- Engine power output using producer gas- Gas quality requirements for trouble free operation.

Technologies for Biomass Utilisation

Biomass utilisation strategy - Applications to be serviced - Biomass classification and -properties Gasification- Combustion vs Gasification - Woody biomass gasifier (thermal and...
electric)-Pulverised fuel gasifier (thermal and electric) - Engine operation - Technologies available-
Production of fuel gas-production of mechanical or Electrical power in stationary installations.-
Mobile applications.

REFERENCES

1. P.F. Stan Bury and A. Witalker, 'Principles of Fermentation Technology, Pergamo
3. Tom B Reed, Biomass Gasification – Principles and Technology, Noyce Data Corporation,
1981.
4. D.O. Hall, G.N. Barnard, and P.A. Moss, Biomass for Energy in the Developing Countries,
6. T.B. Real, Biomass Gasification Principles and Technology, Energy Technology
and II, Academic Press.

COURSE OUTCOMES

Upon completion of the course, students will be able to
1. Understand biomass gasification technology.
2. Learn different types of gasifier and purification systems.
3. Gain knowledge on different fuel properties and their impact on gasification.

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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


Waste Disposal and Radiation Protection

Types of Nuclear Wastes - Safety Control and Pollution Control

REFERENCES

2. Loftness, Nuclear Power Plants.
5. J.R. Lamarsh, Introduction to Nuclear Reactor Theory, Wesley, 1966

COURSE OUTCOMES

1. Able to acquire, apply and share in depth knowledge in the area of Nuclear physics and reactor materials.
2. Gain 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

- To learn different type of conventional and non conventional fuel with their properties, methods to analysis of fuel, Energy conversion techniques in detail.
- To learn the combustion process of conventional and non conventional fuels, able to calculate the necessary air requirement for combustion process.
- To acquire knowledge in the areas of ignition, Flame study and details of burners to develop combustion process.

Introduction


Solid & Liquid Fuels


Gaseous Fuels


Theory of Combustion Process and Stoichiometry

Combustion Thermodynamics, Stoichiometry Relations, Rapid Methods of Combustion Stoichiometry, Theoretical Air Required for Complete Combustion, Mass Basis and Volume Basis
Calculation of Minimum Amount of Air Required for a Fuel of known Composition, Calculation of Dry Flue Gases if Fuel Composition is Known, Calculation of the Composition of Fuel, Excess Air Supplied and Amount of Exhaust gases.

**Burner Design**

Ignition, Concept of Ignition, Auto Ignition, Ignition Temperature, Flame, Flame Propagation, Flame Front, Various Methods of Flame Stabilization, Concepts of Burner, Basic Features and Types of Solid, Liquid and Gaseous Fuel Burners - Different Types of Coal - Oil and Gas Burners, Recuperative & Regenerative Burners.

**REFERENCES**

5. Sharma SP, Mohan Chander, Fuels & Combustion, Tata Mcgraw Hill, 1984 EIA

**COURSE OUTCOMES**

Upon completion of the course, students will be able to
1. Evaluate the properties of conventional and non conventional fuel, and to describe, compare, cost, availability, various advantages and disadvantages for further continued usage of each fuel.
2. Understand the complete combustion process of each fuel, ability to calculate the stoichiometry, theoretical and actual air requirement for the combustion process.
3. Understand the concepts of ignition characteristics, Flame, Flame propagation and Flame front in detail.

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**COURSE OBJECTIVES**

- To learn and understand the various hydropower systems and its concepts.
- To Prepare energy audit and cost analysis of hydropower systems and to Design, Develop and construction of hydropower systems.
- Maintenance of power station and its reservoirs.
- Development of Software for Hydropower System Analysis.


Trends in Development of Generating Plant and Machinery - Plant Equipment for Pumped Storage Schemes - Some aspects of Management and Operation –uprating and refurbishing of turbines

Power Station Operation and Maintenance: Governing of Water Turbines - Function of Turbine Governor - Condition for Governor Stability - Surge Tank Oscillation and Speed Regulative Problem of Turbine Governing in Future.

Reservoir maintenance-Civil Engineering works - Mechanical maintenance of reservoirs-Maintenance of Electrical and instrumentation Works.


REFERENCES

4. www.tva.gov/power
5. indianpowersector.com/power-station/hydro-power-plant
6. mnre.gov.in/schemes/grid-connected/small-hydro

COURSE OUTCOMES

The students graduates will

1. Acquire the knowledge of various hydropower systems and its concepts.
2. Enable to prepare energy audit reports and cost analysis of hydropower systems.
3. Able to Design, Develop and construction of hydropower systems.
4. Basic knowledge of maintenance in power station and its reservoirs.
5. Attain motivation to develop new software for hydropower system analysis.

COURSE OBJECTIVES

- To introduce various programming languages.
- To learn the principle of data base management system.

Introduction to Computer Application

Programming languages-Introduction to Visual C++, C-Programming Design-Computer Organization.

Introduction to Computer Based Information System

Types of CBIS-Relationship among CBIS systems concepts and CBIS- general systems theory-Energy Management concepts and CBIS.
Data Base Management System

Intelligence based systems - energy data bases-networking -time sharing concepts.

Software Engineering

The need for and scope of software engineering -survey of software life cycle models-Transform theory of software performance-network model of structured programs.

Computer based Monitoring and Online Control Systems

Data acquisition systems-expert based systems for energy management-Parallel Processing Concepts-Typical applications in energy management area.

REFERENCES

7. http://www.emd.dk
9. www.energymanagementsys.com

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:
1. Acquire the knowledge of need and scope of software engineering.
2. Understand the programming languages.
3. Learn the principle of data base management system.

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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.

REFERENCE BOOKS


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 solved 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.
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 optimisation

Single variable minimization, multivariate minimization - direct search methods, gradient. Introduction to constrained optimisation.

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.

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COURSE OBJECTIVES

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


REFERENCES


COURSE OUTCOMES

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

1. Gain knowledge about Bio-composites.
2. Understand the various methods of producing bio composites.
3. Able to engage in lifelong learning.

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COURSE OBJECTIVES

- This course has been designed in such a way that to provide in depth knowledge on nano materials fabrication methods, characterization techniques and application of nano materials.

Introduction to nano technology


Nanopowders and Nanomaterials

Classification of nano materials - Properties of nano materials - characteristics of nano particulate materials; Production Methods: Top down approach - mechanical milling, Chemical Etching, Electro explosion, Sputtering, Laser ablation; Bottom up approach Plasma spraying, Chemical vapour deposition, Sol Gels, Laser pyrolosis, Atomic or molecular condensation.

Characterisation and Detection Techniques

Atomic structure and chemical composition: spectroscopic methods, vibrational spectroscopies, Nuclear magnetic resonance, X-ray and UV spectroscopies, X-ray and neutron diffraction. Determination of size, shape and surface area: Electron microscopes, BET and pycnometry, Ephiphaniometer, Laser granulometries and Zeta potential, Elliptically polarised light scattering; Determination of nanoparticles in aerosols and in biological tissues.
Applications of Nanomaterials


Applications of Nanotechnology


REFERENCES

2. Industrial application of nanomaterials - chances and risks, Wulfgang Luther, Future Technologies Division, Germany, 2004.

COURSE OUTCOMES

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

1. Gain knowledge about Nano Materials’
2. Understand the various methods of fabricating Nano Materials
3. Able to engage in lifelong learning.

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Mapping with Programme Outcomes
COURSE OBJECTIVES

- To introduce the different techniques in applied probability and statistics, that have engineering and technological applications.


  Testing of Hypothesis - Parametric test – small samples – Tests concerning proportion, means, standard deviations – Test based on Chi-square, goodness of fit and test of independence.

  Non-parametric test – run test, sign test, U-test, H-test and kolmogorov-Smirnov (k-s) test – spearman rank correlation coefficient test.

  Experimental designs – completely randomised blocks– Latin square – Analysis of variance – Methods for one, two factor models, concepts of factorial design, fractional factorial design, response surface methods and central composite designs.

REFERENCES


COURSE OUTCOMES

1. Acquire basic knowledge in statistics.
2. The student will able to acquire the basic concepts of Probability and Statistical techniques for solving real life problems and Engineering problems.

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COURSE OBJECTIVES

- The objective is to increase machine IQ by overlapping the dynamic system, adaptive control, Statistics with probability and mathematical logic.

Introduction to Fuzzy Logic Principles


Advanced Fuzzy Logic Applications


Introduction to Artificial Neural Networks


Other JANN Architectures

Associative Memory - Exponential BAM - Associative Memory for Real Coded Pattern Pairs - Applications Adaptive Resonance Theory - Introduction - ART 1 - ART2 - Applications - Neural Networks based on Competition - Kohenen Self Organizing Maps - Learning vector Quantization - Counter Propagation Networks Industrial Applications.

Recent Advances


REFERENCES

COURSE OUTCOMES

Upon completion of the course, the student will be able to
2. Analyze the various feedback networks.
3. Understand the concept of fuzziness involved in various systems and fuzzy set theory.

Mapping with Programme Outcomes

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EEMEX0X ENERGY MANAGEMENT IN BUILDINGS

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COURSE OBJECTIVES

- To learn the green buildings concepts applicable to modern buildings.
- Acquaint students with the principle theories materials, construction techniques and to create energy efficient buildings.

Introduction

Conventional versus Energy Efficient buildings – Historical perspective - Water – Energy – IAQ requirement analysis – Future building design aspects – Criticality of resources and needs of modern living

Landscape and Building Envelopes

Energy efficient Landscape design - Micro-climates – various methods – Shading, water bodies-
Building envelope: Building materials, Envelope heat loss and heat gain and its evaluation, paints, Insulation, Design methods and tools.

Heat Transmission in Buildings

Surface co-efficient- air cavity, internal and external surfaces, overall thermal transmittance, wall and windows; Heat transfer due to ventilation/infiltration, internal heat transfer; Solar temperature; Decrement factor; Phase lag. Design of daylighting; Estimation of building loads: Steady state method, network method, numerical method, correlations; Computer packages for carrying out thermal design of buildings and predicting performance.
Passive Cooling

Passive cooling concepts- Evaporative cooling, radiative cooling; Application of wind, water and earth for cooling; Shading, paints and cavity walls for cooling; Roof radiation traps; Earth airtunnel. Hybrid methods.

Renewable Energy in Buildings


REFERENCES


COURSE OUTCOMES

Upon completion of the course, the student will be able to
1. Perform energy audit in any type for buildings and suggest the conservation measures.
2. Provide the renewable energy systems for the buildings

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