Master of Technology

( Thermal Engineering )

(Two Year Regular Programme)

(Applicable for Batches admitted from 2017)
Gokaraju Rangaraju Institute of Engineering & Technology-2017 Regulations (GR 15 Regulations) are given hereunder. These regulations govern all the Post Graduate programmes offered by various departments of Engineering with effect from the students admitted to the programmes from 2017-18 academic year.

1. **Programme Offered:** The Post Graduate programme offered by the department is M.Tech, a two-year regular programme in that discipline.

2. **Medium of Instruction:** The medium of instruction (including examinations and reports) is English.

3. **Admissions:** Admission into the M.Tech Programme in any discipline shall be made subject to the eligibility and qualifications prescribed by the University from time to time. Admissions shall be made either on the basis of the merit rank obtained by the student in PGCET conducted by the APSCHE for M. Tech Programmes or on the basis of any other order of merit approved by the University, subject to reservations as prescribed by the Government from time to time.

4. **Programme Pattern:**
   a) A student is introduced to “Choice Based Credit System (CBCS)” for which he/she has to register for the courses at the beginning of each semesters as per the procedure.
   b) Each Academic year of study is divided into two semesters.
   c) Minimum number of instruction days in each semester is 90.
   d) The total credits for the Programme is 88.
   e) Grade points, based on percentage of marks awarded for each course will form the basis for calculation of SGPA (Semester Grade Point Average) and CGPA (Cumulative Grade Point Average).
   f) A student has a choice of registering for credits from the courses offered in the programme.
   g) All the registered credits will be considered for the calculation of final CGPA.

5. **Award of M.Tech Degree:** A student will be declared eligible for the award of the M. Tech Degree if he/she fulfills the following academic requirements:
   a) A student shall be declared eligible for the award of M.Tech degree, if he/she pursues the course of study and completes it successfully in not less than two academic years and not more than four academic years.
B) A Student, who fails to fulfill all the academic requirements for the award of the degree within four academic years from the date of admission, shall forfeit his/her seat in M.Tech courses.

c) The Degree of M.Tech shall be conferred by Jawaharlal Nehru Technological University Hyderabad (JNTUH), Hyderabad, on the students who are admitted to the programme and fulfill all the requirements for the award of the degree.

6. Attendance Requirements

a) A student shall be eligible to appear for the semester end examinations if he/she puts in a minimum of 75% of attendance in aggregate in all the courses concerned in the semester.

b) Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in a semester may be granted. A committee headed by Dean (Academic Affairs) shall be the deciding authority for granting the condonation.

c) Students who have been granted condonation shall pay a fee as decided by the Academic Council.

d) A candidate shall get minimum required attendance at least in three theory subjects in the semester to get promoted to the next semester. In order to qualify for the award of M.Tech. Degree, the candidate shall complete all the academic requirements of the subjects, as per the course structure.

E) Students whose shortage of attendance is not condoned in any semester are detained and are not eligible to take their end examinations of that semester. They may seek re-registration for that semester when offered next with the academic regulations of the batch into which he/she gets re-registered.

7. Paper Setting, Evaluation of Answer Scripts, Marks and Assessment

a) Paper setting and Evaluation of the Answer Scripts shall be done as per the procedures laid down by the Academic Council of the College from time to time.

b) The following is the division of marks between internal and external evaluations.

<table>
<thead>
<tr>
<th>S.no</th>
<th>Particulars</th>
<th>Internal</th>
<th>External</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Theory</td>
<td>30</td>
<td>70</td>
<td>100</td>
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<tr>
<td>2</td>
<td>Practical</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>3</td>
<td>Comprehensive Viva</td>
<td>-</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>4</td>
<td>Seminar</td>
<td>30</td>
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</tr>
<tr>
<td>5</td>
<td>Project work</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
</tbody>
</table>

c) The marks for internal evaluation per semester per theory course are divided as follows:

i. For Mid written examinations: 20 Marks

ii. For Assignment: 5 Marks

iii. For Attendance: 5 Marks

iv. Total: 30 Marks

d) Mid-Term Written Examination: There shall be two mid-term written examinations during a semester. The first mid-term written examination shall be conducted from the first
50 per cent of the syllabus and the second mid-term written examination shall be conducted from the remaining 50 per cent of the syllabus. The mid-term written examinations shall be evaluated for **20 marks** and average of the marks scored in the two mid-term written examinations shall be taken as the marks scored by each student in the mid-term written examination for that semester.

e) **Assignment:** Assignments are to be given to the students and marks not exceeding 5 (5%) per semester per paper are to be awarded by the teacher concerned.

f) **Attendance:** A maximum of 5 marks (5%) per semester per course are to be awarded on the basis of attendance one puts in. Course-wise attendance is taken for this purpose.

g) **For Internal Evaluation in Practical/Lab Subjects:** The marks for internal evaluation are 30. Internal Evaluation is done by the teacher concerned with the help of the other Staff member nominated by Head of the Department. Marks Distribution is as follows:

i. **Writing the program/Procedure:** 10 Marks
ii. **Executing the program/Procedure:** 10 Marks
iii. **Viva:** 05 Marks
iv. **Attendance:** 05 Marks
v. **Total:** 30 Marks

h) **For External Evaluation in Practical/Lab Subjects:** The Semester end examination shall be conducted by an external examiner and a staff member of the Department nominated by Head of the Department. Marks distribution is as follows:

i. **Writing the program/Procedure:** 20 Marks
ii. **Executing the program/Procedure:** 20 Marks
iii. **Viva:** 15 Marks
iv. **Lab Record:** 15 Marks
v. **Total:** 70 Marks

i) **Evaluation of Main Project Work:** A Project Review Committee (PRC) is to be constituted by the Principal/Director with Head of the Department as the Chairman and two other senior faculty members of the department.

i. **Registration for Project work:** A candidate is permitted to register for the project work after satisfying the attendance requirements of all the courses (theory and practical courses) up to III Semester.

ii. After satisfying the registration requirements, a candidate is permitted to register for the project work after satisfying, the title, objectives and plan of action of his project work to the Project Review Committee for its approval. Only after obtaining the approval of Project Review Committee of the Department, the student can initiate the project work. Any changes thereafter in the project are to be approved by PRC. The student has to work under the guidance of both internal guide (one faculty member of the department) and external guide (from Industry not below the rank of an officer). Internal guide is allotted by the Head of the Department or Coordinator of the Project Work whereas external guide is allotted by the industrial organization in which the project is undertaken.

iii. The candidate shall submit status of the report in two stages at least with a gap of 20 days between them.
iv. The work on the project shall be initiated in the beginning of the fourth semester and the duration is one semester. A candidate is permitted to submit project report only after successful completion of theory and practical courses with the approval of PRC and not earlier than 40 days from the date of registration of the project work. For the approval of PRC the candidate shall submit the draft copy of the thesis to the Head/Coordinator (through internal research guide) and shall make an oral presentation before the PRC.

v. Two hardcopies and one soft copy of the project work (dissertation) certified by the research supervisors shall be submitted to the College/Institute.

vi. The thesis shall be adjudicated by one external examiner selected by the Institute out of 5-member panel, submitted by the department.

vii. The marks allotted for project work review are 100, out of which 30 are for internal and 70 for external. Internal evaluation marks are awarded by the PRC on the basis of the student's performance in the three pre-submission reviews and the external evaluation is done by the external examiner.

viii. The marks allotted for project work and dissertation are 100, out of which 30 are for internal and 70 for external. Internal evaluation marks are awarded by the PRC on the basis of the student’s performance in the three pre-submission reviews and the external evaluation is done by the external examiner. In both internal and external evaluations the student shall score at least 40% marks and an aggregate of 50% marks to pass in the project work. If the report of the examiner is favorable, Viva-voce examination shall be conducted by a Board consisting of the Supervisor, Head and the External Examiner who adjudicated the project work. The Board shall jointly evaluate the student’s performance in the project work.

ix. In case the student doesn’t pass through the project work, he has to reappear for the viva-voce examination, as per the recommendations of the Board. If he fails succeed at the second Viva-voce examination also, he will not be eligible for the award of the degree, unless he is asked to revise and resubmit the Project by the Board. Head of the Department and Project coordinator shall coordinate and make arrangements for the conduct of viva-voce examination. When one does get the required minimum marks both in internal and external evaluations the candidate has to revise and resubmit the dissertation in the time frame prescribed by the PRC. If the report of the examiner is unfavorable again, the project shall be summarily rejected.

x. If the report of the viva-voce is not satisfactory, the candidate will retake the viva-voce examination after three months. If he fails to get a satisfactory report at the second viva-voce examination, he will not be eligible for the award of the degree, unless the candidate is asked to revise and resubmit.

8. **Recounting of Marks in the End Examination Answer Books:** A student can request for re-counting of his/her answer book on payment of a prescribed fee.

9. **Re-evaluation of the End Examination Answer Books:** A student can request for re-evaluation of his/her answer book on payment of a prescribed fee.

10. **Supplementary Examinations:** A student who has failed in an end semester examination can appear for a supplementary examination, as per the schedule announced by the College/Institute.
11. **Malpractices in Examinations:** Disciplinary action shall be taken in case of malpractices during Mid/End examinations as per the rules framed by the Academic Council.

12. **Academic Requirements**

   a) A student shall be deemed to have secured the minimum academic requirement in a subject if he/she secures a minimum of 40% of marks in the Semester-end Examination and a minimum aggregate of 50% of the total marks in the Semester-end examination and Internal Evaluation taken together.

   b) A student shall be promoted to the next semester only when he/she satisfies the requirements of all the previous semesters.

   c) In order to qualify for the award of M.Tech Degree, the student shall complete the academic requirements of passing in all the Courses as per the course structure including Seminars and Project if any.

   d) In case a student does not secure the minimum academic requirement in any course, he/she has to reappear for the Semester-end Examination in the course, or re-register for the same course when next offered or re-register for any other specified course, as may be required. However, one more additional chance may be provided for each student, for improving the internal marks provided the internal marks secured by a student are less than 50% and he/she failed finally in the course concerned. In the event of taking another chance for re-registration, the internal marks obtained in the previous attempt are nullified. In case of re-registration, the student has to pay the re-registration fee for each course, as specified by the College.

E) **Grade Points:** A 10-point grading system with corresponding letter grades and percentage of marks, as given below, is followed

<table>
<thead>
<tr>
<th>Letter Grade</th>
<th>Grade Point</th>
<th>Percentage of Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>O (Outstanding)</td>
<td>10</td>
<td>Marks &gt;= 80 and Marks &lt;= 100</td>
</tr>
<tr>
<td>A+ (Excellent)</td>
<td>9</td>
<td>Marks &gt;= 70 and Marks &lt; 80</td>
</tr>
<tr>
<td>A (Very Good)</td>
<td>8</td>
<td>Marks &gt;= 60 and Marks &lt; 70</td>
</tr>
<tr>
<td>B+ (Good)</td>
<td>7</td>
<td>Marks &gt;= 55 and Marks &lt; 60</td>
</tr>
<tr>
<td>B (Above Average)</td>
<td>6</td>
<td>Marks &gt;= 50 and Marks &lt; 55</td>
</tr>
<tr>
<td>F (Fail)</td>
<td>0</td>
<td>Marks &lt; 50</td>
</tr>
<tr>
<td>Ab (Absent)</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

**Earning of Credit:**

A student shall be considered to have completed a course successfully and earned the credits if he/she secures an acceptable letter grade in the range O-P. Letter grade ‘F’ in any Course implies failure of the student in that course and no credits earned.

**Computation of SGPA and CGPA:**

The UGC recommends the following procedure to compute the Semester Grade Point
Average (SGPA) and Cumulative Grade Point Average (CGPA):

i) The SGPA of kth semester (1 to 4) is the ratio of sum of the product of the number of credits and grade points to the total credits of all courses registered by a student,

\[
SGPA(S_k) = \frac{\sum_{i=1}^{n} (C_i \times G_i)}{\sum_{i=1}^{n} C_i}
\]

Where \(C_i\) is the number of credits of the ith course and \(G_i\) is the grade point scored by the student in the ith course and \(n\) is the number of courses registered in that semester.

ii) The CGPA is calculated in the same manner taking into account all the courses \(m\), registered by a student over all the semesters of a programme, i.e., upto and inclusive of \(S_k\), where \(k \geq 2\).

\[
CGPA = \frac{\sum_{i=1}^{m} (C_i \times G_i)}{\sum_{i=1}^{m} C_i}
\]

iii) The SGPA and CGPA shall be rounded off to 2 decimal points.

13. **Award of Class:** After a student satisfies all the requirements prescribed for the completion of the Degree and becomes eligible for the award of M. Tech Degree by JNTUH, he/she shall be placed in one of the following four classes:

<table>
<thead>
<tr>
<th>Class Awarded</th>
<th>CGPA Secured</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1 First class with distinction</td>
<td>CGPA &gt; 7.75</td>
</tr>
<tr>
<td>3.2 First Class</td>
<td>CGPA &gt; 6.75 and CGPA &lt; 7.75</td>
</tr>
<tr>
<td>3.3 Second Class</td>
<td>CGPA &gt; 6.00 and CGPA &lt; 6.75</td>
</tr>
</tbody>
</table>

14. **Withholding of Results:** If the student has not paid dues to the Institute/ University, or if any case of indiscipline is pending against him, the result of the student (for that Semester) may be withheld and he will not be allowed to go into the next Semester. The award or issue of the Degree may also be withheld in such cases.

15. **Transfer of students from the Constituent Colleges of JNTUH or from other Colleges/Universities:** Transfer of students from the Constituent Colleges of JNTUH or from other Colleges/Universities shall be considered only on case-to-case basis by the Academic Council of the Institute.

16. **Transitory Regulations:** Students who have discontinued or have been detained for want of attendance, or who have failed after having undergone the Degree Programme, may be considered eligible for readmission to the same or equivalent subjects as and when they are offered.

17. **General Rules**

a) The academic regulations should be read as a whole for the purpose of any interpretation.

b) In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Academic Council is final.

c) In case of any error in the above rules and regulations, the decision of the Academic Council is final.

d) The college may change or amend the academic regulations or syllabi at any time and the
changes or amendments made shall be applicable to all the students with effect from the dates notified by the college.
### M.Tech (TE) Programme Structure

#### I Year - I Semester

<table>
<thead>
<tr>
<th>Sub-Code</th>
<th>Group</th>
<th>Subject</th>
<th>L</th>
<th>P</th>
<th>C</th>
<th>Int.</th>
<th>Ext.</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>GR17D5129</td>
<td>PC</td>
<td>Advanced Thermodynamics</td>
<td>4</td>
<td>0</td>
<td>4</td>
<td>30</td>
<td>70</td>
<td>100</td>
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<tr>
<td>GR17D5130</td>
<td>PC</td>
<td>Conduction And Radiation Heat Transfer</td>
<td>4</td>
<td>0</td>
<td>4</td>
<td>30</td>
<td>70</td>
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<td>GR17D5131</td>
<td>PC</td>
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<td>4</td>
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<tr>
<td>OE-I</td>
<td>Open Elective – I</td>
<td>4</td>
<td>0</td>
<td>4</td>
<td>30</td>
<td>70</td>
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**Elective I**

<table>
<thead>
<tr>
<th>Sub-Code</th>
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<th>Subject</th>
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<tbody>
<tr>
<td>GR17D5133</td>
<td>PE</td>
<td>Turbo machines</td>
<td>4</td>
<td>0</td>
<td>4</td>
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<tr>
<td>GR17D5132</td>
<td>PE</td>
<td>Advanced Finite Element Analysis</td>
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<tr>
<td>GR17D5135</td>
<td>PE</td>
<td>Theory of Heat Pipes</td>
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**Elective II**

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<tbody>
<tr>
<td>GR17D5136</td>
<td>PE</td>
<td>Refrigeration &amp; Air- Conditioning</td>
<td>4</td>
<td>0</td>
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<td>70</td>
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<tr>
<td>GR17D5137</td>
<td>PE</td>
<td>Jet Propulsion And Rocket engines</td>
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<tr>
<td>GR17D5138</td>
<td>PE</td>
<td>Thermal And Nuclear Power Plants</td>
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<tr>
<td>GR17D5139</td>
<td>Lab</td>
<td>Thermal Engineering Lab</td>
<td>0</td>
<td>4</td>
<td>2</td>
<td>30</td>
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#### I Year - II Semester

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<th>Subject</th>
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<tbody>
<tr>
<td>GR17D5140</td>
<td>PC</td>
<td>Convective Heat Transfer</td>
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<td>GR17D5141</td>
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<td>0</td>
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<td>GR17D5142</td>
<td>PC</td>
<td>Advanced IC Engines</td>
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<td>100</td>
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<tr>
<td>OE – II</td>
<td>Open Elective – II</td>
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**Elective III**

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<th>Subject</th>
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<th>P</th>
<th>C</th>
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<td>GR17D5146</td>
<td>PE</td>
<td>Cryogenic Engineering</td>
<td>4</td>
<td>0</td>
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<tr>
<td>GR17D5144</td>
<td>PE</td>
<td>Thermal Measurements And Process Controls</td>
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<td>GR17D5145</td>
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<td>GR17D5143</td>
<td>PE</td>
<td>Equipment Design For Thermal Systems</td>
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<td>GR17D5147</td>
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<td>Fuels, Combustion and Environment</td>
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<tr>
<td>GR17D5148</td>
<td>PE</td>
<td>Multiphase Flow</td>
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<td>GR17D5150</td>
<td>Lab</td>
<td>Computational Methods Lab</td>
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<td>30</td>
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<td>Seminar-II</td>
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**Total**

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### II Year-I Semester

<table>
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<tr>
<th>Sub-Code</th>
<th>Group</th>
<th>Subject</th>
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<tbody>
<tr>
<td>GR17D5175</td>
<td>SPW</td>
<td>Comprehensive Viva-voce</td>
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<tr>
<td>GR17D5176</td>
<td>SPW</td>
<td>Project work Review</td>
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### II Year-II Semester

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A student has a choice to select one Open Elective Pool I in I Semester and one Open Elective Pool II in II Semester.

### Open Elective Pool-I

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I- SEMESTER
PRE- REQUISITES

- Engineering Mathematics
- Engineering Thermodynamics

COURSE OBJECTIVES: A student who has met the objectives of the course will be able to

- Explain basic thermodynamic concepts and laws
- Describe the concepts entropy and exergy and their use in analyses of thermal energy systems
- Analyze power plants, refrigeration plants and thermal/chemical installations
- Evaluate means for minimizing exergy losses in selected processes
- Present a relevant topic for a group of peers
- Plan and conduct a lecture within the scientific field
- Discuss form and content of a completed lecture

COURSE OUTCOMES

1. Apply Maxwell’s relations and other empirical relations to evaluate the thermodynamic properties of substances.
2. Evaluate the availability and irreversibility associated with the thermodynamic processes to assess the energy quality.
3. Analyze the fuels and combustion reactions and evaluate the enthalpy and entropy of formations and heat of reaction.
4. Illustrate the chemical equilibrium of ideal gases and phase equilibrium of multi component systems.
5. Analyze the equations of state and evaluate thermodynamic properties of real gases.
6. Evaluate efficiency of binary vapor cycle and combined cycle power plants.
7. Analyze various direct energy conversion techniques for evolving alternative energy sources

UNIT-I:


UNIT-II

UNIT-III

UNIT-IV

UNIT-V
DIRECT ENERGY CONVERSION INTRODUCTION: Fuel cells, Thermo electric energy, Thermionic power generation, Thermodynamic devices magneto hydrodynamic generations, and Photovoltaic cells.

Teaching methodologies:
- Power Point presentations
- Tutorial Sheets
- Assignments

TEXT BOOKS:
2. Thermodynamics/ PK Nag/ TMH
3. Engineering Thermodynamics/PL Dhār / Elsevier

REFERENCE BOOKS:
2. Thermodynamics for Engineers/Doolittle-Messe / John Wiley & Sons
3. Thermal Engineering / Soman / PHI
4. Thermal Engineering / Rathore / TMH
5. Engineering Thermodynamics/Chatopadyaya/Oxford University Press
GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

CONDUCTION AND RADIATION HEAT TRANSFER

M.Tech (Thermal Engineering) I Year - I Semester
Course Code: GR17D5130 L/P/C: 4/0/4

PRE-REQUISITES

- Concepts Of Basic Thermodynamics
- Concepts Of Differential And Integral Calculus

COURSE OBJECTIVES: The course is intended to

- Examine the basic concepts of heat transfer models - thermal gradients, conduction, convection, and radiation.
- Formulate engineering and natural thermal systems in terms of conservation of energy
- Relate the rate of heat transfer to the potential for heat flow (difference in temperature) and thermal resistances
- Determine the resistances for conduction, radiation heat transfer, using the fundamental relationships and correlations
- Discuss the physics of thermal radiation and thermal surface properties, and define surface-grayness and view-factor resistance

COURSE OUTCOMES

- Apply engineering and natural thermal systems in terms of conservation of energy equations.
- Explain the resistances for conduction, radiation heat transfer using the fundamental relationships and correlations.
- Examine the variable thermal conductivity phenomenon in slabs, cylinders and spheres.
- Formulate the integral and differential formulations in heat transfer models.
- Model the transient heat conduction problems.
- Classify the black, grey, opaque, transparent & translucent bodies.
- Analyze the radiation shape factors between a differential element & a finite area.

UNIT- I

Brief Introduction to different modes of heat transfer


One Dimensional Steady State Conduction Heat Transfer: Variable Thermal conductivity – systems with heat sources or Heat generation.
UNIT-II

Heat conduction: Methods of formulation –Integral, and differential formulations; initial and boundary conditions, different kinds of boundary conditions, homogeneous boundary conditions; transient response of thermocouples in the measurement of fluctuating gas temperature; integral formulation of heat conduction in a pin fin of uniform cross section and its approximate analytical solution – heat transfer characteristics of straight, annular, and pin fins of uniform and non-uniform cross sections.

UNIT-III


UNIT-IV

Radiation Heat Transfer: Review of basic definitions – black, gray, opaque, transparent, and translucent bodies, transmissivity of a body, diffuse and specular surfaces; emissivity, absorptivity, and reflectivity of real surfaces; solid angle; radiation intensity, emissive power; irradiation, radiosity; radiant energy exchange between two differential area element; radiation shape factor, radiation shape factor between a differential element and a finite area and between two finite areas, crossed-string method, properties of shape factor – reciprocal, additive, and enclosure properties, shape factor algebra.

UNIT-V

Radiant energy exchange between two surfaces, reradiating surfaces, radiation shields; Radiant energy exchange in enclosures – enclosure composed of black surfaces, enclosure composed of diffuse-gray surfaces; electrical network analogy; radiant energy exchange in presence of absorbing and transmitting media, radiant energy exchange in presence of transmitting, reflecting and absorbing media; radiant energy exchange in the presence of conduction and convection.

TEACHING METHODOLOGIES

1. Power Point presentations
2. Tutorial Sheets
3. Assignments

TEXT BOOKS

1. Heat Transfer – NecatiOzisik (TMH)
2. Heat and Mass Transfer – O P Single (Macmillan India Ltd)
REFERENCE BOOKS
2. Heat Transfer : A basic approach – YunusCengel (MH)
6. Convective Heat and Mass Transfer / W.M.Kays&M.E.Crawford(TMH)
8. Thermal Radiation heat transfer – Siegel&J.R.Howell
GR17 Regulations (2017-18)

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

ADVANCED FLUID MECHANICS

M.Tech (Thermal Engineering) I Year - I Semester
Course Code: GR17D5131 L/P/C: 4/0/4

PRE-REQUISITES
• Concepts Of Basic Thermodynamics
• Concepts Of Differential And Integral Calculus

COURSE OBJECTIVES
• Evaluate control volume analysis to develop basic equations and to solve problems.
• Describe and use differential equations to determine pressure and velocity variations in internal and external flows.
• Examine the concept of viscosity and where viscosity is important in real flows.
• Analyze the equations in combination with experimental data to determine losses in flow systems.
• Compare dimensional analysis to design physical or numerical experiments and to apply dynamic similarity.

COURSE OUTCOMES
• Apply knowledge of mathematics, science and engineering.
• Use the governing equations of fluid flow and applying them to flow problems.
• Explain the mathematical formulation of internal and external flow problems.
• Analyze the boundary layer concept to the fluid flow problems.
• Apply the concept of compressible fluids to various flow problems
• Examination of physics of turbulence and turbulent fluid models applied to specific flow conditions
• Apply the basic principles to derive the equation for viscous flow, including laminar flow & turbulent flow.

UNIT-I

UNIT-II
UNIT-III
Boundary Layer Concepts Prandtl’s contribution to real fluid flows – Prandtl’s boundary layer theory - Boundary layer thickness for flow over a flat plate – Approximate solutions – Creeping motion (Stokes) – Oseen’s approximation - Von-Karman momentum integral equation for laminar boundary layer — Expressions for local and mean drag coefficients for different velocity profiles.

UNIT-IV

UNIT-V


TEACHING METHODOLOGIES
1. Power Point presentations
2. Tutorial Sheets
3. Assignments

TEXT BOOKS

REFERENCE BOOKS
4. Fluid Mechanics and Machinery – D. Rama Durgaiah. (New Age Pub.)
GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

TURBOMACHINES (ELECTIVE-I)

M.Tech (Thermal Engineering) I Year - I Semester
Course Code: GR17D5133 L/P/C: 4/0/4

PRE-REQUISITES
- Concepts Of Thermodynamics
- Concepts Of Compressors And Turbines

COURSE OBJECTIVES
- Explain the classification of the turbomachinery, basic equations for analysis of different devices of turbomachinery
- Discuss the constructional features of velocity triangles of steam turbines, centrifugal & axial compressor and axial turbines
- Introduction to dynamics of gases which involves velocity relations, different types of flow and shock relations
- Visualization of cascade analysis in axial flow devices with nomenclature and design analysis of blades
- Illustrate the methodologies for analysis of axial turbines with different correlations and its impact on matching of compressor and turbines

COURSE OUTCOMES
- Discriminate the basic equations used for different turbo machines
- Schematize the concept of velocity triangles used for performance evaluation of turbines
- Enumerate the effects of backpressure on operating the design parameters of nozzle
- Apply the knowledge of degree of relation for different types of turbines
- Explain the methodology for calculating slip factor for centrifugal compressor
- Illustrate the geometrical terminology of cascade analysis for axial compressor
- Focus on off design performance for better matching of compressor and turbines

UNIT-I
FUNDAMENTALS OF TURBO MACHINES: Classifications, Applications, Thermodynamic analysis, isentropic flow. Energy transfer. Efficiencies, Static and Stagnation conditions, Continuity equations, Euler's flow through variable cross sectional areas, unsteady flow in turbo machines

UNIT -II

UNIT-III

UNIT-IV
AXIAL FLOW COMPRESSORS: Flow Analysis, Work and velocity triangles, Efficiencies, Thermodynamic analysis. Stage pressure rise, Degree of reaction, Stage Loading, General design, Effect of velocity, Incidence, Performance

UNIT-V
AXIAL FLOW GAS TURBINES: Work done. Velocity triangle and efficiencies, Thermodynamic flow analysis, Degree of reaction, Zeisel’s relation, Design cascade analysis, Soderberg, Hawthrone, Ainley, Correlations, Secondary flow, Free vortex blade, Blade angles for variable degree of reaction. Actuator disc, Theory, Stress in blades, Blade assembling, Material and cooling of blades, Performances, Matching of compressors and turbines, off design performance.

Teaching methodologies
1. Power Point presentations
2. Tutorial Sheets
3. Assignments

TEXT BOOKS
1. Principles of Turbo Machines/DG Shepherd / Macmillan
2. Fundamentals of Turbomachinery/William W Perg/John Wiley & Sons
3. Element of Gas Dynamics/Yahiya/TMH

REFERENCE BOOKS
2. Turbines, Pumps, Compressors/Yahya/TMH
4. Theory and practice of Steam Turbines/ WJ Kearton/ELBS Pitman/London
5. Gas Turbines Theory and Practice/Zucrow/John Wiley & Sons/Newyork
GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

ADVANCED FINITE ELEMENT ANALYSIS
(ELECTIVE-I)

M.Tech (Thermal Engineering)  I Year - I Semester
Course Code: GR17D5132  L/P/C: 4/0/4

PRE-REQUISITES
- Concepts Of Numerical Methods
- Concepts Of Strength Of Materials

COURSE OBJECTIVES: The course is intended to

- Explain fundamental understanding of the finite element method for solving boundary value problems.
- Explain important concepts of variational form, minimum potential energy principles, and method of weighted residuals.
- Solve one dimensional problems such as truss, beam, and frame members, two-dimensional problems such as plain stress and plain strain elasticity problems, torsion problem.
- Solve finite element analysis of static and dynamic problems and heat transfer problems.
- Provide the student with some knowledge and analysis skills in applying basic laws in mechanics and integration by parts to develop element equations and steps used in solving the problem by finite element method.

COURSE OUTCOMES: The students will be able to

- Explain the fundamental theory of the FEA method.
- Formulate the governing FE equations for systems governed by differential equations
- Apply finite elements methods for structural applications
- Demonstrate the use of FE methods for heat transfer problems
- Analyse the trusses, frames, machine components using analysis software packages
- Analyse discretization of 1-D, 2-D and 3-D field problems effectively
- Formulate the equations on heat conduction, dynamic behavior of structures, mode shapes, model analysis concepts

UNIT-I
Introduction to FEM, basic concepts, historical back ground, applications of FEM, general description, comparison of FEM with other methods, variational approach, Galerkin’s Methods. Co-ordinates, basic element shapes, interpolation function, Virtual energy principle, Rayleigh – Ritz method, properties of stiffness matrix, treatment of boundary conditions, solution of system of equations, shape functions and characteristics, Basic equations of elasticity, strain-displacement relations.
UNIT-II

1-D STRUCTURAL PROBLEMS: Axial bar element – stiffness matrix, load vector, temperature effects, Quadratic shape functions and problems.
ANALYSIS OF TRUSSES: Plane Trusses and Space Truss elements and problems

UNIT-III


UNIT-IV


UNIT-V


TEACHING METHODOLOGIES
1. Power Point presentations
2. Tutorial Sheets
3. Assignments

TEXT BOOKS
2. Finite Element Methods: Basic Concepts and applications, Alavala, PHI
3. Introduction to Finite Elements in Engineering, Chandrupatla, Ashok and Belegundu, Prentice –Hall

REFERENCE BOOKS
4. Finite Element Method – Krishna Murthy / TMH
5. Finite Element Analysis – Bathe / PHI
GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

THEORY OF HEAT PIPES
(ELECTIVE-I)

M.Tech (Thermal Engineering) I Year - I Semester
Course Code: GR17D5135 L/P/C: 4/0/4

PRE-REQUISITES
• Concepts of Heat Transfer
• Concepts of Phase Change Heat Transfer

COURSE OBJECTIVES: The course is intended to
• To illustrate the heat pipes principles, working fluids and wick structures
• To know about the heat pipe limitations like capillary, sonic entrainment and boiling limitations.
• To demonstrate the design and manufacture of heat pipes.
• To classify the type of flow and its behavior in a particular heat pipe.
• To choose suitable heat pipe for a particular application.

COURSE OUTCOMES
• Apply a suitable heat pipe for a particular heating and cooling applications.
• Analyze and calculate the minimum and maximum heat capacities of a particular heat pipe.
• Understand a suitable heat pipe wick structure for a particular application.
• Illustrate the various heat pipe performance limits for operating under different conditions.
• Solve heat pipe heat exchanger, transient model calculation and procedures.
• Examine the transient response to sudden change in temperature heat input, frozen start up and shut down of heat pipe.
• Solve two phase closed thermo siphon reflux-consideration heat transfer in analysis.

UNIT-I
Operating principle, Working fluids and its temperature ranges, heat transfer limits and heat pipe characteristics, various applications Interfacial heat and transfer, physical surface phenomena, capillary and disjoining forces – Interfacial resistance in vaporization and condensation process, Interfacial mass, momentum energy, pressure balance – interfacial phenomena in grooved structures.

UNIT-II
Steady Hydrodynamics – thermal characteristics and heat transfer limitation, thermal fluid phenomena in capillary media, vapor flow analysis, thermal characteristics including the wall effects and effect of vapor flow – capillary boiling – sonic, entrainment, viscous, condenser, continuum and frozen startup limitations.
UNIT-III
Area temperature relations, Pipe dimensions and structural considerations. Heat pipe heat exchanger, transient model calculations and procedures

UNIT-IV
Heat Pipe Behavior- Transient response to sudden change in temperature heat input, frozen startup and shut down of heat pipe – numerical and analytical model for frozen startup. UNIT -V Two phase closed thermo siphon reflux-condensation heat transfer in analysis, evaporation heat transfer analysis, transient and oscillatory behavior of thermo siphon, Minimum liquid fill requirement, Thermo syphon with capillary wicks

TEACHING METHODOLOGIES
1. Power Point Presentations  
2. Tutorials  
3. Working Model Fabrication

TEXT BOOKS
GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

REFRIGERATION AND AIR CONDITIONING
(ELECTIVE-II)

M.Tech (Thermal Engineering)  I Year - I Semester
Course Code: GR17D5136  L/P/C: 4/0/4

CONCEPTS OF THERMODYNAMICS

• Concepts of Heat Transfer

COURSE OBJECTIVES: The course is intended to

• Gain the Knowledge on vapour compression and vapour absorption refrigeration systems
• Describe the applications of air refrigeration systems
• Cover the basic principles of psychometric and applied psychometrics
• Compare the vapor compression refrigeration and multi-stage vapor compression systems
• Explain the different terms of Air-conditioning systems.
• Examine the production of low temperature systems.

COURSE OUTCOMES

• Elaborate the simple, complex vapour compression and vapour absorption refrigeration system for real time applications
• Analyse the performance aspects of refrigeration and air conditioning systems.
• Explain HVAC technology, engineering, research, systems, system designs, energy impacts and overall goals.
• Distinguish the conventional and alternate refrigerants and their impact on environment and develop understanding of the principles and practice of thermal comfort
• Explain the heat transfer and solar energy and develop techniques for the analysis of building envelope loads.
• Evaluate the parameters of psychrometry to air conditioning equipment
• Investigate air conditioning systems and develop generalized psychometrics of moist air and apply to HVAC processes.

UNIT-I

VAPOUR COMPRESSION REFRIGERATION: Performance of Complete vapor compression system.

Components of Vapor Compression System: The condensing unit-Evaporators-Expansion valve -Refrigerants - Properties - ODP & GWP- Load balancing of vapor compression Unit.
Compound Compression: Flash inter-cooling – flash chamber – Multi-evaporator & Multistage systems.

UNIT- II
PRODUCTION OF LOW TEMPERATURE: Liquefaction system; Cascade System - Applications. - Dry ice system. Vapor absorption system- Simple and modified aqua-ammonia system - Representation on Enthalpy concentration diagram. Lithium - Bromide system Three fluid system - HCOP.

UNIT-III
AIR REFRIGERATION: Applications - Air Craft Refrigeration-Simple, Bootstrap, Regenerative and Reduced ambient systems- Problems based on different systems. 
Steam Jet refrigeration system: Representation on T-s and h-s diagrams- limitations and applications. Unconventional Refrigeration system- Thermo-electric - Vortex tube & Pulse tube - working principles.

UNIT-IV
Cooling load Estimation: Occupants, equipment, infiltration, duel heat gain fan load, Fresh air load.

UNIT-V
AIR–CONDITIONING SYSTEMS: All Fresh air, Re-circulated air with and without bypass, with reheat systems – Calculation of Bypass Factor, ADP, RSHF, ESHF and GSHF for different systems.

TEACHING METHODOLOGIES
1. Power Point presentations
2. Tutorial Sheets
3. Assignments

TEXT BOOKS
2. Refrigeration & Air Conditioning /Arora &Domkundwar/ Dhanpat Rai
3. Refrigeration and Air Conditioning /Manohar Prasad/
REFERENCE BOOKS

1. Refrigeration and Air Conditioning /Stoecker /Mc Graw Hill
2. Principles of Refrigeration/Dossat /Pearson
3. Refrigeration and Air Conditioning /Ananthanarayana /TMH
4. Refrigeration and Air Conditioning /Jordan&Preister /Prentice Hall
5. Refrigeration and Air Conditioning/Dossat /Mc GrawHil
GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

JET PROPULSION AND ROCKET ENGINES
(ELECTIVE-II)

M.Tech (Thermal Engineering) I Year - I Semester
Course Code: GR17D5137 L/P/C: 4/0/4

PRE-REQUISITES
• Concepts of Thermodynamics
• Concepts of Turbo machines

COURSE OBJECTIVES
• Recall the processes in gas turbine cycles, fundamentals of jet propulsions and basic
  relations of motion based on forces acting on the flight
• Explain the classification of jet propulsive devices and theory of nozzle and its
  performance parameters
• Elaborate the processes involved in aero thermo-chemistry of the combustion products
• Summarize the procedure of heat transfer considerations in solid propellant rocket
  engines duly ensuring the design parameters
• Discuss the importance of performance parameters for effective integral propulsion
  systems

COURSE OUTCOMES
• Gain the skills in problem solving air craft propulsion systems in particular gas turbine
  engines.
• Carry out a cyclic analysis of gas turbine engine.
• Generalize the concept of adiabatic flame temperature concept for better rate of
  combustion of charge.
• Recognize the importance of equilibrium pressure with respect to solid propellant
  rocket engines.
• Distinguish between mono and bi-propellant rocket engines and their importance.
• Analyze the parameters for better combustion in design of combustion chambers.
• Evaluate the performance parameters viz gross thrust, thrust coefficient for integral
  rocket propulsion system.

UNIT - I:
TURBO JET PROPULSION SYSTEM: Gas turbine cycle analysis – layout of turbo jet engine.
Turbo machinery- compressors and turbines, combustor, blade aerodynamics, engine off
designer formance analysis.
Flight Performance: Forces acting on vehicle – Basic relations of motion – multi stage vehicles.
UNIT-II

PRINCIPLES OF JET PROPULSION AND ROCKETRY: Fundamentals of jet propulsion, Rockets and air breathing jet engines – Classification – turbo jet, turbo fan, turbo prop, rocket (Solid and Liquid propellant rockets) and Ramjet engines.

Nozzle Theory and Characteristics Parameters: Theory of one dimensional convergent – divergent nozzles – aerodynamic choking of nozzles and mass flow through a nozzle – nozzle exhaust velocity– thrust, thrust coefficient, Ac / At of a nozzle, Supersonic nozzle shape, non-adapted nozzles, summer field criteria, departure from simple analysis – characteristic parameters – 1) characteristic velocity, 2) specific impulse 3) total impulse 4) relationship between the characteristic parameters 5) nozzle efficiency, combustion efficiency and overall efficiency.

UNIT-III


UNIT-IV

SOLID PROPELLANT ROCKET ENGINE: internal ballistics, equilibrium motor operation and equilibrium pressure to various parameters. Transient and pseudo equilibrium operation, end burning and burning grains, grain design. Rocket motor hard ware design. Heat transfer considerations in solid rocket motor design. Ignition system, simple pyro devices.

LIQUID ROCKET PROPULSION SYSTEM: Liquid propellants – classification, Mono and Bi propellants, Cryogenic and storage propellants, and ignition delay of hypergolic propellants, physical and chemical characteristics of liquid propellant. Liquid propellant rocket engine – system layout, pump and pressure feed systems, feed system components. Design of combustion chamber, characteristic length, constructional features, and chamber wall stresses. Heat transfer and cooling aspects. Un-cooled engines, injectors – various types, injection patterns, injector characteristics, and atomization and drop size distribution, propellant tank design.

UNIT-V

RAMJET AND INTEGRAL ROCKET RAMJET PROPULSION SYSTEM: Fuel rich solid propellants, gross thrust, gross thrust coefficient, combustion efficiency of ramjet engine, air intakes and their classification – critical, super critical and sub-critical operation of air intakes, engine intake matching, classification and comparison of IIRR propulsion systems.
TEACHING METHODOLOGIES:
1. Power Point presentations
2. Tutorial Sheets
3. Assignments

TEXT BOOKS
1. Mechanics and Dynamics of Propulsion/ Hill and Peterson/John Wiley & Sons
3. Gas Turbines/Ganensan /TMH

REFERENCE BOOKS
2. Rocket propulsion/Bevere
3. Jet propulsion /Nicholas Cumpsty
PRE-REQUISITES

• Concepts of Thermodynamics
• Concepts of Turbo machines

COURSE OBJECTIVES: The course is intended to

• Provide awareness about resources of energies available in India for Power Production by Thermal and Nuclear Processes.
• Identify the requirements for a Thermal Power Plant and Nuclear Power Plant, from Sources to consumption and economics of power plants.
• Study and learn the processes and cycles followed in Thermal Power Plants and nuclear power Plants and components used in the power plants.
• Gain the knowledge on steam power plants, steam generators and gas turbine power plants, their Analyses on fuel and fluidized bed combustion, ash handling systems,
• List the practices followed in Thermal Power Plant and Nuclear Power Plants, to better Environmental conditions and the safety measures.

COURSE OUTCOMES

• Explain the knowledge about resources of energies available in India for power production by thermal and nuclear process.
• Identify the parts and state functions of steam traps, heaters and fuel handling system.
• Analyze the process and cycles followed in thermal power plants and nuclear power plants and components used in power plants and calculating the power load calculations and distribution, identify the losses to get better efficiency.
• Apply the knowledge gained by analyzing the steam power plants, steam generators and gas turbine power plants to improve the efficiency and reduce the thermal losses.
• Analyze economics of power plants and list power factors affecting the power plants.
• Calculate the performance of power plants based on load variations.
• Identify and explain various measuring instruments used in power plants.

UNIT-I


Steam Power Plants: Introduction – General Layout of Steam Power Plant, Modern Coal-fired Steam Power Plants, Power Plant cycles, Fuel handling, Combustion Equipment, Ash handling,
Dust Collectors. Steam Generators: Types, Accessories, Feed water heaters, Performance of Boilers, Water Treatment, Cooling Towers, Steam Turbines, Compounding of Turbines, Steam Condensers, Jet& Surface Condensers.

**UNIT-II**

**UNIT-III**
Nuclear Power Plants: Nuclear Physics, Nuclear Reactors, Classification – Types of Reactors, Site Selection, Methods of enriching Uranium, Applications of Nuclear Power Plants.
Nuclear Power Plants Safety: By-Products of Nuclear Power Generation, Economics of Nuclear Power Plants, Nuclear Power Plants in India, Future of Nuclear Power.

**UNIT-IV**

**UNIT-V**

**TEACHING METHODOLOGIES**
1. Power Point presentations
2. Tutorial Sheets
3. Assignments

**TEXT BOOKS**
1. Power Plant Engineering / P.K. Nag / TMH.
GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

THERMAL ENGINEERING LAB

M.Tech (Thermal Engineering)  I Year - I Semester
Course Code: GR17D5139  L/P/C: 4/0/4

PRE-REQUISITES

• Concepts of Thermodynamics
• Concepts of Fluid Mechanics

COURSE OBJECTIVES:
The lab is mainly intended to

• Analyze the performance and exhaust emissions of an IC engine by conducting the Performance test on IC Engines.
• Evaluate the performance of the Vapor compression and Air conditioning units
• Analyze the flame propagation velocity of the gaseous fuels
• Evaluate the performance of the Solar flat plate collector and evacuated tube concentrator

COURSE OUTCOMES:

• Analyze the performance and exhaust emission of an IC engine by conducting the performance test on IC engines.
• Evaluate the performance of the vapor compression and air conditioning units.
• Examine the flame propagation velocity of the gaseous fuels.
• Analyse the performance of solar flat plate collector and evacuated tube concentrator
• Evaluate the performance of heat pipes
• Estimate the dryness fraction of steam
• Use alternate fuels for improvement of performance of diesel engines.

LIST OF EXPERIMENTS

Task 1. Performance test on Diesel engine with electrical loading.
Task 2. Dryness fraction estimation of steam.
Task 3. Flame propagation analysis of gaseous fuels.
Task 7. COP estimation of vapour compression refrigeration test rig
Task 10. Determination of power capacity of Solar Flat Plate Collector.
Task 11. Determination of volumetric efficiency of reciprocating air compressor.
OPEN ELECTIVE - I
Course Objectives

• To understand the interest and opportunity of e-commerce
• To know and understand the critical success factors in implementing an e-commerce system
• To know how to plan and how to manage e-commerce solutions
• To have hands on, real-life experience with electronic commerce applications
• To analyze and understand the human, technological and business environment
• Associated with e-commerce

Course Outcomes: At the end of the course, the student will be able to

• Understand the trends in e-Commerce and the use of the Internet.(Level 2)
• Analyze, Understand and Compare the principles of E-commerce and basics of World Wide Web.(Level 2&4)
• Analyze, Understand the concept of electronic data interchange and its legal, social and technical aspects.(Level 2&4)
• Understand and Evaluate the security issues over the web, the available solutions and future aspects of e-commerce security.(Level 2&5)
• Understanding and Validating the concept of E-banking, electronic payment system.(Level 2&5)
• Understand, Analyze and Compare the capabilities and limitation of agents, Web based marketing and various security issues. (Level 2&4)
• Understanding and Evaluation of online advertisements, website design issues and Creating a business transaction using an e commerce site.(Level 2,5 &6)

UNIT-I
INTRODUCTION Traditional commerce and E commerce – Internet and WWW – role of WWW value chains – strategic business and Industry value chains – role of E commerce, advantages of E commerce, anatomy of e commerce applications.

UNIT-II
UNIT-III

UNIT- IV

UNIT-V

TEXT BOOKS
1. Ravi Kalakota, “Electronic Commerce”, Pearson Education,

REFERENCES BOOK
PREREQUISITES

• Fundamentals of enterprise resource planning (ERP) systems concepts
• Importance of integrated information systems in an organization.

COURSE OBJECTIVES: The objective of the course is to provide the student

• Understanding of the basic concepts of ERP systems for manufacturing or service companies, and the differences among MRP, MRP II, and ERP systems
• Thinking in ERP systems: the principles of ERP systems, their major components, and the relationships among these components
• Capability to adapt in-depth knowledge of major ERP components, including material requirements planning, master production scheduling, and capacity requirements planning
• Understanding knowledge of typical ERP systems, and the advantages and limitations of implementing such systems
• Understanding the business process of an enterprise
• Grasp the activities of ERP project management cycle
• Understanding the emerging trends in ERP developments

COURSE OUTCOMES: At the end of the course the student will be able to

• Examine systematically the planning mechanisms in an enterprise, and identify all components in an ERP system and the relationships among the components
• Understand production planning in an ERP system, and systematically develop plans for an enterprise
• Use methods to determine the correct purchasing quantity and right time to buy an item, and apply these methods to material management
• Understand the difficulties of a manufacturing execution system, select a suitable performance measure for different objectives, and apply priority rules to shop floor control
• Knowledge of ERP implementation cycle
• Awareness of core and extended modules of ERP
• Apply emerging trends in ERP

UNIT-I

UNIT-II


UNIT- III


UNIT- IV


UNIT- V

ERP-Present and future: Turbo Charge the ERP System – EIA – ERP and E-Commerce – ERP and Internet – Future Directions in ERP.

TEXT BOOKS

PREREQUISITE: Control Systems, Mathematics.

COURSE OBJECTIVES

• To familiarize students with the modelling of systems
• To familiarize the students with the state space analysis of dynamic systems and observe their controllability and Observability.
• To make students understand the concepts of describing function analysis of nonlinear systems and analyze the stability of the systems.
• To analyze the stability of the nonlinear systems.

COURSE OUTCOMES

• Ability to obtain the mathematical model of any system.
• Ability to obtain the state model for dynamic systems.
• Ability to analyze the controllability and Observability for various types of control systems.
• Ability to understand the various types of nonlinearity.
• Ability to analyze the stability of the nonlinear systems.
• Ability to synthesize the nonlinear systems.

UNIT-I


UNIT-II

STATE VARIABLE ANALYSIS: linear Continuous time models for Physical systems— Existence and Uniqueness of Solutions to Continuous- time State Equations — Solutions of Linear Time Invariant Continuous-Time State Equations—State transition matrix and it’s properties.

UNIT- III
NON LINEAR SYSTEMS -I
Introduction to Non Linear Systems - Types of Non-Linearities-Saturation-Dead-Zone - Backlash Jump Phenomenon etc;— Singular Points-Introduction to Linearization of nonlinear systems, Properties of Non Linear systems-Describing function-describing function analysis of nonlinear systems-Stability analysis of Non-Linear systems through describing functions.

UNIT-IV
NON LINEAR SYSTEMS-II
Introduction to phase-plane analysis, Method of Isoclines for Constructing Trajectories, singular points, phase- plane analysis of nonlinear control systems.

UNIT-V
STABILITY ANALYSIS

TEACHING METHODOLOGIES
1. White board
2. PPTs
3. Seminars

EXT BOOKS
1. Modern Control System Theory by M.Gopal — New Age International -1999

REFERENCE BOOK
COURSE OBJECTIVES

- To develop the skill of solving linear algebraic systems by direct and iteration methods.
- To illustrate advanced matrix techniques in the determination of Eigen values and Eigen vectors of square matrix.
- To analyze the performance of various interpolation technique and perform error analysis.
- To compare various numerical differentiation and integration techniques.
- To explain the various techniques to study Initial and Boundary value problems in ODE.
- To solve a range of problems on applicable software.

COURSE OUT COMES: At the end of the course the student will be able to

- Solve linear algebraic system by direct and iteration methods.
- Apply the knowledge of Eigen values and Eigen vectors to some contents in engineering.
- Develop the skill of working with symmetric matrices in the study of Engineering problems.
- Apply the knowledge of interpolation and extrapolation of uniform and non uniform data to certain contents of Civil Engineering.
- Apply the knowledge of numerical differentiation and integration to some contents of Civil Engineering.
- Learn grid based methods to solve Initial and Boundary value problems that arise in engineering problems.
- Develop the skill of solving computational problems using software.

UNIT-I


UNIT-II

UNIT - III


UNIT-IV


UNIT-V


*NOTE: Demonstration of solutions using open source software in Numerical Methods only for the knowledge of students to apply in their Project Works. Not for examination.

TEXT BOOKS

2. S.S.Shastry, Numerical methods.

REFERENCES BOOKS

3. Dr. M.Shanta Kumar, Computer based numerical analysis, Khanna Book publishers, New Delhi.
GOKARAJU RANGARAJU  
INSTITUTE OF ENGINEERING AND TECHNOLOGY

ADVANCED COMPUTER ARCHITECTURE  
(Open Elective-I)

M.Tech (ECE) I Year - I Semester
Course Code: GR17D5182 L/P/C: 4/0/4

COURSE OBJECTIVES

• To learn how to build the best processor/computing system understanding the underlying tradeoffs and ramifications.
• To identify and analyze the attributes of computer architecture design with recent trend technology.
• To identify the techniques to improve the speed and performance of computers – Parallelism in Instruction level – Hardware approaches - pipelining, dynamic scheduling, superscalar processors, and multiple issue of instructions.
• To implement the design aspects and categorize various issues, causes and hazards due to parallelisms.
• To examine and compare the performance with benchmark standards.
• To understand the framework for evaluating design decisions in terms of application requirements and performance measurements.
• To learn the design and analysis of complex and high performance multiprocessors and supporting subsystems from the quantitative aspect.

COURSE OUTCOMES: After going through this course the student will be able to

• An ability to discuss the organisation of computer-based systems and how a range of design choices are influenced by applications.
• An ability to understand the components and operation of a memory hierarchy and the range of performance issues influencing its design.
• An ability to interpret the organisation and operation of current generation parallel computer systems, including multiprocessor and multicore systems.
• An ability to understand the various techniques to enhance a processors ability to exploit instruction-level parallelism (ILP), and its challenges.
• An ability to know the classes of computers, and new trends and developments in computer architecture.
• An ability to develop the applications for high performance computing systems.
• An ability to undertake performance comparisons of modern and high performance computers.

UNIT -I

Instruction set principles and examples - Introduction, classifying instruction set - memory addressing type and size of operands, Operations in the instruction set.

UNIT-II

Pipelines: Introduction, basic RISC instruction set, Simple implementation of RISC instruction set, Classic five stage pipe lined RISC processor, Basic performance issues in pipelining, Pipeline hazards, Reducing pipeline branch penalties.


UNIT-III

Instruction Level Parallelism (ILP) - The Hardware Approach: Instruction-Level parallelism, Dynamic scheduling, Dynamic scheduling using Tomasulo’s approach, Branch prediction, High performance instruction delivery - Hardware based speculation.

ILP Software Approach:
Basic compiler level techniques, Static branch prediction, VLIW approach, Exploiting ILP, Parallelism at compile time, Cross cutting issues - Hardware versus Software.

UNIT-IV

Multi Processors and Thread Level Parallelism: Multi Processors and Thread level Parallelism - Introduction, Characteristics of application domain, Systematic shared memory architecture, Distributed shared – Memory architecture, Synchronization.

UNIT-V

Inter Connection and Networks: Introduction, Interconnection network media, Practical issues in interconnecting networks, Examples of inter connection, Cluster, Designing of clusters. Intel Architecture: Intel IA-64 ILP in embedded and mobile markets Fallacies and pitfalls.

TEXT BOOKS


REFERENCE BOOKS

COURSE OBJECTIVES: The Objective of this course is to provide
- Analysis of quantitative methods and techniques for effective Decision–making.
- Constructing models that are used in solving business decision problems.
- Introduce the students to the use of basic methodology for the solution of linear programs and integer programs.
- Introduce the students to methods for solving large-scale transportation and assignment problems.
- Illustrate how sequencing is carried out in assigning jobs to machines.
- Understand the concept of Inventory and apply different models in optimizing the same.
- Apply PERT/CPM: [Project scheduling and allocation of resources] to schedule and control construction of dams, bridges, roads etc. in an optimal way.

COURSE OUTCOMES: At the end of the course, the student will be able to:
- Apply various linear programming techniques for optimal allocation of limited resources such as machine, materials and money.
- Solve transportation problems to minimize cost and understand the principles of assignment of jobs and recruitment policies.
- Solve sequencing problems to optimize the outputs in terms of time, cost and profit.
- Apply PERT/CPM: [Project scheduling and allocation of resources] to schedule and control construction of dams, bridges, roads etc. in an optimal way.
- Solve game theory problems to reach interactive optimization problems.
- Solve problems of inventory and develop proper inventory policies for efficient management.
- Develop optimum replacement policy in decision making process of replacing a used equipment with a substitute.

UNIT-I

Introduction: Definition and scope of operations research(OR), OR model, solving the OR model, art of modeling, phases of OR study.

Linear Programming:
Two variable Linear Programming model and Graphical method of solution, Simplex method, Dual Simplex method, special cases of Linear Programming, duality, sensitivity analysis.

UNIT-II

Transportation Problems: Types of transportation problems, mathematical models, transportation algorithms
Assignment: Allocation and assignment problems and models, processing of job through machines.

UNIT-III
Network Techniques: Shortest path model, minimum spanning Tree Problem, Max-Flow problem and Min-cost problem.
Project Management: Phases of project management, guidelines for network construction, CPM and PERT.

UNIT-IV
Theory of Games: Rectangular games, Min-max theorem, graphical solution of 2xnormx2 games, game with mixed strategies, reduction to linear programming model.
Quality Systems: Elements of Queuing model, generalized Poisson queuing model.

UNIT-V
Inventory Control: Models of inventory, operation of inventory system, quantity discount. Replacement models: Equipments that deteriorate with time, equipments that fail with time.

TEXT/REFERENCE BOOKS:

TEACHING METHODOLOGY
1. Lecture is delivered on blackboard, preparing OHP sheets and by preparing Power point presentations.
2. Seminars are conducted on new technologies related to subject.
3. Assignments are given.
4. Group discussions are conducted on familiar topics related to subject.
5. Industrial visits for practical exposure to understand and explore things.
II- SEMESTER
PRE-REQUISITES

- Concepts of Thermodynamics
- Concepts of Heat Transfer

COURSE OBJECTIVES: The course is intended to

- Provide a fundamental treatment of fluid flows controlled by viscous or turbulent stress gradients and the subsequent heat transfer between fluids and solid surfaces.
- Explain analytical solutions to the momentum and energy conservation equations for both laminar and turbulent flows will be considered.
- Develop solid foundation for the engineering practitioner engaged in single phase convective thermal transport.
- Provide solid foundation for further studies in multiphase convective transport.
- Identify the solution methodologies (similarity and integral methods) to solve for external and internal forced convective heat transfer.

COURSE OUTCOMES

- Apply transport equations to convective transport problems and evaluate appropriate transport properties such as friction factors, Nusselt numbers, Sherwood numbers and Stanton numbers.
- Evaluate the heat transfer coefficient for the engineering systems with natural convection, forced convection.
- To differentiate and distinguish between the modes of convective heat transfer (forced, natural, laminar, internal, etc).
- To formulate the fundamental governing equations of mass, momentum and energy and describe their approximations leading to analytical solutions.
- To analyze the solution methodologies (similarity and integral methods) to solve for external and internal forced convective heat transfer.
- To solve related convective heat transfer problems using different methods, correlations and available charts.
- Relate and perform engineering analysis in the area of thermal systems.

UNIT-I
Introduction to Forced, free & combined convection – convective heat transfer coefficient – Application of dimensional analysis to convection – Physical interpretation of dimensionless numbers.

UNIT-II
EXTERNAL LAMINAR FORCED CONVECTION: Similarity solution for flow over an isothermal plate – integral equation solutions – Numerical solutions – Viscous dissipation effects on flow over a flat plate.
Internal Laminar Flows: Fully developed laminar flow in pipe, plane duct & ducts with other cross sectional shapes – Pipe flow & plane duct flow with developing temperature field – Pipe flows & plane duct flow with developing velocity & temperature fields.
Internal Turbulent Flows: Analogy solutions for fully developed pipe flow – Thermally developing pipe & plane duct flow.

UNIT-III

UNIT- IV
COMBINED CONVECTION: Governing parameters & equations – laminar boundary layer flow over an isothermal vertical plate – combined convection over a horizontal plate – correlations for mixed convection – effect of boundary forces on turbulent flows – internal flows - internal mixed convective flows – Fully developed mixed convective flow in a vertical plane channel & in a horizontal duct.

UNIT-V

TEACHING METHODOLOGIES
1. Power Point presentations
2. Tutorial Sheets
3. Assignments

TEXT BOOKS
1. Introduction to Convective Heat Transfer Analysis/ Patrick H. Oosthuigen & David Naylor /McGraw Hill
2. Convective Heat & Mass Transfer /Kays & Crawford/TMH
GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

COMPUTATIONAL METHODS IN HEAT TRANSFER

M.Tech (Thermal Engineering)  I Year - II Semester
Course Code: GR17D5141  L/P/C: 4/0/4

PRE- REQUISITES

• Numerical Methods(Engineering Mathematics)
• Fluid Mechanics
• Heat Transfer

COURSE OBJECTIVES: The course is intended to

• Describe the physical significance of each term in the governing equations for CFD
• Identify the use of a commercial CFD package to solve practical CFD problems
• Quantify and analyse the numerical error in CFD discretization schemes
• Develop finite difference and finite volume forms of the CFD equations for heat transfer and fluid flow problems
• Formulate explicit and implicit algorithms for solving the Navier-Stokes equations

COURSE OUTCOMES

• Implement FDM techniques to steady state and unsteady state problems in heat transfer.
• Examine various numerical techniques (FEM, FVM, FDM) available for solving CFD problems.
• Classify the partial differential equations to understand the behavior of the equations.
• Gain knowledge about the various discretization schemes.
• Calculate the flow field with SIMPLE and SIMPLER schemes.
• Exposure to various turbulent flow modeling techniques in FVM.
• Discuss the pressure velocity and density coupling in compressible flows.

UNIT-I


UNIT-II

UNIT-III

**FVM to Convection and Diffusion:** Concept of Elliptic, Parabolic and Hyperbolic Equations applied to fluid flow – Governing Equations of Flow and Heat transfer – Steady 1D Convection Diffusion – Discretization Schemes and their assessment – Treatment of Boundary Conditions.

UNIT-IV

**Calculation of Flow Field:** Vorticity & Stream Function Method - Staggered Grid as Remedy for representation of Flow Field - Pressure and Velocity Corrections – Pressure Velocity Coupling - SIMPLE & SIMPLER (revised algorithm) Algorithm.

UNIT-V


**TEACHING METHODOLOGIES:**

- Power Point presentations
- Tutorial Sheets
- Assignments

**TEXT BOOKS**

3. An Introduction to Computational Fluid Dynamics – FVM Method – H.K. Versteeg, W. Malalasekhara (PHI)
4. Computational Fluid Dynamics – Anderson (TMH)
5. Computational Methods for Fluid Dynamics – Ferziger, Peric (Springer)

**REFERENCE BOOKS**

1. Computational Fluid Dynamics, T.J. Chung, CambridgeUniversity
2. Computational Fluid Dynamics – A Practical Approach – Tu, Yeoh, Liu (Elsevier)
3. Text Book of Fluid Dynamics, Frank Chorlton, CBS Publishers
GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY
ADVANCED IC ENGINES

M.Tech (Thermal Engineering)  I Year - II Semester
Course Code: GR17D5142  L/P/C: 4/0/4

PRE-REQUISITES
- Concepts of Thermodynamics
- Concepts of Heat Transfer

COURSE OBJECTIVES
- Recall the historical review of engine types, analysis on different cycles and their design and operating parameters
- Explain the importance of charge motion in gas exchanging process to achieve maximum volumetric efficiency
- List various stages involved in combustion processes of CI and SI engines and different types of fuel injection systems
- Discuss the particulates of combustion in CI and SI engines, reasons for formation of particulates and measure and methods adopted to control the pollution
- Infer the importance of heat transfer in combustion process and create an idea on modern trends in different types of concepts to improve the performance

COURSE OUTCOMES
- Describe the engine cycles and factors responsible for making the cycle different from the ideal cycle
- Demonstrate the relationships in the design parameters in context with environmental and social relevance
- Identify the need of computer modeling for engine design modification for performance improvement
- Recognize the need of EGR, MPFI system for emission reduction
- Summarize the different concepts of effective combustion in CI and SI engines
- Integrate the turbulence characteristics with swirl, squish and pre combustion process for better combustion of charge
- Focus on adiabatic engine, lean burning engine, HCCI and GDI engine concepts for better performance

UNIT-I
Introduction: Historical Review – Engine Types – Design and operating Parameters.
UNIT-II
Charge Motion: Mean velocity and Turbulent characteristics – Swirl, Squish – Pre-chamber Engine flows.

UNIT-III
COMBUSTION IN S.I ENGINES: Stages of combustion- Cyclic Variations – Flame propagation and factors influencing–Abnormal combustion Fuel factors, MPFI.

UNIT-IV

UNIT-V
ENGINE HEAT TRANSFER: Importance of heat transfer, heat transfer and engine energy balance, Convective heat transfer, radiation heat transfer, Engine operating characteristics.

TEACHING METHODOLOGIES
1. Power Point presentations
2. Tutorial Sheets
3. Assignments

TEXT BOOKS
1. I.C. Engines / V.Ganesan/TMH
2. I.C. Engines Fundamentals/Heywood/TMH
4. I.C. Engines /RK Rajput/Laxmi Publications

REVERENCE BOOKS
2. Fundamentals of IC Engines/HN Gupta/PHI/2nd edition
4. The I.C. Engine in theory and Practice Vol.I / Teylor / IT Prof. andVol.II
GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

CRYOGENIC ENGINEERING
(ELECTIVE-III)

M.Tech (Thermal Engineering) I Year - II Semester
Course Code: GR17D5146 L/P/C: 4/0/4

PREREQUISITES
• Fundamentals of thermodynamics

COURSE OBJECTIVES: At the end of the course student is expected to:
• Examine basic principles of cryogenics
• Apply the knowledge of cryogenics in different applications of cryogenics like space technology, gas industry, electronics
• Design low temperature system by considering properties and principles of mixtures
• Identify theoretical and mathematical methods of liquefaction systems
• Construction of liquefaction system for different gases

COURSE OUTCOMES
• Acquire knowledge about cryogenics and properties of cryogenic fluids
• To recognize the liquefaction systems for different gases
• Apply theoretical and mathematical methods of liquefaction system
• Design low temperature system by considering properties and principles of mixtures
• Understand and demonstrate the insulation required for fluid storage and transfer
• Apply the knowledge of cryogenic fluid storage and transfer systems
• Develop feasibility study of designed cryogenic machines and related applications

UNIT-I
Introduction to CRYOGENIC Systems – Mechanical Properties at low temperatures – Properties of cryogenic fluids.
Gas Liquefaction: Minimum work for liquefaction – Methods to produce low temperature – Liquefaction systems for gases other than Neon, Hydrogen and Helium

UNIT-II
Liquefaction systems for Neon, Hydrogen and Helium Components of Liquefaction systems – Heat Exchangers – Compressors and Expanders – expansion valve – Losses for real machines

UNIT-III
Gas separation and purification systems – Properties of mixtures – Principles of mixtures – Principles of gas separation – Air separation systems
UNIT-IV
Cryogenic Refrigeration Systems – Working media – Solids, Liquids and gases
Cryogenic fluid storage & transfer – Cryogenic storage systems – Insulation – Fluid transfer mechanisms – Cryostat – Cryo Coolers

UNIT-V
Applications – Space technology – In-flight air separation and collection of LOX – Gas Industry – Biology – Medicine - Electronics

TEACHING METHODOLOGIES
1. Power Point presentations
2. Tutorial Sheets
3. Assignments

TEXT BOOKS

REFERENCE BOOKS
7. Cryogenic Two Phase flow – N.N. Falina and J.G. Weisend –II
9. Cryogenic Engineering – Thomas M. Flynn
GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

THERMAL MEASUREMENTS AND PROCESS CONTROLS
(ELECTIVE-III)

M.Tech (Thermal Engineering) I Year - II Semester
Course Code: GR17D5144 L/P/C: 4/0/4

PRE-REQUISITES
• Fluid Mechanics
• Heat Transfer

COURSE OBJECTIVES: The course is intended to
• Describe operating principles and function of measuring instruments used in Engineering and process industries
• Explain various working principles of instruments
• List and analyze the behavioral characteristics of instruments
• Discover about calibration procedure of the instruments
• Identify fundamental aspects of control systems and their use in the context of industry applications

COURSE OUTCOMES
• Demonstrate the Principles of pressure measurements and calibration methods
• Apply the different working principles of various instruments and learn in the transduction of the signals
• Illustrate the different techniques for measurement of compressible fluid flow.
• Discuss the behavior of an instrument in the measurement process
• Understand the various temperature measurements and level measurement principles
• Analyze and design an instrumentation system, dealing with the concepts of dynamic range, signal noise ratio, and error budget
• Evaluate to build, program, calibrate and use a microprocessor-based instrumentation system

UNIT-I
Measurement of pressure – principles of pressure measurement, static and dynamic pressure, vacuum and high pressure measuring – Measurement of low pressure, Manometers, Calibration methods, Dynamic characteristics- design principles.
UNIT-II

UNIT-III
TEMPERATURE MEASUREMENT: Different principles of Temperature Measurement, use of bimetallic thermometers – Mercury thermometers, Vapor Pressure thermometers, Thermo positive elements, thermocouples in series & parallel, pyrometry, measurement of heat flux, calibration of temperature measuring instruments. Design of temperature measuring instruments.

UNIT-IV

UNIT-V
PROCESS CONTROL: Introduction and need for process control principles, servomechanism, transfer functions, block diagrams, signal flow graphs, open and closed loop control systems – Analysis of First & Second order systems with examples of mechanical and thermal systems. Control System Evaluation – Stability, steady state regulations, and transient regulations.

TEACHING METHODOLOGIES
• Power Point presentations
• Tutorial Sheets
• Assignments

TEXT BOOK

REFERENCE BOOKS
GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

ALTERNATE ENERGY RESOURCES
(ELECTIVE-III)

M.Tech (Thermal Engineering) I Year - II Semester
Course Code: GR17D5145 L/P/C: 4/0/4

PRE-REQUISITES

- Fundamentals of Modern Physics
- Fundamentals Of Thermal And Design Engineering

COURSE OBJECTIVES

- To understand the alternate energy sources
- To 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.
- To Perform the efficiency calculations of solar, wind etc
- To Evaluate the bio gas and power using biomass

COURSE OUTCOME

- Apply the knowledge about various renewable energy sources
- Use the appropriate renewable energy as an alternate for conventional power in any application
- Compare different renewable energy technologies and choose the most appropriate based on local conditions
- Analyze the simple techno economical assessments of renewable energy systems
- Apply the principles of Renewable energy technologies in modern power plants
- Enumerate the efficiencies of various renewable energy technologies and compare with Non renewable techniques
- Evaluate the performance of Renewable energy technologies

UNIT -I


UNIT -II

UNIT-III


UNIT -IV


UNIT-V


Energy from Oceans:

TEACHING METHODOLOGIES
1. Power Point presentations
2. Tutorial Sheets
3. Assignments

TEXT BOOKS

REFERENCE BOOKS
1. Renewable Energy Resources / John Twidell& Tony Weir
   Biological Energy Resources / Malcolm Flescher&ChrrisLawis
GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY
EQUIPMENT DESIGN FOR THERMAL SYSTEMS
(ELECTIVE-IV)

M.Tech (Thermal Engineering)
Course Code: GR17D5143

I Year - II Semester
L/P/C: 4/0/4

PRE-REQUISITES
• Fluid Mechanics
• Heat Transfer

COURSE OBJECTIVES: The course is intended to
• Analyse the LMTD for parallel flow, counter flow, multi pass and, cross flow heat exchanger
• Explain the Shell and tube heat exchanger
• Enable to carry out the performance of heat exchanger with the extended surfaces.
• Predict the performance of the cooling towers.
• Examine the condensation on vertical and horizontal condensers.

COURSE OUTCOMES
• Evaluation of the performance of parallel flow, counter flow, multi-pass and cross flow Heat Exchangers
• Design and Analyze the shell and tube heat exchangers
• Estimate the heat transfer coefficient in the process of condensation in horizontal and vertical orientations
• Explain different methodologies for enhancing the performance of extended surface
• Examine the functioning of evaporators, reboilers and vaporizers
• Elaborate the importance of different types of cooling towers for real time application
• Design and analyse the performance parameters of the cooling towers for various applications

UNIT-I

UNIT-II
Double Pipe Heat Exchanger: Film Coefficient for fluids in annulus, fouling factors, calorific temperature, average fluid temperature, the calculation of double pipe exchanger, Double pipe exchangers in series-parallel arrangements.
Shell & Tube Heat Exchangers: Tube layouts for exchangers, baffle Heat exchangers, calculation of shell and tube heat exchangers – shell side film coefficients, Shell side equivalent diameter, the true temperature difference in a 1-2 heat exchanger, influence of approach temperature on correction factor, shell side pressure drop, tube side pressure drop, Analysis of performance of 1-2 heat exchanger, and design calculation of shell & tube heat exchangers. Flow arrangements for increased heat recovery, the calculations of 2-4 exchangers.

UNIT-III
Condensation of single vapors: Calculation of a horizontal condenser, vertical condenser, De-super heater condenser, vertical condenser – sub-cooler, horizontal condenser – sub cooler, vertical reflux type condenser, condensation of steam.

UNIT-IV
Vaporizers, Evaporators and Reboilers: Vaporizing processes, forced circulation vaporizing exchangers, natural circulation vaporizing exchangers, calculations of a reboiler. Extended Surfaces: Longitudinal fins, weighted fin efficiency curve, calculation of a double pipe fin efficiency curve, and calculation of a double pipe finned exchanger, calculation of a longitudinal fin shell and tube exchanger.

UNIT-V
Direct Contact Heat Exchanger: Cooling towers, relation between wet bulb & dew point temperatures, the Lewis number, and classification of cooling towers, cooling tower internals and the roll of fill. Analysis of cooling tower requirements, Design of cooling towers, Determination of the number of diffusion units, calculation of cooling tower performance.

TEACHING METHODOLOGIES
1. Power Point presentations
2. Tutorial Sheets
3. Assignments

TEXT BOOKS

REFERENCE BOOKS
1. Cooling towers by J.D.Gurney
GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY
FUELS, COMBUSTION AND ENVIRONMENT
(ELECTIVE IV)

M.Tech (Thermal Engineering) I Year - II Semester
Course Code: GR17D5147 L/P/C: 4/0/4

PREREQUISITES
• Fundamentals of thermodynamics

COURSE OBJECTIVES
• Define the different properties of fuels and their analysis
• Explain the importance of chemical kinetics in combustion process and theories of reaction kinetics
• Illustrate the concept of enthalpy of formation, adiabatic temperature and equilibrium composition of gaseous mixtures
• Elaborate the importance of flame stability and flame structure in laminar and turbulent flame propagations
• Appraise the consequences of air pollution on environment, human health etc. and legislative measures for control of emissions

COURSE OUTCOMES
• Differentiate the properties of different fuels and then analyze
• Analyze the combustion products like exhaust and flue gases for regeneration of energy
• Focus on chemical kinetics, reaction order and molecularity importance on combustion
• Describe the importance of enthalpy of formation for effective burning and factors affecting the burning velocity
• Demonstrate different types of combustion systems for combustion of fuel droplets and spray
• Integrate the characteristics of flame and its structure for better combustion
• Summarize the various methods of emission control

UNIT-I

UNIT-II

UNIT-III

UNIT-IV

UNIT-V
Environmental Considerations – Air pollution – Effects on Environment, Human Health etc. Principal pollutants – Legislative Measures – Methods of Emission control.

TEACHING METHODOLOGIES
1. Power Point presentations
2. Tutorial Sheets
3. Assignments

TEXT BOOKS

REFERENCE BOOKS
7. Combustion-I. Glassman
GR17 Regulations (2017-18)

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

MULTI PHASE FLOW
(ELECTIVE IV)

M.Tech (Thermal Engineering)
I Year - II Semester
Course Code: GR17D5148
L/P/C: 4/0/4

PREREQUISITES

• Fundamentals of thermodynamics and Heat Transfer

COURSE OBJECTIVES: The course is intended to

• Describe multiphase and multi component flows
• Choose The Flow Model For Laminar And Turbulent Flow
• List the correlations in two fluid model
• Determine the velocity distribution in in different flow regimes
• Examine the deviations from Nusselt theory in condensation process

COURSE OUTCOMES

• To recognize the thermo fluidic aspects of two phase flows
• Introduce the method of analysis of multi phase and multi component problems
• Define basic one dimensional two phase conservation equations
• Examine the various flow models for multiphase flows
• To get knowledge about pressure loss due to multiphase flow in various pipe fittings
• Determine the static and dynamic instabilities in boiling and condensation
• Evaluate the condensation of flowing vapors

UNIT-I

Introduction- multi phase and multi-component flow, practical examples; method of analysis of multi-phase and
Multi-component flow problems; basic definitions; two phase, one-dimensional conservation equations; pressure
gradient components; flow patterns, two phase flow patterns in mini and micro-channels.

UNIT-II

Basic flow models – homogeneous flow model, pressure gradient, two phase friction factor
for laminar flow and turbulent flow, two phase viscosity, friction multiplier; separated flow
model – pressure gradient, Lokhart Martinelli correlation; Multidimensional two fluid model.

UNIT-III

Drift flux model – gravity dominated flow regime, corrections for void fraction and velocity
distribution in different flow regimes, pressure loss due to multi-phase flow in pipe fittings, velocity
and concentration profiles in multi-phase flow; one-dimensional waves in two component flow, void-quality correlations.

UNIT-IV
Boiling and condensation – evaporation, nucleate boiling, convective boiling; bubble formation and limiting volume; boiling map; DNB; critical boiling conditions; static and dynamic instabilities

UNIT-V
condensation process– types of condensation, Nusselt theory, deviations from Nusselt theory, practical equations, condensation of flowing vapors; introduction to boiling and condensation in small passages.

TEACHING METHODOLOGIES
1. Power Point presentations
2. Tutorial Sheets
3. Assignments

TEXTBOOKS

REFERENCE BOOKS
GR17 Regulations (2017-18)

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech (Thermal Engineering) \textbf{COMPUTATIONAL METHODS LAB} I Year - II Semester
Course Code: GR17D5150 L/P/C: 0/4/2

**COURSE OBJECTIVES:** The lab is intended to,

- Describe the usage of CFD software package, to reduce the time for solving different fluid flow problems.
- Model the heat transfer and fluid flow problems in CFD software package such as ANSYS CFX, ANSYS FLUENT and ABAQUS
- Analyze the different thermal systems for variable fluid flow properties such as mass flow rate, Reynolds number etc.
- Examine the various thermal systems under different flow conditions such as turbulent flow etc.
- Correlating the results obtained using different software with theoretical knowledge.

**COURSE OUTCOMES:**

- Analyze the basics on how to use CFD software package for fluid flow problems
- Evaluate how a software package can reduce time to solve a fluid flow problem and heat transfer problem
- Analyze the thermal systems by varying the fluid flow properties of the system
- Model the different thermal systems used in real world and handle projects related to fluid flow
- Simulate the heat transfer equipment like heat exchanger
- Analyze the temperature distribution in extended surfaces
- Identify the flow behavior over a transonic airfoil

**CFD List of Experiments**

\textbf{Task 1.} Simple thermal system modeling and analysis
\textbf{Task 2.} Fluid Flow and Heat Transfer analysis in a Mixing Elbow
\textbf{Task 3.} Periodic simulation of 2-D heat exchanger using Fluent and correlating the results with theoretical results.
\textbf{Task 4.} Simulation of 3-D heat exchanger
\textbf{Task 5.} Analysis of turbulent flow past a transonic airfoil
\textbf{Task 6.} Analysis of Transient Temperature Distribution in a Slab.
\textbf{Task 7.} Analysis of Temperature Distribution on an Insulated Wall.
\textbf{Task 8.} Analysis of Temperature Distribution along a Straight Fin.
\textbf{Task 9.} Analysis of Temperature Distribution along a Tapered Fin.
\textbf{Task 10.} Analysis of Discharge of Water from a Reservoir.
OPEN ELECTIVE - II
COURSE OBJECTIVES: Students undergoing the course are expected to:

- Demonstrate an understanding of guidelines, principles, and theories influencing human computer interaction.
- Recognize how a computer system may be modified to include human diversity.
- Select an effective style for a specific application.
- Design mock ups and carry out user and expert evaluation of interfaces.
- Carry out the steps of experimental design, usability and experimental testing, and evaluation of human computer interaction systems.
- Use the information sources available, and be aware of the methodologies and technologies supporting advances in HCI.

COURSE OUTCOMES: At the end of the course, the student will be able to:

- Describe what interaction design is and how it relates to human computer interaction and other fields.
- Describe the social mechanisms that are used by people to communicate and collaborate.
- Describe how technologies can be designed to change people's attitudes and behavior.
- Discuss how to plan and run a successful data gathering program.
- Discuss the difference between qualitative and quantitative data and analysis.
- Discuss the conceptual, practical, and ethical issues involved in evaluation.
- Describe how to perform two types of predictive techniques, GOMS and Fitts Law, and when to use them.

UNIT-I
Introduction: Importance of user Interface –definition, importance of good design. Benefits of good design. A brief history of Screen design. The graphical user interface –popularity of graphics, the concept of direct manipulation, graphical system, Characteristics, Web user – Interface popularity, characteristics-Principles of user interface.

UNIT-II
Design process: Human interaction with computers, importance of human characteristics human consideration, Human interaction speeds, Understanding business junctions.

UNIT-III
Screen Designing: Design goals –Screen planning and purpose, organizing screen elements, ordering of screen data and content –screen navigation and flow –Visually pleasing composition
amount of information – focus and emphasis – presentation information simply and meaningfully – information retrieval on web – statistical graphics – Technological consideration in interface design.

UNIT-IV

**Develop System Menus and Navigation Schemes** - Select the proper kinds of Windows, - Select the proper Device based Controls, Choose the proper screen based controls.

UNIT-V


**TEXT BOOKS**
1. The essential guide to user interface design, Wilbert O Galitz, Wiley Dreamtech.
2. Designing the user interface. 3rd Edition Ben Shneidermann, Pearson Education Asia

**REFERENCE BOOKS**
COURSE OBJECTIVES: The objective of the course is to provide the student:

- Understanding about big data for business intelligence
- Learning business case studies for big data analytics
- Learning about the cloud and big data
- Knowledge about risk management involved in big data
- Understanding nosql big data management
- Understanding about map reduce work flows.
- Capability to perform map-reduce analytics using Hadoop and related tools

COURSE OUTCOMES: At the end of the course the student will be able to:

- Understand the importance of big data
- Understand challenges with big data
- Knowledge about the technological developments in big data environment
- Understanding about map reduce work flows
- Knowledge aboutnosql data environment.
- Analysis with Hadoop and related tools
- Capability of understanding the usage of big data in context to cloud and other technologies.

UNIT-I

INTRODUCTION TO BIG DATA What is big data, why big data, convergence of key trends, unstructured data, industry examples of big data, web analytics, big data and marketing, fraud and big data, risk and big data, credit risk management, big data in medicine, introduction to Hadoop open source technologies, cloud and big data

UNIT-II

UNDERSTANDING BIG DATA Types of digital data, characteristics of data, challenges with big data, definition of big data, big data analytics, data science, technologies in big data environments, CAP theorem.

UNIT-III

NOSQL DATA MANAGEMENT Introduction to NoSQL, aggregate data models, aggregates, key-value and document data Models, relationships, graph databases, schemaless databases, materialized views, distribution models, sharding, master-slave replication, peer-peer replication, sharing and replication
UNIT-IV

BASICS OF HADOOP Data format, features of Hadoop, analyzing data with Hadoop, design of Hadoop distributed file system (HDFS), HDFS concepts, scaling out, Hadoop streaming, Hadoop pipes, Hadoop related tools

UNIT- V

MAPREDUCE APPLICATIONS MapReduce workflows, unit tests with MRUnit, test data and local tests, anatomy of MapReduce job run, classic Map-reduce, YARN, failures in classic Map-reduce and YARN, job scheduling, shuffle and sort, task execution, MapReduce types, input formats, output formats

TEXT BOOKS

REFERENCE BOOK

COURSE OBJECTIVES: The objective of the course is to provide the student

- To introduce the students with the concepts of learning methods.
- To provide students with the artificial neural networks and their architecture.
- To familiarize the students with the various applications of artificial neural networks.
- To introduce the concepts of the fuzzy logic control and their real time applications.

COURSE OUTCOMES: At the end of the course the student will be able to

- Define the advances in neural networks
- Evaluate the design and control of fuzzy systems.
- Articulate the applications of fuzzy control block sets.
- Evaluate the design of various models in neural networks
- To analyze the techniques of various types of neural networks
- Evaluate the design and control of associative memories
- Techniques to Design fuzzy logic system

UNIT-I

UNIT-II
Essentials of Artificial Neural Networks: Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules, Types of Application

Feed Forward Neural Networks
UNIT-III

Multilayer Feed forward Neural Networks
Credit Assignment Problem, Generalized Delta Rule, Derivation of Backpropagation (BP) Training, Summary of Backpropagation Algorithm, Kolmogorov Theorem, Learning Difficulties and Improvements.

Associative Memories

UNIT-IV

Self-Organizing Maps (SOM) and Adaptive Resonance Theory (ART)

UNIT-V

Classical and Fuzzy Sets and Fuzzy Logic System Components
Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions. Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods.


TEACHING METHODOLOGIES
1. White board
2. PPTs
3. Seminars

TEXT BOOK

REFERENCE BOOKS
2. Neural Engineering by C.Eliasmith and CH.Anderson, PHI
3. Neural Networks and Fuzzy Logic System by Bork Kosko, PHI Publications
COURSE OBJECTIVES: On completion of this Subject/Course, following objectives shall get accomplished

• To provide students about the basics of Management in general and Project Management in particular.
• To train the students about the Monitoring of Projects.
• To make understand the students about the Planning of projects.
• To make understand the students about the Scheduling of projects.
• To train the students about the drawing of CPM & PERT Networks.
• To train the students about teaching of Project Management to UG & PG students
• To motivate the students about the Research Development activities of Project Management which results in timely completion of projects without time and cost over runs.

Course outcomes: On completion of this Subject/Course the student shall be able to

• Perform the Project Management functions effectively.
• Plan the projects.
• Schedule the various activities of Projects.
• Monitor the actual progress with planned progress.
• Draw the CPM & PERT Networks/
• Handle Resources planning including levelling & smoothing.
• Interpret the Indian Contract Act and understand the litigations involved for better Contract Management.

UNIT- I


UNIT-II

PROJECT SCHEDULING: Scheduling, Project/Construction Schedules, Steps involved in Scheduling, Methods of Scheduling, Bar Charts, Steps involved in Bar Charts, Limitations of Bar Charts, Milestone Charts and Limitations of Milestone Charts.
UNIT-III

PROJECT MONITORING: Network Techniques, Prime Objectives of Networks, Network Terminology, Types of Networks, CPM & PERT, Differences between CPM & PERT, Rules to draw the Network, Drawing of Networks, Advantages of Network, Critical Path, Float and its Types, Slack and Types of Slack.

UNIT-IV

PROJECT COST CONTROL: Direct Costs, Indirect Costs, Total Project Cost, Optimisation of Cost and Steps involved, Resources, Resources Smoothing and Resources Levelling, Crashing of Activities, Time and Cost Over runs of Project.

UNIT-V

PROJECT QUALITY & CONTRACTS:

TEXT BOOKS
1. Project Planning and Control with PERT & CPM – BC Punmia, KK Khandielwala.
2. Project Scheduling & Monitoring in Practice – S Chowdhury

REFERENCE BOOKS
1. Project Management Handbook – Lock, Gower
Course Objectives

- Describe an embedded system design flow from specification to physical realization
- Describe structural behavior of systems.
- Master complex systems.
- Devise new theories, techniques, and tools in design, implementation and testing.
- Master contemporary development techniques.

Course Outcomes: After going through this course the student will be able to

- Gain knowledge of contemporary issues and algorithms used.
- Know the interfacing components, different verification techniques and tools.
- Demonstrate practical skills in the construction of prototypes.
- Understand the use of modern hardware and software tools for building prototypes of embedded systems.
- Apply embedded software techniques to satisfy functional and response time requirements.
- Apply verification tools.
- Understand design representation for system level synthesis.

UNIT-I:
Co-Design Issues: Co-Design Models, Architectures, Languages, A Generic Co-design Methodology.
Co-Synthesis Algorithms:
Hardware software synthesis algorithms: hardware – software partitioning distributed system cosynthesis.

UNIT –II:
Prototyping and Emulation: Prototyping and emulation techniques, prototyping and emulation environments, future developments in emulation and prototyping architecture specialization techniques, system communication infrastructure
Target Architectures: Architecture Specialization techniques, System Communication infrastructure, Target Architecture and Application System classes, Architecture for control dominated systems (8051-Architectures for High performance control), Architecture for Data dominated systems (ADSP21060, TMS320C60), Mixed Systems.
UNIT-III

Compilation Techniques and Tools for Embedded Processor Architectures: Modern embedded architectures, embedded software development needs, compilation technologies, practical consideration in a compiler development environment.

UNIT-IV

Design Specification and Verification: Design, co-design, the co-design computational model, concurrency coordinating concurrent computations, interfacing components, design verification, implementation verification, verification tools, interface verification

UNIT-V

Languages for System – Level Specification and Design-I: System – level specification, design representation for system level synthesis, system level specification languages,

Languages for System – Level Specification and Design-II:
Heterogeneous specifications and multi language co-simulation, the cosyma system and lycos system.

TEXT BOOKS


REFERENCE BOOKS

1. A Practical Introduction to Hardware/Software Co-design -Patrick R. Schaumont -2010 –Springer
Course Objectives: The Objective of this course is to provide the student to

- Introduce the need of the non-conventional energy sources.
- Impart the role of non-conventional energy for the environment.
- Identify the energy resources utilization systems.
- Recognise the source and potential of wind energy and understand the classifications of wind mills.
- Summarize the principles of bio-conversion, ocean energy and geo thermal energy.

Course Outcomes: At the end of the course the learners will be able to

- Evaluate the appropriate renewable energy as an alternate for conventional power for any application.
- Analyze the environmental and cost economics of using renewable energy sources compared to fossil fuels.
- Apply the principles of various energy systems in day to day life.
- Analyze the industrial needs and convert theoretical model to practical circuits with wide range of specifications.
- Evaluate the importance of the renewable resources of energy as the fossil fuels are depleting in the world very fast express about clean and green energy for next generation.
- Analyze large scale demand of heat energy for meeting day to day domestic, institutional and industrial requirements can be met by utilizing solar thermal systems, biogas, PV cells, wind energy, Geothermal, MHD etc.
- Design the various techniques and models fabricated in utilizing the above said sources of energy.

UNIT-I
Introduction: Various Non-conventional energy sources-Introduction, availability, classification, relative merits and demerits.


UNIT-II
UNIT-III

Geothermal Energy: Resources of geothermal energy, thermodynamics of geothermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations.
Magneto hydrodynamics (MHD):
Principle of working of MHD Power plant, performance and limitations

FuelCells:
Principle of working of various type of fuels cells and their working, performance and limitations.

UNIT-IV

Thermo-electric and thermionic Conversions:
Principle of working, performance and limitations.

Wind Energy: Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augment, wind characteristics. Performance and limitations of energy conversion systems.

UNIT-V


TEXT/REFERENCESBOOKS