# ACADEMIC REGULATIONS
# PROGRAM STRUCTURE
# and
# DETAILED SYLLABUS

## Master of Technology

### ( Thermal Engineering )

(Two Year Regular Programme)

(Applicable for Batches admitted from 2017)


GOKARAJU RANGARAJU

INSTITUTE OF ENGINEERING AND TECHNOLOGY

(Autonomous)

# ACADEMIC REGULATIONS

## GOKARAJU RANGARAJU
## INSTITUTE OF ENGINEERING AND TECHNOLOGY

**For all Postgraduate Programmes (M.Tech)**
**GR17 REGULATIONS**

Gokaraju Rangaraju Institute of Engineering and Technology-2017 Regulations (GR 17 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) 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.

| S.no | Particulars | Internal | External | Total |
|---|---|---|---|---|
| 1 | Theory | 30 | 70 | 100 |
| 2 | Practical | 30 | 70 | 100 |
| 3 | Comprehensive Viva | - | 100 | 100 |
| 4 | Seminar | 30 | 70 | 100 |
| 5 | Project work | 30 | 70 | 100 |

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

i. **Mid written examinations: 20 Marks**
ii. **Assignment: 5 Marks**
iii. **Continuous Assessment: 5 Marks**
iv. **Total: 30Marks**

**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)** **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.** | **Continuous Assessment:** | **05 Marks** |
| **v.** | **Total:** | **30Marks** |

g) **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** |

h) **Comprehensive Viva:** There shall be a Comprehensive Viva-Voce in II year I semester. The Comprehensive Viva-Voce will be conducted by the committee consisting of Head of the Department and two senior faculty members of the Department. The Comprehensive Viva-Voce is aimed to assess the student's understanding in various subjects he/she studies during the M.Tech course of study. The Comprehensive Viva-Voce is valued for 100 marks by the committee. There are no internal marks for the Comprehensive Viva-voce.

**i)** **Seminar:** There shall be two Seminar Presentations by the student, one each in I and II semesters. For the seminar, the student shall collect the information on a specialized topic other than his/her project and prepare a technical report, showing his understanding over the topic, and submit to the department, which shall be evaluated by a Departmental committee consisting of the Head of the department, seminar Supervisor and a senior faculty member. **The seminar shall be evaluated for 100 marks. Internal evaluation is for 30 marks and external for 70 marks.**

**j) Evaluation of Main Project Work:** A Project Review Committee (PRC) is to be constituted by the Principal/Director with Head of te 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. After approval from the PRC, the final thesis is to be submitted along with ANTI-PLAGIARISM report from the approved agency with a similarity index not more than 30%.

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

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

viii. The marks allotted for project work review are 100, out of which30 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.

ix. 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 favourable, 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.

x. 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 unfavourable again, the project shall be summarily rejected.

xi. 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

| Letter Grade | Grade Point | Percentage of Marks |
|---|---|---|
| O (Outstanding) | 10 | Marks>=90 |
| A+ (Excellent) | 9 | Marks>=80 and Marks < 90 |
| A (Very Good) | 8 | Marks>=70 and Marks < 80 |
| B+ (Good) | 7 | Marks>=60 and Marks < 70 |
| B (Above Average) | 6 | Marks>=50 and Marks < 60 |
| F (Fail) | 0 | Marks < 50 |
| Ab (Absent) | 0 | |

**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-B. 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) Skthe 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 creditsof all courses registered by a student,

$$\text{SGPA } (S_k) = \sum_{i=1}^{n} (Ci * Gi) / \sum_{i=1}^{n} Ci$$

Where Ci is the number of credits of the ith course and Gi 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 Sk, where k ≥ 2.

$$\text{CGPA} = \sum_{i=1}^{m} (Ci * Gi) / \sum_{i=1}^{m} Ci$$

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:

| Class Awarded | | CGPA Secured |
|---|---|---|
| 3.1 | First class with distinction | CGPA ≥ 7.75 |
| 3.2 | First Class | CGPA ≥ 6.75 and CGPA < 7.75 |
| 3.3 | Second Class | CGPA ≥ 6.00 and CGPA < 6.75 |

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)** **M.Tech (TE) PROGRAMME STRUCTURE** **I Year-I Semester**

| Sub-Code | Group | Subject | L | T | P | C | Int | Ext | Total |
|---|---|---|---|---|---|---|---|---|---|
| GR17D5129 | PC | Advanced Thermodynamics | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| GR17D5130 | PC | Conduction And Radiation Heat Transfer | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| GR17D5131 | PC | Advanced Fluid Mechanics | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| | **OE-I** | **Open Elective – I** | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| | **Elective I** | | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| GR17D5133 | PE | Turbo machines | | | | | | | |
| GR17D5132 | PE | Advanced Finite Element Analysis | | | | | | | |
| GR17D5135 | PE | Theory of Heat Pipes | | | | | | | |
| | **Elective II** | | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| GR17D5136 | PE | Refrigeration & Air- Conditioning | | | | | | | |
| GR17D5137 | PE | Jet Propulsion And Rocket engines | | | | | | | |
| GR17D5138 | PE | Thermal And Nuclear Power Plants | | | | | | | |
| GR17D5139 | Lab | Thermal Engineering Lab | 0 | 0 | 2 | 2 | 30 | 70 | 100 |
| GR17D5173 | SPW | Seminar – I | 0 | 0 | 2 | 2 | 30 | 70 | 100 |
| | | **Total** | **18** | **6** | **4** | **28** | **240** | **560** | **800** |

**M.Tech (TE)** **M.Tech (TE) PROGRAMME STRUCTURE** **I Year-II Semester**

| Sub-Code | Group | Subject | L | T | P | C | Int | Ext | Total |
|---|---|---|---|---|---|---|---|---|---|
| GR17D5140 | PC | Convective Heat Transfer | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| GR17D5141 | PC | Computational Methods In Heat Transfer | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| GR17D5142 | PC | Advanced IC Engines | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| | **OE-I** | **Open Elective – I** | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| | **Elective III** | | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| GR17D5146 | PE | Cryogenic Engineering | | | | | | | |
| GR17D5144 | PE | Thermal Measurements And Process Controls | | | | | | | |
| GR17D5145 | PE | Alternate Energy Sources | | | | | | | |
| | **Elective IV** | | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| GR17D5143 | PE | Equipment Design For Thermal Systems | | | | | | | |
| GR17D5147 | PE | Fuels, Combustion and Environment | | | | | | | |
| GR17D5148 | PE | Multiphase Flow | | | | | | | |
| GR17D5150 | Lab | Computational Methods Lab | 0 | 0 | 2 | 2 | 30 | 70 | 100 |
| GR17D5174 | SPW | Seminar – II | 0 | 0 | 2 | 2 | 30 | 70 | 100 |
| | | **Total** | 18 | 6 | 4 | 28 | 240 | 560 | 800 |

### II Year-I Semester

| Sub-code | Group | Subject | L | T | P | C | Int | Ext | Total |
|---|---|---|---|---|---|---|---|---|---|
| GR17D5175 | SPW | Comprehensive Viva-voce | - | - | - | 4 | 0 | 100 | 100 |
| GR17D5176 | SPW | Project work Review | - | - | - | 12 | 30 | 70 | 100 |
| | | Total | - | - | - | 16 | 30 | 170 | 200 |

### II Year-II Semester

| Sub- code | Group | Subject | L | T | P | C | Int | Ext | Total |
|---|---|---|---|---|---|---|---|---|---|
| GR17D5177 | SPW | Project work and Dissertation | - | - | - | 16 | 30 | 70 | 100 |
| | | Total | - | - | - | 16 | 30 | 70 | 100 |

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

| Sub-code | Group | Subject | L | T | P | C | Int. | Ext. | Total |
|---|---|---|---|---|---|---|---|---|---|
| GR17D5178 | OE-I | E- Commerce and Applications (CSE) | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| GR17D5179 | | Enterprise Resource Planning (IT) | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| GR17D5180 | | Modern Control Theory (EEE) | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| GR17D5181 | | Computer Oriented Numerical Methods in Engineering (CE) | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| GR17D5182 | | Advanced Computer Architecture (ECE) | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| GR17D5183 | | Operations Research (ME) | 3 | 1 | 0 | 4 | 30 | 70 | 100 |

### Open Elective Pool-II

| Sub-Code | Group | Subject | L | T | P | C | Int | Ext | Total |
|---|---|---|---|---|---|---|---|---|---|
| GR17D5184 | OE-II | Human Computer Interaction (CSE) | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| GR17D5185 | | Big Data and Analytics (IT) | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| GR17D5186 | | Neural and Fuzzy Systems (EEE) | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| GR17D5187 | | Project Management (CE) | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| GR17D5188 | | Hardware Software Co-Design(ECE) | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| GR17D5189 | | Non-Conventional Energy Resources(ME) | 3 | 1 | 0 | 4 | 30 | 70 | 100 |

# I- SEMESTER

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## ADVANCED THERMO DYNAMICS

M.Tech (Thermal Engineering) I Year - I Semester
Course Code: GR17D5129 L/T/P/C : 3/1/0/4

**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**

- Apply Engineering principles and analyze problems dealing with advanced thermodynamics.
- Use the thermodynamic properties and basic concepts of phase equilibrium of multi component systems.
- Illustrate the direction of the process from the first and second law of thermodynamics
- Use the availability, energy and energy equilibrium equations.
- Analyze the familiar with property equations and thermodynamic properties of real gases.
- Evaluate efficiency of boiler for binary vapor cycle.
- Examine the Maxwell's relations for using empirical relations.

**UNIT-I**

**REVIEW OF THERMODYNAMIC LAWS AND COROLLARIES:** Transient flow analysis, Secondlaw thermodynamics, Entropy, Availability and unavailability, Thermodynamic potential. Maxwellrelations, Specific heat relations, Mayer's relation. Evaluation of thermodynamic properties of workingsubstance

**UNIT-II**

**P.V.T SURFACE:** Equation of state. Real gas behavior, Vander Waal's equation, Generalizationcompressibility factor. Energy properties of real gases. Vapour pressure, Clausius, Clapeyronequation. Throttling, Joule. Thompson coefficient. Non-reactive mixtures of perfect gases. Governinglaws, Evaluation of properties, Psychometric mixture properties and psychometric chart, Air conditioningprocesses, cooling towers. Real gas mixture.

**UNIT-III**

**COMBUSTION:** Combustion Reactions, Enthalpy of formation. Entropy of formation, Reference levelsof tables. Energy of formation, Heat reaction, Adiabatic flame temperature generated product,Enthalpies, Equilibrium. Chemical equilibrium of ideal gases, Effect of non-reacting gasesequilibrium in multiple reactions, the vent Hoff's equation. The chemical potential and phaseequilibrium. The Gibbs phase rule.

**UNIT-IV**

**POWER CYCLES:** Review binary vapour cycle, co-generation and combined cycles, Second law analysis of cycles. Refrigeration cycles. Thermodynamics off irreversible processes.Introduction, Phenomenological laws, OnsagerReciprocity relation, Applicability of thePhenomenological relations, Heat flux and entropy production, Thermodynamic phenomena, thermoelectric circuits.

**UNIT-V**

**DIRECT ENERGY CONVERSION INTRODUCTION:** Fuel cells, Thermo electric energy, Thermionic power generation, Thermodynamic devices magneto hydrodynamic generations, and Photovoltaiccells.

**TEACHING METHODOLOGIES**

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

**TEXT BOOKS**

1. Basic and Applied Thermodynamics/ P.K.Nag/ TMH
2. Thermodynamics/Holman/ Me Graw Hill.
3. Engg. Thermodynamics/PL. Dhār / Elsevier

**REFERENCE BOOKS**

1. Thermodynamics/Sonnatag& Van Wylen / John Wiley & Sons
2. Thermodynamics for Engineers/Doolittle-Messe / John Wiley & Sons
3. Irreversible thermodynamics/HR De Groff.
4. Thermal Engineering / Soman / PHI
5. Thermal Engineering / Rathore / TMH
6. Engineering Thermodynamics/Chatopadyaya/

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## CONDUCTION AND RADIATION HEAT TRANSFER

M.Tech (Thermal Engineering) I Year - I Semester
Course Code: GR17D5130 L/T/P/C : 3/1/0/4

**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**

Conduction: General heat conduction equation-in Cartesian, cylindrical and spherical coordinate systems. Initial and Boundary conditions One Dimensional Steady State Conduction Heat Transfer: Homogeneous slabs, hollow cylinders and spheres – overall heat transfer coefficient – electrical analogy– Critical radius of insulation.

**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**

**Transient Heat Conduction:** Differential formulation of transient heat conduction problems with time- independent boundary conditions in rectangular, cylindrical, and spherical geometries and their analytical solution - method of separation of variables, method of Laplace transforms; differential formulation of steady two-dimensional heat conduction problems in rectangular, cylindrical, and spherical geometries and their analytical solution - methods of separation of variables; treatment of non-homogeneity in differential equations and boundary conditions – method of superposition.

**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)
3. Heat Transfer – P.S. Ghoshdastidar (Oxford Press)
4. Engg. Heat & Mass Transfer- Sarit K. Das (Dhanpat Rai)

## REFERENCE BOOKS


1. Fundamentals of Heat & Mass Transfer – Incroera Dewitt (Jhon Wiley)
2. Heat Transfer : A basic approach – YunusCengel (MH)
3. Heat & Mass Transfer – D.S. Kumar
4. Heat Transfer – P.K. Nag(TMH)
5. Principle of Heat Transfer – Frank Kreith&Mark.Bohn.
6. Convective Heat and Mass Transfer / W.M.Kays&M.E.Crawford(TMH)
7. Radiation Heat Transfer –G.M.Sparrow&R.D.Cess
8. Thermal Radiation heat transfer – Siegel&J.R.Howell
9. Radiation Heat Transfer – H.G.Hottel&A.F.Sarofim

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## ADVANCED FLUID MECHANICS

M.Tech (Thermal Engineering) I Year - I Semester
Course Code: GR17D5131 L/T/P/C : 3/1/0/4

### 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 simple flow problems.
- Explain the mathematical formulation of various flow problems.
- Analyze the boundary layer concept to the fluid flow problems.
- Apply the concept of fluid and models of fluids for flow problems.
- Explain the stream function and potential function to fluid flow problems.
- Apply the basic principles to derive the equation for viscous flow, including laminar flow & turbulent flow.

### UNIT-I

**Non – viscous flow of incompressible Fluids:** Lagrangian and Eulerain Descriptions of fluid motion- Path lines, Stream lines, Streak lines, stream tubes – velocity of a fluid particle, types of flows, Equations of three dimensional continuity equation- Stream and Velocity potential functions. Basic Laws of fluid Flow: Condition for irrationality, circulation & vorticity Accelerations in Cartesian systems normal and tangential accelerations, Euler's, Bernoulli equations in 3D– Continuity and Momentum Equations.

### UNIT-II

**Principles of Viscous Flow:** Derivationof Navier-Stoke's Equations for viscous compressible flow – Exact solutions to certain simple cases: Plain Poisoulle flow - Coutte flow with and without pressure gradient - Hagen Poisoulle flow - Blasius solution.

**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**

**Introduction to Turbulent Flow:** Fundamental concept of turbulence – Time Averaged Equations – Boundary Layer Equations - Prandtl Mixing Length Model - Universal Velocity Distribution Law: Van Driest Model –Approximate solutions for drag coefficients – More Refined Turbulence Models – k-epsilon model - boundary layer separation and form drag – Karman Vortex Trail, Boundary layer control, lift on circular cylinders Internal Flow: Smooth and rough boundaries – Equations for Velocity Distribution and frictional Resistance in smooth rough Pipes – Roughness of Commercial Pipes – Moody's diagram.

**UNIT-V**

**Compressible Fluid Flow – I:** Thermodynamic basics – Equations of continuity, Momentum and Energy - Acoustic Velocity Derivation of Equation for Mach Number – Flow Regimes – Mach Angle – Mach Cone – Stagnation State.

**Compressible Fluid Flow – II:** Area Variation, Property Relationships in terms of Mach number, Nozzles, Diffusers – Fanno and Releigh Lines, Property Relations – Isothermal Flow in Long Ducts – Normal Compressible Shock, Oblique Shock: Expansion and Compressible Shocks – Supersonic Wave Drag.

**TEACHING METHODOLOGIES**

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

**TEXT BOOKS**

1. Schlichting H – Boundary Layer Theory (Springer Publications).
2. Convective Heat and Mass Transfer – Oosthigen, McGraw hill
3. Convective Heat and Mass Transfer – W.M. Kays, M.E. Crawford, McGraw-Hill

**REFERENCE BOOKS**

1. Yuman S.W – Foundations of Fluid Mechanics.
2. An Introduction to Compressible Flow – Pai.
3. Dynamics & Theory and Dynamics of Compressible Fluid Flow – Shapiro.
4. Fluid Mechanics and Machinery – D. Rama Durgaiah. (New Age Pub.)
5. Fluid Dynamics – William F. Hughes & John A. Brighton (Tata McGraw-Hill Pub.)

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## TURBO MACHINES
## (ELECTIVE-I)

M.Tech (Thermal Engineering) I Year - I Semester

Course Code: GR17D5133 L/T/P/C : 3/1/0/4

### 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

**STEAM NOZZLES:** Convergent and Convergent-Divergent nozzles, Energy Balance, Effect of backpressure of analysis. Designs of nozzles.

**Steam Turbines:** Impulse turbines, Compounding, Work done and Velocity triangle, Efficiencies, Constant reactions, Blading, Design of blade passages, Angle and height, Secondary flow. Leakage losses, Thermodynamic analysis of steam turbines.

**UNIT-III**

**GAS DYNAMICS:** Fundamental thermodynamic concepts, isentropic conditions, Mach numbers andarea, Velocity relations, Dynamic Pressure, Normal shock relation for perfect gas. Supersonic flow,oblique shock waves. Normal shock recoveries, detached shocks, Aerofoil theory.
Centrifugal compressor: Types, Velocity triangles and efficiencies, Blade passage design,Diffuserand pressure recovery. Slip factor, Stanitz and Stodolas formulas, Effect of inlet machnumbers, Pre whirl, Performance

**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
**Cascade Analysis:** Geometrical and terminology. Blade force, Efficiencies, Losses, Free end force,Vortex Blades.

**UNIT-V**

**AXIAL FLOW GAS TURBINES:** Work done. Velocity triangle and efficiencies, Thermodynamic flowanalysis, 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**

1. Principles of Jet Propulsion and Gas Turbine/NJ Zucrow/John Wiley & Sons/Newyork
2. Turbines, Pumps, Compressors/Yahya/TMH
3. Practice on Turbo Machines/ G.Gopal Krishnan &D.Prithviraj/ Sci Tech Publishers,Chennai
4. Theory and practice of Steam Turbines/ WJ Kearton/ELBS Pitman/London
5. Gas Turbines Theory and Practice/Zucrow/John Wiley & Sons/Newyork
6. Element of Gas Dynamics/Liepeman and Roshkow/ Dover Publicationsa

# 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/T/P/C : 3/1/0/4

**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 an understanding of fundamental theory of the FEA method.
- Write the governing FE equations for systems governed by differential equations.
- Use the basic finite elements for structural applications.
- Use the FE method for heat transfer problems.
- Solve trusses, frames, plate structures, machine components using ANSYS general purpose software.
- Investigate discretization of 1-D, 2-D and 3-D field problems effectively.
- Solve problems on heat conduction, dynamic behavior of structures, mode shapes, model analysis, etc.

**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
**ANALYSIS OF BEAMS:** Hermite shape functions – stiffness matrix – Load vector – Problems.

**UNIT-III**

**2-D PROBLEMS:** CST, LST, force terms, Stiffness matrix and load vectors, boundary conditions, Isoparametric elements – quadrilateral element, shape functions – Numerical Integration. Finite element modeling of Axi- symmetric solids subjected to Axi- symmetric loading with triangular elements.
**3-D PROBLEMS:** Tetrahedran element – Jacobian matrix – Stiffness matrix.

**UNIT-IV**

**SCALAR FIELD PROBLEMS:** 1-D Heat conduction-Slabs – fins - 2-D heat conduction problems –Introduction to Torsional problems.

**UNIT-V**

Dynamic considerations, Dynamic equations – consistent mass matrix – Eigen Values, Eigen vector,natural frequencies – mode shapes – modal analysis.

**TEACHING METHODOLOGIES**

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

**TEXT BOOKS**

1. The Finite Element Methods in Engineering / SS Rao / Pergamon.
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**

1. Finite Element Method – Zincowitz / Mc Graw Hill
2. Introduction to Finite element analysis- S.Md.Jalaludeen, Anuradha Publications, print-2012
3. A First Course in the Finite Element Method/Daryl L Logan/Cengage Learning/5th Edition
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/T/P/C : 3/1/0/4

### 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**

1. S.W.Chi,1976 , Heat pipe theory and practice, Hemisphere publishing corporation , Washington
2. Dunn, P.D.and Reay D.A. 1982 , “Heat Pipes” , Third Edition , Pregamon Press
3. Amir Faghri , 1995 Heat Pipe science and Technology , publisher , Taylor and Francis
4. V.P. Carey , 1992 , Liquid – Vapor phase – Change phenomena. An Introduction to the Thermophysics of vaporization and condensation processes in heat transfer equipment , Hemisphere Publishers , New York
5. J.N.Israelachvili , 1985 , Inrtermolecular and surface forces – Academic press, London
6 I.B.Ivanov , 1988, Thin liquid films :Fundamentals and application – Marcel Dekkar , New York M.N.Ivanovskii ,V.P.Sorokin and I.V. Yagodkin , 1982 , The physical principles of heat pipes Clarendon press , Oxford

# 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/T/P/C : 3/1/0/4

**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**

- Apply theoretical and mathematical principles to simple, complex vapor compression and vapor absorption refrigeration system.
- Discuss the physical and mathematical aspects of refrigeration and air conditioning systems.
- Explain HVAC technology, engineering, research, systems, system designs, energy impacts and overall goals.
- Explain 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.
- Apply basic principles of psychrometry and applied psychrometrics.
- Investigate air conditioning systems and develop generalized psychrometrics 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-Expansionvalve -Refrigerants - Properties - ODP & GWP- Load balancing of vapor compression Unit.

**Compound Compression:** Flash inter-cooling – flash chamber – Multi-evaporator & Multistagesystems.

**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 andReduced 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**

**AIR–CONDITIONING:** Psychrometric properties and processes – Construction of Psychrometricchart. Requirements of Comfort Air –conditioning – Thermodynamics of human body – Effective temperature and Comfort chart – Parameters influencing the Effective Temperature. Summer,winter and year round air – conditioning systems.

Cooling load Estimation: Occupants, equipment, infiltration, duet heat gain fan load, Fresh air load.

**UNIT-V**

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

**COMPONENTS:** Humidification and dehumidification equipment – Systems of Air cleaning – Grills anddiffusers – Fans and blowers – Measurement and control of Temperature and Humidity.

**TEACHING METHODOLOGIES**

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

**TEXT BOOKS**

1. Refrigeration & Air Conditioning /R. S. Khurmi/TMH
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/T/P/C : 3/1/0/4

### 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 designper 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, Rocketsand air breathing jet engines – Classification – turbo jet , turbo fan, turbo prop, rocket (Solid andLiquid propellant rockets) and Ramjet engines.

**Nozzle Theory and Characteristics Parameters:** Theory of one dimensional convergent – divergentnozzles – 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) characteristicvelocity, 2) specific impulse 3) total impulse 4) relationship between the characteristic parameters 5)nozzle efficiency, combustion efficiency and overall efficiency.

**UNIT-III**

**AERO THERMO CHEMISTRY OF THE COMBUSTION PRODUCTS:** Review of properties of mixtureof gases – Gibbs – Dalton laws – Equivalent ratio, enthalpy changes in reactions, heat of reaction andheat of formation – calculation of adiabatic flame temperature and specific impulse – frozen andequilibrium flows.

Solid Propulsion System: Solid propellants – classification, homogeneous and heterogeneouspropellants, double base propellant compositions and manufacturing methods. Composite propellantoxidizers and binders. Effect of binder on propellant properties. Burning rate and burning rate laws,factors influencing the burning rate, methods of determining burning rates.

**UNIT-IV**

**SOLID PROPELLANT ROCKET ENGINE:** internal ballistics, equilibrium motor operation and equilibriumpressure to various parameters. Transient and pseudo equilibrium operation, end burning and burninggrains, grain design. Rocket motor hard ware design. Heat transfer considerations in solid rocketmotor 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 chemicalcharacteristics of liquid propellant. Liquid propellant rocket engine – system layout, pump andpressure feed systems, feed system components. Design of combustion chamber, characteristiclength, constructional features, and chamber wall stresses. Heat transfer and cooling aspects.Uncooled engines, injectors – various types, injection patterns, injector characteristics, andatomization 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 theirclassification – 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
2. Rocket propulsion elements/Sutton/John Wiley & Sons/8th Edition
3. Gas Turbines/Ganensan /TMH

**REFERENCE BOOKS**

1. Gas Turbines & Propulsive Systems/Khajuria& Dubey/Dhanpat Rai & Sons
2. Rocket propulsion/Bevere
3. Jet propulsion /Nicholas Cumpsty

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## THERMAL AND NUCLEAR POWER PLANTS
## (ELECTIVE II)

M.Tech (Thermal Engineering) | I Year - I Semester
Course Code: GR17D5138 | L/T/P/C : 3/1/0/4

### 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

**Introduction:** Sources of Energy, types of Power Plants, Direct Energy Conversion System, Energy Sources in India, Recent developments in Power Generation. Combustion of Coal, Volumetric Analysis, Gravimetric Analysis, and Flue gas Analysis.

**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, CoolingTowers, Steam Turbines, Compounding of Turbines, Steam Condensers, Jet& Surface Condensers.

**UNIT-II**

Gas Turbine Power Plant: Cogeneration, Combined cycle Power Plants, Analysis, Waste-Heat Recovery, IGCC Power Plants, Fluidized Bed Combustion – Advantages & Disadvantages.

**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**

Economics of Power Generation: Factors affecting the economics, Load Factor, Utilization factor, Performance and Operating Characteristics of Power Plants. Economic Load Sharing, Depreciation, Energy Rates, Criteria for Optimum Loading, Specific Economic energy problems.

**UNIT-V**

Power Plant Instrumentation: Classification, Pressure measuring instruments, Temperature measurement and Flow measurement. Analysis of Combustion gases, Pollution – Types, Methods to Control.

**TEACHING METHODOLOGIES**

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

**TEXT BOOKS**

1. Power Plant Engineering / P.K. Nag / TMH.
2. Power Plant Engineering / R.K. Rajput / Lakshmi Publications.
3. Power Plant Engineering / P.C.Sharma / Kotaria Publications.
4. Power Plant Technology / Wakil.

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## THERMAL ENGINEERNG LAB

M.Tech (Thermal Engineering) I Year - I Semester
Course Code: GR17D5139 L/T/P/C : 0/0/4/2

### 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.
- Justify the performance of solar flat plate collector and evacuated tube concentrator.
- Analyze the performance of fluid flow in pipes.
- Evaluate the testing of boilers.
- Use alternate fuels for improvement of performance of diesel engines.

### LIST OF EXPERIMENTS

1. Compressibility factor measurement of different real gases.
2. Dryness fraction estimation of steam.
3. Flame propagation analysis of gaseous fuels.
4. Performance test and analysis of exhaust gases of an I.C. Engine.
5. Heat Balance sheet, Volumetric Efficiency and air fuel ratio estimation of an I.C. Engine.
6. COP estimation of vapour compression refrigeration test.
7. Performance analysis of Air conditioning unit.
8. Performance analysis of heat pipe.
9. Solar Flat Plate Collector

# OPEN ELECTIVE - I

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## E - COMMERCE AND APPLICATIONS
## (Open Elective I)

M.Tech (CSE) | I Year - I Semester

Course Code: GR17D5178 | L/T/P/C : 3/1/0/4

**Course Objectives**

- To understand the interest and opportunity of e-commerce
- To know and understand the critical success factors in implementing an ecommerce
- 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 Comparethe principles of E-commerce and basics of World Wide Web.(Level 2&4)
- Analyze, Understandthe concept of electronic data interchange and its legal, social and technical aspects.(Level 2&4)
- Understandand Evaluate the security issues ssssover 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 Comparethe capabilities and limitation of agents, Web based marketing and various security Issues. (Level 2&4)
- Understandingand 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**

**INFRASTRUCTURE FOR E COMMERCE** Packet switched networks – TCP/IP protocol script – Internet utility programmes – SGML, HTML and XML – web client and servers – Web client/server architecture – intranet and extranets.

**UNIT-III**

**WEB BASED TOOLS FOR E COMMERCE** Web server – performance evaluation - web server software feature sets – web server software and tools – web protocol – search engines – intelligent agents –EC software – web hosting – cost analysis

**UNIT- IV**

**SECURITY** Computer security classification – copy right and Intellectual property – electronic commerce threats – protecting client computers – electronic payment systems and risks involved in it –electronic cash __ micro payment system– strategies for marketing – sales and promotion – cryptography –authentication.

**UNIT-V**

**INTELLIGENT AGENTS** Definition and capabilities – limitation of agents – security – web based marketing – search engines and Directory registration – online advertisements – Portables and info mechanics – website design issues.

**TEXT BOOKS**

1. Ravi Kalakota, " Electronic Commerce", Pearson Education,
2. Gary P Schneider "Electronic commerce", Thomson learning & James T Peny Cambridge USA, 2001.

**REFERENCES BOOK**

1. EfraimTurvanJ.Lee, David kug and chung, "Electronic commerce" Pearson Education Asia 2001.
2. Brenda Kienew E commerce Business Prentice Hall, 2001.
3. Manlyn Greenstein and Miklos "Electronic commerce" McGraw-Hill, 2002.

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## ENTERPRISE RESOURCE PLANNING
## (Open Elective-I)

M.Tech (IT) I Year - I Semester

Course Code: GR17D5179 L/T/P/C : 3/1/0/4

**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 systematicallydevelop 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**

**Introduction:** Overview – Benefits of ERP – ERP and Related Technologies – Business Process Reengineering – Data Warehousing – Data Mining – On–line Analytical Processing – Supply Chain Management.

**UNIT-II**

**IMPLEMENTATION:** Implementation Life Cycle – Implementation Methodology – Hidden Costs – Organizing Implementation – Vendors, Consultants and Users – Contracts – Project Management and Monitoring.

**UNIT- III**

**BUSINESS MODULES:** Business Modules in an ERP Package – Finance – Manufacturing – Human Resource –Plant Maintenance – Materials Management – Quality Management – Sales and Distribution.

**UNIT- IV**

**ERP MARKET:** ERP Market Place – SAP AG – PeopleSoft – Baan Company – JD Edwards World Solutions Company – Oracle Corporation – QAD – System Software Associates.

**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**

1. Alexis Leon, “ERP Demystified”, Tata McGraw Hill, 1999.
2. Joseph A. Brady, Ellen F. Monk, Bret J. Wangner, “Concepts in Enterprise Resource Planning” , Thomson Learning, 2001.
3. Vinod Kumar Garg and N.K .Venkata Krishnan, “Enterprise Resource Planning – concepts and Planning”, Prentice Hall, 1998.
4. Jose Antonio Fernandz, “ The SAP R /3 Hand book”, Tata McGraw Hill

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## MODERN CONTROL THEORY
## (Open Elective-I)

M.Tech (EEE) I Year - I Semester

Course Code: GR17D5180 L/T/P/C : 3/1/0/4

**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

**MATHEMATICAL PRELIMINARIES:** Fields, Vectors, Vector Spaces — Linear combinations and Bases — Linear Transformations and Matrices — Scalar Product and Norms ,Eigenvalues, Eigen Vectors and a Canonical form representation of linear operators, The concept of state — State Equations for Dynamic systems, Time invariance and Linearity Non uniqueness of state model — State diagrams for Continuous-Time State models.

### 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.

**CONTROLLABILITY AND OBSERVABILITY-**General concept of controllability— General concept of Observability—Controllability tests for Continuous-Time Invariant Systems ---
Observability tests for Continuous-Time Invariant Systems— Controllability and Observability of State Model in Jordan Canonical form— Controllability and Observability Canonical forms of State model.

**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**

Stability in the sense of Lyapunov, Lyapunovs stability and Lyapunov's instability theorems - StabilityAnalysis of the Linear continuous time invariant systems by Lyapunov second method — Generation of Lyapunov functions Variable gradient method — Krasooviski's method.

**TEACHING METHODOLOGIES**

1. White board
2. PPTs
3. Seminars

**EXT BOOKS**

1. Modern Control System Theory by M.Gopal — New Age International -1999
2. Modern Control Fngineering by Ogata:K — Prentice Hall – 1997

**REFERENCE BOOK**

1. Control Systems Engineering, N. S. Nise: 4th Ed., Wiley, 2004.Engineering, 4th Ed., Wiley, 2004.

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## COMPUTER–ORIENTED NUMERICAL METHODS IN ENGINEERING
## (Open Elective-I)

M.Tech (Civil) I Year - I Semester

Course Code: GR17D5181 L/T/P/C : 3/1/0/4

### 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

**Solutions of linear equations:** Direct method – Cramer's rule, Guass – Elimination method-Gauss Jordan elimination – Triangulation (LU Decomposition) method – Iterative methods Jacobi – Iteration method – Gauss – Siedel iteration, Successive over –relaxation method.
Eigen values and eigen vectors: Jacobi method for symmetric matrices- Given's method for symmetric matrices-Householder's method for symmetric matrices-Rutishauser method of arbitrary matrices –Power method.*Demonstration of solutions using open source software in Numerical Methods.

### UNIT-II

**Interpolation:** Linear Interpolation - Higher order Interpolation - Lagrange Interpolation – Interpolating polynomials using finites differences- Hermite Interpolation -piece-wise and spline Interpolation.*Demonstration of solutions using open source software in Numerical methods.

**UNIT - III**

**Finite Difference and their Applications:** Introduction- Differentiation formulas by Interpolating parabolas – Backward and forward and central differences- Derivation of Differentiation formulae using Taylor series- Boundary conditions- Beam deflection – Solution of characteristic value problems- Richardson's extrapolation- Use of unevenly spaced pivotal points- Integration formulae by interpolating parabolas- Numerical solution to spatial differential equations. *Demonstration of solutions using open source software in Numerical Methods.

**UNIT-IV**

**Numerical Differentiation:** Difference methods based on undetermined coefficients- optimum choice of step length– Partial differentiation. Numerical Integration: Method based on interpolation-method based on undetermined coefficient – Gauss – Lagrange interpolation method- Radaua integration method- composite integration method – Double integration using Trapezoidal and Simpson's method.*Demonstration of solutions using open source software in Numerical Methods.

**UNIT-V**

**Ordinary Differential Equation:** Euler's method – Backward Euler method – Mid point method – single step method, Taylor's series method- Boundary value problems-case studies. *Demonstration of solutions using open source software in Numerical Methods.

***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**

1. M.K.Jain-S.R.K.Iyengar, R.K.Jain Numerical methods for scientific and engineering computations, Willey Eastern Limited, 1987
2. S.S.Shastry, Numerical methods.
3. Curtis I.Gerala, Applied numerical analysis, Addisson Wasley published campus.

**REFERENCES BOOKS**

1. C.Chopra, Raymond P.Canal, Numerical methods for Engineers Stevan, Mc. Graw Hill book Company, 4th edition, 2002.
2. C.Xavier, C Language and Numerical methods, New age international publisher, 2003.
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/T/P/C : 3/1/0/4

### 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 comparisions of modern and high performance computers.

### UNIT -I

**Fundamentals of Computer Design:** Fundamentals of Computer design, Changing faces of computing and task of computer designer, Technology trends, Cost price and their trends, measuring and reporting performance, Quantitative principles of computer design, Amdahl's law.

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.

**Memory Hierarchy Design:** Introduction, review of ABC of cache, Cache performance, Reducing cache miss penalty, Virtual memory.

**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 verses 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 pit falls.

**TEXT BOOKS**

1. John L. Hennessy, David A. Patterson - Computer Architecture: A Quantitative Approach, 3rd Edition, an Imprint of Elsevier.

**REFERENCE BOOKS**

1. John P. Shen and Miikko H. Lipasti -, Modern Processor Design : Fundamentals of Super Scalar Processors
2. Computer Architecture and Parallel Processing - Kai Hwang, Faye A.Brigs., MC Graw Hill.

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## OPERATIONS RESEARCH
## (Open Elective-I)

Mtech (ME) I Year - I Semester

Course Code: GR17D5183 L/T/P/C : 3/1/0/4

**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 polices.
- Solve game theory problems.
- Solve problems of inventory and develop proper inventory policies.
- Apply PERT/CPM: [Project scheduling and allocation of resources] to schedule and control construction of dams, bridges, roads etc in a optimal way.
- Solve sequencing problems.
- Develop optimum replacement policy

**UNIT-I**

**Introduction:** Definition and scope of operations research(OR),ORmodel, solving the O**R** 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:**

1. Wayne L. Winston,"OperationsResearch", Thomson Learning, 2003.
2. Hamdy H. Taha, "Operations Research - An Introduction", Pearson Education, 2003.
3. R. Panneer Seevam, "Operations Research", PHI Learning, 2008.
4. V. K. Khanna, "Total Quality Management", New Age International, 2008.

**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

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## CONVECTIVE HEAT TRANSFER

M.Tech (Thermal Engineering) I Year - II Semester
Course Code: GR17D5140 L/T/P/C : 3/1/0/4

### 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.
- Iidentifythe solution methodologies (similarity and integral methods) to solve for external and internal forced convective heat transfer.

### COURSE OUTCOMES

- 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 – Applicationof dimensional analysis to convection – Physical interpretation of dimensionless numbers.

**Equations of Convective Heat Transfer:** Continuity, Navier-Strokes equation & energy equation forsteady state flows – similarity – Equations for turbulent convective heat transfer – Boundary layerequations for laminar, turbulent flows – Boundary layer integral equations.

**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 flatplate.

**External Turbulent Flows:** Analogy solutions for boundary layer flows – Integral equation solutions –Effects of dissipation on flow over a flat plate.

**Internal Laminar Flows:** Fully developed laminar flow in pipe, plane duct & ducts with other crosssectionalshapes – 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 developingpipe & plane duct flow.

**UNIT-III**

**NATURAL CONVECTION:** Boussineq approximation – Governing equations – Similarity – Boundarylayer equations for free convective laminar flows – Numerical solution of boundary layer equations. Free Convective flows through a vertical channel across a rectangular enclosure – Horizontal enclosure – Turbulent natural convection.

**UNIT- IV**

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

**UNIT-V**

**CONVECTIVE HEAT TRANSFER THROUGH POROUS MEDIA:** Area weighted velocity – Darcy flowmodel – energy equation – boundary layer solutions for 2-D forced convection – Fully developed duct flow –Natural convection in porous media – filled enclosures – stability of horizontal porous layers.

**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/T/P/C : 3/1/0/4

### 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

Introduction to Numerical Methods - Finite Difference, Finite Element and Finite Volume Methods – Classification of Partial Differential Equations – Solution of Linear Algebraic Equations – Direct and Iterative Approaches.

**Finite difference methods:** Taylor's series – FDE formulation for 1D and 2D steady state heat transfer problems – Cartesian, cylindrical and spherical co-ordinate systems – boundary conditions – Un steady state heat conduction – Errors associated with FDE - Explicit Method – Stability criteria – Implicit Method – Crank Nickolson method – 2-D FDE formulation – ADI – ADE.

### UNIT-II

**Finite Volume Method:** Formation of Basic rules for control volume approach using 1D steady heat conduction equation – Interface Thermal Conductivity - Extension of General Nodal Equation to 2D and 3D Steady heat conduction and unsteady heat conduction.

**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**

**Turbulent Flows:** Direct Numerical Simulation, Large Eddy Simulation and RANS Models Compressible Flows: Introduction - Pressure, Velocity and Density Coupling.

**TEACHING METHODOLOGIES:**

- Power Point presentations
- Tutorial Sheets
- Assignments

**TEXT BOOKS**

1. Computational Fluid Flow and Heat Transfer – Muralidharan&Sundarajan (Narosa Pub)
2. Numerical heat transfer and fluid flow – S.V. Patankar (Hemisphere Pub. House)
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. Computaional 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/T/P/C : 3/1/0/4

### 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 inthe design parameters in context with environmental and social relevance
- Identify the need of computer modelling 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.
Cycle Analysis: Thermo-chemistry of Fuel – Air mixtures, properties – Ideal Models of Engine cycles– Real Engine cycles - differences and Factors responsible for – Computer Modeling.

**UNIT-II**

**GAS EXCHANGE PROCESSES:** Volumetric Efficiency – Flow through ports – Supercharging and Turbo charging.

**Charge Motion:** Mean velocity and Turbulent characteristics – Swirl, Squish – Pre-chamber Engine flows.

**UNIT-III**

**ENGINE COMBUSTION IN S.I ENGINES:** Combustion and Speed – Cyclic Variations – Ignition –Abnormal combustion Fuel factors, MPFI, SI engine testing.

**Combustion in CI engines:** Essential Features – Types off Cycle. Pr. Data – Fuel Spray Behavior – Ignition Delay – Mixing Formation and control, Common rail fuel injection system.

**UNIT-IV**

**POLLUTANT FORMATION AND CONTROL:** Nature and extent of problems – Nitrogen Oxides, Carbon monoxide, un burnt Hydrocarbon and particulate – Emissions – Measurement – Exhaust Gas Treatment, Catalytic converter, SCR, Particulate Traps, Lean, NOx, Catalysts.

**UNIT-V**

**ENGINE HEAT TRANSFER:** Importance of heat transfer, heat transfer and engine energy balance,Convective heat transfer , radiation heat transfer, Engine operating characteristics.Fuel supply systems for S.I. and C.I engines to use gaseous fuels like LPG, CNG and Hydrogen.

**Modern Trends in IC Engines:** Lean Burning and Adiabatic concepts, Rotary Engines, Modification in I.C engines to suit Bio – fuels, HCCI and GDI concepts.

**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
3. I.C. Engines/G.K. Pathak & DK Chevan/ Standard Publications
4. I.C. Engines /RK Rajput/Laxmi Publications

**REVERENCE BOOKS**

1. Computer Simulation of C.I. Engine Process/ V.Ganesan/University Press
2. Fundamentals of IC Engines/HN Gupta/PHI/2nd edition
3. I.C. Engines/Fergnson/Wiley
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/T/P/C : 3/1/0/4

### 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**

1. Cryogenic Systems – R.F. Barron, Oxford University Press

**REFERENCE BOOKS**

1. Cryogenic Research and Applications – Marshall Sitting, Von NostrandInc, New Jersey
2. Cryogenics Engineering Edit by B.A.Hands, Academic Press, 1986
3. Cryogenics Engineering – R. B. Scott, Von NostrandInc, New Jersey, 1959
4. Experimental Techniques in Low Temperature Physics – G.K. White, Oxford Press, 1968
5. Cryogenics process Engineering – K.D.Timmerhaus& TM Flynn, Plenum press, 1998
6. Cryogenic Heat Transfer - R.F. Baron.
7. Cryogenic Two Phase flow – N.N .Falina and J.G. Weisend –II
8. Cryogenic Regenerative Heat Exchangers – Robort Ackermann, Plenum Press, 1997
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/T/P/C : 3/1/0/4

**PRE- REQUISITES**

- Fluid Mechanics
- Heat Transfer

**COURSE OBJECTIVES:** The course is intended to

- Describe operating principles and function of measuring instruments used inEngineering 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 contextof 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 compressible fluid flow measurement, thermal anemometers and calibration of flow measurement instruments
- Discuss the behavior of an instrument in the measurement process
- Classification of 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**

**GENERAL CONCEPTS:** Fundamental elements of a measuring instrument. Static and dynamiccharacteristics – errors in instruments – Different methods of measurement and their analysis –Sensing elements and transducers.

Measurement of pressure – principles of pressure measurement, static and dynamic pressure,vacuum and high pressure measuring – Measurement of low pressure, Manometers, Calibrationmethods, Dynamic characteristics- design principles.

**UNIT-II**

**MEASUREMENT OF FLOW:** Obstruction meters, variable area meters. Pressure probes,compressible fluid flow measurement, Thermal anemometers, calibration of flow measuringinstruments. Introduction to design of flow measuring instruments.

**UNIT-III**

**TEMPERATURE MEASUREMENT:** Different principles of Temperature Measurement, use ofbimetallic 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**

**LEVEL MEASUREMENT:** Direct & indirect methods, manometric methods, float level meters, electricalconductivity, Capacitive, Ultrasonic, and Nucleonic Methods.
Measurement of density – Hydrometer, continuous weight method, Gamma rays, Gas impulse wheel. Velocity Measurement – Coefficient of viscosity, Ostesld method, free fall of piston under gravity,torque method.Measurement of moisture content and humidity.Measurement of thermal conductivity of solids, liquids and gases.

**UNIT-V**

**PROCESS CONTROL:** Introduction and need for process control principles, transfer functions, blockdiagrams, signal flow graphs, open and closed loop control systems – Analysis of First & Secondorder 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**

1. Measurement System, Application & Design – E.O. Doeblin.

**REFERENCE BOOKS**

1. Mechanical and Industrial Measurements – R.K. Jain – Khanna Publishers.
2. Mechanical Measurements – Buck & Beckwith – Pearson.
3. Control Systems, Principles & Design, 2nd Edition – M. Gopal – TMH.

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## ALTERNATE ENERGY RESOURCES
## (ELECTIVE-III)

M.Tech (Thermal Engineering) I Year - II Semester

Course Code: GR17D5145 L/T/P/C : 3/1/0/4

### PRE-REQUISITES

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

### COURSE OBJECTIVES

- To understand the alternate energy sourses
- To analyze the present and future energy demand of world and nation and t e c h n i q u e s
- 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,windetc
- 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

**Introduction** – Energy Sinario - Survey of Energy Resources – Classification – Need for Non-Conventional Energy Resources. Solar Energy: The Sun – Sun-Earth Relationship – Basic matter to waste heat energy circuit – Solar radiation – Attention – Radiation measuring instruments. Solar Energy Applications:Solar water heating, space heating – active and passive heating – energy storage – selective surface – solar stills and ponds – solar refrigeration – photovoltaic generation.

### UNIT -II

**Geothermal Energy:** Structure of Earth – Geothermal Regions – Hot springs – Hot Rocks – Hot Aquifers – Analytical Methods to estimate Thermal Potential – Harnessing Techniques – Electricity Generating Systems.

**UNIT-III**

**Direct Energy Conversion:** Nuclear Fusion: Fusion – Fusion Reaction- P-P Cycle carbon Cycle, Deuterium cycle – condition for controlled Fusion. Fuel Cells and Photovoltaic – Thermionic and Thermoelectric Generation – MHD Generator.
Hydrogen gas a Fuel – Production methods – Properties – I.C. Engines Applications – Utilization Strategy – Performances.

**UNIT -IV**

**Bio – Energy:** Biomass Energy Sources – Plant Productivity, Biomass Wastes – Aerobic and Anaerobic bio-conversion processes – Raw Materials and properties of Bio-gas-Bio-gas plant Technology and Status – The Energetics and Economics of Biomass Systems – Biomass gasification.

**UNIT-V**

**Wind Energy:** Wind – Beaufort number – characteristics – wind energy conversion systems – types – Betz model – Interference Factor – Power Coefficient – Torque Coefficient and thrust coeff.-Lift machines and drag machines – matching – electricity generation.

**Energy from Oceans:**

Tidal Energy; Tides – Diurnal and Semi – Diurnal Nature – Power from Tides.
Wave Energy; Waves – Theoretical Energy Available – Calculation of period and phase velocity of waves – wave power systems – submerged devices. Ocean Thermal Energy: principles – Heat Exchangers – Pumping requirements – Practical Considerations.

**TEACHING METHODOLOGIES**

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

**TEXT BOOKS**

1. Renewable Energy Resources – Basic Principles and Applications – G.N.Tiwari and M.K.Ghosal, NarosaPub

**REERENCE BOOKS**

1. Renewable Energy Resources / John Twidell& Tony WeirBiological Energy Resources / Malcolm Flescher&ChrrisLawis

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## EQUIPMENT DESIGN FOR THERMAL SYSTEMS (ELECTIVE-IV)

M.Tech (Thermal Engineering) I Year - II Semester
Course Code: GR17D5143 L/T/P/C : 3/1/0/4

### 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

- Design and Analyze the parallel flow, counter flow, multipass and cross flow Heat Exchangers
- Design and Analyze the shell and tube heat exchangers
- Evaluate the performance of heat exchanger with plate fin and tubular fins
- Calculate the heat transfer coefficient in horizontal and vertical condensation
- Determine the fin efficiency
- Classify the various types of cooling towers
- Design and calculate the performance of the cooling tower

### UNIT-I

**Classification of heat exchangers:** Introduction, Recuperation & Regeneration – Tubular heat exchangers: double pipe, shell & tube heat exchanger, Plate heat exchangers, Gasketed plate heat exchanger, spiral plate heat exchanger, Lamella heat exchanger, extended surface heat exchanger, Plate fin, and Tubular fin.
Basic Design Methods of Heat Exchanger: Introduction, Basic equations in design, Overall heat transfer coefficient – LMTD method for heat exchanger analysis – parallel flow, counter flow, multipass, cross flow heat exchanger design calculations.

### 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
2. Assignments

**TEXT BOOKS**

1. Process Heat Transfer – D.Q. Kern, TMH.
2. Cooling Towers by J.D. Gurney
3. Heat Exchanger Design – A.P.Fraas and M.N. Ozisick. John Wiely& sons, New York.

# 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/T/P/C : 3/1/0/4

### 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

Fuels - Detailed Classification – Conventional and Unconventional Solid, Liquid, gaseous fuels and nuclear fuels – Origin of Coal – Analysis of coal.
Coal – Carborisation, Gasification and liquefaction – Lignite: petroleum based fuels – problems associated with very low calorific value gases: Coal Gas – Blast Furnace Gas Alcohols and Biogas.

### UNIT-II

Principles of Combustion – Chemical composition – Flue gas anlaysis – dew point of products – Combustion stoichiometry.

Chemical kinetics – Rate of reaction – Reaction order – Molecularity – Zeroth, first, second and third order reactions - complex reactions – chain reactions. Theories of reaction Kinetics – General oxidation behavior of Hc's.

**UNIT-III**

Thermodynamics of Combustion – Enthalpy of formation – Heating value of fuel - Adiabatic flame Temperature – Equilibrium composition of gaseous mixtures.

**UNIT-IV**

Laminar and Turbulent flames Propagation and Structure – Flame stability – Burning velocity of fuels – Measurement of burning velocity – factors affecting the burning velocity.
Combustion of fuel, droplets and sprays – Combustion systems – Pulverised fuel furnaces – fixed, Entrained and Fluidised Bed Systems.

**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**

1. Combustion Fundamentals by Roger A strehlow – Mc Graw Hill

**REFERENCE BOOKS**

1. Fuels and combustion by Sharma and Chander Mohan – Tata Mc Graw Hill
2. Combustion Engineering and Fuel Technology by Shaha A.K. Oxford and IBH.
3. Principles of Combustion by KannethK.Kuo, Wiley and Sons.
4. Combustion by Sarkar – Mc. Graw Hill.
5. An Introduction to Combustion – Stephen R. Turns, Mc. Graw Hill International Edition.
6. Combustion Engineering – Gary L. Berman & Kenneth W. Ragland, Mc. Graw Hill International Edition.
7. Combustion-I. Glassman

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## MULTI PHASE FLOW
## (ELECTIVE IV)

M.Tech (Thermal Engineering) I Year - II Semester

Course Code: GR17D5148 L/T/P/C : 3/1/0/4

**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 inmulti-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**

1. Collier, J. G., Convective Boiling and Condensation, McGraw-Hill, 1981.
2. Wallis, G. W., One-dimensional Two Phase Flow, McGraw-Hill, 1969.
3. Stephen, K. Heat Transfer in Condensation and Boiling, Berlin Hiedelberg, 1992.
4. Hsu, Y. Y. and Graham, R. W., Transport Processes in Boiling and Two phaseSystems, McGraw-Hill, 1976.

**REFERENCE BOOKS**

1. Ginoux, J. J., Two Phase Flows and Heat Transfer, McGraw-Hill, 1978.
2. Hewitt, G., Delhaye, J. M., and Zuber, N., Multiphase Science and Technology, Vol. I, McGraw-Hill,1982.
3. Ghiaasiaan, S. M., Two-Phase Flow, Boiling and Condensation: In Conventional and Miniature Systems, Cambridge University Press, 2008.
4. Tong, L. S. and Tang, Y. S., Boiling Heat Transfer and Two-Phase Flow, secondEdition, Taylor & Francis, 1997.

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech (Thermal Engineering) **COMPUTATIONAL METHODS LAB** I Year - II Semester

Course Code: GR17D5150 L/T/P/C : 0/0/4/2

**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:**

- Analiyze 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
- Determine the temperature distribution in fins
- Identify the flow behavior over a transonic airfoil

**CFD List of Experiments**

1. Simple thermal system modeling and analysis
2. Fluid Flow and Heat Transfer analysis in a Mixing Elbow
3. Periodic simulation of 2-D heat exchanger using Fluent and correlating the results with theoretical results.
4. Simulation of 3-D heat exchanger
5. Analysis of turbulent flow past a transonic airfoil
6. Analysis of Transient Temperature Distribution in a Slab.
7. Analysis of Temperature Distribution on an Insulated Wall.
8. Analysis of Temperature Distribution along a Straight Fin.
9. Analysis of Temperature Distribution along a Tapered Fin.
10. Analysis of Discharge of Water from a Reservoir.

using

FLUENT, ICEM CFD and ABACUS.

# OPEN ELECTIVE - II

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## HUMAN COMPUTER INTERACTION
## (Open Elective-II)

M.Tech (CSE) I Year - II Semester

Course Code: GR17D5184 L/T/P/C : 3/1/0/4

**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**

**Mobile Ecosystem:** Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools.

**Interaction Devices** – Keyboard and Function Keys – Pointing Devices – Speech Recognition Digitization and Generation – Image and Video Display – Drivers.

**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
3. Brian Fling, “Mobile Design and Development”, First Edition, Reilly Media Inc., 2009

**REFERENCE BOOKS**

1. Human – Computer Interaction. Alan Dix, Janet Fincay, GreGoryd, Abowd, Russell Bealg, Pearson Education
2. Interaction Design Prece, Rogers, Sharps. Wiley Dreamtech.
3. User Interface Design, Soren Lauesen, Pearson Education.

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## BIG DATA ANALYTICS
## (Open Elective-II)

M.Tech (IT) I Year - II Semester

Course Code: GR17D5185 L/T/P/C : 3/1/0/4

**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
- Understandingnosql 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 about nosql 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**

1. Seema Acharya,S.Chellappan,"Big Data and Analytics",Wiley,2014

**REFERENCE BOOK**

1. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
2. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.
3. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012.
4. Eric Sammer, "Hadoop Operations", O'Reilley, 2012.

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## NEURAL AND FUZZY SYSTEMS
## (Open Elective-II)

M.Tech (EEE) I Year - II Semester

Course Code: GR17D5186 L/T/P/C : 3/1/0/4

**PRE–REQUISITE:** Control Systems, Power Systems, Mathematics, Physics.

**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

**Introduction to Neural Networks:** Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Hodgkin-Huxley Neuron Model, Integrate-and- Fire Neuron Model, Spiking Neuron Model, Characteristics of ANN, McCulloch-Pitts Model, Historical Developments, Potential Applications of ANN.

### UNIT-II

**Essentials of Artificial Neural Network**s: 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**

Introduction, Perceptron Models: Discrete, Continuous and Multi-Category, Training Algorithms: Discrete and Continuous Perceptron Networks, Perceptron Convergence theorem, Limitations of the Perceptron Model, Applications.

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**

Paradigms of Associative Memory, Pattern Mathematics, Hebbian Learning, General Concepts of Associative Memory (Associative Matrix, Association Rules, Hamming Distance, The Linear Associator, Matrix Memories, Content Addressable Memory), Bidirectional Associative Memory (BAM) Architecture, BAM Training Algorithms: Storage and Recall Algorithm, BAM Energy Function, Proof of BAM Stability Theorem Architecture of Hopfield Network: Discrete and Continuous versions, Storage and Recall Algorithm, Stability Analysis, Capacity of the Hopfield Network.

**UNIT-IV**

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

Introduction, Competitive Learning, Vector Quantization, Self-Organized Learning Networks, Kohonen Networks, Training Algorithms, Linear Vector Quantization, Stability-Plasticity Dilemma, Feed forward competition, Feedback Competition.

**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.

**Applications Neural network applications:** Process identification, Function Approximation, control and Process Monitoring, fault diagnosis and load forecasting.

**Fuzzy logic applications:** Fuzzy logic control and Fuzzy classification.

**TEACHING METHODOLOGIES**

1. White board
2. PPTs
3. Seminars

**TEXT BOOK**

1. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by Rajasekharan and G.A.VijayalakshmiPai – PHI Publication.

**REFERENCE BOOKS**

1. Introduction to Artificial Neural Systems - Jacek M. Zuarda, Jaico Publishing House, 1997.
2. Neural Engineering by C.Eliasmith and CH.Anderson, PHI
3. Neural Networks and Fuzzy Logic System by Bork Kosko, PHI Publications

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## PROJECT MANAGEMENT

M.Tech(Civil) I Year - II Semester

Course Code: GR17D5187 L/T/P/C : 3/1/0/4

**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**

**PROJECT PLANNING:** Prime Objectives of Project Management, Main Functions of Project Management, Planning, Principles of Planning, Objectives of Planning, Steps involved in Planning, Stages of Planning, Advantages & limitations of Planning, Failures of Projects & Construction Projects.

**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:**

Quality, Quality Control, Quality Assurance, Project Quality Plans in Construction Projects, Inspection & Test Plans, Method Statements, ISO Certification; Project Contracts, Contract Law, Types of Contracts and Indian Contract Act.

**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
2. Project Management – NJ Smith- Blackwell Publication.

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## HARDWARE - SOFTWARE CO-DESIGN
## (Open Elective-II)

M.Tech (ECE) I Year - II Semester

Course Code: GR17D5188 L/T/P/C : 3/1/0/4

**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**

1. Hardware / Software Co- Design Principles and Practice – Jorgen Staunstrup, Wayne Wolf –2009, Springer.
2. Hardware / Software Co- Design - Giovanni De Micheli, Mariagiovanna Sami, 2002, Kluwer Academic Publishers

**REFERENCE BOOKS**

1. A Practical Introduction to Hardware/Software Co-design -Patrick R. Schaumont - 2010 –Springer

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## NON CONVENTIONAL ENERGY RESOURCES

## (Course Objectives)

M.Tech (ME) I Year - II Semester
Course Code: GR17D5189

**Course Objectives:** The Objective of this course is to provide the student to

- Introduce the need of the non-convectional energy sources.
- Impart the role of non-convectional 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

- Choose the appropriate renewable energy as an alternate for conventional power in 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.
- Analyse 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-conven tionalenergy resources-Introduction, availability, classification, relative merits and demerits.
**Solar Cells:** Theory of solarcells. solarcell materials, solarcellarray, solar callower plant, limitations.

### UNIT-II

**Solar Thermal Energy:** Solar radiation, flat plate collectors and their materials, applications and performance, focusing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.

**UNIT-III**

**Geothermal Energy:** Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electricalconversion, non-electricalconversion,environmentalconsiderations.
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-electrical and the rmionic Conversions:
Principle of working, performance and limitations.
**Wind Energy:** Wind power and its sources, sites election, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics. Performance and limitation sofenergy conversion systems.

**UNIT-V**

**Bio-mass:**Availability of bio-mass and its conversion
theory. Ocean Thermal Energy Conversion (OTEC):
Availability, theory and working principle, per formance and
limitations. Wave and Tida l Wave:
Principle of working, performance and limitations. Waste Recycling Plants.

**TEXT/REFERENCESBOOKS**

1. John Twideu and TonyWeir, “Renewal Energy Resources” BSP Publications, 2006.
2. M.V.R.KoteswaraRao, “Energy Resources: Conventional&Non-Conventional “ BSPPublications,2006.
3. D.S.Chauhan, ”Non-conventional Energy Resources” New Age International.
4. C.S. Solanki, “Renewal Energy Technologies: A Practical Guidefor Beginners” PHILearning.