DEPARTMENT OF MECHANICAL ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

| COURSE PLAN – PART I | | | |
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| Name of the programme and specialization | MECHANICAL ENGINEERING | | |
| Course Title | ENGINEERING THERMODYNAMICS | | |
| Course Code | MEPC11 | No. of Credits | 3 |
| Course Code of Pre-requisite subject(s) | NIL | | |
| Session | July/ 2018 | Section (if, applicable) | --- |
| Name of Faculty | Dr. V. MARIAPPAN | Department | MECHANICAL ENGINEERING |
| Email | vmari@nitt.edu | Telephone No. | 0431-2503420, 9894471094 |
| Name of Course Coordinator(s) (if, applicable) | | | |
| E-mail | | Telephone No. | |
| Course Type | ✓ Core course | ☐ Elective course | |

**Syllabus (approved in BoS)**

Review of basic concepts of thermodynamics, properties of pure substances - First law applied to control mass, control volumes. First law of thermodynamics steady flow energy equation - applications of SFEE - uniform state, uniform flow.
Second law statements – irreversible processes, Carnot theorem, Clausius Inequality -entropy, entropy change for pure substances -T-s diagram, entropy change applied to control mass, control volume - availability and irreversibility.
Vapour power cycles - Rankine cycle - Effect of pressure and temperature on rankine cycle - Reheat cycle - Regenerative cycle -
Air standard power cycles - Assumptions regarding air standard cycles - Otto , Diesel , dual , Stirling and Brayton cycles.
Thermodynamic relations : Partial derivatives - Maxwell relations - Clapeyron equation, entropy of a pure substance - entropy change of an ideal gas - the ideal gas - Behavior of real gases - equations of state. Isothermal and adiabatic compressibility.
Mixture of non - reacting gases - Dalton's and Amalgam's model - calculation of Cp , Cv , R and U , h and s changes for gas mixtures fuels and combustion - combustion chemistry - calculation of air fuel ratio - exhaust gas analysis.

**COURSE OBJECTIVES**

1. To explain the principles of thermodynamics and to be able to use it in accounting for the bulk behavior of the simple physical systems
2. To explain the importance of energy, its various forms and energy transfer.
3. To provide in-depth study on thermodynamics of state, basic thermodynamic relations, and properties of pure substance
4. To enlighten the basic concepts of vapor and gas power cycles

| 5. To introduce the techniques for analyzing the refrigeration and air conditioning systems |
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| COURSE OUTCOMES (CO) | |
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| **Course Outcomes** | Aligned Programme Outcomes (PO) |
| 1. Apply thermodynamic concepts and understand the fundamentals of first and second laws of thermodynamics and their application to wide range of systems | 1, 2, 3, 5, 7, 10, 11, 12 |
| 2. Analyze the work and heat interactions associated with a prescribed process path and to perform analysis of a flow system. | 1, 2, 3, 4, 5, 6, 10, 11, 12 |
| 3. Evaluate entropy changes in a wide range of processes and determine the reversibility or irreversibility of a process from such calculations.. | 1, 2, 5, 6, 7, 10, 11, 12 |
| 4. Understand the interrelationship between thermodynamic functions and use such relationships to solve practical problems. | 1, 2, 5, 6, 7, 10, 11, 12 |

## COURSE PLAN – PART II

### COURSE OVERVIEW

This course involves the understanding of fundamental principles on energy transfer and its effect on the various systems/devices and the surroundings. The course famililiarizes the students with laws of Thermodynamics, concept of entropy, many appilcation areas like thermodynamic cycles, air conditioning and refrigeration, combustion and design of energy conversion devices in an interesting manner.

### COURSE TEACHING AND LEARNING ACTIVITIES

| Sl. No. | Week | Topic | Mode of Delivery |
|---|---|---|---|
| 01 | 1st week | Review of basic concepts of thermodynamics, Properties, Temperature, Zeroth law of thermodynamics, | Lecture C & T; PPT; VL |
| 02 | 2nd week | Mass and energy conversion principles. Properties of pure substances. | Lecture C & T; PPT |
| 03 | 3rd week | First law applied to systems, Control mass, Control volumes. Steady flow energy equation, Applications of SFEE, Uniform flow, | Lecture C & T; PPT |
| 04 | 4th week | Second law of thermodynamics: Reversible and irreversible processes. Second law statements, Carnot heat engine and Carnot refrigerator,. | Lecture C & T |
| 05 | 5th week | Carnot theorem – entropy: Definition of entropy, Clausius Inequality, Entropy change for pure substances. | Lecture C & T |
| 06 | 6th week | T-S diagram, entropy change applied to systems, Availability: availability of various forms of energies, availability and irreversibility, | Lecture C & T; PPT |
| **07** | | **Cycle Test - 1** | |
| 08 | 7th week | Vapor power cycles: Rankine cycle Reheat cycle - Regenerative cycle. | Lecture C & T |
| 09 | 8th week | Air standard power cycles: Assumptions regarding | Lecture C & T; VL; |

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|---|---|---|---|
| | | air standard cycles. Otto, Diesel, Dual, Stirling and Brayton cycles. | Lab Visit |
| 10 | 9th week | Thermodynamic relations: Partial derivatives, Maxwell relations - Clapeyron equation. | Lecture C & T |
| 12 | 10th week | General relations for du, dh, ds, cv and cp, Isothermal compressibility and volume expansivity. | Lecture C & T |
| 13 | | **Cycle Test – 2** | |
| 14 | 11th week | Various equations of state – Generalized compressibility chart Psychromtery: Psychrometric properties, Psychrometric charts, | Lecture C & T; PPT |
| 15 | 12th week | Property calculations of air vapor mixtures using chart and expressions. Psychrometric processes: Adiabatic saturation process | Lecture C & T |
| 16 | 13th week | Sensible heating and cooling, Humidification, Dehumidification | Lecture C & T; PPT |

**COURSE ASSESSMENT METHODS (shall range from 4 to 6)**

| Sl. No. | Mode of Assessment | Week / Date | Duration | % Weightage |
|---|---|---|---|---|
| 1. | Cycle Test - 1 | After 6th week | 60 Minutes | 20 |
| 2. | Cycle Test – 2 | After 12th week | 60 Minutes | 20 |
| 3. | Tutorials | Every week | 50 Minutes | 10 |
| CPA | Compensation Assessment* | | | 20 |
| 4. | Final Assessment * | | | 50 |

***mandatory; refer to guidelines on page 4**

**COURSE EXIT SURVEY (mention the ways in which the feedback about the course shall be assessed)**

1. Feedback from the students during class committee meeting.
2. End semester feedback on Course Outcomes.

**COURSE POLICY (preferred mode of correspondence with students, compensation assessment policy to be specified)**

**MODE OF CORRESPONDENCE (email/ phone etc)**

All the communication to the class (schedule of assessment/ course material/ any other information regarding this course) will be through the class representative.

**COMPENSATION ASSESSMENT POLICY**

1. Attending all the assessments is MANDATORY for every student
2. If any student is not able to attend any one or both of the Continuous Assessments (Cycle Tests I & II due to genuine reasons, he/she is permitted to appear for one time Compensation Assessment (CPA) (This is not valid for students who have attendance lag.). At any case, CPA will not be considered as an improvement test.

**ATTENDANCE POLICY** (A uniform attendance policy as specified below shall be followed)

- **At least 75% attendance in each course is mandatory.**
- **A maximum of 10% shall be allowed under On Duty (OD) category.**
- Students with **less than 65% of attendance** shall be prevented from writing the final assessment and **shall be awarded 'V' grade.**

**ACADEMIC DISHONESTY & PLAGIARISM**

- Possessing a mobile phone, carrying bits of paper, talking to other students, copying from others during an assessment will be treated as punishable dishonesty.
- Zero mark to be awarded for the offenders. For copying from another student, both students get the same penalty of zero mark.
- The departmental disciplinary committee including the course faculty member, PAC chairperson and the HoD, as members shall verify the facts of the malpractice and award the punishment if the student is found guilty. The report shall be submitted to the Academic office. The above policy against academic dishonesty shall be applicable for all the programmes.

**ADDITIONAL INFORMATION**

The Course Coordinator is available for consultation at times those are displayed on the coordinator's office notice board. Queries may also be emailed to the Course Coordinator directly at **vmari@nitt.edu**

**FOR APPROVAL**

**Course Faculty** (V. MARIAPPAN) **CC-Chairperson** _____ **HOD** _____

**Guidelines:**

a) The number of assessments for a course shall range from 4 to 6.
b) **Every course shall have a final assessment on the entire syllabus with at least 30% weightage.**
c) **One compensation assessment for absentees in assessments (other than final assessment) is mandatory. Only genuine cases of absence shall be considered.**
d) **The passing minimum shall be as per the regulations.**
e) **Attendance policy and the policy on academic dishonesty & plagiarism by students are uniform for all the courses.**
f) **Absolute grading fdfpolicy shall be incorporated if the number of students per course is less than 10.**
g) Necessary care shall be taken to ensure that the course plan is reasonable and is objective.