

**DEPARTMENT OF MECHANICAL ENGINEERING**

**NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI**

<b>COURSE PLAN – PART I</b>			
<b>Name of the programme and specialization</b>	<b>B. Tech. MECHANICAL ENGINEERING</b>		
<b>Course Title</b>	<b>THERMAL ENGINEERING</b>		
<b>Course Code</b>	<b>MEPC17</b>	<b>No. of Credits</b>	<b>4</b>
<b>Course Code of Pre-requisite subject(s)</b>	-		
<b>Session</b>	<b>January 2021</b>	<b>Section (if, applicable)</b>	<b>A&amp;B</b>
<b>Name of Faculty</b>	<b>Dr. R. Anand</b> Associate Professor  <b>Dr. S. Venkatesh</b> PDF	<b>Department</b>	<b>Mechanical</b>
<b>Email</b>	<b>anandachu@nitt.edu</b> <b>venkats@nitt.edu</b>	<b>Telephone No.</b>	<b>0431 2503423</b>
<b>Name of Course Coordinator(s) (if, applicable)</b>	-		
<b>E-mail</b>	-	<b>Telephone No.</b>	-
<b>Course Type</b>	<input checked="" type="checkbox"/> <b>Core course</b> <input type="checkbox"/> <b>Elective course</b>		
<b>Syllabus (approved in BoS)</b>			
<p>Classification of IC engines – Working of SI &amp; CI, two and four stroke engines – Ideal and actual valve and port timing diagrams – Comparison of ideal and actual air standard cycles (p-v diagram) – Engine operating characteristics: mean effective pressure, torque and power, specific fuel consumption, efficiencies, pressure-crank angle diagram – Determination of fuel properties – Thermochemistry of fuels – Calculation of air fuel ratio – stoichiometric, lean and rich mixtures – Exhaust gas analysis</p> <p>Subcritical and supercritical boilers, fluidized bed boilers, fire-tube and water-tube boilers, mountings and accessories - Steam turbine basic cycles – velocity diagrams, Work done and efficiency –Multistage turbines, governing systems, Effects of reheating and regeneration, Application of Mollier diagram, Gas turbine basic cycle (open and closed), Application of</p>			

intercooling, reheating and regeneration – cogeneration and combined system

Steam Nozzles: Types and Shapes of nozzles – Flow through nozzles – Stagnation, sonic properties and isentropic expansion in nozzle – Critical pressure ratio – Effect of friction. Metastable flow.

Compressors: Classification of compressors – Radial and axial compressors – Performance characteristics: Volumetric efficiency, Isothermal efficiency and Isentropic efficiency – Effect of clearance volume – Multi stage air compressor with intercooling – Surging and stalling, Slip.

Refrigeration & air conditioning system: Vapour compression system – Effect of Super heat and Sub cooling – Performance calculations - Vapour absorption system - Ammonia water, Lithium bromide water – Psychrometric processes – Air conditioning system – Working principles and concept of RSHF, GSHF, ESHF- Cooling load calculations.

### COURSE OBJECTIVES

1. To enable the students, understand the principles, working and performance of IC engines
2. To introduce students to the working of compressors, steam nozzles and various refrigeration and air-conditioning systems.
3. To teach students the principles of waste heat recovery and thermal storage systems.

### COURSE OUTCOMES (CO)

Course Outcomes	Aligned Programme Outcomes (PO)																																																																																	
<p>At the end of the course student will be able to</p> <ol style="list-style-type: none"> <li>1. Solve problems on internal combustion engines and prepare heat balance sheet.</li> <li>2. Get an insight of various components and principles of engines, boilers, compressors, Steam Nozzles, etc.</li> <li>3. Design refrigeration and air-conditioning system for a particular application.</li> <li>4. Demonstrate the knowledge of waste heat recovery and thermal storage.</li> </ol>	<table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th style="width: 10%;"></th> <th style="width: 10%;">POs/COs</th> <th colspan="5">Course Outcomes (Cos)</th> </tr> <tr> <th></th> <th></th> <th>CO1</th> <th>CO2</th> <th>CO3</th> <th>CO4</th> <th>CO5</th> </tr> </thead> <tbody> <tr> <td rowspan="11" style="writing-mode: vertical-rl; transform: rotate(180deg); font-weight: bold;">Programme Outcomes (POs)</td> <td>PO1</td> <td>H</td> <td>H</td> <td>H</td> <td>H</td> <td>H</td> </tr> <tr> <td>PO2</td> <td>H</td> <td>H</td> <td>H</td> <td>M</td> <td>M</td> </tr> <tr> <td>PO3</td> <td>M</td> <td>H</td> <td>L</td> <td>L</td> <td>L</td> </tr> <tr> <td>PO4</td> <td>L</td> <td>M</td> <td>M</td> <td>L</td> <td>L</td> </tr> <tr> <td>PO5</td> <td>L</td> <td>L</td> <td>L</td> <td>M</td> <td>M</td> </tr> <tr> <td>PO6</td> <td>M</td> <td>H</td> <td>M</td> <td>H</td> <td>H</td> </tr> <tr> <td>PO7</td> <td>H</td> <td>M</td> <td>H</td> <td>H</td> <td>H</td> </tr> <tr> <td>PO8</td> <td>H</td> <td>M</td> <td>H</td> <td>M</td> <td>H</td> </tr> <tr> <td>PO9</td> <td>M</td> <td>L</td> <td>H</td> <td>H</td> <td>H</td> </tr> <tr> <td>PO10</td> <td>L</td> <td>L</td> <td>M</td> <td>H</td> <td>M</td> </tr> <tr> <td>PO11</td> <td>L</td> <td>M</td> <td>L</td> <td>M</td> <td>H</td> </tr> </tbody> </table>		POs/COs	Course Outcomes (Cos)							CO1	CO2	CO3	CO4	CO5	Programme Outcomes (POs)	PO1	H	H	H	H	H	PO2	H	H	H	M	M	PO3	M	H	L	L	L	PO4	L	M	M	L	L	PO5	L	L	L	M	M	PO6	M	H	M	H	H	PO7	H	M	H	H	H	PO8	H	M	H	M	H	PO9	M	L	H	H	H	PO10	L	L	M	H	M	PO11	L	M	L	M	H
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### COURSE OVERVIEW

This course deals with the fundamentals of IC engines and SI engines. In addition, the students can be able to understand the operation characteristics of engines, fuel properties and exhaust gas analysis in engines by this course. Moreover, this course provides knowledge in boilers and its mountings. Students can be able to understand the applications of steam turbine and nozzles

through this course. Furthermore, the classifications of compressors and its performance characteristics are provided in this course. Refrigeration and air conditioning systems to be explained in detail with their performance and applications in different environment through this course.

**COURSE TEACHING AND LEARNING ACTIVITIES**

S.No.	Week/Contact Hours	Topic	Mode of Delivery
1	1 <sup>st</sup> week	Classification of IC engines – Working of SI & CI, two and four stroke engines – Ideal and actual valve and port timing diagrams – Comparison of ideal and actual air standard cycles (p-v diagram)	PPT
2	2 <sup>nd</sup> week	Engine operating characteristics: mean effective pressure, torque and power, specific fuel consumption, efficiencies, pressure-crank angle diagram	PPT
3	3 <sup>rd</sup> week	Determination of fuel properties – Thermochemistry of fuels – Calculation of air fuel ratio – stoichiometric, lean and rich mixtures – Exhaust gas analysis	PPT
4	4 <sup>th</sup> week	Subcritical and supercritical boilers, fluidized bed boilers, fire-tube and water-tube boilers, mountings and accessories	PPT
5	5 <sup>th</sup> week	Steam turbine basic cycles – velocity diagrams, Work done and efficiency – Multistage turbines, governing systems, Effects of reheating and regeneration, Application of Mollier diagram	PPT
6	6 <sup>th</sup> week	Gas turbine basic cycle (open and closed), Application of intercooling, reheating and regeneration – cogeneration and combined system	PPT
7	7 <sup>th</sup> week	Steam Nozzles: Types and Shapes of nozzles – Flow through nozzles	PPT
8	8 <sup>th</sup> week	Stagnation, sonic properties and	PPT

		isentropic expansion in nozzle – Critical pressure ratio – Effect of friction. Metastable flow	
9	9 <sup>th</sup> week	Compressors: Classification of compressors – Radial and axial compressors	PPT
10	10 <sup>th</sup> week	Performance characteristics: Volumetric efficiency, Isothermal efficiency and Isentropic efficiency – Effect of clearance volume	PPT
11	11 <sup>th</sup> week	Multi stage air compressor with intercooling – Surging and stalling, Slip	PPT
12	12 <sup>th</sup> week	Refrigeration & air conditioning system: Vapour compression system – Effect of Super heat and Sub cooling – Performance calculations	PPT
13	13 <sup>th</sup> week	Vapour absorption system - Ammonia water, Lithium bromide water – Psychrometric processes	PPT
14	14 <sup>th</sup> week	Air conditioning system – Working principles and concept of RSHF, GSHF, ESHF- Cooling load calculations	PPT

#### **COURSE ASSESSMENT METHODS**

<b>S.No.</b>	<b>Mode of Assessment</b>	<b>Week/Date</b>	<b>Duration</b>	<b>% Weightage</b>
1	Cycle Test - 1	After 7 <sup>th</sup> week	60 Minutes	25
2	Cycle Test - 2	After 14 <sup>th</sup> week	60 Minutes	25
3	Assignment / Seminar Presentation			20
CPA	Compensation Assessment	May First week	60 Minutes	25
4	Final Assessment	May Third week	180 Minutes	30

**ESSENTIAL READINGS:** Textbooks, reference books, etc.

1. Rajput R.K., (2013), Thermal Engineering, 10th Edition, Laxmi Publications (P) Ltd.

2. Kothandaraman.C.P., Domkundwar. Domkundwar. A.V., "A course in thermal Engineering", Fifth Edition, "Dhanpat Rai & sons , 2002
3. Sarkar, B.K,"Thermal Engineering" Tata McGraw-Hill Publishers.
4. Arora.C.P, "Refrigeration and Air Conditioning ," 3rd Edition, Tata McGraw-Hill Publishers.
5. Ganesan V.." Internal Combustion Engines" , 4th Edition, Tata McGraw-Hill.
6. Rudramoorthy, R, "Thermal Engineering ",Tata McGraw-Hill, New Delhi.
7. Ramalingam. K.K., "Thermal Engineering", 2nd Edition, SCITECH Publications (India) Pvt. Ltd., 2009

### **COURSE EXIT SURVEY**

1. Students can meet the faculty at any stage in the course duration in case he/she finds difficulty in understanding the concept.
2. Feedback form issued to students to express their comments about the course after completing the syllabus. Students are requested to give genuine feedback about the course.
3. Student knowledge about the topic covered in this course will be judged based on the marks obtained in the written examinations.

### **COURSE POLICY**

#### **MODE OF CORRESPONDENCE**

- Students must attend all the classes regularly.
- The Institute follows relative grading with flexibility given to teachers to decide the mark ranges for grades.
- All assessment of a course will be done on the basis of marks.

#### **COMPENSATION ASSESSMENT POLICY**

Students who absent for Written test - I & II for genuine reasons may be permitted for writing compensation assessment. The syllabus for the compensation assessment will be for those prescribed for the written test I & II and prior approval from the faculty in-charge is mandatory for appearing compensation assessment.

#### **ATTENDANCE POLICY**

- **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.**

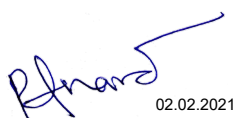
#### **ACADEMIC DISHONESTY & PLAGIARISM**

- 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.

### **ADDITIONAL INFORMATION**

- Students can reach course faculty by fixing appointment through E-mail: anandachu@nitt.edu , venkats@nitt.edu or phone (9444838909 , 9790530731)

**FOR APPROVAL**

  
02.02.2021

**Dr. R. Anand**



**Dr. S. Venkatesh**

**Course Faculty**

**CC-Chairperson**

**Head of the Department**

**Guidelines:**

- The number of assessments for a course shall range from 4 to 6.
- Every course shall have a final assessment on the entire syllabus with at least 30% weightage.**
- One compensation assessment for absentees in assessments (other than final assessment) is mandatory. Only genuine cases of absence shall be considered.**
- The passing minimum shall be as per the regulations.**

B.Tech. Admitted in					P.G.
2019	2018	2017	2016	2015	
35% or class average/2 whichever is greater.			Peak/3 or class average/2 whichever is lower		40%

- Attendance policy and the policy on academic dishonesty & plagiarism by students are uniform for all the courses.**
- Absolute grading policy shall be incorporated if the number of students per course is less than 10.**
- Necessary care shall be taken to ensure that the course plan is reasonable and is objective.