SEMESTER S6

THERMAL ENGINEERING

Course Code	**PBMET604**	**CIE Marks**	60
Teaching Hours/Week (L: T:P: R)	3:0:0:1	**ESE Marks**	40
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	PCMET403 Engineering Thermodynamics	**Course Type**	Theory

Course Objectives:

1. To become proficient with steam turbines and steam power systems.
2. To comprehend and evaluate the performance of internal combustion engines and examine their combustion processes

SYLLABUS

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Module No.	Syllabus Description	Contact Hours
1	**Steam Power Cycle**: Simple Rankine cycle, Improvements in Rankine cycles-Reheat and Regenerative cycles – Numerical problems. **Steam Boilers**: Types of boilers, Fire tube boiler - Cochran boiler, Water tube boiler - Babcock and Wilcox, Boiler Mountings and Accessories. **Steam nozzles**: -Types of nozzles, Velocity, Effect of friction, nozzle efficiency and its effects - Simple numerical problems, Super saturated flow.	9
2	**Steam turbines**: Classification, compounding of turbines-pressure velocity variation. Velocity diagrams, work done, efficiency, Condition for maximum efficiency (Derivation not required). Graphical Method for solving velocity triangle problems on impulse and reaction turbines. **Multistage turbines** -Condition line, stage efficiency, reheat factor and degree of reaction. Governing of turbines – Centrifugal governing and Nozzle governing.	9

3	**Fundamentals of IC Engines**: Air standard cycles, their analysis, and applications - Otto cycle, Diesel cycle, Dual cycle, Atkinson cycle (No numerical problems and derivations) **Reciprocating type SI and CI engines:** Ideal and Actual cycle for IC engines– Deviation from ideal cycle and associated factors. Super charging, and turbo charging. **Engine Testing and Performance of SI and CI engines:** Torque, Engine power- BHP, IHP, Efficiencies of IC engines, Specific fuel consumption, Mean effective pressure. Morse test, Heat balance test and Retardation test – Simple Numerical problems.	**9**
4	**Combustion in IC Engines**: Fuels for IC engines, Ignition limits, air-fuel ratio, equivalence ratio. **S.I. engines**: Stages of combustion in S.I. Engines, Ignition lag, Auto ignition and Detonation, Effects of engine variables on detonation and Octane rating of fuels. **C.I. Engines**: Stages of combustion in C.I engines, Delay period, variables affecting delay period; knocking, Cetane rating of fuels. **Major pollutants** from S.I. and C.I. Engines, Measurement of exhaust emissions, Emission Control techniques – Catalytic convertors, Particulate traps Thermal reactor, Exhaust Gas Recirculation	**9**

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Suggestion on Project Topics

Course Assessment Method
(CIE: 60 marks, ESE: 40 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Project	Internal Ex-1	Internal Ex-2	Total
5	30	12.5	12.5	60

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 2 marks **(8x2 =16 marks)**	• 2 questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 2 sub divisions. • Each question carries 6 marks. **(4x6 = 24 marks)**	**40**

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Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply the basic thermodynamic principles and analyse the operation of steam power cycles	**K4**
CO2	Analyse the performance of steam turbines and identify methods to improve their efficiency.	**K3**
CO3	Identify the performance parameters of IC engines and evaluate their performance.	**K3**
CO4	Explain the combustion phenomenon and pollution in IC engines.	**K2**
CO5	Conduct case studies, carry out simulation/testing, and prototyping.	**K6**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-
CO3	3	2	2	-	-	-	-	-	-	-	-	2
CO4	2	2	-	-	-	-	2	-	-	-	2	2
CO5	3	3	2	2	2	2	2	2	3	3	2	2

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Thermal Engineering	Rudra Moorthy	McGraw Hill Education India	2003
2	Thermal Engineering	R.K Rajput	Laxmi publications	2010
3	Fundamentals of IC engines	V. Ganesan	Tata McGraw-Hill	2002
4	Fundamentals of IC engines	H N Gupta	PHI	Second Edition, 2018
5	Internal Combustion Engines	V Sajith and Shijo Thomas	Oxford University Press	2017

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	I.C engine fundamentals	J.B.Heywood	McGraw-Hill	2011
2	Thermal Engineering	Mahesh Rathore	McGraw Hill Education India	2010

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Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptelvideos.com/video.php?id=1181
2	https://nptelvideos.com/video.php?id=1181
3	https://archive.nptel.ac.in/courses/112/103/112103262/
4	https://archive.nptel.ac.in/courses/112/103/112103262/

PBL Course Elements

L: Lecture (3 Hrs.)	**R: Project (1 Hr.), 2 Faculty Members**		
	Tutorial	**Practical**	**Presentation**
Lecture delivery	Project identification	Simulation/ Laboratory Work/ Workshops	Presentation (Progress and Final Presentations)
Group discussion	Project Analysis	Data Collection	Evaluation
Question answer Sessions/ Brainstorming Sessions	Analytical thinking and self-learning	Testing	Project Milestone Reviews, Feedback, Project reformation (If required)
Guest Speakers (Industry Experts)	Case Study/ Field Survey Report	Prototyping	Poster Presentation/ Video Presentation: Students present their results in a 2 to 5 minutes video

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Assessment and Evaluation for Project Activity

Sl. No	**Evaluation for**	**Allotted Marks**
1	Project Planning and Proposal	5
2	Contribution in Progress Presentations and Question Answer Sessions	4
3	Involvement in the project work and Team Work	3
4	Execution and Implementation	10
5	Final Presentations	5
6	Project Quality, Innovation and Creativity	3
Total		**30**

1. **Project Planning and Proposal (5 Marks)**

    - Clarity and feasibility of the project plan
    - Research and background understanding
    - Defined objectives and methodology

2. **Contribution in Progress Presentation and Question Answer Sessions (4 Marks)**

    - Individual contribution to the presentation
    - Effectiveness in answering questions and handling feedback

3. **Involvement in the Project Work and Team Work (3 Marks)**

    - Active participation and individual contribution
    - Teamwork and collaboration

4. **Execution and Implementation (10 Marks)**

    - Adherence to the project timeline and milestones
    - Application of theoretical knowledge and problem-solving
    - Final Result

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5. **Final Presentation (5 Marks)**

    - Quality and clarity of the overall presentation
    - Individual contribution to the presentation
    - Effectiveness in answering questions

6. **Project Quality, Innovation, and Creativity (3 Marks)**

    - Overall quality and technical excellence of the project
    - Innovation and originality in the project
    - Creativity in solutions and approaches