

APPLIED THERMODYNAMICS		Semester	4
Course Code	BME401	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2:2:0:0	SEE Marks	50
Total Hours of Pedagogy	30	Total Marks	100
Credits	03	Exam Hours	03
Examination type (SEE)	Theory		

**Course objectives:**

- Explain the air standard cycle and combustion in I. C. Engines.
- Describe the gas power cycle and vapour power cycles.
- Explain the performance of compressor.
- Explain the concepts of Refrigeration and Air conditioning.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
2. Chalk and Talk method for Problem Solving.
3. Adopt flipped classroom teaching method.
4. Adopt collaborative (Group Learning) learning in the class.
5. Adopt Problem Based Learning (PBL), which fosters students' analytical skills and develops thinking skills such as evaluating, generalizing, and analysing information.

**Module-1**

**Air standard cycles:** Carnot cycle. Otto, Diesel, Dual and cycles, p-v and T -s diagrams, description, efficiencies and mean effective pressures. Comparison of Otto and Diesel cycles.

**I.C.Engines:** Classification of IC engines, Combustion of SI engine and CI engine, Detonation and factors affecting detonation, Performance analysis of I.C Engines, Heat balance, Morse test

**Module-2**

**Gas power Cycles:** Gas turbine (Brayton) cycle; description and analysis. Regenerative Intercooling and reheating in gas turbine cycles.

**Jet Propulsion cycles:** Turbojet, Turboprop, Turbofan, Ram Jet, Rocket, Pulse Jet, Ram Rocket.

**Module-3**

**Vapour Power Cycles:** Carnot vapour power cycle, drawbacks as a reference cycle. Simple Rankine cycle; description, T-S diagram, analysis for performance. Comparison of Carnot and Rankine cycles. Effects of pressure and temperature on Rankine cycle performance.

**Actual vapour power cycles:** Actual vapour power cycles, regenerative vapour power cycle with open and closed feed water heaters. Reheat Rankine cycle.

**Module-4**

**Refrigeration Cycles:** Vapour compression refrigeration system; description, analysis, refrigerating effect. Capacity, power required, units of refrigeration, COP, Refrigerants and their desirable properties, alternate Refrigerants. Vapour absorption refrigeration system.

**Psychrometrics and Air-conditioning Systems:** Psychrometric properties of Air (*only for review*), Psychrometric Chart, Analyzing Air-conditioning Processes; Heating, Cooling, Dehumidification and Humidification, Evaporative Cooling. Adiabatic mixing of two moist air streams.

**Module-5**

**Reciprocating Compressors:** Operation of a single stage reciprocating compressors. Work input through p-v diagram and steady state steady flow analysis. Effect of Clearance and Volumetric efficiency. Adiabatic, Isothermal and Mechanical efficiencies. Multi-stage compressor, saving in work, Optimum intermediate pressure, Inter-cooling, Minimum work for compression.

**Steam nozzles:** Flow of steam through nozzles, Shape of nozzles, effect of friction, Critical pressure ratio, Super saturated flow.

**Course outcome (Course Skill Set)**

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

1. Analyse air standard cycle to evaluate the performance of I C engines.
2. Analyze the gas power cycles to evaluate the overall efficiency of gas turbine plant.
3. Apply thermodynamic concepts to analyze the performance of vapour power cycles.
4. Analyze the vapour compression and vapour absorption systems to improve refrigeration.
5. Determination of various parameters of air compressors and steam nozzles.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**).

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.
- Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:****Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)****Text Books:**

1. Engineering Thermodynamics, P.K. Nag, Tata McGraw Hill, 6th Edition 2018
2. Thermodynamics, Yunus A, Cengel, Michael A Boles, Tata McGraw Hill 7th Edition

**Reference Books:**


1. Thermodynamics for engineers Kenneth A. Kroosand Merle C. Potter, Cengage Learning 2016
2. Principles of Engineering Thermodynamics, Michael J, Moran, Howard N. Shapiro, Wiley 8th Edition
3. I.C.Engines, M.L.Mathur&Sharma. Dhanpat Rai& sons-India

**Web links and Video Lectures (e-Resources):**

- <https://www.youtube.com/watch?v=AwbhbN20x18&list=PLwdnzlV3ogoVjnW1S9GgOKYj5heOzl1dn>
- <https://ciechanow.ski/internal-combustion-engine/>
- <https://www.youtube.com/watch?v=1Vn1PDuPHsY&list=PL4K9r9dYCOoozyQU9kmQFJkTz>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Organise Industrial visits to Thermal power plants and submission of report.
- Visit to a building under construction to explore the design consideration of duct to understand the concept of centralized Air Conditioning.

  
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