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Question Paper Code : 11659

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2026.

Fourth Semester

Mechanical Engineering

ME3451 – THERMAL ENGINEERING

(Common to Mechanical Engineering (Sandwich))

(Regulations 2021)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State the purpose of reheat in steam power cycles.
2. Define the term 'dual cycle' in thermodynamics.
3. List any two types of nozzles used in steam or gas flow applications.
4. State the impact of metastable flow in nozzle efficiency.
5. State the principle of impulse turbine.
6. Mention any two methods of compounding.
7. Define valve timing diagram.
8. Mention any two differences between SI and CI engines.
9. State the function of a lubrication system in IC engines.
10. List two types of cooling systems used in IC Engines.

PART B — ($5 \times 13 = 65$ marks)

11. (a) (i) Derive the expression for thermal efficiency of the Otto Cycle using Compression ratio. (6)
(ii) Discuss the assumptions made in air-standard cycle analysis and their imitations. (7)

Or

- (b) (i) Derive the expression for air-standard efficiency of the Brayton cycle. (6)
(ii) Explain how pressure ratio influences the performance of the cycle. (7)

12. (a) (i) Explain the flow of steam through a convergent-divergent nozzle with sketch. (7)
(ii) Discuss the role of throat section and conditions for choking. (6)

Or

- (b) (i) Describe the design considerations and working principle of a steam injector. (6)
(ii) Explain the role of nozzle shape in controlling steam expansion and velocity. (7)

13. (a) (i) Explain the construction and working of an impulse turbine with velocity diagrams. (6)
(ii) Derive expressions for work done and efficiency. (7)

Or

- (b) (i) Discuss the concept of multi-staging in steam turbines. (6)
(ii) Compare open and closed gas turbine cycles with schematic diagrams. (7)

14. (a) (i) Compare the combustion processes in SI and CI engines with diagrams. (6)
(ii) Explain the influence of air-fuel ratio on engine performance and emissions. (7)

Or

- (b) (i) Discuss the importance of valve timing diagrams in engine operation. (6)
- (ii) Discuss the importance of port timing diagrams in engine operation. (7)
15. (a) (i) Explain the working and advantages of common rail direct injection (CRDI) systems. (6)
- (ii) Discuss the role of lubrication systems in engine performance and longevity. (7)

Or

- (b) (i) Compare air cooling and liquid cooling systems used in IC engines. (6)
- (ii) Describe the working principle and benefits of supercharging in IC engines. (7)

PART C — (1 × 15 = 15 marks)

16. (a) Analyze the performance of a Dual cycle used in a high-speed diesel engine. Given specific compression and cut-off ratios, calculate the efficiency and compare it with Otto and Diesel cycles for the same conditions.

Or

- (b) Design a gas turbine cycle with intercooling, reheating, and regeneration for a combined cycle plant. Justify the configuration and evaluate its impact on specific output and thermal efficiency.

