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Question Paper Code : 40919

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2025.

Fourth/Sixth Semester

Mechanical Engineering

ME 8493 — THERMAL ENGINEERING – I

(Common to Mechanical Engineering (Sandwich))

(Regulations 2017)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Write the four processes of the ideal Otto cycle.
2. List any two key applications of the Brayton cycle.
3. A single acting two stage compressor with complete inter cooling delivers 6 kg/mm air at 16 bar. Assuming an intake at 1 bar and 15°C, calculate the intermediate pressure.
4. Mention any two advantages and applications of rotary compressors.
5. State the functions of (a) crank and (b) rocker arm in an IC engine.
6. Draw the actual valve-timing diagram for a diesel engine.
7. List out the various emissions produced by IC engines.
8. What are the advantages of forced cooling system over passive cooling systems?
9. Mention the significance of inter-cooling in gas turbines.
10. Name any two applications of gas turbines.

PART B — ($5 \times 13 = 65$ marks)

11. (a) A diesel engine operating on air standard diesel cycle operates on 1 kg of air with an initial pressure of 98 kPa and a temperature of 36°C . The pressure at the end compression is 35 bar and cut off is 6% of the stroke. Determine the (i) each state point values (ii) thermal efficiency and (iii) mean effective pressure.

Or

- (b) In a dual cycle, the pressure and temperature at the beginning of compression 1.03 bar and 303 K. Maximum pressure is 41.4 bar and temperature at the end of heat supply is 1666 K. Find the total heat supplied per kg of air, the fraction of the total heat supplied at constant volume and at constant pressure and the net work per kg of air.
12. (a) What are the Criteria's for selecting a compressor? Explain the construction and working of double stage reciprocating compressor with a neat layout.

Or

- (b) A single acting air compressor takes in air at 1 bar 27°C and delivers at 1.4 MPa running at 300 rpm and has cylinder diameter of 160 mm and stroke 200 mm. Clearance volume is 4% of stroke volume. If the pressure and temperature at the end of the suction stroke is 100 kPa, 47°C and compression and expansion takes places by polytropic process ($n=1.2$), find (i) mass of air delivered per minute (ii) volumetric efficiency and driving power required if mechanical efficiency is 85%.
13. (a) Discuss the performance of an IC Engine with the lean and rich mixtures. List out the effects of detonation and write the factors affecting Octane number.

Or

- (b) In detail compare and contrast the two stroke and four stroke IC engines. Also draw the relevant sketches for two stroke and four stroke engines.
14. (a) Explain in detail, the working of magneto ignition system with a neat sketch.

Or

- (b) With a neat illustration, explain the working of common rail direct injection system employed in latest vehicles.
15. (a) With neat sketch, explain the Gas turbine operation with the help of Brayton cycle. Also draw the T-S diagram for constant pressure open cycle gas turbine.

Or

- (b) In a Brayton cycle, the air at inlet is 27°C , 0.1 MPa. The pressure ratio is 6.25 and the maximum temperature is 800°C . The turbine and compressor efficiencies are each 80%. Find compressor work, turbine work, heat supplied, cycle efficiency and turbin exhaust temperature.

PART C — ($1 \times 15 = 15$ marks)

16. (a) Heat balance test was conducted in a single-cylinder oil engine working on dual cycle and the following observations were made : Compression ratio: 15; Brake torque: 186 N-m; Speed: 1900 rpm.; Fuel consumption: 10.2 kg/h; Calorific value of fuel: 43890 kJ/kg; Cooling water flow rate: 15.5 kg/mm; Rise in temperature of cooling water: 36°C; Air consumption: 3.8 kg/mm; Exhaust gas temperature: 410°C; Room temperature: 20°C; Specific heat of exhaust: 1.17 kJ/kg K, Estimate brake power, brake specific fuel consumption and thermal efficiency. Draw up a heat balance sheet of the engine on minute basis.

Or

- (b) Consider a steam power plant that operates on a simple ideal Rankine cycle. Steam enters the turbine at 7 MPa and 450°C and is condensed in the condenser at a pressure of 10 kPa by running cooling water from a lake through the tubes of the condenser at a rate of 1600 kg/s. Rankine cycle has a net power output of 40 MW, Show the cycle on T-s diagram with respect to saturation lines and determine, (i) the thermal efficiency of this cycle (ii) the back work ratio (iii) the mass flow rate of the steam in kg/s and (iv) the temperature rise of the cooling water, in °C.

