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Fifth Semester

Mechanical Engineering

080120023 — THERMAL ENGINEERING

(Regulation 2008)

Time : Three hours Maximum : 100 marks

(Use of relevant thermodynamic property tables are permitted in the examination)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define: Mean Effective Pressure.

2. What are the differences between actual and ideal cycle?

3. Why the two stroke engines are not widely used in two wheelers?

4. What do you understand by Ignition delay?

5. Name few reaction turbines and state its application.

6. How do you determine the dryness fraction of steam? Why it is needed?

7. What is the effect of clearance volume in an air compressor?

8. What is the application of a screw compressor?

9. What are the advantages of vapour absorption refrigeration system?

10. What are the requirements for dehumidification process in air conditioning?

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PART B — (5 × 16 = 80 marks)

11. (a) (i) A diesel engine has a compression ratio of 14 to 1 and fuel is cut off at 0.08 of stroke. Calculate the mass of fuel used per kW hour, if the calorific value is 42000 kJ/kg and the relative efficiency is 0.54. (10)

(ii) Show that the efficiency of the otto cycle is greater than diesel cycle for the same compression ratio. (6)

Or

(b) (i) 1 kg of air is taken through a diesel cycle. Initially the air is at 15°C and 1 bar. The compression ratio is 15 and the heat added is 1850 kJ. Calculate the ideal cycle efficiency and the mean effective pressure. (10)

(ii) Compare the actual and ideal PV diagrams of a four and two stroke engine. (6)

12. (a) (i) Explain the combustion phenomenon and discuss detonation and knocking with the factors affecting the same. (10)

(ii) Explain supercharging and turbocharging. (6)

Or

(b) A 21 cm bore and 28 cm stroke, single cylinder two stroke engine give the following results on the performance test.

Speed	= 350 rpm
Net brake load	= 620 N
Diameter of the brake drum	= 1 m
Fuel consumption	= 4.25 kg/hr
Imep	= 275 KN/m^2
Calorific value of the fuel	= 43000 kJ/kg
Air fuel ratio by weight	= 32
Temperature of air in the test room	= 15°C
Temperature of exhaust gas	= 370°C

Calculate,

(i) Indicated power

(ii) Brake power

(iii) Indicated thermal efficiency

(iv) Brake thermal efficiency

(v) Percent heat loss to exhaust gases (16)

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13. (a) (i) Explain the compounding of steam turbines with sketches. (8)

(ii) Explain the modified Rankine cycle with a sketch and derive an expression for the efficiency of the same. (8)

Or

(b) A single row impulse turbine develops 132.4 kW at a blade speed of 175m/s using 2 kg of steam per second. Steam leaves the nozzle at 400 m/s. Velocity coefficient of the blade is 0.9. Steam leaves the turbine blades axially. Determine the Nozzle angle and Blade angles at entry and exit, assuming no shock. (16)

14. (a) (i) Explain the role of intercooler and after cooler in air compressors. (6)

(ii) Compare the performance characteristics of a vane, centrifugal and axial flow compressors. (10)

Or

(b) A single stage, single acting reciprocating air compressor has a bore and stroke of 200mm and 300mm respectively. The compressor sucks air at 1 bar and 20°C and delivers at 5.5 bar. If the compression follows the law $PV^{1.3}$ =C and clearance volume is 5 percent of the stroke volume, determine,

(i) The mean effective pressure

(ii) The power required to drive the compressor, if it runs at 500 rpm. (16)

15. (a) (i) Compare the vapour compression refrigeration system with the vapour absorption refrigeration system with a sketch. (6)

(ii) A refrigerating system operates with a condensing and evaporating temperatures of 30°C and -5°C respectively. The liquid temperature at the throttle valve entrance is 25°C and the vapour is 0.97 dry before leaving the evaporating coil. Determine,

(1) The condition of the refrigerant entering the evaporator.

(2) The theoretical C.O.P.

(3) Mass of cooling watewr used per kg of refrigerant for the condenser, if the temperature rise is to be restricted to 20°C.

Temperature, °C	Enthalpy, kJ/kg		Entropy		Specific heat	
	Liquid	Vapour	Liquid	Vapour	Liquid	Vapour
-5	158.261	1434.885	0.63	5.4072	–	–
30	323.22	1465.38	1.2037	4.9839	5.024	3.35

(10)

Or

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(b) (i) Explain the factors involved in heat load estimation for air-conditioning. (8)

(ii) Write short notes on air handling, distribution and control in an air conditioning system. (8)

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