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1100MET303112401



Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S5 (R, S) / S5 (WP) (R) / S3 (PT) (S,FE) Examination November 2024 (2019 Scheme)

Course Code: MET 303

Course Name: THERMAL ENGINEERING

Max. Marks: 100

Duration: 3 Hours

*Use of steam tables, refrigeration tables, and psychrometric chart are permitted*

**PART A**

*(Answer all questions; each question carries 3 marks)*

		Marks
1	Illustrate the main classifications of boilers with a schematic diagram.	3
2	Describe reheat cycle and illustrate the cycle on both a P-V and T-S diagram.	3
3	Compare impulse and reaction turbines.	3
4	Plot the pressure and velocity profiles in a pressure compounded reaction turbine.	3
5	What are the methods for estimating frictional power in an engine?	3
6	Define the fuel-air cycle and discuss the key assumptions made.	3
7	Compare and contrast petrol knock and diesel knock.	3
8	Explain the significance of sensible heat factor.	3
9	Represent the basic psychrometric processes in a psychrometric chart.	3
10	What are dry bulb, wet bulb, and dew point temperatures? Define each term.	3

**PART B**

*(Answer one full question from each module, each question carries 14 marks)*

**Module -1**

- 11 a) A Rankine cycle operates between pressures 35 bar and 0.2 bar. The steam at inlet to a turbine is dry saturated. Calculate 10
- (a) Pump work,
  - (b) Turbine work,
  - (c) Rankine efficiency,
  - (d) Condenser heat flow. Assume a flow rate of 9.5 kg/s.
- b Why is reversed Carnot cycle impractical? 4

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- 12 a) Describe the working of a Cochran boiler with a neat sketch. 7  
b) Derive the expression for critical pressure ratio of a steam turbine. 7

### Module -2

- 13 a) Steam, expands through a convergent-divergent nozzle from 15 bar, dry saturated, down to atmospheric pressure of 1 bar. Calculate the critical pressure and throat area per unit mass-flow rate of steam. Assume that the inlet velocity is negligible and that the expansion is isentropic. 8  
Explain Reheat factor. Why is the value greater than one? 6
- 14 a) Explain any one method of governing of a steam turbine. 6  
b) Describe the various methods of compounding in an impulse turbine. 8

### Module -3

- 15 a) Describe the operation of a Wankel engine with neat sketches. 8  
b) A 4-cylinder, four-stroke engine has an 85 mm bore and 130 mm stroke. It develops 30 kW of power at 1500 rpm and it runs at 20% rich mixture. If the volume of air in the cylinder measured at 17°C and 762 mm of mercury is 70% of the swept volume, theoretical air-fuel ratio is 14.8, calorific value of fuel is 45000 kJ/kg and mechanical efficiency of the engine is 90%, calculate (a) indicated thermal efficiency, and (b) brake mean effective pressure. 6  
Assume  $R = 0.287$  kJ/kgK for air.
- 16 a) Explain the concept of a heat balance sheet and outline its purpose. 5  
b) A two-stroke diesel engine was motored when the meter reading was 1.5 kW. 9  
Then the test on the engine was carried out for one hour and the following observations were recorded: Brake torque = 120 Nm; Speed = 600 rpm; Fuel used = 2.5 kg; calorific value of fuel = 40.3 MJ/kg; Cooling water used = 818 kg; Rise in temperature of cooling water = 10°C. Exhaust gas temperature = 345°C. Room temperature = 25°C;  $A/F = 32:1$ . Determine:  
(a) Mechanical efficiency,  
(b) Indicated thermal efficiency, and  
(c) Draw heat balance sheet on minute basis and also in percentage.

### Module -4

- 17 a) Explain the major pollutants produced by a CI engine. Discuss the emission control of any one in detail. 7  
b) Discuss the different factors affecting delay period of a CI engine. 7

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- 18 a) Explain any three combustion chamber designs of SI engines with neat sketches. 8  
b) Describe any 6 characteristics of good combustion chamber. 6

**Module -5**

- 19 a) Explain about any six factors that affect human comfort. 6  
b) An Ideal vapour compression system using R-12 as the refrigerant operates between an evaporation temperature of  $0^{\circ}\text{C}$  and a condenser temperature of  $40^{\circ}\text{C}$ . The capacity of the system is 5 Tonnes. Determine (i) the mass flow rate of refrigerant (ii) power required to run the compressor (iii) heat rejected in the condenser (iv) COP of the system. Take  $C_p$  for superheated vapour as  $0.6 \text{ kJ/kg}$ . 8
- 20 a) Derive expression for COP for the Bell Coleman air refrigeration system. 7  
b) Define summer air conditioning and explain its principles, components and factors. 7

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