

April 2018

Time - Three hours
(Maximum Marks: 75)

[N.B: (1) Q.No. 8 in PART - A and Q.No. 16 in PART - B are compulsory.
Answer any FOUR questions from the remaining in each PART - A
and PART - B

(2) Answer division (a) or division (b) of each question in PART - C.

(3) Each question carries 2 marks in PART - A, 3 marks in Part - B and
10 marks in PART - C.

(4) Use of steam tables and Mollier chart are permitted.]

PART - A

1. What are intensive properties? Give two examples.
2. What is free expansion process?
3. Define calorific value of a fuel.
4. State the disadvantages of single stage reciprocating air compressor.
5. Write any two applications of rockets.
6. What is steam calorimeter? Name any two types of steam calorimeters commonly used.
7. What are the standard conditions of feed water evaporation in a boiler?
8. What is the effect of cut-off ratio and compression ratio on efficiency of diesel cycle?

PART - B

9. What are the types of thermodynamic systems? Give one example for each system.
10. State and explain the Zeroth law of thermodynamics.
11. No engine can work on Carnot cycle. Why?
12. Explain the working of an axial flow air compressor with a neat sketch.
13. Differentiate between ram-jet and turbo-jet.

[Turn over.....

14. What is meant by throttling process? State any two applications of throttling process.
15. What are the essential features of a high pressure boiler?
16. Steam at 4 bar absolute and 200°C expands isentropically in a steam turbine to 0.4 bar. Determine the final condition of steam and heat drop using Mollier chart.

PART - C

17. (a) 0.5kg of a gas occupies 0.3m³ at 20°C and 140kN/m² and after adiabatic compression to 0.15m³, the pressure is 370kN/m². Determine the value of gas constant and the two specific heats.
(Or)
(b) A perfect gas of molecular weight 28 and specific heat at constant pressure 1.016kJ/kgK is compressed according to the law $PV^{1.2} = C$ from an initial volume of 0.1m³, temperature 35°C and pressure 98kN/m² to the final temperature of 145°C. Determine the final pressure of the gas, work done, heat transfer and change of entropy.
18. (a) An engine working on Otto cycle has a compression ratio of 7. The temperature of air at the start of compression stroke is 40°C. The maximum temperature is 1250°C. Determine the work done per cycle and the efficiency of the cycle. Assume $C_p = 1.005 \text{ kJ/kgK}$ and $C_v = 0.717 \text{ kJ/kgK}$.
(Or)
(b) What is meant by delay period in diesel engines? Explain the variables affecting the delay period.
19. (a) A two stage compressor works between 1 bar and 16 bar. The inlet temperature is 30°C. Determine the exit temperature, if intercooling is perfect and compression is isentropic. Also determine the work done per kg. of air with and without intercooling.
(Or)
(b) Explain with a neat sketch the working of a turbo-prop. engine. What are the advantages of the turbo-prop. engine?

20. (a) A sample of 1kg of steam at a pressure of 15 bar exists in the following two conditions: (i)Wet steam with dryness fraction 0.8 and (ii)Super heated with temperature 215°C. Take the specific heat of super heated steam as 2.3kJ/kgK and neglect volume of water. Determine the following properties in each case (1)volume (2)enthalpy (3)entropy (4)external work of evaporation and (5)internal energy.
(Or)
(b) 1 kg of dry and saturated steam at 250°C isothermally expands to 6 bar. Determine (1)Change in entropy (2)Change in enthalpy (3)Change in internal energy (4)Heat transferred. Also determine the work done for the non-flow process.
21. (a) A boiler produces 2267kg of dry saturated steam per hour at a pressure of 11.5 bar absolute from feed water at 121°C. The coal fired in 3 hours is 750kg and has a calorific value of 32,000kJ/kg. It is found that 10% of the coal is unburnt. Calculate (1)Efficiency of the boiler (2)Efficiency of the boiler and grate combined (3)Equivalent evaporation from and at 100°C per kg of coal fired.
(Or)
(b) The following observations were made during a test on a steam boiler:

Furnace oil used per hour	- 1666 litres.
Specific gravity of furnace oil	- 0.83
Steam supplied by boiler	- 20,800 kg/hr.
Steam pressure	- 24 bar.
Steam temperature	- 300°C
Mean temperature of feed water	- 125°C
Boiler room temperature	- 35°C
Flue gas temperature	- 240°C
Specific heat of dry flue gases	- 1.005kJ/kgK
Specific heat of superheated steam	- 2.1kJ/kgK
Calorific value of furnace oil	- 52000kJ/kg

Air supplied is 21 times the quantity of furnace oil used. Loss due to incomplete combustion is 1% of the fuel. Draw up a heat balance sheet for the boiler for unit mass of the oil and workout the thermal efficiency.
