546 Register No.:

October 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 extensive properties? Give two examples.
2. What is meant by throttling process?
3. What is meant by reversible and irreversible processes?
4. What are the effects of detonation?
5. What are the applications of gas turbines?
6. What are the different methods of heating and expanding the steam?
7. How will you compare the performance of different boilers?
8. What are the effects of clearance volume in volumetric efficiency of a compressor?

PART – B

9. State and explain the Clausius statement of the second law of thermodynamics.
10. What is the universal gas constant? What is its relation with characteristic gas constant?
11. What is pre-ignition? What are the causes of pre-ignition?
12. What are the fuel additives? Name any four additives used in petrol.
13. State the merits and demerits of multistage compression.
14. Name any three occasions to which, boiler owner shall report to chief inspector of boiler as per Indian Boiler Act.
15. What are the factors influencing boiler efficiency?

[Turn over.....

16. Steam at a pressure of 8 bar absolute and dry saturated is throttled to a pressure of 2 bar absolute. The mass flow rate is 5 kg/min. Using Mollier chart, find the condition of steam after throttling.

PART – C

17. (a) 1 kg of air at 11 bar and 80°C is expanded to 10 times to its original volume by (i)Isothermal process and (ii)Isentropic process. Determine the work done in each of the cases. Plot these two on a common p-V diagram. Take R=287 J/kgK, γ=1.4

(Or)

(b) 0.25 Kg of air at a pressure of 140 kN/m^2 occupies 0.15 m^3 and from this condition, it is compressed to 1.4 MN/m^2 according to the law $pv^{1.25}$ = C. Determine: (i)The change in internal energy (ii)The work done on or by the air (iii)The heat received or rejected by the air and (iv)The change in entropy. Assume $C_p = 1.005\ kJ/kgK$ and C_v=0.718 kJ/kgK.

18. (a) A Carnot cycle works between the temperatures limits 627°C and 27°C and pressure limits of 60 bar and 1 bar. Determine (i)Pressure and temperature at all points of the cycle (ii)Work done per kg of air and (iii)Thermal efficiency. Assume γ=1.4.

(Or)

(b) In an ideal Diesel cycle, the compression ratio is 15:1 and the expansion ratio is 7.5:1. The pressure and temperature at the beginning of compression are 98 kN/m^2 and 44°C respectively and the pressure at the end of expansion is 258.6 kN/m^2. Determine: (i)The maximum temperature of the cycle and (ii)Thermal efficiency of the cycle. Take γ=1.4

19. (a) A single acting reciprocating air compressor has got the piston diameter 120 mm and stroke 150 mm and runs at 300 rpm. Air is drawn at 0.9 bar pressure and is delivered at 8 bar pressure. The law of compression is $pv^{1.3}$ =constant. Determine the power required to drive the compressor. Assume volumetric efficiency 80%, also determine the mass of air delivered per minute, if the intake temperature is 25°C.

(Or

(b) Explain the working of an open cycle gas turbine equipped with inter cooler, regenerator and re-heater.

20. (a) A rigid vessel is divided into two parts A and B by a partition. Part A contains 1 kg of dry saturated steam at 3.5 bar. Part B contains 2 kg of wet steam at 7 bar with dryness fraction 0.8. The partition is removed and the pressure in the vessel after some time is measured as 5 bar. Determine: (i)Volume of the vessel (ii)Quality of steam at 5 bar and (iii)Heat interchange between steam and surrounding walls of the vessel.

(Or)

(b) In a combined separating and throttling calorimeter the following readings were taken:

Total quantity of steam passed	= 24 kg
Water drained in the separator	= 1.23 kg
Steam pressure before throttling	= 9 bar
Steam pressure after throttling	=1.2 bar
Temperature of steam after throttling	=110°C
Specific heat of super heated steam	= 2.0 kJ/kgK

Determine :(i)Dryness fraction by separating calorimeter (ii)Dryness fraction by throttling calorimeter and (iii)Dryness fraction of steam in the main.

21. (a) A boiler generates 750 kg of steam per hour at 11 bar absolute and with 50°C superheat. The coal supplied is 100 kg per hour and calorific value of coal is 29300 kJ/kg. The feed water temperature is 45°C and specific heat of superheated steam is 2.09 kJ/kgK. Calculate: (i)Actual evaporation (ii)Factor of evaporation (iii)Equivalent evaporation from and at 100°C (iv)Boiler efficiency and (v)Boiler power.

(Or)

(b) A boiler plant consists of an economiser, boiler and super heater. The feed water leaves the economiser at 77°C and 97% dry steam leaves the boiler drum at 21 bar pressure. The same gets super heated to 270°C on the super heater. If the feed water supplied to the economiser at 38°C is 10 kg per kg of coal fired, determine. (i)Equivalent evaporation in kg per kg of coal (ii)The efficiency of the plant, if the calorific value of coal is 32.6x10^3 kJ/kg and (iii)The percentage of heat received in economiser, boiler and super heater. Take specific heat of super heated steam 2.1 kJ/kgK.
