

**MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL**

Paper Code : ES-EE 401/ES-ME 401 Thermal Power Engineering

UPID : 004433

Time Allotted : 3 Hours

Full Marks : 70

*The Figures in the margin indicate full marks.**Candidate are required to give their answers in their own words as far as practicable***Group-A (Very Short Answer Type Question)**

1. Answer any ten of the following :

[1 x 10 = 10]

- (I) What do you mean by Gas Turbine efficiency?
- (II) Write the type of energy conversion in boiler.
- (III) Write the function of nozzle in a steam power plant.
- (IV) Write the function of carburetor.
- (V) Name the processes (In sequence) of Gas Turbine cycle.
- (VI) Define fire tube boiler.
- (VII) State the type of flow through steam nozzle for $M < 1$ (Mach no).
- (VIII) What is ignition lag?
- (IX) How the GT efficiency is improved by a reheater?
- (X) Define artificial draught or draft in boiler.
- (XI) State the blade profile of impulse turbine.
- (XII) State the different parts of IC engine.

Group-B (Short Answer Type Question)

Answer any three of the following :

[5 x 3 = 15]

2. Compare between impulse & reaction turbine. [5]
3. Distinguish between SI & CI engine. [5]
4. Draw a neat sketch of Babcock and Wilcox boiler showing the mountings. [5]
5. Why are steam turbine compounded? [5]
6. Write a short on FD & ID fan. [5]

Group-C (Long Answer Type Question)

Answer any three of the following :

[15 x 3 = 45]

7. (a) Explain with fig. [8]
 - i) Supersonic nozzle, ii) Subsonic nozzle, iii) Supersonic diffuser, iv) Subsonic diffuser
- (b) A convergent divergent adiabatic steam nozzle is supplied with steam at 10 bar and 250°C . the discharge pressure is 1.2 bar. assuming that the nozzle efficiency is 100% and initial velocity of steam is 50 m/s. find the discharge velocity. [7]
8. (a) Derive the efficiency of Diesel engine air standard cycle. [6]
- (b) A 4S SI engine has the compression ratio of 6 & swept volume of 0.15 m^3 . Pressure & temperature at the beginning of compression are 98 KPa & 6°C . Determine the Pressure, Volume & temperature at all salient points if heat supplied to it is 150 KJ/Kg. Also find out entropy change, work done, efficiency & mep of cycle. $C_p = 1 \text{ KJ/Kg}$, $C_v = 0.71 \text{ KJ/Kg-K}$ [9]
9. (a) How the boiler can be classified? [6]
- (b) Describe the followings: [9]
 - i) Fusible Plug ii) Water level indicator iii) Pressure gauge
10. (a) Dry steam at 10 bar & 100 m/s enters a nozzle & leaves it with velocity of 300 m/s at 5 bar. For 16 kg/s of steam mass flow rate, determine heat drop in nozzle & final state of steam leaving nozzle, assuming heat loss to surroundings as 10 KJ/kg. [8]
- (b) In an impulse turbine, the fixed nozzle angle is α , the blades are equiangular, the blade velocity coefficient is k , show that maximum efficiency is $[(1+k) \cos^2 \alpha]/2$ [7]

$$t = 151.8^\circ\text{C} \quad v_f = 0.001093 \text{ m}^3/\text{kg} ; v_g = 0.37466 \text{ m}^3/\text{kg} ;$$

water steam

$$h_f = 640.1 \text{ KJ/Kg} ; h_{fg} = 2107.4 ; h_g = 2797.5 \quad \text{Specific Enthalpy}$$

water Evaporation steam

$$s_f = 1.860 ; s_{fg} = 4.959 ; s_g = 6.819 \quad \text{KJ/Kg-K.} \quad \text{Specific Entropy}$$

11. (a) Explain Velocity compounding impulse turbine showing pressure & velocity variations along the axis.

[7]

(b) In a single stage impulse turbine, the isentropic enthalpy drop of 200 KJ/kg occurs in the nozzle having efficiency of 96% & nozzle angle of 15° . The blade velocity co-efficient is 0.96 & ratio of blade speed to steam velocity is 0.5. The steam mass flow rate is 20kg/s & velocity of steam entering is 50 m/s.

[8]

Find, a) The blade angles at inlet & outlet if the steam enters blades smoothly & leaves axially b) The blade efficiency c) The power developed d) The axial thrust

*** END OF PAPER ***