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Question Paper Code : 60923

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2026.

Fifth/Seventh Semester

Mechanical Engineering

ME8595 — THERMAL ENGINEERING – II

(Common to Mechanical Engineering (Sandwich))

(Regulations 2017)

Time : Three hours

Maximum : 100 marks

(Steam Table may be permitted)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define Critical Pressure Ratio.
2. What are the effects of friction on the flow through a steam nozzle?
3. Compare water tube boilers and fire tube boilers.
4. Name any four accessories used in boilers.
5. Highlight the fundamental difference between the operation of impulse and reaction steam turbines.
6. Mention the different methods of compounding in turbines.
7. State the factors influencing cogeneration.
8. Distinguish between Heat pipes and Heat pumps.
9. Distinguish between super heating and sub cooling.
10. What is the purpose of generator assembly in vapour absorption refrigeration system?

PART B — ($5 \times 13 = 65$ marks)

11. (a) A convergent-divergent nozzle is required to discharge 2 kg of steam per second. The nozzle is supplied with steam at 7 bar and 180°C and discharge takes place against a back pressure of 1 bar. The expansion up to throat is isentropic and the frictional resistance between the throat and exit is equivalent to 63 kJ/kg of steam. Taking approach velocity of 75 m/s and throat pressure of 4 bar, estimate:
- (i) Suitable areas for the throat and exit and (6)
 - (ii) Overall efficiency of the nozzle based on the enthalpy drop between the actual inlet pressure and temperature and the exit pressure. (7)

Or

- (b) Dry saturated steam at a pressure of 8 bars absolute enters a convergent-divergent nozzle and leaves it at a pressure of 1.5 bar. If the steam flow process is isentropic and the corresponding expansion index is 1.135, find the ratio of cross-sectional area at exit and throat for maximum discharge.
12. (a) Draw a neat line diagram of Benson boiler and discuss its construction, working principle and also its relative merits.

Or

- (b) A coal fired boiler plant consumes 400 kg of coal per hour. The boiler evaporates 3200 kg of water at 45°C into superheated steam at a pressure of 12 bar and 275°C . If the calorific value of fuel is 32,760 kJ/kg of coal, determine :
- (i) Equivalent evaporation from and at 100°C
 - (ii) Thermal efficiency of the boiler. Specific heat of superheated steam as 2.1 kJ/kgK.
13. (a) Explain the working principle of an impulse turbine with velocity diagrams.

Or

- (b) The steam supply to an impulse turbine with a single row of moving blades is 3 kg/s. The turbine develops 150 kW, the blade velocity being 150 m/s. The steam flows from a nozzle with a velocity of 450 m/s and the coefficient of velocity of blade is 0.95. Find the nozzle angle, blade angle at entry and exit, if the steam flows axially after passing over the blades.

14. (a) (i) Explain the advantages and disadvantages of cogeneration. (8)
(ii) Discuss the benefits of residual heat recovery. (5)

Or

- (b) (i) Briefly explain the working of Recuperators with a neat sketch. (8)
(ii) Write short notes on Regenerative heat exchangers. (5)
15. (a) Explain the working of vapour absorption refrigeration cycle with a neat schematic layout.

Or

- (b) State and explain the working of the winter air conditioning system with a neat process diagram.

PART C — (1 × 15 = 15 marks)

16. (a) A simple impulse turbine has one ring of moving blades running at 150 m/s. The absolute velocity of steam at exit from the stage is 85 m/s at an angle of 80° from the tangential direction. Blade velocity coefficient is 0.82 and the rate of steam through the stage is 2.5 Kg/s. If the blades are equiangular, determine the
- (i) blade angles,
 - (ii) nozzle angle
 - (iii) absolute velocity of steam issuing from the nozzle and
 - (iv) axial thrust.

Or

- (b) The following data was obtained in a steam boiler trial :
- Feed water supplied per hour = 690 kg at 28°C
Steam produced = 0.97 dry at 8 bar.
Coal fired per hour = 91 kg of calorific value 27,255 kJ/kg
Ash and unburnt coal collected beneath fire bars = 7.5 kg/hr of calorific value 3700 kJ/kg
Mass of flue gases per kg of coal burnt = 17.4 kg
Temperature of flue gases = 325°C
Room temperature = 17°C
Specific heat of flue gases = 1.005 kJ/kgK
Estimate the boiler efficiency and draw up a heat balance sheet.

