Code No: R2031031 **R20** SET - 1

III B. Tech I Semester Supplementary Examinations, JULY - 2023
THERMAL ENGINEERING - II
(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

Answer any **FIVE** Questions **ONE** Question from **Each unit**
All Questions Carry Equal Marks
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UNIT-I

1. a) Steam is supplied to a turbine at a pressure of 25 bar and a temperature of 500°C and is expanded adiabatically to a pressure of 0.05 bar. At a stage of turbine where the pressure is 4 bar a connection is made to a surface heater in which the feed water is heated by bled steam to a temperature of 150°C. The condensed steam from the feed heater is cooled in a drain cooler to 30°C. The feed water passes through the drain cooler in a drain cooler before entering the feed heater. The cooled drain water combines with the condensate in the well of the condenser. Assuming no heat losses in the steam, calculate the following : (i)Mass of steam used for feed heating per kg of steam entering the turbine; (ii) Thermal efficiency. [7M]
   b) What is H.P boiler? Give classification. Explain any one type of H.P boiler with neat sketch. [7M]

(OR)

2. a) A steam turbine is fed with steam having an enthalpy of 3000 kJ/kg. It moves out of the turbine with an enthalpy of 2000 kJ/kg. Feed heating is done at a pressure of 4 bar with steam enthalpy of 3000 kJ/kg. The condensate from condenser with an enthalpy of 130 kJ/kg enters into the feed heater. The quantity of bled steam is 11000 kg/h. find the power developed by the turbine. Assume that the water leaving the feed heater is saturated liquid at 4 bar and the heater is direct mixing type. Neglect pump work. [7M]
   b) Explain the following artificial draughts with neat sketch: (i)Forced draught, (ii)Induced draught, (iii) Balanced draught. [7M]

UNIT-II

3. a) Define steam nozzle. State the relation between the velocity of steam and heat during any part of a steam nozzle. [7M]
   b) The following data refer to a single stage impulse turbine: isentropic nozzle heat drop = 250 kJ/kg, nozzle efficiency = 85%, nozzle angle = 18°, ratio of blade to speed whirl component of steam speed = 0.5, blade velocity coefficient = 0.89, the velocity of steam entering the nozzle = 22 m/s. Determine: (i) the blade angles at inlet and outlet if the steam enters the blades without the shock and leaves the blades in an axial direction. (ii) blade efficiency (iii) power developed and axial thrust if the steam flow is 12 kg/s. [7M]

(OR)

4. a) Define various methods of compounding in turbines with neat sketch. [7M]
   b) Dry saturated steam is passed at 9 bar through a convergent-divergent nozzle. The throat cross-sectional area is 5 cm^2. Find the mass of steam passing through the nozzle per minute. [7M]

UNIT-III

5. a) In a stage of impulse turbine operating with 50% degree of reaction, the blades are identical in shape. The outlet angle of the moving blade is 20°and the absolute discharge velocity of steam is 120 m/s in the direction of 95° to the motion of the blades. If the rate of flow of steam through the turbine is 18000 kg/h, Calculate the power developed by the turbine in kW. [7M]

   b) What is a Jet condenser? Explain various types of Jet condensers with neat diagrams. [7M]

(OR)

6. a) A 50% reaction turbine with symmetrical velocity triangles running at 500 r.p.m. has the exit angle of the blades as 20° and the velocity of the steam relative to the blades at the exit is 1.65 times the mean blade speed. The steam flow rate is 9.99 kg/s and at a particular stage the specific volume is 1.856 m^3/kg. Calculate for this stage :
   (i)A suitable blade height, assuming rotor mean diameter 11 times the blade height, (ii) The diagram work. [7M]

   b) What is the chief function performed by an Air pump? Explain briefly with neat sketch any two of the following : (i)Edward's air pump, (ii)Rotary dry air pump,(iii)Propeller type water pump, (iv)Plunger type water pump. [7M]

UNIT-IV

7. a) Differentiate reciprocating and rotary compressors. [7M]

   b) Derive the work done/kg of air and volumetric efficiency of a single stage compressor. [7M]

(OR)

8. a) What is a roots blower? Explain with *p-v* diagram in detail. [7M]

   b) A two-stage, single acting air compressor takes air at 1.0325 bar and 298 K and delivers at 10 bar with rate of 6.85 kg/min when running at 360 r.p.m. Considering perfect inter cooling and assuming the compression and expansion both follow the law $pv^{1.3} = C$, Determine the indicated power and the cylinder swept volumes. Assume clearance is 5% of swept volume in both stages. [7M]

UNIT-V

9. a) Define and explain surging, choking and stalling of the compressors in detail. [7M]

   b) A centrifugal compressor running at 8000 r.p.m. delivers 500 m^3/min of free air. The air is compressed from 1 bar and 22°C to a pressure ratio of 4 with an isentropic efficiency of 0.85. Blades are radial at outlet of impeller and the flow of velocity of 65 m/s may be assumed throughout constant. The outer radius of the impeller is twice the inner and the slip factor may be assumed as 0.9. the blade area co-efficient may be assumes as 0.9 at the inlet. Calculate ; [7M]
      (i) final temperature of air,
      (ii) theoretical power,
      (iii) impeller diameters at inlet and outlet,
      (iv) breadth of impeller at inlet

(OR)

10. a) Draw the velocity diagram of a centrifugal compressor and derive the equation for work done. [7M]

   b) Describe briefly axial flow compressors. [7M]