

B.E.Mechanical Engineering Sem VI
ME604 - Thermal Engineering

P. Pages : 2

Time : Three Hours



GUG/S/18/5398

Max. Marks : 80

- Notes :
1. All questions carry marks. as indicated.
 2. Due credit will be given to neatness and adequate dimensions.
 3. Assume suitable data wherever necessary.
 4. Diagrams and Chemical equation should be given wherever necessary.
 5. Retain the construction lines.
 6. Illustrate your answers wherever necessary with the help of neat sketches.
 7. Use of slide rule, Logarithmic tables, Steam tables, Moller's chart, Drawing instruments, Thermodynamic tables for moist air, Psychrometric charts and Refrigeration charts is permitted.
 8. Solve Qu. 1 or Qu. 2 ; Qu. 3 or Qu. 4; Qu. 5 or Qu. 6; Qu. 7 or Qu. 8; Qu. 9 or Qu. 10

1. a) Elaborate the difference between water tube and fire tube boilers. Why water tube boilers are preferred over fire tube boilers? 8
- b) A boiler is equipped with a chimney of 30m height the flue gases which passes through the chimney are at temp. of 288°C, where as the atm. temp. is 21°C. If the air flow through the combustion chamber is 18 kg/kg of fuel burnt. Find: 8
- i) The theoretical draught produced in mm of water & in height of hot gas column.
 - ii) Velocity of flue gases passing through the chimney, its 50% of theoretical draught is lost in friction at the grate & passage.

OR

2. a) Explain Equivalent evaporation; Evaporation capacity and boiler efficiency in detail. 8
- b) What is boiler mountings? Enlist them with their location & explain the working of fusible plug with neat sketch. 8
3. a) What do you mean by critical pressure ration in steam nozzle? Derive an expression for it. 6
- b) Steam at a pressure of 15bar and dryness fraction 0.97 is discharged through a convergent divergent nozzle to a back pressure of 0.2 bar. The mass flow rate is 9 kg/kWh. If the power developed is 220 kW. 10
- Determine:
- i) Throat pressure
 - ii) No. of nozzles required if each nozzle has a throat of rectangular cross section 4mm x 8mm
 - iii) If 12% of the overall isentropic enthalpy drop is lost in friction in divergent portion. Find the cross section of exit rectangle.

OR

4. a) Differentiate between Impulse & reaction turbine. 6
- b) Steam enters a group of nozzle at 12 bar, 220°C on a discharges at 12 bar. The turbine develops 184 kW with a specific steam consumption of 16.45 kg/kWh. If the diameter of nozzle at throat is 7mm, calculate the numbers of nozzles. 10

5. The outlet of a nozzle in a simple impulse turbine delivers steam with mass 3.1 kg/s, 0.9 dry at 3 bar and velocity of 750 m/s. The nozzles are inclined at 20° to the plane of wheel. The blade speed is 300m/s. The outlet blade angle ϕ is 30° and blade velocity coefficient is 0.82. Calculate :
- Power developed
 - Steam used per kWhr.
 - Diagram efficiency
 - Axial thrust on shaft
 - Loss of K.E. due to friction

OR

6. a) Explain the Governing of steam turbine in detail. Explain throttle governing method. 8
- b) Explain : 8
- Reheat cycle & Reheat factor
 - Regenerative cycle.
7. a) State Dalton's law of partial pressure; vacuum efficiency; condenser efficiency. 6
- b) A prime mover uses 15000kg of steam /hr & develops 2450 kW. The steam is supplied at 30bar & 350°C . The exhaust from the prime mover is condensed at 725mm of Hg; When barometer reading is 755mm of Hg. The condensate temp from condenser is 31°C & rise of temp. of circulating water is from 8°C to 18°C . Determine: 10
- Quality of steam entering the condenser
 - Quantity of circulating cooling water and the ratio of cooling.

OR

8. a) What are cooling towers? How they classifies? Explain mechanical draft cooling tower. 8
- b) Derive an expression for determining weight of cooling water required in case of surface condenser. 8
9. a) With the help of P-V & T-S diagram; Derive an expression for work done by a single stage reciprocating air compressor without clearance volume. 8
- b) A single stage single acting reciprocating air compressor has a bore of 200mm and a stroke 300mm. It receive air at 1bar & 20°C and delivers it at 5.5 bar. If the compression follows the law $PV^{1.3} = C$ and clearance volume is 5% of stroke volume. Determine power required to drive the compressor; if it runs at 500rpm. 8

OR

10. A single acting two stage air compressor delivers air at 18 bar. The temp and pressure of air before the compression in L.P. Cylinder are 25°C and 1bar. The discharge of L. P. Cylinder is 4.2 bar pressure. The pressure of air leaving the intercooler is 4 bar and air is cooled to 25°C . The diameter & stroke of L.P. Cylinder are 40cm & 50cm. respectively. The clearance volume is 5% of stroke volume in both cylinders. The speed of compressor is 200rpm. Assuming the index of compression & re-expansion in both cylinders are 1.25 and C_p for air = 1.00 kJ/kgK. Find the power required to run the compressor & heat rejected in intercooler/minute. 16
