i) The intermediate pressure
ii) Total volume of the cylinder
iii) The power required to drive the compressor

OR

A centrifugal compressor running at 16000 r.p.m. takes in air at 295K and compresses it through a pressure ratio of 4:1 with an isentropic efficiency of 80%. The mean diameter of the eye and the impeller tip diameter are 25cm and 60cm respectively and the absolute air velocity at inlet is 160m/s. The blades are radially inclined at exit and the guide vanes at the inlet gives the air at an angle of pre-whirl of 20° to the axial direction at all radii. Calculate the slip factor for the impeller.

a) What do you understand by the term vacuum efficiency and condenser efficiency?
b) What are the different classifications of condensers?
c) Compare jet and surface condensers.
d) A surface condenser deals with 13625 kg of steam per hour at a pressure of 0.09 bar. The steam enters 0.85 dry and the temperature at the condensate and air extraction pipes is 36°C. The air leakage amounts to 7.26kg/hour. Determine:
   i) The surface required if the average heat transmission rate is 3.97kJ/cm^2 per second
   ii) The cylinder diameter for the dry air pump, if it is to be single acting at 60 r.p.m. with a stroke to bore ratio of 1.25 and volumetric efficiency of 0.85.

OR

Prove that the expression of LMTD for parallel flow heat exchanger is given by: $\theta_m = \frac{\theta_1 - \theta_2}{\log_e\left(\frac{\theta_1}{\theta_2}\right)}$ where, θ_1 = temperature difference of hot and cold water at entry and θ_2 = temperature difference of hot and cold water at exit.

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Roll No .....

ME-404

B.E. IV Semester

Examination, June 2016

Thermal Engineering And Gas Dynamics

Time : Three Hours

Maximum Marks : 70

Note: i) Answer five questions. In each question part A, B, C is compulsory and D part has internal choice.
ii) All parts of each questions are to be attempted at one place.
iii) All questions carry equal marks, out of which part A and B (Max.50 words) carry 2 marks, part C (Max.100 words) carry 3 marks, part D (Max.400 words) carry 7 marks.
iv) Except numericals, Derivation, Design and Drawing etc.

1. a) Why mountings and accessories are essential for boilers? Explain fusible plug.
   b) What do you understand by the term chimney efficiency?
   c) Derive the expression for chimney height.
   d) A chimney of 1.8m diameter fitted with a certain thermal power plant produces a draught equal to 18mm water column. The mean temperature of flue gases is 270°C and the boiler house temperature is 32°C. If the flue gases formed per kg of fuel burnt are 22kg, make calculation for the mass of flue gases passing through the chimney.

OR

The following data was obtained in a steam boiler trial: Feed water supplied per hour 690kg at 28°C, steam produced 0.97 dry at 8 bar, coal fired per hour 91kg of calorific value 27,200 kJ/kg, ash and unburnt coal collected from beneath the fire bars 7.5kg/hour of calorific value 2,760kJ/kg, mass of flue gases per kg of

coal burnt 17.3kg, temperature of flue gases 325°C, room temperature 17°C, and the specific heat of the flue gases 1.026kJ/kg k. Estimate:

i) The boiler efficiency
ii) The percentage heat carried away by the flue gases
iii) The percentage heat loss in ashes and
iv) The percentage heat loss unaccounted for

Explain what may have actually happened to the heat included under unaccounted losses.

2. a) Discuss the limitations of Carnot vapour cycle.
   b) Draw the p-v and h-s diagram for ideal Rankine cycle.
   c) Explain Binary vapour cycle.
   d) Steam is the working fluid in an ideal Rankine cycle with superheat and reheat. Steam enters the first-stage turbine at 8.0 MPa, 480°C, and expands to 0.7MPa. It is then reheated to 440°C before entering the second-stage turbine, where it expands to the condenser pressure of 0.008 MPa. The net power output is 100 MW. Determine

i) The thermal efficiency of the cycle
ii) The mass flow rate of steam, in kg/h
iii) The rate of heat transfer from the condensing steam as it passes through the condenser, in MW.

Discuss the effects of reheat on the vapor power cycle.

OR

Steam is the working fluid in an ideal Rankine cycle. Saturated vapor enters the turbine at 8.0 MPa and saturated liquid exits the condenser at a pressure of 0.008 MPa. The net power output of the cycle is 100 MW. Determine for the cycle

i) The thermal efficiency
ii) The mass flow rate of the steam, in kg/h
iii) The rate of heat transfer, from the condensing steam as it passes through the condenser, in MW
iv) The mass flow rate of the condenser cooling water, in kg/h, if cooling water enters the condenser at 15°C and exits at 35°C.

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3. a) Prove that the speed of sound in liquid is given by $\sqrt{\frac{B}{\rho}}$ where 'B' is bulk modulus and 'ρ' is density of the flui
   b) Derive the expression for relation between area, pressu velocity and Mach number.
   c) Show that in steam nozzle the Mach number at throat ar is unity.
   d) A supersonic nozzle is to be designed for air flow wi Mach number 3 at the exit section which is 250m diameter. The pressure and temperature of air at the nozz exit are 8.5 kN/m^2 and 215K. Make calculation f reservoir pressure, reservoir temperature and throat are

OR

Air flows through a convergent divergent nozzle. At sor section in the nozzle, pressure = 2 bar, velocity = 170 m/s a temperature = 200°C and cross sectional area = 1000mn Assuming isentropic flow condition determine:

i) Stagnation temperature and pressure
ii) Sonic velocity and Mach number at this section
iii) Mach number and flow area at outlet where pressu is 1.1 bar.

4. a) Discuss the utility of compressed air.
   b) What is the difference between single acting and doub acting compressor?
   c) What do you understand by the term slip and slip facto Explain.
   d) A two stage single acting reciprocating compressor tak in air at the rate of 0.2 m^3/s. The intake pressure a temperature of air are 0.1 MPa and 16°C. The air compressed to a final pressure of 0.7MPa. Tl intercooling is perfect and the intermediate pressure for minimum work input conditions. The compressi index in both the stages is 1.25 and the compressor ru at 600 r.p.m. Neglecting clearance determine: