COLLEGE OF ENGINEERING, PUNE
(An Autonomous Institute of Government of Maharashtra)

Elect

END - SEMESTER EXAMINATION

Subject : **Thermal and Fluid Engineering (ME 311)**

Program : T. Y. Electrical **Date :** 24/11/2012
Year: 2012-13 **Semester : I**
Duration: 3hrs **Max. Marks: 50**

Instructions:

1) All questions are compulsory. .

2) Assume suitable data, if necessary.

3) Figures to the right indicate full marks for the questions

4) Use of Non programmable calculator, Steam Table is permitted.

Q.1 Solve any **THREE**

A A four cylinder, four stroke cycle petrol engine 82.5 mm bore and 130 mm stroke develops 28 kW brake power while running at 1500 rpm and using 20 % more fuel than theoretical. If the volume of the air into the cylinder when measured at 15.5^0C and 760 mm of mercury is 70% of the swept volume. The theoretical air fuel ratio is 14.8. The heating value of petrol used is 45980 kJ/kg and Mechanical efficiency is 90 %.
Find i) Indicated thermal efficiency ii) Brake mean effective pressure
Take R = 0.287 kJ/kg K **5**

B Steam enters the nozzle, operating at steady state at 30 bar and 350^0C with negligible velocity and exit at 30 bar and a velocity of 500 m/sec. The mass flow rate is 2.22 kg/sec. Determine 1) the exit temperature of steam 2) exit area of nozzle. Specific heat of superheated steam is 2.1 kJ/kg .K **5**

C A house is maintained at a temperature of 20^0c by means of a reversible heat pump in winter by pumping heat from atmosphere. Heat losses through the walls of the house are estimated at 0.65 kW per degree of temperature difference between inside of the house and outside atmosphere.
1. If the atmosphere temperature is -10^0C,what is the minimum power required to drive the heat pump ?
2. It is proposed to use the same heat pump to cool the house in summer . If the same power is supplied to heat pump, what is the maximum permissible atmospheric temperature ? **5**

D A 3 stage, single acting, reciprocating air compressor has a low pressure cylinder of 450 mm bore and 300 mm stroke. The clearance volume of low pressure cylinder is 5 percent of swept volume. Intake pressure and temperature are 1 bar and 18^0C, respectively; the final delivery pressure is 15 bar. Intermediate pressures are ideal and intercooling is perfect. n = 1.3 throughout. Determine 1) the intermediate pressures 2) the effective swept volume of the low pressure cylinder 3) the temperature and volume of air delivered at 15 bar.4) the work done per kg of air. Take R = 0.29 kJ/kg .K **5**

Q.2 A i) State the specific advantage with 1) Regeneration 2) Multistage with intercooling 3) Reheating in case of gas turbine. Justify your comment. 3

ii) State the assumption made and limitation of Morse test in case of I.C. engines. Which factor is to be kept constant during test and how ? 2

B

i) What is natural draught and artificial draught in case of boiler ? Why draught is necessary ? State the factors affecting draught . 3

ii) State the function and location of steam separator and feed check valve. 2

Q.3 Solve any **TWO**

A A boiler generates 7.5 kg of steam per kg of coal burnt at a pressure of 11 bar from feed water having temperature of 70^0C. The efficiency of boiler is 75 % and factor of evaporation 1.15, specific heat of steam at constant pressure is 2.3 kJ/kg.K. Calculate 1) Degree of superheat and temperature of steam generated 2) Calorific value of coal 3) Equivalent evaporation in kg of steam per kg of coal 5

B A wall 30 cm thick of size 5m × 3m made of red bricks (k = 0.35 W/m.K). It is covered on both the sides by the layers of plaster 2 cm thick (k = 0.6 W/m.K). The wall has a window of size 1m × 2m.The window door is made of glass, 12 mm thick having thermal conductivity 1.2 W/m.K. Estimate the rate of heat flow through the wall including window in closed position. Inner and outer surface temperatures are 10^0C and 40^0C respectively. 5

C Aniline is to be cooled from 100^0C to 80^0C in a double pipe heat exchanger having a heat transfer surface area of 7 m^2. For cooling a stream of Toluene amounting to 4000 kg/hr at 40^0C is available. The Aniline flow rate is 5000 kg/hr. If the flow is counter current, find, Toluene outlet temperature, LMTD, overall heat transfer coefficient and effectiveness of heat exchanger .
C_p (aniline) = 2.5 kJ / kg.K and C_p (Toluene) = 1.7 kJ/ kg.K 5

Q.4 Solve any **THREE**

A i) Explain the working principal of centrifugal pump. What is priming and why it is necessary ? State the purpose of scroll casing. 3

ii) Differentiate between impulse and reaction hydraulic turbine w.r.t.
1) Conversion of fluid energy 2) Installation of unit 3) Relative velocity of fluid 4) Flow regulation 2

B i) Distinguish between following types of flow and give one example of each.
1) Compressible and incompressible flow 2) Uniform and non uniform flow 3) One, two and three dimensional flow 3

ii) Define the heads against which centrifugal pump has to work 2

C A centrifugal pump having overall efficiency of 62 % handle brine (S_p gravity = 1.19) or gasoline (S_p gravity = 0.7) whose quantity is 50 lit/sec. against the net pressure developed (H_m) is 4 bar. Prove that power required in both the cases is same. 5

D i) Water is flowing through a pipe having diameter 300 mm and 200 mm at the bottom and upper end respectively. The intensity of pressure at the bottom end is 2.45 bar and the pressure at the upper end is 0.98 bar. Determine the difference in datum head if the rate of flow through pipe is 40 lit/sec. 3

ii) Water is flowing through a pipe of 5 cm diameter under a pressure of 29.43 N/cm^2 (gauge) and with mean velocity of 2 m/sec. Find the total head at a cross section which is 5m above the datum line. 2