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

END-SEMESTER EXAMINATION

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

Program : T. Y. Electrical
Term : I
Year: 2013-14

Duration: 3 hrs.
Max. Marks: 60

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

A The following particulars were obtained in a trial on a 4-stroke, single cylinder gas engine.
Duration of trial = 1 hr., Revolution = 14000, No. of missed cycle = 500, Net brake load = 1470 N, Indicated mean effective pressure = 7.5 bar, Gas consumption = 20000 liters, LCV of the gas = 21 kJ/lit., cylinder diameter = 250 mm and stroke = 400 mm., Effective brake circumference = 4 m, Compression ratio = 6.5. Calculate 1) Indicated power 2) Brake power 3) Mechanical efficiency 4) Indicated thermal efficiency 5) Relative efficiency on IP basis. **6**

B 1 kg of air at 1 bar and 300 K is compressed adiabatically till its pressure becomes 5 times the original pressure. Then it is expanded at constant pressure and finally cooled at constant volume to return to its original conditions. Calculate 1) heat transfer 2) work transfer and 3) internal energy for each process and the cycle. C_p = 1.005 kJ/kg-K. C_v = 0.717 kJ/kg-K. **6**

C A single stage , single acting reciprocating air compressor delivers 0.6 kg/min of air at 6 bar. The temperature and pressure at the inlet are 30^0C and 1 bar respectively. The bore and stroke are 100 mm and 150 mm respectively. The clearance volume is 3 % of the swept volume and index of expansion and compression is 1.3. Determine 1) the volumetric efficiency of compressor 2) the brake power required if mechanical efficiency is 85 % 3) speed of the compressor **6**

D A heat pump working on reversible cycle takes in heat from a reservoir at 5^0C and delivers heat to a reservoir at 60^0C. The heat pump is driven by a reversible heat engine which takes in heat from a reservoir at 840^0C and rejects heat at 60^0C. The reversible heat engine also drives a machine that absorbs 30 kW. If pump extracts 17 kJ/sec. from 5^0C reservoir, determine 1) The rate of heat supply from 840^0C source 2) The rate of heat rejection to 60^0C sink **6**

Q.2 Solve any **THREE**

A i) State the function and location of 1) Fusible plug 2) Blow off cock in case of boiler **2**

ii) Draw a block diagram showing location of economiser , superheater and airpreheater in a path of flue gases. State the advantage with each of these units. **2**

iii) Draw a neat sketch of shell and tube heat exchanger and state its application. **2**

B In a boiler trial of one hour duration the following observations were made. Steam generated = 5250 kg. Fuel burnt = 695 kg. Calorific value of fuel = 30200 kJ/kg. Steam condition leaving boiler = 0.94 dry. Boiler pressure = 11 bar (gauge). Feed water inlet temperature = 47^0C. Temperature of steam leaving superheater = 240^0C. Calculate 1) Equivalent evaporation per kg of coal with and without superheater.2) Boiler efficiency with and without superheater. Assume atmospheric pressure of 100 kPa. **6**

C A steam pipe 20 m long, 100 mm internal diameter and 40 mm thick is covered by a layer of lagging of 25 mm thick. The coefficient of thermal conductivities for the pipe material and lagging are 0.07 W/m K and 0.1 W/m K respectively. If the steam is conveyed at a pressure of 17 bar and 30^0C superheat and the outside temperature of the lagging is 24^0C. Determine i) the heat loss per hour and ii) the interface temperature. Assume temperature of the inside surface of the steel pipe is at the same temperature as the superheated steam. **6**

D Find the surface area required in a counter flow steam superheater in which steam enter at 180^0C in a dry saturated state and leaves at 250^0C with an increase of enthalpy of 159 kJ/kg. The hot combustion gases (C_p = 1.05 kJ/kg.K) enter the superheater at 510^0C. The steam flow rate is 1000 kg / hr, the hot gas flow rate is 2000 kg / hr and the overall heat transfer coefficient is 26 W/m^2.K **6**

Q.3 Solve any **SIX**

A Differentiate between Francis turbine and Kaplan turbine w.r.t. 1) Head and discharge 2) Governor required 3) Number of blades 4) Adjustability of runner vanes 5) Type of turbine according to direction of fluid flow 6) Position of shaft **3**

B State the purpose of 1)Spear 2) Nozzle 3) Braking jet 4) casing in pelton wheel. What is the driving force on the runner of Pelton wheel ? **3**

C State the significance of mechanical efficiency and volumetric efficiency in case of centrifugal pump. State the heads against which centrifugal pump has to work. **3**

D Differentiate between centrifugal pump and reciprocating pump with respect to 1) Discharge 2) Discharge pressure 3) Balancing 4) Priming 5) speed 6) use with viscous fluid **3**

E An orifice meter with orifice diameter 10 cm is inserted in a pipe of 20 cm diameter. The pressure gauges fitted upstream and down stream of the orifice meter gives reading of 19.62 N/cm^2 and 9.81 N/cm^2 respectively. Coefficient of discharge for the meter is given as 0.6. Find the discharge of water through the pipe **3**

F Water is flowing through a pipe having diameter 200 mm and 100 mm at a section 1 and 2 respectively. The rate of flow through pipe is 35 lit/sec. The section 1 is 6 m above datum and section 2 is 4 m above datum. If pressure at section 1 is 400 kN/m^2, find the intensity of pressure at section 2. **3**

G A horizontal venturimeter with inlet diameter 20 cm and throat diameter 10 cm is used to measure flow of oil of specific gravity 0.8. The discharge of oil through venturimeter is 60 lit/sec. Find the reading of the oil-mercury differential manometer. Take C_d = 0.98 **3**