Code No. 5079 / O

FACULTY OF ENGINEERING

B.E. 2/4 (EEE) II – Semester (Old) Examination, January 2013

Subject : Prime Movers and Pumps

Time : 3 hours **Max. Marks : 75**

Note: Answer all questions from Part-A. Answer any FIVE questions from Part-B.

PART – A (25 Marks)

1. How is frictional loss estimated for flow through a pipe line with a bend of 90^0? (2)
2. Write down the form of Bernoulli's equation with all terms expressed in pressure units. (3)
3. List important parts of a Francis turbine. (3)
4. Draw velocity triangles for flow over a Pelton wheel bucket. (2)
5. State important mountings used in Lancashire boiler. (3)
6. What modification is necessary to adopt Rankine cycle for analysis of steam engine. (2)
7. Draw typical velocity diagrams for 0.5 degree of reaction steam turbine. (3)
8. Sketch Joule cycle on P-V diagram. (2)
9. Plot the variation of acceleration head w.r.t. stroke in reciprocating pump. (3)
10. Why priming is necessary to start a centrifugal pump? (2)

PART – B (50 Marks)

11.a) Discuss the classification of flow through pipes based on Reynolds number. (4)

b) Three pipes of lengths 800 m, 600 m and 300 m and of diameters 400 mm, 300 mm and 200 mm respectively are connected in series. The ends of the compound pipe is connected to two tanks, whose water surface levels are maintained at a difference of 15 m. Determine the rate of flow of water through pipes if f = 0.005. What will be diameter of a single pipes of length of 1700 m and f = 0.005, which replaces the three pipes. (6)

12.a) Derive relations for power output and efficiencies of a Kaplan turbine. (4)

b) A Pelton wheel is revolving at a speed of 200 r.p.m. and develops 5886 kW shaft power when working under a head of 200 m with an overall efficiency of 80%. Determine unit speed, unit discharge and unit power. The speed ratio for the turbine is given as 0.48. Find the speed, discharge and power when this turbine is working under a head of 150 m. (6)

13.a) Discuss the need of accessories in a steam boiler. List some of them. (4)

b) A single cylinder double acting steam engine develops 75 kW when steam is admitted at 1035 kN/m^2. The cut-off is at one-third of the stroke and the back pressure is 27.5 kN/m^2. The diagram factor is 0.7 and the mechanical efficiency 84%. If the mean piston speed is 240 m/min and the stroke/bore ratio is 1.2, calculate the bore and stroke of the engine. (6)

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14. A simple gas turbine unit consists of single stage compressor, regenerator, combustion chamber and single stage turbine. The initial pressure and temperature of the cycle is 1.03 bar and 15.5^0C. The pressure ratio of the compressor is 5. The maximum temperature of the cycle is limited to 813 ^{0}K. The isentropic efficiencies of the compressor and turbine are 85% and 80% respectively. Pressure loss through the combustion chamber is 0.07 bar.

    Take c_p = 1 kJ/kg ^{0}K and γ = 1.4 for air and gases and find the air flow rate through the system if the power capacity of the plant is 1560 kW. Neglect the mass of fuel. (10)

15.a) Sketch and label important parts in a centrifugal pump. (4)

    b) A double-acting reciprocating pump, running at 50 r.p.m. is discharging 900 litres of water per minute. The pump has a stroke of 400 mm. The diameter of piston is 250 mm. The delivery and suction heads are 25 m and 4 m respectively. Find the slip of the pump and power required to drive the pump. (6)

16.a) A Kaplan turbine runner is to be designed to develop 7357.5 kW shaft power. The net available head is 10 m. Assume that the speed ratio is 1.8 and flow ratio 0.6. If the overall efficiency is 70% and diameter of the boss is 0.4 time the diameter of the runner, find the diameter of the runner, its speed and specific speed. (5)

    b) A centrifugal pump having outer diameter equal to two times the inner diameter and running at 1200 r.p.m. works against a total head of 75 m. The velocity of flow through the impeller is constant and equal to 3 m/s. The vanes are set back at an angle of 30^0 at outlet. If the outer diameter of the impeller is 600 mm and width at outlet is 50 mm, determine : a) vane angle at inlet, b) work done per second by impeller, c) manometric efficiency. (5)

17. A single stage impulse turbine 1 m in diameter rotates at 3,000 r.p.m. Steam is supplied from the nozzles with a velocity of 300 m/sec, and nozzle angle is 20^0. The blades are equiangular. Assuming the friction loss in the blade passages is 33% of the K.E. corresponding to the relative velocity at inlet to the blade, find the power developed by the turbine. The axial thrust on the bearing of turbine is 150 N. (10)

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