B.E. ELECTRICAL ENGG. (PART TIME) 1st YEAR 1st SEMESTER EXAM 2018

PRIME MOVERS FOR ELECTRICALSYSTEMS

Time: Three hours **Use Separate answer script for *Group A* and *Group B*** Marks: 100

Different parts of the same question should be answered together. All symbols carry their usual meanings unless otherwise mentioned. Assume any relevant data if necessary.

Group A
(Answer Any THREE and Question 1 is compulsory)

1. Answer the following questions (any **TWO**) 5 X 2 = 10
   a) What is the working principle of a simple impulse steam turbine?
   b) How do you compare a closed cycle gas turbine plant from an open cycle gas turbine plant?
   c) What do you mean by the following terms related to an IC engine?
   (i) Bore, (ii) stroke, (iii) compression ratio and (iv) specific fuel consumption 10

2. a) Derive an expression of maximum net work output for an ideal gas turbine cycle. 10
   b) In a gas turbine plant working on the Brayton cycle, the air at the inlet is at 27^0C, 0.1MPa. The pressure ratio is 6.25 and the maximum temperature is 800^0C. The turbine and compressor efficiencies are each 80%. Find (i) the compressor work per kg of air (ii) the turbine work per kg of air (iii) the heat supplied per kg of air and (iv) the cycle efficiency. Take C_p=1.005 kJ/kgK, C_v=0.718kJ/kgK, γ=1.4 10

3. a) Differentiate between SI and CI engines. 8
   b) A four stroke, four cylinder SI engine of one litre cubic capacity has a brake thermal efficiency of 27% and indicated power is 40kW at full load. At half load, it has a mechanical efficiency of 65%. Assuming constant mechanical losses, calculate: (i) brake power (ii) frictional power (iii) mechanical efficiency at full load (iv) indicated thermal efficiency. If the volume decreases by seven fold during the compression stroke, calculate clearance volume. 12

4. a) Derive an expression of maximum blade efficiency for a de-Laval turbine with relevant parameters. 8
   b) In a stage of an impulse turbine provided with a single row wheel, the mean diameter of the blade ring is 800 mm and the speed of rotation is 3000 rpm. The steam issues from the nozzles with a velocity of 300 m/s and the nozzle angle is 20^o. The rotor blades are equiangular and the blade friction factor is 0.86. What is the power developed in the blade when the axial thrust on the blades is 140N ? 12

Group B

(Answer Any THREE and Question 5 is compulsory)

5. Write short note on (any TWO) 5 X 2 = 10 — 10

   a) Wind Turbine

   b) Specific speed of turbine

   c) Draft Tube

   d) Moody's diagram

6. a) What is viscosity of fluid? State and explain the Newton's Law of viscosity. — 8

   b) A 90 mm diameter shaft rotates at 1200 rpm in a 100mm long journal bearing of 90.5 mm internal diameter. The annular space in the bearing is filled with oil having a dynamic viscosity of 0.12 Pa.s. Determine the power required in overcoming viscous friction. — 6

   c) The velocity vector in a fluid flow is given by $V = 2x^2\hat{i} - 5x^2y\hat{j} + 4t\hat{k}$. Find the velocity and acceleration of a fluid particle at (1,2,3) at time t=1 — 6

7. a) Derive Bernoulli's theorem with its assumptions. — 8

   b) A horizontal venturimeter with inlet and throat diameters 20 cm and 10 cm respectively is used to measure the flow of water. The pressure at inlet is 15 N/cm^2 and the vacuum pressure at the throat is 30 cm of mercury. Determine the rate of flow. Assume Cd = 0.96. — 6

   c) An oil of viscosity 0.1Ns/m^2 and sp. gravity 0.8 is flowing through a circular pipe of diameter 60 mm and length 200 m. Calculate the pressure drop in a length of 200m and the shear stress at the pipe wall if the discharge through the pipe is 4 litres/s. — 6

8. a) How water turbines are classified? Draw a schematic layout of hydroelectric power plant with its major components. — 10

   b) A Pelton turbine works under a head of 500 m and rotating at 15rps. Calculate the power produced and the hydraulic efficiency when discharge through the turbine is 400 litre per second and jet deflected at 165 degree. Assume speed ratio =0.46, Cv= 0.96 and K=0.9 — 10