BACHELOR OF ENGINEERING (ELECTRICAL ENGINEERING)
FIRST YEAR FIRST SEMESTER EXAM 2019

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) Classify steam turbine based on the principle of working.

   b) State advantages of gas turbine cycle.

   c) What do you mean by the following terms related to an IC engine?

   (i)TDC, (ii) clearance volume, (iii) Brake thermal efficiency, (iv) mechanical efficiency and (v) specific fuel consumption 10

2. a) Derive an expression of cycle efficiency as the function of pressure ratio for an ideal gas turbine cycle. 10

   b) Air enters the compressor of a gas turbine plant operating on Brayton cycle at 1 bar and 27°C. The pressure ratio in the cycle is 6. Calculate the maximum temperature in the cycle and cycle efficiency. Assume $W_T = 2.5W_C$, where W_T and W_C are the turbine and compressor work respectively. Take $\gamma = 1.4$ 10

3. a) Differentiate between 2-stroke and 4-stroke engines. 8

   b) A four stroke SI engine at full load delivers 50 kW. It requires 8.5 kW to rotate it without load at the same speed. Find its mechanical efficiency at full load, half load and quarter load. Also find out the volume of the fuel consumed per second at full load if the brake thermal efficiency is 25%, given that calorific value of the fuel is 42 MJ/kg and specific gravity of fuel 0.75. Estimate the indicated thermal efficiency. 12

4. a) Derive an expression of optimum blade speed ratio for a simple impulse turbine with relevant parameters. 8

   b) An impulse steam turbine has nozzles inclined at 20^0 to the plane of rotation. The inlet and outlet angles of the moving blades are equal, the blades friction factor is 0.8 and the mean diameter of the blades is 0.6 m. The steam leaves the nozzle with a velocity of 700 m/s. Determine (a) the optimum value of the blade angles, (b) the steam flow rate required to produce 20kW and (c) the blade efficiency. Assume the rotational speed of the wheel 3000rpm. 12

Group B

(Answer Any THREE and Question 5 is compulsory)

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

   a) Non-Newtonian Fluid

   b) Hydrostatic law

   c) Draft Tube

   d) Vertical Axis Wind Turbine

6. a) State and explain the Newton's Law of viscosity. How viscosity of fluid varies with temperature. — 10

   b) A 100 mm diameter shaft rotates at 1200 rpm in a 100mm long journal bearing of 101 mm internal diameter. The annular space in the bearing is filled with oil having a dynamic viscosity of 0.1 Ns/m^2. Determine the shear force and power required in overcoming viscous friction. — 10

7. a) Derive the Euler's equation of motion with its assumptions. — 10

   b) The inlet and throat diameters of a venturi-meter are 30 cm and 15 cm respectively is used to measure the rate of flow of water. The pressure at inlet is 135 kN/m^2 and the vacuum pressure at the throat is 40 cm of mercury. Determine the rate of flow. Assume Cd = 0.96. — 10

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 900 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 Cv= 0.96 and K=0.9 — 10