Model Question Paper (CBCS) with effect from 2015-16

15ME53

USN | | | | | | | | | | |

Fifth Semester B.E. Degree (CBCS) Examination

Turbomachines

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

Important Note: 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written e.g, 38+2 = 40, will be treated as malpractice.

MODULE – I

1	**a**	Define turbomachine. Compare positive displacement machines and turbomachines.	(08Marks)
	b	A Pelton wheel is running at a speed of 200 rpm and develops 5200kW of power when working under a head of 220m with an overall efficiency of 80%. Determine its unit speed, unit discharge, unit power and specific speed.	(08Marks)
		OR	
2	**a**	Show that for expansion process, stage efficiency is higher than overall efficiency.	(08Marks)
	b	Find the number of stages of an axial flow compressor with symmetrical balding in order to produce a total pressure rise from 1bar to 4bar. The blade height is 3cm, the mean diameter is 100cm, mean speed of the rotor is 2400rpm and the stage efficiency is 82%.	(08Marks)

MODULE – II

3	**a**	Derive an alternate form of Euler Turbine equation.	(08 Marks)
	b	In an axial flow turbine the discharge blade angles are 20° each for both the stator and the rotor. The steam speed from the nozzle exit is 140m/s. The ratio of Va/U = 0.7 at the entry and 0.76 at the exit of the rotor blade. Find the rotor inlet blade angle and the power developed by the blade ring for a mass flow rate of 2.6kg/s.	(04 Marks)
		OR	
4	**a**	For an axial flow compressor, derive an expression for degree of reaction.	(08 Marks)
	b	In a radial inward flow turbine the degree of reaction is 0.8 and the utilization factor of the runner is 0.9. The tangential speeds of the wheel at the inlet and the outlet are respectively 11m/s and 5.5m/s. Draw the velocity triangles at inlet and outlet assuming radial velocity is constant and equal to 5m/s. Flow is radial at exit. Find the power output for a volumetric flow rate of $2m^3$ of water per second.	(10 Marks)

MODULE – III

5	**a**	Define compounding. List different methods of compounding. With a neat sketch explain velocity compounding of steam turbine.	(08 Marks)
	b.	A single wheel impulse steam turbine has equiangular rotor blades that develop 3.75kW and produce a torque in the disc of 1.62N-m at a mean radius of 132.5mm. The rotor receives 0.014kg/s of steam from nozzles inclined at 70° to the axial direction and steam discharges from the wheel chamber in an axial direction. Find (a) the blade angles, (b) the diagram efficiency.	(08 marks)
		OR	
6	**a**	Derive an expression for degree of reaction of a reaction steam turbine.	(08 Marks)

b Find the blade of a two stage velocity compounded axial flow steam turbine from the following data:

i) Rotor blade angles = 30°, ii) Absolute velocity of steam entering the first stage = 500m/s, iii) Discharge is axial at the second stage (08 Marks)

MODULE – IV

7 **a** With a neat sketch, explain the working principle of Francis turbine. Write the functions of draft tube. (08 Marks)

b A medium Francis runner has a diameter of 75cm and with of 10cm. Water leaves the guide vanes at a velocity of 16m/s inclined at 25° with the runner periphery. The net head is 20m. The overall and hydraulic efficiencies are 80% and 90% respectively. Assuming that 8% of the flow area is lost due to the runner vanes thickness. Calculate the runner vane angle at inlet, power output by the runner and speed of the machine. (08 Marks)

OR

8 **a** Derive an expression for the work on the vane of Pelton turbine. (08 Marks)

b A Kaplan turbine produces 10Mw at a head of 25m. The runner and the hub diameters are 3m and 1.2m respectively. The inlet and outlet velocity triangles are right angles triangles. Calculate the speed and outlet angles of the guide and runner blades if the hydraulic and overall efficiencies are 96A% and 85% respectively. (08 Marks)

MODULE - V

9 **a** Derive an expression for energy transfer and discharge. Plot the variation of Energy transfer with discharge. Discuss the effect with respect to the discharge angle. (08 Marks)

b A centrifugal pump is required to lift 910lit/s of water against 6m when running at 500rpm. The velocity of flow through the wheel is 2m/s and the manometric efficiency is 60%. The angle of the vane tip makes with the direction of the motion is 30°. Determine the diameter and width of the impeller. (08 Marks)

OR

10 **a** Explain i) Cavitation, ii) Net Positive Suction Head, iii) Priming, iv) Manometric Head. (08 Marks)

b The following data refers to a centrifugal pump: (i) Both angle at the impeller exit = 30°, ii) Outer diameter of the impeller = 0.6m, (iii) inner diameter of the impeller = 0.25m, iv) width of the impeller at the exit = 8cm, (v) width of the impeller at the inlet = 12.5cm, (vi) speed = 400rpm, vii) discharge = 6780lit/min. Find the theoretical head developed in kW and the blade angle at the impeller entry. (08 Marks)