BME502

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Model Question Paper 2022-23 (CBCS Scheme)
Fifth Semester B.E. Degree Examination (Mechanical Engineering)
TURBOMACHINES

TIME: 03 Hours **Max. Marks: 100**

Note: 01. Answer any FIVE full questions, choosing at least ONE question from each MODULE

		Module -1	Bloom's Taxonomy Level	Marks	CO
Q.01	**a**	Distinguish between turbo machines with positive displacement machines.	**L2**	**10**	**CO1**
	b	Total efficiency of power absorbing turbo machines handling liquid water of standard density is 70 %. Suppose that the pressure of water increased by 4 bar. Find i. Isentropic change in enthalpy ii. Actual change in total enthalpy iii. Change in total enthalpy of water iv. Power input to water if flow rate 30 kg/s.	**L3**	**10**	**CO1**
		OR			
Q.02	**a**	Explain main parts and classifications of turbo machines.	**L2**	**6**	**CO1**
	b	Distinguish between static and stagnation pressure.	**L2**	**4**	**CO1**
	c	Derive an expression for polytropic efficiency for expansion processes.	**L3**	**10**	**CO1**
		Module-2			
Q.03	**a**	Define utilization factor and degree of reaction. Establish the relationship between utilization factor and degree of reaction.	**L3**	**10**	**CO2**
	b	The following data refers to a hydraulic reaction turbine of radial type. a) Head of the water = 160 m, b) Rotor blade angle at energy = 119° , c) Diameter at entry = 3.65 m, d) Diameter at exit = 2.45 m , e) Discharge angle at exit = 30°, radial with a velocity of 15.5 m/s , f) Radial component at inlet = 10.3 m/s . Find the power developed in KW, Degree of reaction and utilization factor for a flow rate of 10 m^3 /s.	**L3**	**10**	**CO2**
		OR			
Q.04	**a**	For a 50% reaction steam turbine, show that $\alpha_1=\beta_2$ and $\alpha_2=\beta_1$, where α_1 and β_1 are the inlet angles of fixed and moving blades, α_2 and β_2 are the outlet angles of fixed and moving blades Derive an expression for maximum efficiency of reaction steam turbine and Show That $\eta_{b_{max}} = \frac{2\cos^2\alpha_1}{1+\cos^2\alpha_1}$.	**L3**	**10**	**CO2**
	b	In a Parson turbine the axial velocity of steam flow is 0.5 times the mean blade speed. The outlet angle of the blade is 20°, the diameter of the blade ring is 1.3 m and the rotational speed is 3000 rpm. Determine the inlet blade angle, power developed for the steam flow is 65 kg/s and the isentropic enthalpy drop if the stage efficiency is 80 %.	**L3**	**10**	**CO2**
		Module-3			
Q. 05	**a**	Derive an expression for maximum blade efficiency equation for curties turbine.	**L2**	**10**	**CO3**
	b	A single stage impulse turbine has a diameter of 1.5 m and running	**L3**	**10**	**CO3**

		at 3000 RPM the nozzle angle is 20 degrees speed ratio is 0.45 the ratio of relative velocity at outlet to that inlet is 0.9 the outlet angle of the blade is 3 degrees less than the inlet angle 6 kg /s. Draw the velocity diagram find velocity power.			
OR					
Q. 06	**a**	Explain in detail significance of compounding steam turbine and types of compounding	**L2**	**10**	**CO3**
	b	Steam flows through the nozzle with a velocity of 450 m/s at a direction which is inclined at an angle of 16 o to the plane tangent. Steam comes out of the moving blades with a velocity of 100 m/s in the direction of 110 o with the direction of blade motion. The blades are equiangular and the steam flow rate is 10 kg/s. Find i) Power developed ii) the power loss due to friction iii) Axial thrust iv) Blade efficiency and v) Blade coefficient.	**L3**	**10**	**CO3**
Module-4					
Q. 07	**a**	Derive an expression of Hydraulic efficiency of hydraulic impulse Turbine	**L2**	**10**	**CO4**
	b	Pelton wheel has to be designed for the following data: power developed =5880kW, Net head available=300m, Speed=550RPM, ratio of jet diameter to wheel diameter=1/10 and overall efficiency=85%. Find the number of jets, diameter of jet, diameter of the wheel and the quantity of water required. Assume Cv =0.98, , ϕ=0.46. overall efficiency =85%.	**L3**	**10**	**CO4**
OR					
Q. 08	**a**	Sketch and explain parts and working of Kaplan turbine.	**L2**	**10**	**CO4**
	b	In a Francis turbine, the discharge is radial. The blade speed at inlet=25m/s. At the inlet tangential component of velocity=18m/s. The radial velocity of flow is constant and equal to 2.5m/s.Waterflowsattherateof0.8m/s. The utilization factor is 0.82. Find i) Euler's head ii) Power developed iii) Inlet blade angle iv) Degree of reaction(R). Draw the velocity triangles.	**L3**	**10**	**CO4**
Module-5					
Q. 09	**a**	Define explain, and write an expression for the following efficiencies of centrifugal pump: i) Mechanical efficiency, (ii) Manometric efficiency, (iii) overall efficiency and (iv) Hydraulic efficiency .	**L2**	**10**	**CO5**
	b	A centrifugal compressor runs at a speed of 15000 RPM and delivers 30 kg per second exit radius is 0.35 relative velocity and when angles at exit are 100 m/s and 75 degrees assuming axial inlet stagnation temperature and power as 300 Kelvin and 1 bar calculate the torque, power required and work done take CP is equal to 1.005 KJ / KG.	**L3**	**10**	**CO5**
OR					
Q. 10	**a**	Explain the following heads of a centrifugal pump: (i) Suction head, (ii) Delivery head, (iii) Static head, (iv) Manometer of head (v) Total or gross or effective head.	**L2**	**10**	**CO5**
	b	A centrifugal pump is running at 100 rpm. The outlet vane angle of the impeller is 30 o and velocity of flow rate at outlet is 3 m/s. The pump is working against a total head of 30 m and the discharge through the pump is 0.3 m3 /s. If the manometric efficiency is 75 % determine a) Diameter of the impeller b) width of the impeller at outlet.	**L3**	**10**	**CO5**