Basavarajeswari Group of Institutions
BALLARI INSTITUTE OF TECHNOLOGY & MANAGEMENT
(Autonomous Institute under Visvesvaraya Technological University, Belagavi)

USN											Course Code	2	1	M	E	5	1

Fifth Semester B.E. Degree Examinations, April/May 2024

THERMO FLUID ENGINEERING

Duration: 3 hrs **Max. Marks: 100**

Note:* *1. Answer any* FIVE *full questions choosing ONE full Question from each Module.
2. Missing data, if any, may be suitably assumed

Q. No		Question	Marks	(RBTL:CO:PI)
		Module-1		
1.	**a.**	Define the turbomachine and explain how turbomachines are classified with examples.	**10**	(1 :1: 1.6.1)
	b.	Explain with neat sketch parts of a turbomachines.	**10**	(2 :1: 1.6.1)
		(OR)		
2.	**a.**	Explain the applications of first and second law of thermodynamics to turbomachines.	**10**	(2 :1: 1.6.1)
	b.	A Pelton wheel is running at a speed of 190 rpm and develops 5150 kW when working under a head of 220 m with overall efficiency of 80 %. Determine the speed, discharge and power when this turbine is working under a head of 150 m.	**10**	(3 :1: 1.7.1)
		Module-2		
3.	**a.**	With a neat sketch, derive an expression for Euler's turbine equation in general.	**08**	(1 :2: 1.6.1)
	b.	Define utilization factor of a turbine and derive an expression relating utilization factor with the degree of reaction a turbine.	**12**	(2 :1: 1.6.1)
		(OR)		
4.	**a.**	Derive theoretical head capacity relation in case of radial flow pump (centrifugal). Also explain the effect of discharge angle on it.	**08**	(2 :2: 1.6.1)
	b.	The outer diameter of the impeller of a centrifugal pump is 40 cm, width of the impeller at outlet is 5 cm, and the pump is running at 800 rpm and working against a total head of 1.5 m. The Vanes angle at outlet 40^0 and manometric efficiency is 75%. Determine (i) velocity of flow at outlet (ii) velocity of water leaving the vane (iii) angle made by the absolute velocity at outlet with the direction of motion at outlet (iv) discharge.	**12**	(3 :2: 1.7.1)
		Module-3		
5.	**a.**	Define compounding in Steam turbine. With a neat sketch explain velocity compounding of an impulse steam turbine.	**08**	(2 :3: 1.6.1)
	b.	Steam emerges from a nozzle to a De-laval turbine with a velocity of 1000 m/s. The nozzle angle is 20^0. The mean blade velocity is 400 m/s. The blades are symmetrical ($\beta_1 = \beta_2$). The mass flow rate of steam is 1000 kg/hr. Friction factor is 0.8, nozzle efficiency is 0.95. Calculate (i) Blade angles (ii) Axial thrust (iii) power developed (iv) blade efficiency (v) Stage efficiency.	**12**	(3 :3: 1.7.1)
		(OR)		

Note: (RBTL - Revised Bloom's Taxonomy Level: CO - Course Outcome: PI– Performance Indicator)

Q. No.		Question	Marks	RBTL:CO:PI
6.	a.	Derive an expression for condition for maximum blade efficiency for velocity compounded impulse steam turbine (Curtis Turbine).	08	(2 :3: 1.6.1)
	b.	The following data refers to a velocity compounded Impulse steam turbine having two rows of moving blades and a fixed row between them, velocity of steam leaving the nozzle is 1200 m/s, nozzle angle is 20°, blade speed is 250 m/s, blade angles of first moving row are equiangular, blade outlet angle of the fixed blade is 25^0. Blade outlet angle of the second moving row is 30^0. Friction factor for all the rows is 0.9. Draw the velocity diagrams for a suitable scale and calculate the power developed, axial thrust, diagram efficiency for steam flow rate of 5000 kg/hr.	12	(3 :3: 1.7.1)

Module-4

Q. No.		Question	Marks	RBTL:CO:PI
7.	a.	Classify hydraulic turbine. With a neat sketch explain the working of a Pelton wheel.	10	(2 :4: 1.6.1)
	b.	A Pelton wheel has to be designed for the following data: Power to be developed= 5880 kW, net head available =300 m, speed= 550 rpm, jet ratio m =10 and overall efficiency = 85 %. Find the number of jets (n), diameter of jet (d), and diameter of the wheel (D) and quantity of water required. Assume C_v= 0.98 and speed ratio=0.46.	10	(3 :4: 1.7.1)
		(OR)		
8.	a.	With reference to hydraulic turbines, define the following with a neat sketch (i) Overall efficiency, hydraulic efficiency, mechanical efficiency and volumetric efficiency (ii) Various heads of hydraulic turbines.	12	(1 :2: 1.6.1)
	b.	Explain with a neat sketch the parts and working of Kaplan Turbine.	08	(2 :1: 1.6.1)

Module-5

Q. No.		Question	Marks	RBTL:CO:PI
9.	a.	Define priming in centrifugal pump and why it is necessary?	06	(1 :2: 1.6.1)
	b.	What is cavitation? What are the effects of cavitation? How to avoid the cavitation.	08	(2 :1: 1.6.1)
	c.	Explain with neat sketch multistage centrifugal pump (i) When connected in series (ii) When impellers connected in parallel.	06	(2 :1: 1.6.1)
		(OR)		
10	a.	Explain the phenomenon of surging as applied to a centrifugal compressor.	08	(2 :5: 1.6.1)
	b.	A Centrifugal compressor running at 5950 rpm having an impeller tip diameter =1m. Mass flow rate of air is 30 kg/s, total pressure ratio is 2.125, pressure at inlet is 1 bar and temp is 25°c, slip-coefficient is 0.9 and mechanical efficiency is 0.97. Find (i) total efficiency (ii) temp of air at exit (iii) power input needed (iv) pressure co-efficient.	12	(3 :5: 1.7.1)

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