

BALLARI INSTITUTE OF TECHNOLOGY & MANAGEMENT

(Autonomous Institute under Visvesvaraya Technological University, Belagavi)

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Course Code

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Fifth Semester B.E. Degree Examinations, September/October 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

<u>Q. No</u>	<u>Question</u>	<u>Marks</u>	<u>(RBTL:CO:PI)</u>
<u>Module-1</u>			
1.	a. With neat sketch, state the function and principal components of turbomachines.	06	(2 : 1 : 1.6.1)
	b. Explain the comparison between positive displacement machines and turbo machines.	08	(2 : 1 : 1.6.1)
	c. Define and write an expression for the following: (i) unit Speed (ii) unit discharge (iii) unit power	06	(2 : 1 : 1.6.1)
(OR)			
2.	a. With the help of T-s diagram, show that polytropic efficiency during expansion process is given by $(\gamma/\gamma-1)(n-1/n)$.	10	(2 : 1 : 1.6.1)
	b. Define the following, with the help of a h-s diagram, for the power generating turbo machines: (i) Total-to-total efficiency, (ii) Total-to-static efficiency, (iii) Static-to-total efficiency, (iv) Static-to static efficiency.	10	(2 : 1 : 1.6.1)
<u>Module-2</u>			
3.	a. With a neat sketch, of velocity triangles derive an expression of alternative form of Euler's Turbine equation.	10	(2 : 2 : 1.7.1)
	b. Obtain an equation of general utilization factor irrespective of any type of turbines.	06	(2 : 2 : 1.7.1)
	c. Define (i) degree of Reaction (ii) utilization factor	04	(2 : 2 : 1.6.1)
(OR)			
4.	a. Derive a theoretical head capacity (H-Q) relationship for centrifugal pumps and compressors and explain the influence of outlet blade angle.	10	(2 : 2 : 1.6.1)
	b. The velocity of steam outflow from a nozzle in De-laval turbine is 1200 m/s. The nozzle angle being 22°. If the rotor blades are equiangular and the rotor tangential speed is 400 m/s, compute (i) the rotor angles β_1 and β_2 (ii) the tangential force on blade ring power output assuming $V_{r1}=V_{r2}$, also find the utilization factor.	10	(3 : 2 : 1.7.1)
<u>Module-3</u>			
5.	a. Define compounding in steam turbine. With a neat sketch, explain pressure compounding of impulse steam turbine.	10	(2 : 3 : 1.6.1)
	b. A single stage Impulse turbine has diameter of 1.5 m and running at 3000 RPM. The nozzle angle is 20°. Speed ratio is 0.45. Ratio of relative velocity at outlet to that of inlet is 0.9. The outlet angle of the blade is 3° less than inlet angle. Steam flow rate is 6 kg/s. Draw the velocity diagrams and find (i) velocity of whirl (ii) axial thrust (iii) blade angles (iv) power developed.	10	(3 : 3 : 1.7.1)

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

(OR)

6. a. With the help of combined velocity diagram, obtain an expression for condition for maximum efficiency. **12** (2 : 3 : 1.6.1)
- b. The following data refers to a particular stage of Parsons reaction turbine. Speed of the turbine=1500 RPM, mean diameter of rotor =1 m, stage efficiency=0.8, blade outlet angle=20°, speed ratio=0.7. Determine the available isentropic drop in the stage **08** (3 : 3 : 1.7.1)

Module-4

7. a. With reference to hydraulic turbines, explain the following with equations:
(i) Overall efficiency (ii) Hydraulic efficiency (iii) Mechanical efficiency and (iv) Volumetric efficiency **08** (2 : 4 : 1.6.1)
- b. A Pelton wheel has to be designed for a net head of 60 m when running at 220 rpm. The Pelton wheel develops 100 kW of shaft power. Take coefficient of velocity $C_v=0.99$, speed ratio $\phi = 0.45$, overall efficiency $\eta_o=0.87$. Design the Pelton to find diameter of jet (d), diameter of the wheel (D), width and depth of buckets and number of buckets on the wheel (Z). **12** (3 : 4 : 1.7.1)

(OR)

8. a. With neat sketch, explain the principle of working of Francis turbine. **06** (2 : 4 : 1.6.1)
- b. A Kaplan turbine runner is to be designed to develop 9100 kW. The net head available is 5.6 m. If the speed ratio=2.09, flow ratio=0.68, overall efficiency 86% and the diameter of the boss is 1/3 the diameter of the runner, find (i) the diameter of runner (ii) speed (iii) specific speed of turbine. **08** (3 : 4 : 1.7.1)
- c. With neat sketch, explain the types of draft tubes. **06** (2 : 4 : 1.6.1)

Module-5

9. a. Explain with a neat sketch, the multistage centrifugal pump when the impellers connected in parallel. **06** (2 : 5 : 1.6.1)
- b. Derive an expression for minimum speed for starting centrifugal pump. **06** (2 : 5 : 1.6.1)
- c. The inner and outer diameters of an impeller of centrifugal pump are 250 mm and 450 mm respectively. The pump is running at 1300 rpm. The vane angles of the impeller at inlet and outlet are 20° and 30° respectively. The water enters the impeller radially and the velocity of flow is constant. Determine the work done by the impeller per unit weight of water. **08** (2 : 5 : 1.7.1)

(OR)

- 10 a. Explain the phenomenon called surging in compressors. **05** (2 : 5 : 1.6.1)
- b. Explain (i) slip factor (ii) power input factor **05** (2 : 5 : 1.6.1)
- c. Briefly explain (i) Pre-whirl (ii) Diffuser (iii) Vane less diffuser (iv) vaned diffuser (v) volute casing **10** (2 : 5 : 1.6.1)

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