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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S4 (R,S) / S4 (WP) (R) / S2 (PT) (S, FE) Examination May 2024 (2019 Scheme)

Course Code: MET206

Course Name: FLUID MACHINERY

Max. Marks: 100 Duration: 3 Hours

PART A

(Answer all questions; each question carries 3 marks) Marks

1	What should be the optimum speed of the curved plate in terms of the jet velocity when the plate is moving in the direction of the jet for its maximum efficiency?	3
2	Sketch the inlet and outlet velocity triangles of the Francis turbine and label all the salient velocities and angles.	3
3	What is Specific speed of a turbine? What is its significance?	3
4	What do mean by priming? Why priming necessary for a centrifugal pump?	3
5	Explain the working of the vane pump using suitable diagram.	3
6	Define the term Slip in reciprocating pumps. Explain the possibility of negative slip in reciprocating pump.	3
7	Explain the working of the Roots blower using suitable diagram.	3
8	Explain surging and choking in centrifugal compressors.	3
9	Compare Gas turbines with IC engines.	3
10	Describe the working of a simple constant-pressure combustion gas turbine cycle. Draw its P-v and T-S diagrams.	3

PART B

(Answer one full question from each module, each question carries 14 marks)

Module -1

11	a)	Explain the working of the Francis Turbine using suitable diagrams.	7
	b)	A Pelton wheel is receiving water from a penstock with a gross head of 510 m. One-fourth of gross head is lost in friction in the penstock. The rate of flow through the nozzle fitted at the end of the penstock is 2·4 m^3 /s. The angle of deflection of	7

the jet is 165° after hitting the buckets. Determine: (i) The power given by water to the runner, (ii)The power developed by the runner(iii) Hydraulic efficiency of the Pelton wheel. Take C_v (co-efficient of velocity) = 0.9 and speed ratio = 0·46.

12 a) An inward flow reaction turbine has external and internal diameters as 1·2 m and 0.6 m. The turbine is running at 240 r.p.m. The width of the turbine at inlet is 240 mm and velocity of flow through the runner is constant and is equal to 2.4 m/s. The guide blades make an angle of 10° to the tangent of the wheel and discharge at the outlet of the turbine is radial. Draw the inlet and outlet velocity triangles and determine (i) The runner blade angles, (ii) the Width of the runner at outlet, (iii) the power developed in the runner, and (iv) the hydraulic efficiency of the turbine. 8

b) A Kaplan turbine develops 24000 kW at an average head of 42 m. Assuming a speed ratio of 2, flow ratio of 0.6, diameter of the boss equal to 0·36 times the diameter of the runner and an overall efficiency of 90 percent, calculate the diameter, speed of the turbine. 6

Module -2

13 a) Why draft tube is necessary in the discharging side of the reaction turbine? Explain. Sketch some of the configurations of the draft tubes commonly used. 7

b) With a net sketch explain the working of Governing system of a Pelton Turbine 7

14 a) What is Specific speed of a pump? Derive an expression for the same? 6

b) A centrifugal pump running at 1200 rpm has impeller internal and external diameters 200 mm and 400 mm respectively. The water enters radially into the impeller and velocity of flow through the impeller is constant. If the impeller vane angle at inlet and outlet are 20^0 and 30^0 respectively, calculate (i) the flow velocity, (ii) the velocity of whirl at outlet, and (iii) the work done by the impeller. 8

Module -3

15 a) Starting from the fundamental principles derive expressions for the effect of acceleration and friction of water in the suction and delivery side of the single-acting single-stage reciprocating pump. Also explain how these effects modify the indicator diagram and the expression for the work done per second. 14

16 a) Explain the working of the air vessel. Also, deduce the percentage work saved by fitting the air vessel in the suction side of a single acting reciprocating pump. 8

b) Explain the working of the Vane pump using suitable diagram. 6

Module -4

17	a)	Derive an expression for the indicated work for a single-stage reciprocating air compressor with clearance volume.	7
	b)	A single stage reciprocating air compressor takes 1 m^3 of air per minute at 1bar and 15°C and delivers it at 7bar. The law of compression is $PV^{1.3}$ = constant. Calculate the indicated power neglect clearance. If the speed of the compressor is 300 rpm and stroke to bore ratio is 1.5, calculate the cylinder dimensions. Find the power required if the mechanical efficiency of the compressor is 85% and the motor transmission efficiency is 90%	7
18	a)	Derive an expression for the volumetric efficiency for a single-stage reciprocating air compressor.	7
	b)	Explain the working of the centrifugal compressor using suitable diagram	7

Module -5

19	a)	Derive an expression for the air standard efficiency of a Brayton cycle.	6
	b)	Consider an air standard cycle in which the air enters the compressor at 1.0 bar, 20° C. The pressure of the air leaving the compressor is 3.5 bar and the temperature at the turbine inlet is 600 °C. Determine per kg (i)The efficiency of the cycle (ii)Heat supplied to the air (iii)Work available at the shaft (iv) Heat rejected in the cooler (v) Temperature of the air leaving the turbine (vi) work ratio Assume for air, γ=1.4 and Cp=1.005 kJ/kg K	8
20	a)	In gas turbine plant working on Brayton cycle, the air at inlet is 27°C, 0.1 MPa. The pressure ratio is 6.25 and the maximum temperature is 800°C. The turbine and the compressor efficiencies are each 80.0%. Find the compressor work, turbine work, heat supplied, cycle efficiency, and the turbine exhaust temperature for the isentropic and non-isentropic cases. The mass of air may be considered as 1 kg.	14

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