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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S4 (S, FE) / S2 (PT) (S, FE) / S4 (WP) (S) Examination December 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 | Differentiate between Impulse and Reaction Turbine. | 3 |
| 2 | Why draft tube is necessary in the discharging side of the reaction turbine? Explain. | 3 |
| 3 | What are unit quantities of a turbine? What is its importance | 3 |
| 4 | What is Cavitation? Why this is important in the design of in Hydraulic machines? | 3 |
| 5 | What is air vessel? Describe the advantage of air vessels in reciprocating pumps. | 3 |
| 6 | Construct the ideal Indicator diagram for a reciprocating pump. | 3 |
| 7 | Derive an expression for the volumetric efficiency of the reciprocating air compressors. | 3 |
| 8 | Describe degree of reaction in an axial compressor. | 3 |
| 9 | Differentiate between the open cycle and closed cycle Gas Turbine. | 3 |
| 10 | What are the different types of combustion chambers for a Gas turbine? | 3 |

PART B*(Answer one full question from each module, each question carries 14 marks)***Module -1**

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|----|---|---|
| 11 | a) A nozzle of 60 mm diameter delivers a stream of water at 24 m/s perpendicular to a plate that moves away from the jet at 6 m/s. Find: (i) The force on the plate, (ii) The work done, and (iii) The efficiency of the jet. For what velocity of the vane, the system will give the maximum efficiency? | 7 |
| | b) Explain the working of the Pelton wheel using suitable diagrams. | 7 |
| 12 | a) A jet of water with a velocity of 18 m/s and 10 cm diameter strikes a curved vane tangentially at one tip which is moving away from the jet with a velocity of 6 m/s. The vane is symmetrical and is so shaped that the jet is deflected through | 8 |

120°. Draw the velocity triangle and determine: (i) The angle of the jet at inlet of the vane so that there is no shock, (ii) The absolute velocity of the jet at outlet in magnitude and direction, (iii) The work done by water on the vane and (iv) Hydraulic efficiency.

- b) Explain the working of the Kaplan Turbine using suitable diagrams. 6

Module -2

- 13 a) What is Specific speed of a turbine? Derive an expression for the same? 7
 b) A turbine is to operate under a head of 25 m at 200 r.p.m. The discharge is 9 m³ /s. If the efficiency is 90 percent determine the power output of the turbine. Also determine the speed, discharge, and power output of the turbine if the turbine is working under a head of 20 m. 7
- 14 a) With a neat sketch explain the working of Centrifugal pump. Explain why priming necessary in centrifugal pumps. 6
 b) With the help of neat diagrams, explain how the head and discharge of a centrifugal pump can be increased by multi-staging. 8

Module -3

- 15 a) Explain the working of the Hydraulic ram using suitable diagram. 6
 b) A single-acting reciprocating pump has a 250 mm diameter piston with a crank radius of 250 mm. The delivery pipe is of 10 cm diameter. The pump has a discharge of 100 litres/minute of water and is lifted to a total height of 100 m. Friction losses are estimated to be 1 m in suction pipe and 19 m in delivery pipe. Velocity of water in delivery pipe is 1 m/s, overall efficiency is 85% and the slip is 3%. Determine: (i) Speed of the pump, and (ii) Power required to run the pump. 8
- 16 a) The piston diameter and stroke length of a double-acting single cylinder reciprocating pump are 150 mm and 300 mm respectively. The center of the pump is 4.5 m above the water level in the sump and 32 m below the delivery water level. Both the suction and delivery pipes have the same diameter of 75 mm and are 6 m and 36 m long respectively. If the pump is working at 30 r.p.m. determine: (i) The pressure heads on the piston at the beginning, middle and end of both suction and delivery strokes, (ii) The maximum head at any instant against which the pump has to work and its power. Take atmospheric pressure 14

head = 10.3 m of water, and Darcy's friction co-efficient for both the pipes as 0.01.

Module -4

- 17 a) Derive an expression for the indicated work for the 2-stage reciprocating air compressor assuming perfect intercooling between the cylinders. 10
- b) Explain the working of the Vane pump using suitable diagram. 4
- 18 a) A single-stage single-acting reciprocating air compressor receives 3 m^3 of free air per minute at 1.013 bar and 20°C and delivers to 8 bar with the following data. The speed of the compressor is 300 rpm. The clearance volume is 5% of the stroke volume; the Index of compression and expansion, $n = 1.35$, and the length of the stroke is 1.2 times the cylinder diameter. Calculate (i) the indicated power ii) the volumetric efficiency (iii) the cylinder dimensions (iv) the indicated power saved by converting the compressor to two-stage with perfect intercooler 14

Module -5

- 19 a) Derive an expression for the optimum pressure ratio for the maximum work output of a gas Turbine considering efficiencies of compressor and turbine. 8
- b) Compare the gas turbine with IC engines. 6
- 20 What are the methods to improve the performance of the Gas turbine cycle? State the effect of improvement on thermal efficiency in each case. 14
