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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fourth Semester B.Tech Degree Examination June 2022 (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	Obtain the expression for the force exerted by the jet of water on a fixed inclined plate in the direction of jet.	3
2	Differentiate between inward flow and outward flow reaction turbines	3
3	Differentiate between pumps and outward turbines	3
4	Define the terms : suction head, delivery head and manometric head	3
5	Define slip, percentage slip and negative slip of a reciprocating pump	3
6	What is a hydraulic intensifier? Explain its principle and working	3
7	Compare reciprocating and rotary air compressors	3
8	Explain surging and choking in centrifugal compressors	3
9	What do you mean by the term Gas Turbine? How are Gas Turbines classified?	3
10	Describe with sketches the working of simple constant Pressure Gas Turbine.	3

PART B

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

Module -1

11	a)	Find an expression for the efficiency of a series of moving curved vanes when a jet of water strikes the vanes at one of its tips. Prove that maximum efficiency is when u=V and value of maximum efficiency is 50%.	7
	b)	A square plate weighing 115N and uniform thickness and 30cm edge is hung so that horizontal jet 2cm diameter and having velocity of 15 m/sec impinges on the plate. The centre line of jet is 15cm below the upper edge of the plate, and when the plate is vertical the jet strikes the plate normally and at its centre. Find the force must be applied at the lower edge of the plate in order to keep the plate	7

vertical. If the plate is allowed to swing freely, find the inclination to the vertical which the plate will assume under the action of jet.

12 a) A Pelton wheel has a bucket speed of 35m/sec with a jet of water flowing at the rate of $1m^3/sec$ under a head of 270m. The bucket deflected the jet through an angle of 170 °. Calculate the power delivered to the runner and the hydraulic efficiency of the runner. Assume coefficient of velocity as 0.98 — 7

b) Describe briefly the function of various main components of a Pelton turbine with neat sketches. — 7

Module -2

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

b) A turbine operate under a head of 30m at 300rpm. The discharge is 10 m^3/sec.The overall efficiency is 90 %. Determine the specific speed of the machine, power generated and type of the turbine. — 7

14 a) A centrifugal pump having outer diameter equal to two times the inner diameter and running at 1200 rpm works under total head of 32m. The velocity of flow through the impeller is constant and equal to 3m/sec. The vanes are set back at an angle of 30° at the outlet. If the outer diameter of the impeller is 600mm and width at outlet is 50mm, determine (i) vane angle at inlet (ii) work done per sec by the impeller (iii) manometric efficiency. — 7

b) Derive an expression for the minimum starting speed of a centrifugal pump. — 7

Module -3

15 a) Draw an indicator diagram, considering the effect of acceleration and friction in suction and delivery pipes. Find the expression for work done per second in the case of single acting reciprocating pump. — 7

b) A double acting reciprocating pump, having cylinder diameter 15 cm and stroke length 30 cm is used raise the water through a height of 30 meters. If the pump is working at 30rpm and the pump efficiency is 73%, what power is required to drive the pump? — 7

16 a) Explain with neat sketch , the principle and working of the following hydraulic devices i)hydraulic ram, ii) Accumulator iii) Intensifier — 7

b) Explain with neat sketch, the working of jet pump, vane pump and lobe pump — 7

Module -4

17 a) A single stage single acting compressor has a delivers 0.6kg of air per minute at — 7

6 bar. The temperature and pressure at the end of suction stroke are 30 °C and 1bar. The bore and stroke length of the compressor are 100mm and 150mm respectively. The clearance is 3% of the stroke volume. Assume n =1.3. Find (i) volumetric efficiency of the compressor ii) power required to drive the compressor if mechanical efficiency 85% and speed of the compressor

b) Derive the expression of degree of reaction of an axial flow air compressor in terms of blade angles and blade velocity. 7

18 a) An axial flow compressor having eight stages and with 50% reaction design compresses air in the pressure ratio of 4:1. The air enters the compressor at 20° C and flows through it with a constant speed of 90m/s. The rotating blades of compressor rotates with a mean speed of 180m/s, isentropic efficiency of the compressor may be taken as 82%. Calculate work done by the machine and Blade angles 7

b) Explain the working of (i) vane compressor and (ii) screw compressor 7

Module -5

19 a) The gas turbine unit has a pressure ratio of 6:1 and maximum cycle temperature of 610 ^{0}C. The isentropic efficiencies of compressor and turbine are 80% and 82% respectively. Calculate the power output in kilowatts of an electric generator geared to the turbine when the air enters the compressor at 15^{0}C at the rate of 16kg/s. Assume c_p= 1.005kJ/kgK and γ=1.4 for the compression process, and take c_p= 1.11kJ/kgK and γ = 1.3333 for the expansion process. 7

b) Explain the different methods employed to increase the specific output and thermal efficiency of open cycle Gas Turbine Plant. 7

20 a) Find the required air fuel ratio in a gas turbine whose turbine and compressor efficiencies are 85% and 80% respectively. Maximum cycle temperature is 875°C. The working fluid can be taken as air (cp=1kJ/kgK , γ=1.4) which enters the compressor at 1bar and 27°C. The pressure ratio is 4. The fuel used has calorific value of 42000kJ/kg. There is a loss of 10% of calorific value in the combustion chamber. 7

b) Briefly explain the various fuels used in Gas turbine and list the application of Gas Turbines 7

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