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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S4 (S,FE) (FT/WP/S2PT) Examinations May 2026 (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	Define hydrodynamic thrust. How does it vary for a moving flat plate?	3
2	Why is the runner of a Pelton wheel turbine fitted with double hemispherical (split) buckets instead of a single curved blade?	3
3	State the primary functions of draft tubes in reaction turbines and explain their importance in turbine performance.	3
4	Define suction head, delivery head, and manometric head, and explain their relevance in pump operation.	3
5	Distinguish between rotodynamic pump and positive displacement pump.	3
6	Describe the operating conditions under which flow separation occurs in a reciprocating pump.	3
7	Explain why multistage compression is preferred for producing high-pressure air and list its advantages.	3
8	Discuss the role of diffusers in centrifugal compressor.	3
9	Provide a brief overview of the different types of fuels used in gas turbine systems.	3
10	Explain the following terms in Gas turbine Power Plants (i) Pressure Ratio (ii) Work Ratio (iii) Compression efficiency.	3

PART B

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

Module -1

11	a)	A jet of water of diameter 75 mm strikes a curved vane at its centre with a velocity of 20 m/s.The vane is moving with a velocity of 8 m/s in the direction of the jet. The jet is deflected through an angle of 165 ^{0}. Assuming the vane is smooth find: (i) The force exerted on the vane in the direction of the jet. (ii) Power of the jet, and (iii) Efficiency of the jet.	7

b). Explain the working of the Francis turbine using suitable diagram. 7

12 a). A Kaplan turbine runner is to be designed to develop 9100 kW. The net available head is 5.6 m. If the speed ratio = 2.09 and flow ratio =0.68, overall efficiency is 86% and the diameter of the boss is 1/3 the diameter of the runner. Find the diameter of the runner, its speed and specific speed of the turbine. 7

b) Derive the expression for work done and hydraulic efficiency of a Pelton turbine. Also derive the condition for maximum hydraulic efficiency. 7

Module -2

13 a). A turbine is to operate under a head of 25 m at 200 rpm. The discharge is 9 cumec. If the efficiency is 90%, determine the performance of the turbine under a head of 20 meters. 7

b). Using a neat sketch, explain the governing mechanism used in a Pelton turbine. 7

14 a). 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 per unit weight of water. 8

b) Define the specific speed of a pump. Derive an expression for it. 6

Module -3

15 a). In a single acting reciprocating pump the bore and stroke are 100 mm and 150 mm respectively. The static head requirements are 4m suction and 18 m delivery. If the pressure at end of delivery pip is 75mm and the length if the delivery pipe is 24. Determine the acceleration head at $\theta = 33^0$ from the start of delivery. 8

b). With the help of necessary sketch, explain the working of a jet pump. Where are they used? 6

16 a). Show from first principle that work saved against friction in the delivery pipe of a double – acting reciprocating pump, by fitting air vessel is 39.2%. 9

b). Enlist factors used to select pumps for specific applications. 5

Module -4

17 a). A single stage single acting reciprocating compressor delivers 15 m^3/ min of free air from 1 bar to 8 bar at 300 rpm. The clearance volume is 5% of the stroke volume and compression and expansion follow the law $PV^{1.3}$ = constant. Calculate 8

the diameter and stroke of the compressor. Take L/D =1.5. The temperature and pressure of the air at suction are same as atmospheric air.

b) Define the term 'Free Air Delivered (F.A.D)'. Why free air delivered is less than the displacement of the compressor. 6

18 a) Explain the phenomena of surging and choking in a centrifugal compressor, and support your explanation with appropriate diagrams. 8

b) Explain the working of roots blower and obtain the expression for its efficiency. 6

Module -5

19 a) The gas turbine unit has a pressure ratio of 6 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 16 kg/s. Take Cp= 1.005 kJ/kg K and γ=1.4 for the compression process, and take Cp= 1.11 kJ/kg K and γ = 1.333 for the expansion process. 10

b) Explain primary, intermediate, dilution and cooling air used in gas turbine combustion chambers. 4

20 a) Calculate the required air-fuel ratio in a gas turbine plant, 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 = 1.0 kJ/kg. K, γ=1.4), which enters the compressor at 1 bar and 27°C. The pressure ratio is 4. The fuel used has calorific value of 42000 kJ/kg. There is loss of 10% of calorific value in combustion chamber. 8

b) Explain the different methods employed to increase the specific output and thermal efficiency of open cycle Gas Turbine Plan 6

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