Total No. of Questions : 12]

SEAT No. :

P4553

[Total No. of Pages : 4

[4958] - 117
T.E. (Mech. & Mech. S/W)
TURBO MACHINES
(2008 Pattern) (Semester - II)

Time : 3 Hours] *[Max. Marks :100*

Instructions to the candidates:

1) ***Answers three questions from Section -I and three questions from Section -II.***
2) ***Answer to the two sections should be written in separate books.***
3) ***Neat diagrams must be drawn whenever necessary.***
4) ***Figure to the right indicate full marks.***
5) ***Use of logarithmic tables, electronics calculator is allowed.***
6) ***Assume suitable data, if necessary.***

SECTION - I

Q1) a) Prove that the maximum efficiency for curved vanes with jet strikes at the center is given by **[6]**

$$\eta_{max} = \frac{8}{27}(1+\cos\theta)$$

$$= \frac{16}{27}\cos^2\left(\frac{\theta}{2}\right)$$

The notations carry the usual meaning.

b) The following data refer to a Pelton wheel:
4 nozzles each 50 mm in diameter with C_p = 0.97; reservoir head 300m; Head loss in friction 30 m on 360 m of pipeline with f = 0.024; bucket pitch circle diameter 0.83m; bucket speed is equal to 0.46 of jet speed; bucket friction reduces the relative velocity by 15 percent; angle through which the buckets deflect the jet 165°; mechanical efficiency 94 percent. Determine: **[12]**

i) The diameter of penstock pipe
ii) The speed of rotation
iii) Hydraulic and overall efficiencies of the machine
iv) The output power
v) Specific speed

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OR

Q2) a) Prove that the hydraulic efficiency of Pelton wheel is given by **[6]**

$$\eta_h = \frac{2u_1(V_1 - u_1)(1 + k\cos\phi)}{V^2}$$

b) A Jet of water having a velocity of 40 m/s impinges on a series of vanes moving with a velocity of 20m/s. The jet makes an angle of 30° to the direction of motion of the vanes which entering and leaves at an angle of 120°. Draw a velocity triangle at inlet and outlet and find **[12]**

i) The vane angle at inlet and outlet
ii) Work done
iii) Efficiency

Q3) a) What is the governing of Water Turbine? Describe with sketch the working of a system to regulate the speed of Francis Turbine. **[6]**

b) The Propeller reaction turbine of runner diameter 4.5m is running at 48 rpm. The guide blade angle at inlet is 145° and runner blade angle at the outlet is 25° to the direction of the vane. The axial flow area of water through the runner is 30 m^2. If the runner blade angle at inlet is radial, determine: **[10]**

i) Hydraulic efficiency of the turbine,
ii) Discharge through the turbine, and
iii) Power developed by the runner.

OR

Q4) Write note on any four : **[16]**

a) Cavitation in water turbines & its control.
b) Comparison of : Francis Turbine & Kaplan Turbine.
c) Deriaz Turbine.
d) Draft Tube.
e) Operating characteristic.

Q5) a) Why is compounding of the steam turbine is necessary or what are the disadvantages of the single stage steam turbine? How can we overcome such disadvantages? **[8]**

b) What is governing of steam turbine? How is governing is done in steam turbine? Explain. **[8]**

OR

Q6) a) In Parson's reaction turbine running at 400 rpm with 50% reaction develops 75 kW per kg per second of steam. The exit angle of the blade is 20° and the steam velocity is 1.4 times the blade velocity determine **[10]**

i) Blade efficiency

ii) Diagram power

b) Discuss in detail various losses in a steam turbine. **[6]**

SECTION - II

Q7) a) The compressor and turbine unit of a small gas turbine plant have an isentropic efficiency of 85%. The temperature of the air at inlet to compressor is at 15°C and the maximum temperature during the cycle is limited to 700°C . The pressure ratio is 4. Assuming, C_p = 1.1 and C_v = 0.786 kj/kg K, calculate the specific output and the overall efficiency of the cycle. Neglecting all other losses. **[12]**

b) What are the advantages and disadvantages of liquid propellants compared to solid propellant? Explain in details. **[6]**

OR

Q8) a) What are the different methods used in improving the efficiency of the gas turbine? Explain any one method with a neat sketch. **[10]**

b) Compare the constructional features and operating performance of turboprop and turbojet engines. **[8]**

Q9) a) Define the following terms : **[8]**

i) Manometric head

ii) Manometric efficiency

iii) Net positive suction head

iv) Overall efficiency

b) Define the minimum starting speed of a centrifugal pump. Derive an expression to calculate the minimum starting speed. **[8]**

OR

Q10)a) Determine the manometric and overall efficiencies of a centrifugal pump from the following data. **[10]**

Head	:	22m
Discharge	:	160 lps
Liquid pumped	:	brine of specific gravity 1.18
Speed	:	1200 rpm
Diameter	:	30 cm
Width	:	5 cm
Shaft power	:	55 kW
Vane angle at outlet	:	35°

b) Why multiple pumps are required? Under what circumstances, do we use multiple pumps? Write a note on operation of multistage pumps. **[6]**

Q11)a) The diameter ratio of the impeller of a centrifugal compressor is 2 and the pressure ratio is 4. At a speed of 12000 rpm, the flow rate is 10 m^3/s of free air. The isentropic efficiency of compressor is 84%. The blades are radial at the outlet and the entry is radial at the inlet. The velocity of flow remains constant at 60 m/s through the impeller. Calculate **[10]**

i) Power input to the machine

ii) Impeller diameter at the inlet and outlet

The suction is from the atmosphere at 100 kPa and 300°K

b) Write short note on comparison between centrifugal and axial flow compressor. **[6]**

OR

Q12)a) A 16 stage axial flow compressor is to have an overall pressure ratio of 6.3. The test has shown that a stage efficiency of 89.5% can be obtained. The intake conditions are 1 bar and 288°K. Find the overall efficiency and polytropic efficiency. **[10]**

b) Discuss surging and chocking in a centrifugal compressor. How do these phenomena affect the working of the compressor? **[6]**

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