

**B.TECH. SEM -IV MECHANICAL 2014 COURSE (CBCS) :
WINTER - 2017**

SUBJECT: TURBOMACHINERY

Day: **Thursday**
Date: **23/11/2017**

Time: **02.30 PM TO 05.30 PM**
Max Marks: 60

W-2017-2096

N.B.:

- 1) All questions are **COMPULSORY**.
- 2) Figures to the right indicate **FULL** marks.
- 3) Use of non-programmable **CALCULATOR** is allowed.
- 4) Use of steam table is allowed.
- 3) Assume suitable data, if necessary.

Q.1 Prove that efficiency of a free jet striking normally as series of flat plates (10)
mounted on the periphery of a wheel never exceeds 50%.

OR

Q.2 A pollen wheel of 1.1m mean bucket diameter works under ahead of 500 m. (10)
The deflection of jet is 165° and its relative velocity is reduced over the
bucket by 15% due to friction. If the diameter of jet is 100 mm and the water
is to leave the bucket without any whirl, determine:

- i) Rotational speed of wheel
- ii) Ratio of bucket speed to jet velocity
- iii) Impulsive force and power developed by the wheel
- iv) Available water power
- v) Power input to the buckets

Take $C_v = 0.97$

Q.3 What is a draft tube? Why it is fitted at the exit of reaction turbines? Derive (10)
an expression for efficiency of conical draft tube.

OR

Q.4 Calculate the diameter and speed of the runner of a Kaplan turbine (10)
developing 6000 kW under an effective head of 5 m. The overall efficiency
of the turbine is 90%. The diameter of the boss is 0.4 times the external
diameter of the runner. The turbine speed ratio is 2.0 and flow ratio 0.6. What
is the specific speed of the turbine?

Q.5 a) With the help of a neat sketch, explain the construction and working of (05)
reaction steam turbine.
b) Write a steady flow energy equation for a nozzle. What is use of nozzle in a (05)
steam turbine?

OR

Q.6 a) What are the facture to be considered for selection of steam turbines? (05)
b) With the help of a neat sketch explain velocity compounded impulse turbine. (05)

Q.7 a) With the help of a neat sketch, explain component parts of a centrifugal (05)
pump. Also working of a centrifugal pump.
b) Write a short note on: Centrifugal pump troubles and remedies. (05)

P.T.O.

OR

- Q.8** Explain following characteristic curves of a centrifugal pump: **(10)**
- i) Main characteristic curves
 - ii) Operating characteristic curves
 - iii) Constant efficiency curves
 - iv) Constant head and discharge curves

- Q.9** A centrifugal air compressor stage has the following data: **(10)**
- Type of impeller : radial tipped
Impeller tip diameter : 48 cm
Eye tip diameter : 24 cm
Eye hub diameter : 12 cm
Mass – flow rate : 8 kg /s
Slip factor rate : 0.92
Stage efficiency : 0.77
Entry conditions : $P_{01} = 1.05$ bar, $T_{01} = 306$ K
- Determine: the air angles at the hub, mean and tip section of the inducer, total pressure ration developed and power required to drive the compressor.

OR

- Q.10 a)** Explain the pre-whirl losses and the concept of choking in centrifugal compressor. **(05)**
- b)** Give detailed classification of rotodynamic compressors. **(05)**

- Q.11** An axial flow compressor stage has the following data: **(10)**
- Temperature and pressure at entry: 300 K , 1.0 bar
Degree of reaction: 50%
Mean blade ring diameter : 36 cm
Rotational speed : 18000 rpm
Blade height at entry : 6 cm
Air angles at rotor and stator : 25°
Axial velocity: 180 m/s
Stage efficiency : 85%
Mechanical efficiency : 96.7%
- Determine:
- i) Air angles at the rotor and stator entry
 - ii) The mass-flow rate of air
 - iii) The power required to drive the compressor
 - iv) The pressure ratio developed by the stage
 - v) The Mach number at the for entry

OR

- Q.12 a)** Derive an expression for stage efficiency or an axial flow compressor. **(05)**
- b)** Explain stage losses in axial flow compressor. **(05)**

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