

CS/B.Tech/ME/EVEN/SEM-6/ME-605C/2015-16



**MAULANA ABUL KALAM AZAD UNIVERSITY OF
TECHNOLOGY, WEST BENGAL**
Paper Code : ME-605C
TURBOMACHINERY

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own
words as far as practicable.*

GROUP - A
(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following :

$10 \times 1 = 10$

- i) Choked flow through nozzle refers to the condition when
- a) normal shock wave
 - b) sonic velocity occurs at exit
 - c) mass flow rate through nozzle is maximum
 - d) enthalpy drop is maximum.

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- ii) At stagnation point of a flow field, the value is zero for
- a) pressure
 - b) velocity
 - c) temperature
 - d) none of these.
- iii) The vanes of centrifugal pump are generally
- a) radial
 - b) curved backward
 - c) curved forward
 - d) twisted.
- iv) The use of draft tube in reaction turbine helps to
- a) preventing air from entering
 - b) increase the flow rate
 - c) convert the kinetic energy to pressure energy
 - d) eliminating eddies in the down stream.
- v) Kaplan turbine is used for
- a) low head high discharge
 - b) high head high discharge
 - c) low head low discharge
 - d) high head low discharge.

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- vi) Efficiency of pelton wheel shall be maximum if the ratio of jet velocity to tangential velocity of wheel is
- a) $\frac{1}{2}$ b) 1
- c) 2 d) 4.
- vii) The function of diffuser in centrifugal compressor is
- a) to increase the velocity of air
- b) to decrease the velocity of air
- c) to neither increase nor decrease the velocity of air
- d) to increase the pressure of air.
- viii) The specific speed (N_S) of a turbine is given by
- a) $N_S = \frac{N\sqrt{P}}{H^{3/4}}$ b) $N_S = \frac{N\sqrt{Q}}{H^{3/4}}$
- c) $N_S = \frac{N\sqrt{P}}{H^{5/4}}$ d) $N_S = \frac{NP^{5/4}}{\sqrt{H}}$
- ix) Efficiency of the jet of water having velocity v striking a series of vertical plates moving with A velocity u is given by
- a) $\eta = \frac{2v(v-u)}{u^2}$ b) $\eta = \frac{2u(v-u)}{v^2}$
- c) $\eta = \frac{u(v-u)}{v^2}$ d) none of these.

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- x) To produce a high head by multistage centrifugal pumps, the impellers are connected
- a) in parallel
- b) in parallel and in series both
- c) in series
- d) none of these.

GROUP - B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

- Calculate the Mach number & Mach angle of the mach cone produced by an ICBM moving at 7500 km/h. Temperature of ambient air is -10°C . Assume $R = 287 \text{ J/kg-k}$ and $\gamma = 1.4$.
- An air compressor has eight stages of equal pressure ratio 1.35. The flow rate through the compressor & its overall efficiency are 50kg/s & 82% respectively. If the conditions of air at entry are 1.0 bar & $t_1 = 40^\circ\text{C}$. Determine the state of air at the compressor exit. Take $\gamma = 1.4$.

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4. Define cavitation. What are the effects of cavitation ?
Give the necessary precautions against cavitation.
5. Show that the exit of reaction turbine pressure is less than the atmospheric pressure.
6. Derive an expression for Bernoulli's equation when the process is adiabatic.

GROUP - C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. In a tidal power plant, a bulb turbine (which is basically an axial flow turbine) operates a 5MW generator at 150 r.p.m. under a head of 5.5 m. The generator efficiency is 93% and the overall efficiency of the turbine is 88%. The tip diameter of the runner is 4.5 m and the hub diameter is 2 m. Assuming hydraulic efficiency of 94% and no exit whirl, determine the vane angles at inlet and at exit at the mean diameter of the vane.

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8. a) Define stagnation point and explain stagnation velocity and stagnation pressure.
b) Find the Mach number when an aeroplane is flying at 900 km/hour through still air having a pressure of 8.0 N/cm^2 and temperature -15°C . Take $k = 1.4$ and $R = 287 \text{ J/kgK}$. Calculate the pressure, temperature and density of air at the stagnation point on the nose of the plane. 3 + 12
9. a) Write the purposes of the draft tube. Draw the neat sketch of important types of draft tube used in the turbine.
b) What do you mean by the governing of the turbine ? Explain the Governing of impulse Turbine with a sketch. 7 + 8
10. The cylinder bore diameter a single acting reciprocating pump is 150 mm and its stroke is 300 mm. The pump runs at 50 r.p.m. and lifts water through a height of 25 m, the delivery pipe is 22 m long and 100 mm in diameter. Find the theoretical discharge and the theoretical power required to run the pump. If the actual discharge is 4.2 liters/s, find the percentage slip. Also determine the acceleration head at the beginning and the middle of the delivery stroke.

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11. a) Explain the term 'dynamic similarity'. Mention the significance and composition of the dimensionless parameters Reynolds number and Mach number.
- b) The efficiency η of a fan depends on density ρ , dynamic viscosity μ of the fluid, angular velocity ω , diameter D of the rotor and the discharge Q . Express η in terms of dimensionless parameters.

7 + 8

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