# Bihar Engineering University, Patna
## B.Tech. 5th Semester Examination, 2023

Course: B.Tech.
Code: 102501

*Subject: Fluid Machinery*

Time: 03 Hours
Full Marks: 70

**Instructions:-**
(i) The marks are indicated in the right-hand margin.
(ii) There are NINE questions in this paper.
(iii) Attempt FIVE questions in all.
(iv) Question No. 1 is compulsory.

**Q.1** *Choose the correct answer of the following (Any seven question only):* [2 x 7 = 14]

(a) The force exerted by a jet of water on a stationary vertical plate in the direction of jet is given by
(i) $\rho a V$      (ii) $\rho a V^2$      (iii) $\rho a^2 V$      (iv) $\rho a V^3$.

(b) The force exerted by a jet of water on a moving vertical plate, in the direction of motion of plate is given by
(i) $\rho a V^2$      (ii) $\rho a V^3$      (iii) $\rho a (V - u)^2$      (iv) $\rho a (V - u)^3$

(c) When a steady jet impinges on a fixed inclined surface
(i) the flow is divided into parts proportional to the angle of inclination of the surface
(ii) no force is exerted by the jet on the vane
(iii) the momentum component is unchanged parallel to the surface
(iv) none of the above

(d) For an impulse turbine which of the following statements is *correct*:
(*i*) It makes use of a draft tube
(*ii*) It is not exposed to atmosphere
(iii) It is most suited for low head installations
(*iv*) It operates with initial complete conversion of pressure head to velocity head.

(e) Which of the following statements is correct in case of a Pelton wheel:
(i) It can operate at optimum efficiency at all high speeds
(ii) It is kept entirely submerged in water below the tail race.
(iii) It gives optimum efficiency at runaway speed.
(iv) It operates by converting the available energy fully into kinetic energy before entering the rotor.

(f) Francis turbine is
(i) an impulse turbine
(iii) an axial flow turbine
(ii) a radial flow impulse turbine
(iv) a reaction radial flow turbine.

(g) With respect to a reciprocating pump which of the following statements is *incorrect*
(i) The limiting value of separation pressure head for water is 6·8 m (absolute).
(ii) During suction, the separation may take place at the beginning of suction stroke.
(iii) During delivery, the separation may take place at the end of delivery stroke.
(iv) Indicator diagram shows variation of pressure head in the cylinder for one revolution of crank.

(h) Reciprocating pumps are most suited where
(i) constant heads are required on mains despite fluctuation in discharge
(ii) operating speeds are much high
(iii) constant supplies are required regardless of pressure fluctuations
(iv) none of the above.

(i)      Cavitation can take place in case of
        (i) Pelton Wheel                           (ii) Tangential Flow Turbine
        (iii) Reciprocating Pump                  (iv) Centrifugal Pump

(j)      Governing of turbine means
        (i) The head is kept constant under all condition of working.
        (ii) The speed kept constant under all condition
        (iii) The discharge is kept constant under all condition.
        (iv) None of the above

**Q.2**     Derive Euler's equation of motion of a fluid and deduce that to Bernoulli's equation.     [14]

**Q.3**    (a)     A 75 mm diameter jet having a velocity of 30 m/s strikes a flat plate, the normal     [7]
               of which is inclined at 45° to the axis of the jet. Find the normal pressure on the
               plate,
               (i) When the plate is stationary;
               (ii) When the plate is moving with a velocity of 15 m/s in the direction of jet,
               away from the jet.
               Also determine the power and efficiency of the jet when the plate is moving.

       (b)     Prove that for a curved radial vane the efficiency is given by     [7]

$$\eta = \frac{2(V_{w1}u_1 \pm V_{w2}u_2)}{V_1^2}$$

**Q.4**     Explain impulse-momentum principle. Derive impulse momentum-equation for a fluid.     [14]

**Q.5**    (a)     What is cavitation? Discuss the effect of cavitation. How can it be avoided in     [7]
               reaction turbines?

       (b)     What is governing of turbine and how it is accomplished for different types of     [7]
               water turbines?

**Q.6**     What is model analysis? Write the advantages of model analysis. Discuss various model     [14]
        laws applied in model analysis.

**Q.7**    (a)     Describe the principle and working of a reciprocating pump.     [7]
       (b)     A single-acting reciprocating pump, running at 50 r.p.m. delivers 0.00736 m³/s of     [7]
               water. The diameter of the piston is 200 mm and stroke length 300 mm. The
               suction and delivery heads are 3.5 m and 11.5 m respectively. Determine:
               (i) Co-efficient of discharge,
               (ii) Percentage slip of the pump, and
               (iii) Power required to run the pump

**Q.8**    (a)     Define centrifugal pump. Explain the working of single stage centrifugal pump     [7]
               with neat sketch.

       (b)     The diameter of the centrifugal pump which is discharging 0.03 m³/s of water     [7]
               against total head of 20 m is 0.4 m. The pump is running at 1500 rpm. Find the
               head, discharge and ratio of power of geometrically similar pump of diameter
               0.25 m when it is running at 3000 rpm.

**Q.9**     Explain briefly (*any four*):     [3½ x4=14]
       (a)     Scale effect
       (b)     The term 'negative slip' as referred to reciprocating pumps
       (c)     Net Positive Suction Head (NPSH)
       (d)     Draft Tube
       (e)     Priming of Centrifugal Pump