

Roll No \_\_\_\_\_

## Fluid Machinery

Subject Code: BTME-603

Time: 3 Hours

Maximum Marks: 60

Note: Section A is compulsory consisting of Ten questions carrying two marks each. Section B contains five questions carrying five marks each and students have to attempt any four questions. Section C contains three questions carrying ten marks each and students have to attempt any two questions.

## Section A

1. (a) What are the various assumptions made in impact of free jets.
- (b) Define jet ratio.
- (c) What is scale effect.
- (d) Define thomas cavitation number.
- (e) Define slip in centrifugal pumps.
- (f) Draw discharge vs crank angle diagram for double acting reciprocating pumps.
- (g) What are the different types of draft tubes.
- (h) What is the function of air vessels in pumps.
- (i) Name the various components of a hydraulic power plant.
- (j) Define degree of reaction.

## Section B

2. Show that the maximum efficiency for the jet strikes at flat plates mounted on the periphery of a wheel is fifty percent.
3. A single jet pelton wheel runs at 300 rpm under a head of 510 m. the jet diameter is 200 mm, its deflection inside the bucket is  $165^\circ$  and its relative velocity is reduced by 15% due to friction. Find (i) water horsepower (ii) resultant force on the bucket (iii) break power if mechanical losses are 3% of power supplied and overall efficiency. Assume values for the velocity coefficient 0.98 and speed ratio 0.46.
4. Differentiate between inward flow reaction turbine and outward flow reaction turbine.
5. A centrifugal pump having 35 cm outlet diameter and 18 cm inlet diameter is to deliver water against a net head of 25 m at the design speed of 1200 rpm. The width of impeller wheel at outlet is 6 cm and the flow velocity is constant from inlet to outlet. The entry is radial and the impeller vanes are bent back at  $30^\circ$  to the tangent at outlet. Presuming a hydraulic efficiency of 90%, make calculations for the width of the impeller at inlet, the angle of vane tip at inlet and the discharge from the pump.

6. A single acting reciprocating pump has a stroke length of 15 cm, the suction pipe is 7 m long and the ratio of suction pipe diameter to the plunger diameter is  $\frac{3}{4}$ . The water level in the sump is 2.5 m below the axis of the pump cylinder and the pipe connecting the sump and pump cylinder is 7.5 cm diameter. if the crank is running at 75 rpm, determine the pressure head on the piston at the beginning, mid and end of the suction stroke. Take friction coefficient 0.1.

### Section C

7. Explain construction and working of hydraulic intensifier and differential accumulator.

8.(a) Derive the equation for specific speed of Pelton turbine.

(b) A hydraulic turbine is to develop 845 kW when running at 100 rpm under a net head of 10 m. Work out the maximum flow rate and specific speed for the turbine if the overall efficiency is 92%. In order to predict its performance, a 1:10 scale model is tested under a head of 6 m. What would be the speed, power output and water consumption of the model if it runs under the conditions similar to the prototype.

9. What is the purpose of draft tube in hydraulic turbine and how does it operate? Francis turbine develops 365 kW at an overall efficiency of 80% when working under a static head of 5 m, the draft tube being cylindrical and of diameter 2.5 m. What increase in power and efficiency of the turbine would you expect if a tapered draft tube having an inlet diameter of 4 m and efficiency of conversion of 90% is substituted for the cylindrical one. It may be presumed that head speed and discharge remain constant.

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