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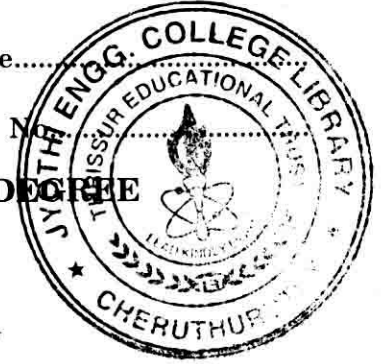
# FOURTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION, APRIL 2014

(2009 Scheme)

ME 09 405/PTME 09 404—FLUID MACHINERY

Time : Three Hours                                                    Maximum : 70 Marks

## Part A

*Answer **all** the questions.*

1. State the applications of impulse-momentum equation.

2. What is meant by dynamic similarity ?

3. Give the comparison between impulse and reaction turbines.

4. What is priming ? Why is it necessary ?

5. What is negative slip in reciprocating pump ?

(5 × 2 = 10 marks)

## Part B

*Answer any **four** questions.*

6. Derive an expression for the force exerted by a jet of water on stationary curved plate when jet strikes the plate at the centre.

7. Describe the Rayleigh's method for dimensional analysis.

8. Prove that hydraulic efficiency of a Pelton wheel is maximum when the velocity of the wheel is half the velocity of jet of water at inlet.

9. A Kaplan turbine develops 22000 kW at an average head of 35 m. Assuming a speed ratio of 2, flow area of 0.6, diameter of the boss equal to 0.35 times the diameter of the runner and an overall efficiency of 88 %, calculate the diameter and speed of the turbine.

10. Derive an expression for the work done by the impeller of a centrifugal pump on liquid.

11. Describe with neat sketch, the working of an air lift pump.

(4 × 5 = 20 marks)

**Turn over**

### Part C

*Answer **all** the questions.*

12. (a) A jet of water having a velocity of 45 m/s. impinges without shock on a series of vanes moving at 15 m/s. The direction of motion of the vanes is inclined at 20° to that of the jet, the relative velocity at outlet is 0.9 of that at inlet, and absolute velocity of water at exit is to be normal to the motion of vanes. Find :

    (i) Vane angles at inlet and outlet ;

    (ii) Work done on vanes per newton of water supplied by the jet ; and

    (iii) Hydraulic efficiency.

*Or*

12. (b) A small ship is fitted with jets of total area 0.65 m². The velocity through the jet is 9 m/s. and speed of the ship is 18 km/h. in sea water. The efficiencies of the engine and the pump are 85 % and 65 % respectively. If the water is taken amid-ship, determine :

    (i) Propelling force.

    (ii) Overall efficiency

Assume the pipe losses to be 10 % of the kinetic energy of the jets.

13. (a) A Pelton wheel is to be designed for the following specifications :

    Power (brake or shaft) = 9560 kW.

    Head = 350 m.

    Speed = 750 r.p.m.

    Overall efficiency = 85 %.

    Jet diameter = not to exceed 1/6 th of the wheel diameter.

    Determine the following :

    (i) The wheel diameter ;

    (ii) Diameter of the jet ; and

    (iii) The number of jets required.

Take $C_v$ = 0.985, speed ratio = 0.45

*Or*

(b) An inward flow reaction turbine has an external diameter of 1 m. and its breadth at inlet is 250 mm. If the velocity of flow at inlet is 2 m/s, find weight of water passing through the turbine per second. Assume 10 per cent of the area of flow is blocked by blade thickness. If the speed of the runner is 210 r.p.m. and guide blades make an angle of 10° to the wheel tangent, draw the inlet velocity triangle and find :

   (i) The runner vane angle at inlet ;

   (ii) The velocity of wheel at inlet ;

   (iii) The absolute velocity of water leaving the guide vanes ; and

   (iv) The relative velocity of water entering the runner blade.

14. (a) A centrifugal pump impeller runs at 80 r.p.m. and has outlet vane angle of 60°. The velocity of flow is 2.5 m/s. throughout and diameter of the impeller at exit is twice that at inlet. If the manometric head is 20 m. and the manometric efficiency is 75 per cent, determine :

   (i) The diameter of the impeller at the exit ; and

   (ii) Inlet vane angle

*Or*

(b) A three stage centrifugal pump has impellers 400 mm. in diameter and 20 mm. wide at outlet. The vanes are curved back at the outlet at 45° and reduce the circumferential area by 10 %. The manometric efficiency is 90 % and the overall efficiency is 80 %.The pump is running at 1000 r.p.m. and delivering 0.05 m³/s. Determine :

   (i) Head generated by the pump ; and

   (ii) Shaft power required to run the pump.

15. (a) A single-acting reciprocating pump has a stroke length of 150 mm. suction pipe is 7 m. long and the ratio of suction pipe diameter to the piston is ¾. 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 75 mm. in diameter. If the crank is running at 75 r.p.m, determine the pressure head on the piston at the beginning, middle and end of the suction stroke. Take friction co-efficient, $f = 0.01$.

*Or*

(b) Explain with the aid of neat sketch the construction and working of a rotary vane pump. Also discuss its performance characteristics.

(4 × 10 = 40 marks)