



Reg. No. :

Name :

Fourth Semester B.Tech. Degree Examination, May 2015
(2013 Scheme)
13.405 : FLUID MACHINERY (M)

Time : 3 Hours

Max. Marks : 100

PART – A

(Answer **all** questions in Part **A** and **one full** question from **each** module in Part **B**.)

1. What is a draft tube ? Why is it used in a reaction turbine ?
2. Differentiate between inward and outward flow reaction turbine.
3. Define the term unit power.
4. What is manometric efficiency ?
5. How can cavitation be prevented in hydraulic machines ?
6. Define negative slip of reciprocating pump.
7. Describe the function of an air vessel.
8. Differentiate between hydraulic accumulator and differential accumulator.
9. State the conditions which lower the volumetric efficiency.
10. Explain the term degree of reaction.



(10×2=20 Marks)

PART – B

(**Each full** question carries **20** marks.)

Module – I

11. a) Derive an expression for work done by the jet of water on a single curved plate when the plate is moving in the direction of jet. 10
- b) A Pelton wheel is to be designed for a head 60 m when running at 200 rpm. The Pelton wheel develops 95.6475 kW shaft power. The velocity of the buckets = 0.45 times the velocity of the jet, overall efficiency = 0.85 and co-efficient of the velocity is equal to 0.98. 10

OR

P.T.O.



12. a) By means of a neat sketch explain the governing mechanism of Impulse turbine. 8
- b) A Kaplan turbine runner is to be designed to develop 7357.5 kW shaft power. The net available head is 5.50 m. Assume that the speed ratio is 2.09 and flow ratio is 0.68 and the overall efficiency is 60%. The diameter of the boss is $1/3^{\text{rd}}$ of the diameter of the runner. Find the diameter of the runner, its speed and its specific speed. 12

Module – II

13. a) Obtain an expression for the work done by impeller of a centrifugal pump on water per second per unit weight of water. 8
- b) The outer diameter of an impeller of a centrifugal pump is 400 mm and outlet width 50 mm. The pump is running at 800 r.p.m. and is working against a total head of 15 m. The vanes angle at outlet is 40° and manometric efficiency is 75%. Determine :
- i) Velocity of flow at outlet,
 - ii) Velocity of water leaving the vane,
 - iii) Angle made by the absolute velocity at outlet with the direction of motion at outlet, and
 - iv) Discharge. 12

OR

14. a) Explain the principle and working of centrifugal pump with a neat sketch. 10
- b) A centrifugal pump with 1.2 m diameter runs at 200 r.p.m. and pumps 1880 l/s the average life being 6 m. The angle which the vanes make at exit with the tangent to the impeller is 26° and the radial velocity of flow is 2.5 m/s. Determine the manometric efficiency and the least speed to start pumping against a head of 6 m, the inner diameter of the impeller being 0.6 m. 10

Module – III

15. a) Draw an indicator diagram, considering the effect of acceleration and friction in suction and delivery pipes. Find an expression for the work done per second in case of a single-acting reciprocating pump. 10



b) A single-acting reciprocating pump has a plunger 100 mm diameter and a stroke length of 200 mm. The centre of the pump is 4 m above the water level in the sump and 14 m below the level of water in a tank to which water is delivered by the pump. The diameter and length of suction pipe are 40 mm and 6 m while of the delivery pipe are 30 mm and 18 m respectively. Determine the maximum speed at which the pump may be run without separation, if separation occurs at $7.848 \times 10^4 \text{ N/m}^2$ below the atmospheric pressure. Take atmospheric pressure head = 10.3 m of water.

10

OR

16. a) What is a hydraulic intensifier ? Explain its principle and working.

8

b) The cylinder of a single-acting reciprocating pump is 150 mm in diameter and 300 mm in stroke. The pump is running at 30 r.p.m. and discharge water to a height of 12 m. The diameter and length of the delivery pipe are 100 mm and 30 m respectively. If a large air vessel is fitted in the delivery pipe at a distance of 2 m from the centre of the pump, find the pressure head in the cylinder.

i) At the beginning of the delivery stroke, and

ii) In the middle of the delivery stroke. Take $f = 0.01$.



Module – IV

17. a) Derive an expression for the work done by single stage reciprocating air compressor, when compression is

i) Isothermal and

ii) Adiabatic

8

b) Air at a temperature of 300 K flows in a centrifugal compressor running at 18000 r.p.m. The other data given is as follows : Isentropic efficiency = 0.76, Outer diameter of blade tip = 550 mm, Slip factor = 0.82. Calculate : i) The temperature rise of air passing through the compressor, ii) The static pressure ratio. Assume that the absolute velocities of air at inlet and exit of the compressor are same. Take $C_p = 1.005 \text{ kJ/kg K}$.

12

OR



18. a) Describe with a neat sketch the construction and working of a centrifugal compressor stage. 8
- b) A single acting two stage compressor with complete intercooling delivers 10.5 Kg/min of air at 16 bar. The suction occurs at 1 bar and 27°C . The compression and expansion processes are reversible, polytropic index $n = 1.3$. Calculate : i) The power required to drive the compressor, ii) The isothermal efficiency, iii) The free air delivery, iv) The heat transferred in intercooler when the compressor runs at 440 r.p.m. and v) If the clearance ratio for L.P. and H.P. cylinders are 0.04 and 0.06 respectively, calculate the swept and clearance volumes for each cylinder. 12

