# Indian Maritime University

(A Central University, Govt of India)

**End Semester Examinations- June-July 2019**

**B.Tech (Marine Engineering)**

**Semester – V**

**Fluid Mechanics – II**

**(UG11T1504 / UG11T2504)**

| | |
|---|---|
| **Duration: 3 Hrs** | **Max Marks: 100** |
| **Date: 17-07-2019** | **Pass Marks: 50** |

**Part – A**

**(Compulsory Question) (3x10 = 30 Marks)**

1 (a) State Model or Similarity Laws.

(b) State Froude's Model Law.

(c) Write and explain the formula for the pressure head due to the acceleration in a reciprocating pump.

(d) State the three uses of air vessel fitted to the reciprocating pumps.

(e) State the losses in a centrifugal pump.

(f) Define manometric efficiency and volumetric efficiency of a centrifugal pump.

(g) Explain in brief when the cavitation occurs in a centrifugal pump.

(g) Explain briefly the principle on which hydraulic impulse turbine works.

(i) Explain briefly the principle on which hydraulic reaction turbine works.

(j) State the two functions of a draft tube fitted to the water turbine.

**Part – B (14x5 =70 marks)**

**(Answer any five Questions)**

Q.2 (a) The force required to tow a 1:30 scale model of a motor boat in a lake at a speed of 2 m/s is 0.5 N. Assuming that the viscous resistance due to water and air is negligible in comparison with the wave resistance, calculate the corresponding speed of the prototype for dynamically similar conditions. What would be the force required to propel the prototype at that velocity in the same lake. (4+3)

(b) A ship 300 m long moves in sea–water, whose density is 1030 Kg/$m^3$. A 1:100 model of this ship is to be tested in a wind tunnel. The velocity of air in wind tunnel around the model is 30 m/s and resistance of the model is 60N. Determine the velocity of ship in sea-water and also the resistance of the ship in sea-water. The density of air is given as 1.24 Kg/$m^3$. Take

the kinetic viscosity of sea-water and air as 0.012 stokes and 0.018 stokes respectively. (4+3)

Q.3 (a) A torpedo shaped object, 900 mm diameter in to move in air at 60 m/s and its drag is to be estimated from tests in water on a half scale model. Determine the necessary speed of the model and the drag of full scale object if that of the model is 1140 N. Given properties Air viscosity = $1.86 \times 10^{-5}$ Ns/m$^2$, water viscosity = $1.01 \times 10^{-3}$ Ns/m$^2$, air density = 1.2 Kg/m$^3$, water density =1000 Kg/m$^3$. (7)

(b) The Impeller of a centrifugal pump has an external diameter of 450 mm and internal diameter of 200mm and it runs at 1440 r.p.m Assuming a constant radial flow through the impeller at 2.5 m/s and that the vanes at exit are set back at an angle of 25°, determine : (i) Inlet vane angle (ii) the angle, absolute velocity of water at exit makes with tangent (iii) The head of pump. (3+2+2)

Q.4 (a) A centrifugal pump is to discharge 0.118 m$^3$/s at a speed of 1450 r.p.m against a head of 25m. The impeller diameter is 250mm, its width at outlet is 50mm and manometric efficiency is 75 percentage. Determine: (i) the vane angle at the outer periphery of the impeller, (ii) the speed at which pump can be run without separation in the suction pipe. (4+3)

(b)The impeller of a centrifugal pump having an external and internal diameters 500 mm and 25 mm respectively, width at outlet 50 mm and running at 1200 r.p.m works against a head of 48 m. The velocity of flow through the impeller in constant and equal to 3.0 m/s. The vanes are set back at an angle of 40° at outlet. Determine: (i) Inlet vane angle, (ii) Work done by the impeller on water per second (iii) Manometric efficiency. (3+2+2)

Q.5 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 impeller at exit is twice that at inlet. If the manometric head is 20m and the manometric efficiency is 75 percent, Determine: (i) The diameter of the impeller at the exit, (ii) Inlet vane angle. (8+6)

Q.6 A single-acting reciprocating pump has a piston diameter of 100 mm and stroke length 200 mm. The length of diameter of suction pipe are 6.5 m and 50 mm respectively. If the suction lift of the pump is 3.2 m and separation occurs when pressure in the pump falls below 2.5 m of water absolute and manometer reads 763 mm of mercury, find the maximum speed at which pump can be run without separation in the suction pipe. (14)

Q.7 A Pelton wheel is receiving water from a penstock with a gross head of 510 m. One third of gross head is lost in friction in the penstock. The rate of flow of water through the nozzle fitted at the end of the penstock is 2.2 $m^3/s$. The angle of deflection of the jet is 165°. Determine; (i) The power given by water to the runner, (ii) Hydraulic efficiency of the Pelton wheel.

(8+6)

Q.8 A reaction turbine works at 450 rpm under a head of 120 m. Its diameter at inlet is 1.2 m and the flow area 0.4 $m^2$. The angles made by absolute and relative velocities at inlet are 20° and 60° respectively with the tangential velocity. Determine: (i) The volume flow rate, (ii) The power developed, (iii) The hydraulic efficiency. (6+4+4)

********