Total Pages—5

B.Tech-6
FDHM

Set-2

Full Marks : 70

Time : 3 hours

Answer **Q. No. 1** and any **five** out of the remaining seven questions

The figures in the right-hand margin indicate marks

1. Answer *all* questions : 2 × 10

(*a*) Explain with a suitable example the advantage of dimensional analysis.

(*b*) Why do you resort to model study ?

(*c*) Show the boundary layer growth over one side of a flat plate along with velocity profiles.

(*d*) Why and where do you use draft tubes ?

(*e*) What is cavitation ? When does it occur ?

(Turn Over)

(*f*) Explain the advantage of Kaplan turbine over other turbines.

(*g*) Define specific speed of a centrifugal pump. What is its application ?

(*h*) Draw the indicator diagram of a reciprocating pump showing the effects of acceleration and friction.

(*i*) Why is it desirable that water leaves the turbine runner radially ?

(*j*) Describe some methods of controlling boundary layer separation.

2. (*a*) How do you recognise superfluous variables in dimensional analysis ? 4

(*b*) The resisting force F of a supersonic plane during flight can be considered as dependent upon the length of the air craft l, velocity V, air viscosity μ, air density ρ and bulk modulus of air K. Express the functional relationship between these variables and the resisting force F. 6

3. (*a*) Explain the Magnus effect and Kutta Jokousky equation. 3

(*b*) What is an aerofoil ? On what factors does the total drag, of air foil depend ? Draw the pressure distribution on an air foil moving in a fluid. 7

4. (*a*) Explain the significance of Von-Karman integral momentum equation. 3

(*b*) A plate 0·5 m × 0·2 m has been placed longitudinally in a stream of crude oil which flows with a velocity of 6 m/s. Given that oil has a specific gravity 0·9 and kinematic viscosity 1 stoke, calculate the boundary layer thickness and shear, stress at the middle of the plate and the friction drag on one side of the plate. 7

5. (*a*) Why are spiral casings of varying area employed in Kaplan and Francis turbines ? 3

(*b*) A Francis turbine works at 450 r.p.m. under a head of 120 metres. Its diameter at inlet is 120 cm and the flow area is 0·4 m^2. The angles made by the absolute and relative

velocities at inlet are 20° and 60° respectively with the tangential velocity. Determine (*i*) the flow rate (*ii*) power developed and (*iii*) efficiency. Assume whirl at outlet to be zero. 7

6. (*a*) Draw the operating characteristic curves of a centrifugal pump. What is their application ? 3

(*b*) A centrifugal pump is running at 1000 rpm. The outlet vane angle is 45° and the velocity of flow at outlet is 2·5 m/s. The discharge through the pump is 0·2 m^3/s when it is working against a total head of 20 m. If the manometric efficiency of the pump is 80 percent, determine (*i*) diameter of the impeller and its width at outlet. 7

7. (*a*) Give a brief account of providing air vessels in a reciprocating pump. 4

(*b*) Show that the work saved in overcoming friction in pipe lines by fitting air vessels is 84·8% for single acting and 39·2% for double acting pumps. 6

8. Describe any *two* of the following with neat sketches : 5 × 2

(*a*) governing of a reaction turbine

(*b*) hydraulic intensifier

(*c*) hydraulic press.