# Heat Power Engineering (CBCS Pattern) M.Tech. Third Semester CBCS <br> PHPS32x - Elective-III : Advanced Fluid Mechanics 

P. Pages: 2

GUG/W/18/11056
Time : Three Hours

* 3174 *

Max. Marks : 70

Notes: 1. All questions carry equal marks.
2. Due credit will be given to neatness and adequate dimensions.
3. Assume suitable data wherever necessary.
4. Illustrate your answers wherever necessary with the help of neat sketches.
5. Answer any five questions.

1. a) Define the following.
i) Vapour pressure
ii) Kinematic viscosity.
iii) Capillary depression
iv) Dynamic viscosity
b) If the velocity distribution over a plate is given by $u=\frac{2}{3} y-y^{2}$ in which $u$ is the velocity in meter per sec. at a distance y meter above the plate, determine the shear stress at $\mathrm{y}=0$ \& $\mathrm{y}=0.15 \mathrm{~m}$ take dynamic viscosity of fluid as 8.63 poise.
c) Define surface tension. Prove that the relationship between surface tension \& pressure The Pipe A contains a liquid of Sp. gravity 1.2 while pipe B contains a liquid of Sp. gravity 0.8 . The pressures at A \& B are 1 bar \& 1.8 Bar respectively. Find the difference in mercury level in the differential monometer.

b) A 1 m wide \& 1.5 m deep rectangular plane surface lies in water in such a way that its plane makes an angle of $30^{\circ}$ with the free surface of water. Determine the total pressure \& center of pressure when upper edge is 0.75 m below the free surface of water.
2. a) A solid cylinder 4 m in diameter \& 4 m high is floating in water with its axis vertical. If its Sp. gravity is 0.6 . Find the metacentric height. Also state whether the equilibrium is stable or not.
b) Explain the terms:
i) Metacentric height
ii) Meta-centre
iii) Center of buoyancy.
3. a) What is the irrotational velocity field associated with the potential $\phi=3 x^{2}-3 x+3 y^{2}+16 t^{2}+12 z t$. Does the flow field satisfy the the incompressible continuity equation?
b) A reservoir discharges through a rectangular orifice is 4 m below the water level in the reservoir, calculate the discharge through the orifice. The Coeff of discharge of the orifice is 0.62 . What would be the percentage error if the orifice were to be treated as a small orifice.
4. a) Explain with the help of neat sketch Kinetic energy correction factor \& momentum correction factor.
b) State \& prove Bernoulli's equation. Also list the assumptions \& limitations.
5. a) Water flows through a triangular right angle weir first \& then over a rectangular weir of 1.1 m width. The discharge coeff. of triangular \& rectangular weirs are $0.65 \& 0.75$ respectively. If the depth of water over the triangular weir is 365 mm . Calculate the depth of water over the rectangular weir.
b) Find the discharge through a trapezoidal notch which is 1 m wide at the top \& 0.4 m at the bottom \& is 0.3 m in height. The head of water on the notch is 0.2 m . Assume cd for rectangular notch as $0.62 \&$ that for triangular notch as 0.6 .
6. a) Explain the following terms:
i) Equivalent pipe.
ii) Syphon.
iii) Major losses in pipes \& fittings.
b) The rate of flow of water through a horizontal pipe of $0.3 \mathrm{~m}^{3} / \mathrm{sec}$. The diameter of the pipe is suddenly enlarged from 250 mm to 500 mm . The pr. intensity in the smaller pipe is $13.734 \mathrm{~N} / \mathrm{cm}^{2}$. Determine $\rightarrow$
i) Loss of head due to sudden enlargement.
ii) Pr. intensity in the large pipe
iii) Power lost due to enlargement
7. a) Find the displacement thickness, the momentum thickness \& energy thickness for the velocity distribution in the boundary layer is given by $\frac{u}{U}=2\left(\frac{y}{\delta}\right)-\left(\frac{y}{\delta}\right)^{2}$ where
$\delta \rightarrow$ Boundary layer thickness
$\mathrm{U} \rightarrow$ free stream velocity
$\mathrm{u} \rightarrow$ velocity in boundary layer at distance ' y '
b) Write short notes on any two.
i) Boundary layer separation.
ii) Pitot tube
iii) Lift force, Drag force \& Resultant force.
