R13

Code No: 113BK

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech II Year I Semester Examinations, December-2014
FLUID MECHANICS
(Common to CE, CEE)

Time: 3 Hours **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A.
Part B consists of 5 Units. Answer any one full question from each unit.
Each question carries 10 marks and may have a, b, c as sub questions.

Part- A **(25 Marks)**

1.a) State Newton's law of Viscosity. What is the kinematic viscosity? [2M]

b) Calculate the capillary rise in a glass tube of 3 mm diameter when immersed in water. Both the liquids being at 20^0C and the values of the surface tensions for water and mercury at 20^0C in contact with air are respectively $0.0075\frac{kgf}{m}$ and $0.0562\frac{kgf}{m}$. [3M]

c) What is stream function and velocity potential? [2M]

d) A stream function is given by $\Psi = 29x - 54y + 24x^2 + 56y^2$. Calculate the velocity components at any point. [3M]

e) What are the different types of forces acting on fluid in motion? [2M]

f) What is momentum correction factor? State its significance. [3M]

g) Consider an object of characteristics length, moving with velocity V, through a fluid of mass density ρ, viscosity μ, and modulus of elasticity K. Perform dimensional analysis to find the value of coefficient of drag C_D, and coefficient of lift C_L. [2M]

h) Define momentum thickness and energy thickness. [3M]

i) How friction factor varies with Reynold's number? [2M]

j) Write a complete equations for head loss including minor losses in a given arrangements shown in figure 1. [3M]

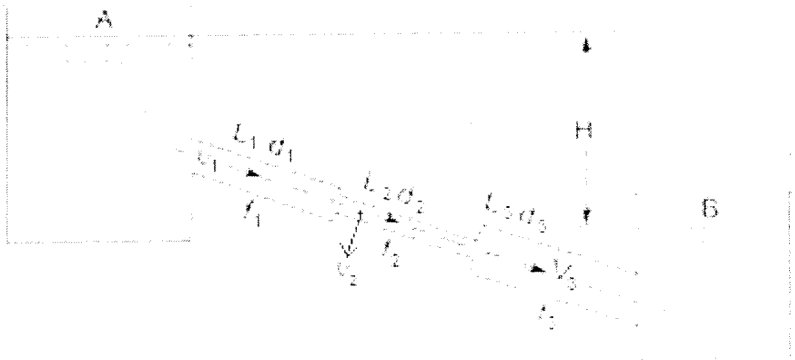

Figure: 1

Part- B (50 Marks)

2.a) What is vapor pressure? How it is related to saturation pressure?

b) A rectangular tanker carrying water as shown in figure 2. is being slowly accelerated. What is the maximum possible acceleration that can be given if the water does not spell over the edge?

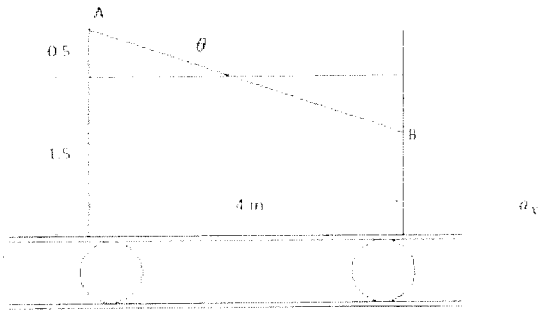

Figure: 2

OR

3.a) A concrete dam shown in figure 3 retains water to a depth of 25 m. the face of the dam in contact with water is vertical for the first 8 m and there after it is inclined at an angle of 15^0 to the vertical in order to increase the thickness of the dam towards the base. Determine the magnitude and direction of the resultant water pressure of the water per metre length of the dam and the depth of its point of application of the face of the dam.

b) If the concrete weighs 33.8 KN m^{-3}, determine:
i) the point of application of the resultant of the water pressure and the weight of the dam, on the basis of the dam; and
ii) normal stresses at the toe and heel of the dam.

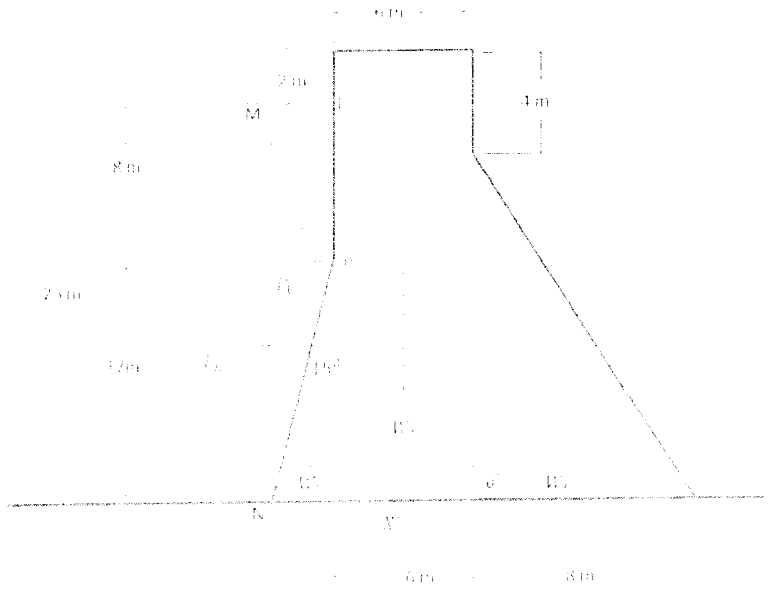

Figure: 3

4.a) Derive an expression for continuity equation in Cylindrical polar co-ordinate system.

b) The velocity components of the two-dimensional lane motion of a fluid are

$$u = \frac{8xy}{\left(x^2+y^2\right)^2} \text{ and } v = \frac{y^2-x^2}{\left(x^2+y^2\right)^2}$$

Show that the fluid is incompressible and flow is irrotational.

OR

5.a) Distinguish between:
i) rotational and irrotational flows
ii) one, two and three dimensional flows
iii) compressible and incompressible flows.

b) What are the limitations of flow net? Briefly explain the use of flow net.

6.a) Derive Euler's equation of motion along a streamline.

b) Derive an expression for measuring the discharge of fluid across triangular notch.

OR

7.a) Derive an expression for measuring the discharge of fluid from venturimeter through a pipe.

b) A rectangular notch of crest width 0.6 m is used to measure the flow of water in a rectangular channel 0.8 m wide and 0.6 m deep. If the water level in the channel is 0.3 above the weir crest, find the discharge in the channel. For the notch assume C_d 0.7 and the velocity of approach is taken to be into account.

8.a) What are the different methods available for controlling of boundary layer? Explain any two with neat sketches.

b) Draw variation of drag and lift coefficients with angle α for Joukowski airfoil of an infinite span where α is angle of attack which is the inclination of the tangent to the lower boundary of the profile.

OR

9.a) Derive an expression for momentum integral equation of the boundary layer.

b) Find the displacement thickness, the momentum thickness and energy thickness for the distribution in the boundary layer given by

$$\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$$

10.a) Three pipes of 300 mm, 200 mm and 400 mm diameters have a length of 300 mm, 170 mm and 200 mm respectively. They are connected in series to make a compound pipe. The ends of this compound pipes are connected with two tanks whose difference of water level is 15 m. If coefficients of friction for these pipes are equal to 0.005, 0.0048 and 0.0065 respectively, determine the discharge through compound pipe neglecting first the minor losses and then including them.

b) For the figure 4, draw the hydraulic gradient line and total energy line.

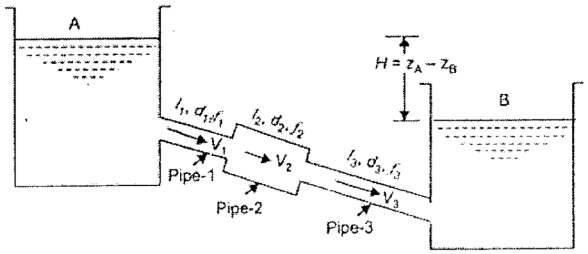

Figure: 4

OR

11.a) A pipe line of 0.7 m diameter is 2 km long. To increase the discharge, another line of same diameter is introduced parallel to the first in the second half of the length. Neglecting the minor losses, find the increase in discharge if $4f = 0.04$. The head at the inlet is 400 mm.

b) For a pipe network shown in below figure, determine the flow in each pipe. The head loss $h_f = KQ^2$. The value of K for each pipe is indicated in given figure 5.

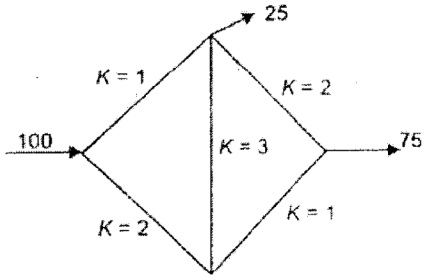

Figure: 5

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