(3 hours) **Total marks : 80**

N.B:(1)Question no. 01 is compulsory.

(2)Attempt any 3 questions out of the remaining 5 questions.

(3)Assume data wherever necessary and clearly mention the assumption made.

(4)Draw neat figures as required.

Q1 : Attempt any Four **(20)**

a) Explain boundary layer separation .
b) Explain the terminal velocity of a body.
c) Derive conditions for most economical trapezoidal channel.
d) Explain specific energy curve with neat sketch.
e) Differentiate Keneddy's and Lacey's theory for alluvial channel.

Q2:-

a) For velocity profile for laminar boundary $\frac{u}{U} = \frac{3}{2}(\frac{y}{\delta}) - \frac{1}{2}(\frac{y}{\delta})^3$. **(10)**
Determine the boundary layer thickness , shear stress , drag force and co-efficient of drag in terms of Reynold number.

b) Water is flowing over a thin smooth place of length 4m and width 2 m at a velocity of 1.0 m/s. If the boundary layer flow changes from laminar to turbulent at a Reynold number 5×10^5 , Find (i) the distance from leading edge upto which boundary layer is laminar , (ii) the thickness of the boundary layer at the transition point , and (iii) the drag force on one side of the plate . Take viscosity of water $\mu = 9.81 \times 10^{-4}$ Ns/m^2 . **(10)**

Q3:-

a) A cylinder whose axis is perpendicular to the stream of air having a velocity of 20 m/s , Rotates at 300 r.p.m. The cylinder is 2 m in diameter and 10 m long . (a)Find : (i)the circulation ,(ii) theoretical lift force per unit length , (iii) position of stagnation points . and (iv)the actual lift , drag and direction of resultant force. Take density of air 1.24 kg/m^3. For actual drag and lift , take C_L = 3.4 , C_D = 0.65 and u_θ /U = 1.57 . (b) Find the speed of rotation of the cylinder which will give only a single stagnation point. **(10)**

b) (i)Calculate the diameter of a parachute to be used for dropping an object of mass 100 kg so that the maximum terminal velocity of dropping is 5 m/s . The drag co-efficient for the parachute which may be treated as hemispherical is 1.3 . the density of air is 1.216 kg/m^3. **(5)**

(ii) An airfoil of chord length 2m and span 15m has an angle of attack as 6^0 . The airfoil is moving with a velocity of 80 m/s in air whose density is 1.25 kg/m^3. Find the weight of the airfoil and the power required to drive it. The values of co-efficient of drag and lift corresponding to angle of attack are given as 0.003 and 0.0 respectively. (5)

Q4:-

a) A trapezoidal channel has side slopes 1 to 1 . It is required to discharge 13.75 m^3/s of water with a bed gradient of 1 in 1000. If unlined the value of Chezy's C is 44 . If lined with concrete ,its value is 60. The cost per m^3 of excavation is four times the cost per m^2 of lining. The channel is to be the most efficient one. Find whether the lined canal or the unlined canal will be cheaper. What will be the dimensions of that economical canal ? **(10)**

b) Derive an expression for depth of hydraulic pump. **(10)**

Q5:-

a) Derive Vor Karman momentum integral equation. **(10)**

b) Determine the length of the back water curve caused by an afflux of 1.5 m in a rectangular Channel of width 50 m and depth 2.0 m . The slope of the bed is given as 1 in 2000 . Take Manning's , N=0.03 **(10)**

Q6:-

a) A stable channel is to be designed for a discharge of 40 m^3 /s and silt factor 1 . calculate the dimensions of the channel using Lacey's regime equation. Also calculate the dimensions of the channel if it were to be designed on the basis of Kennedy's method with critical velocity ratio equal to 1 , and the ratio of bed width to depth if flow is same as obtained from Lacey's method. **(10)**

b) (i)The ratio of flow through a circular channel of diameter 0.6 m is 150 liter/s. Find the Slope of the bed of the channel for maximum velocity . Take C=60 **(05)**

(ii)Find the slope of the free water surface in a rectangular channel of width 20 m, having Depth of flow 5m . the discharge through the channel is 50 m^3/s . The bed of the channel is having a slope of 1 in 4000. Take the value of Chezy's constant c=60. **(05)**

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