

S-746

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S.E. (Civil) (Part-II) (Semester-IV) Examination, Dec. - 2013

FLUID MECHANICS - II

Sub. Code : 43590

Day and Date : Saturday, 14 - 12 - 2013

Total Marks : 100

Time : 02.30 p.m. to 05.30 p.m.

- Instructions :
- 1) Question Nos. 1 and 5 are compulsory.
  - 2) Attempt any other two questions from each section.
  - 3) Assume any other data, if necessary.
  - 4) Figures to the right indicate full marks.

SECTION - I

Q1) Attempt any Four:

[20]

- a) A channel is of rectangular section. It is to carry 15 cumecs of water with a velocity of 2.5 m/s. Design the most economical section for the channel. Take Chezy's constant as  $70 \text{ m}^{1/2}/\text{s}$ . Also, calculate the necessary slope for bed of the channel.
- b) Prove that in an open channel minimum specific energy at a given section occurs, when Froude number is unity.
- c) Discuss with a neat sketch a resulting gradually varied surface profile when a mild sloped channel meets with steep sloped channel.
- d) What is hydraulic jump ? Discuss the use of hydraulic jump as energy dissipating device.
- e) A tank is 3m x 2m in plan and is provided with a triangular  $90^\circ$  notch. Find how long it will take for the head of water to change from 300mm to 100mm, if there is no inflow to the tank. Take  $C_D = 0.62$ . Prove the formula used.

- Q2) a) The Froude number of flow in a rectangular channel is 0.6. If the depth of flow is 2.2m, find the critical depth and minimum specific energy. [5]
- b) Derive discharge formula for maximum discharge over a board crested weir. [5]

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- c) A sharp edged weir is in the form of a symmetrical trapezium. The horizontal base is 200mm. The top is 450mm and the depth is 250mm. Find the discharge over the weir when the head of water over the weir crest is 150mm. Take  $C_D = 0.62$ . [5]
- Q3) a) Derive the basic differential equation which governs the GVF. State the assumptions made. [7]
- b) A very wide rectangular channel conveys a discharge of  $3.25 \text{ m}^3/\text{s}/\text{m}$  at a normal depth of 2.50m. The bed slope is 1:5000. Due to weir placed across the channel the water level is raised by 1.50m just upstream of it. Find at what distance upstream of the weir the depth of water will be 3m. Take  $C = 52$ . Use step method and take single step. Also sketch and classify the type of water surface profile. [8]
- Q4) a) Derive the formula for loss of energy head in a hydraulic jump in terms of conjugate depths. [5]
- b) A hydraulic jump takes place in a rectangular channel with initial and sequent depths of 0.6m and 2.4m respectively. Determine (i) the discharge per meter width, (ii) Efficiency of jump. [5]
- c) A cippoletti weir with crest width of 400mm discharge water, the head over the crest being 250mm. If the approach channel is 600mm wide and 450mm deep, find the discharge considering velocity of approach. Take  $C_D = 0.623$ . [5]

### SECTION - II

- Q5) Attempt any four from the following. [20]
- a) Show that the maximum efficiency of a wheel with series of semicircular vanes can reach upto 100% theoretically. Practically why it is not possible?
- b) Comment on heads and efficiencies of pump.
- c) Distinguish between reaction turbine and impulse turbine. Draw sketch of each one type of turbine.
- d) What is Boundary Layer separation ? What are the effects ? How to control separation ?

- e) What do you mean by Drag & lift ? Give some practical examples related to these terms ?
- Q6) a)** A jet of water 7.5cm diameter having velocity of 20 m/s, strikes normally a flat smooth plate find the force on the plate when  
 i) Plate is stationary      ii) Plate is moving with velocity 5 m/s  
 Find also work done per second and efficiency. [5]
- b) Draw and explain inlet and outlet velocity triangles of a asymmetrical moving curved plate when jet strikes tangentially. [5]
- c) What is cavitation ? What are its possible locations in pumps and turbines ? Give the necessary precautions against cavitation. [5]
- Q7) a)** Draw a neat sketch of a centrifugal pump and explain its working. [5]
- b) Draw main and operating performance characteristic curves and constant efficiency curves for a centrifugal pump. [5]
- c) What is specific speed of a turbine ? Derive an expression for it. What is its significance ? [5]
- Q8) a)** The velocity distribution in the boundary layer is given by  $u/v = 3/2(n) - 1/2(n)^2$ , where  $n = y/\delta$  compute  $\delta^*/\delta$  and  $\theta/\delta$ , where  $\delta^*$  is displacement thickness and  $\theta$  is momentum thickness. [5]
- b) Write a short note on Hydrodynamically smooth and rough boundaries. [5]
- c) A kite having 10 KN weight has effective area  $0.6\text{m}^2$  & makes an angle of  $20^\circ$  to horizontal in air. The string attached to the kite makes  $45^\circ$  to horizontal.  $C_D = 0.6$ ,  $C_L = 0.8$ . Find the speed of the air & tension in string. Take mass density of air as  $1.25\text{ Kg/m}^3$ . [5]

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