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M – 6076

Reg. No. : .....

Name : .....

Fourth Semester B.Tech. Degree Examination, December 2021

13.404 — FLUID MECHANICS – II (C)

(2013 Scheme)

Time : 3 Hours

Max. Marks : 100

## PART – A

Answer all questions. Each question carries 4 marks.

- I. (a) What do you understand by critical, Sub-critical and super critical flow in open channel?
- (b) Differentiate between gradually varied flow and rapidly varied flow.
- (c) Explain the separation of boundary layer.
- (d) Explain the cavitation in centrifugal pump.
- (e) Write a short note on draft tube theory.

(5 × 4 = 20 Marks)

## PART – B

Answer one full question from each Module. Each full question carries 20 marks.

## Module – I

- II. (a) Design a concrete lined channel to carry a discharge of  $600 \text{ m}^3/\text{sec}$  at a slope of 1 in 3000. The side slopes of channel may be taken as 1:1. The Manning's roughness co-efficient for the lining is 0.014. Assume the permissible velocity in the section as  $3 \text{ m}/\text{sec}$ . 12

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- (b) A triangular gutter, whose sides include an angle of  $60^\circ$ , conveys water at a uniform depth of 3.5 m. If the slope of the bed is 1 in 1000 find the rate of flow of water. Take Chezy's constant  $C = 55$ . 8

OR

- III. (a) A 4.0 m wide rectangular channel carries water to a depth of 1.5 m. In order to measure the discharge, the channel width is reduced to 2m and a hump of 0.3m height is provided at the bottom. Calculate the discharge if water surface in the contracted section drops by 0.20 m. Assume no losses. 10
- (b) A 4 m wide rectangular channel discharges  $10 \text{ m}^3/\text{s}$  of water with a velocity of 5 m/s. Will a hydraulic jump occur? If so determine the height, length and type of the jump. What is the loss of energy per kg of water? 10

**Module – II**

- IV. (a) A rectangular flume 2.2 m wide carries discharge at the rate of  $2 \text{ m}^3/\text{s}$ . The bed slope of the flume is 0.0004. At a certain section the depth of flow is 1 m. Calculate the distance of the section downstream where the depth of flow is 0.9 m. Solve by single step method. Assume rugosity co-efficient as 0.014. Is the slope of the channel mild or sleep? How is this type of surface profile classified? 10
- (b) Determine the approximate water surface slope (m/km) at a point in a rectangular channel in which the discharge is 0.9 cumec, the bed width is 3 m, depth of flow is 0.75 m and the bed slope is 0.2 m/km. Assume  $C$  in Chezy's formula as 55 and take energy coefficient  $\alpha$  equal to unity. 10

OR

- V. (a) The depth and velocity of flow in a rectangular channel are 0.8 m and 2 m/s respectively. If a gate at the downstream end of the channel is closed abruptly, what will be the height and absolute velocity of the resulting surge? If the channel is 920 m long, how much time will be required for the surge to reach the upstream end of the channel? 12
- (b) In a rectangular channel of width 24m and depth of flow 5m, the rate of flow of water is  $80 \text{ m}^3/\text{sec}$ . If the bed slope of the channel is 1 in 3000, find the slope of the free water surface. Take Chezy's constant  $C = 60$ . 9



### Module – III

- VI. (a) The performance of a lubricating oil ring depends on the inside diameter of the ring  $d$ , shaft speed  $N$ , oil discharge  $Q$ , density  $\rho$ , viscosity  $\mu$ , surface tension  $\sigma$  and specific weight  $\omega$  of the fluid. Find the functional relationship in terms of dimensionless parameters. 12
- (b) A 1:65 model is constructed of an open channel in concrete which has Manning's  $N = 0.014$ . Find the value of  $N$  for the model. 8

OR

- VII. (a) Find the ratio of friction drag on the front half and rear half of the flat plate kept at zero incidence in a stream of uniform velocity, if the boundary layer is laminar over the whole plate. 10
- (b) In the boundary layer over the face of a high spillway, the velocity distribution was observed to have the following form:  $\frac{u}{U} = \left(\frac{y}{\delta}\right)^{0.22}$ . The free stream velocity  $U$  at a certain section was observed to be 25 m/s and boundary layer thickness of 50 mm. The discharge is 5 m<sup>3</sup>/s per metre length of spillway. Calculate displacement thickness, thickness and loss of energy. 10

### Module – IV

- VIII. Design a pelton wheel which is required to develop 1500 kw, when working under a head of 160m at a speed of 420 r.p.m. The overall efficiency may be taken as 85% and assume other data required. 20

OR

- IX. (a) A four stage centrifugal pump has impellers 400 mm diameter and 20 mm wide at outlet. The outlet vane angle is 45° and the vanes occupy 8% of the outlet area. The manometric efficiency is 85% and the overall efficiency is 75%. Determine the head generated by the pump when running at 1000 r.p.m and discharging 60 litres/sec. Also determine the power required to drive the pump. 10
- (b) A centrifugal pump of the radial type delivers 4000 litres per minute against a total head of 40 m when running at a speed of 1500 r.p.m. If the outer diameter of the impeller is 300 mm and its width at the outer periphery is 14 mm, find the exit angle taking manometric efficiency as 85%. 10

(4 × 20 = 80 Marks)

