Model Question

FOURTH SEMESTER B.Tech DEGREE EXAMINATION
(2013 Scheme)

13.404 Fluid Mechanics- II (C)

Time : Three Hours Maximum : 100 Marks

Part A

*Answer **all** questions. Each question carries 4 marks.*

I. a) Differentiate between alternate depths and conjugate depths.
b) Sketch the water surface profiles that can occur in a mild slope channel.
c) Explain the characteristics of laminar and turbulent boundary layers.
d) Differentiate between distorted & undistorted models.
e) Explain the function of a surge tank in a hydroelectric plant.
(**5 x 4 = 20 Marks**)

Part B

*Answer any **one** full question from each module. Each full question carries 20 marks*

Module I

II. a) An irrigation channel of trapezoidal section, having side slopes 3 H to 4 V, is to carry a flow of 10 cumecs on a longitudinal slope of 1 in 5000. The channel is to be lined for which the value of friction coefficient in Manning's formula is 0.012. Find the dimensions of the most economical section of the channel **(10 marks)**

b) A rectangular channel 3.5m wide is laid on a slope of 0.0005. Calculate the normal depth of flow for a discharge of $5m^3/s$ in this channel. Take manning's n as 0.02. **(10 marks)**

OR

III. a) A trapezoidal channel has a bottom width of 6 m and side slopes of 2 horizontal to vertical. If the depth of flow is 1.2m at a discharge of 10 m^3/s, compute the specific energy and the critical depth. **(12 marks)**

b) A stationary hydraulic jump occurs in a rectangular channel with the initial and sequent depths being equal to 0.2m and 1.2m respectively. Estimate i) the discharge per unit width and ii) the energy loss. **(8marks)**

Module II

IV. a) Derive the differential equation for gradually varied flow, stating the assumptions involved **(10 marks)**

b) In a gradually varied flow in a rectangular channel of bottom width 3m, the discharge is $8m^3/s$ and the depth of flow changes from 1.4m at section A to 1.05m at section B. Calculate the average energy line slope between these sections. Take Manning's n as 0.018. **(10 marks)**

OR

V. a) A rectangular channel 4m wide carries a discharge of $12m^3/s$ at a depth of 2m. Calculate the height and velocity of a surge produced when the flow is suddenly stopped by the complete closure of a sluice gate at the downstream end. **(10 marks)**

b) The depth and velocity of flow in a rectangular channel are 1m and 1.5m/s respectively. If the rate of inflow at the upstream end is suddenly doubled, what will be the height and absolute velocity of the resulting surge and the celerity of the wave? **(10 marks)**

Module III

VI. (a) The velocity distribution in the boundary layer is given by $u/U = 2(y/\delta) - (y/\delta)^2$, δ being boundary layer thickness, u is the velocity at a distance y from plate and $u = U$ at $y = \delta$. Find (i) the displacement thickness, (ii) the momentum thickness and (iii) the energy thickness. **(10 marks)**

(b) A plate of 600mm length and 400mm wide is immersed in a fluid of specific gravity 0.9 and kinematic viscosity 10^{-4} m^2/s. The fluid is moving with a velocity of 6m/s. Determine i) boundary layer thickness ii) shear stress at the end of the plate, and (iii) drag force on one side of the plate. **(10 marks)**

OR

VII. (a) Derive on the basis of dimensional analysis suitable parameters to present the thrust developed by a propeller. Assume that the thrust P depends upon the angular velocity ω, speed of advance V, diameter D, dynamic viscosity μ, mass density ρ, elasticity of the fluid medium which can be denoted by the speed of sound in the medium C. **(12 marks)**

(b) In the model test of a spillway, the discharge and velocity of flow over the model were $2m^3/s$ and 1.5m/s respectively. Calculate the velocity and discharge over the prototype which is 36 times the model size. **(8 marks)**

Module IV

VIII. (a)A jet of water having a velocity of 45m/s impinges without shock a series of vanes moving at 20^0 to that of the jet. The relative velocity at outlet is 0.9 of that at inlet and the absolute velocity of the water at exit is normal to the motion of the vanes. Find i) the vane angles at entrance and exit ii) the hydraulic efficiency. **(10 marks)**

(b) A Pelton wheel working under a head of 800 m develops 15MW running at 600rpm with an overall efficiency of 85%. The ratio of wheel diameter to jet diameter is 15, the coefficient of velocity for the nozzle is 0.97 and the speed ratio is 0.46. Make calculations for the rate of flow, diameter of wheel and number of jets. **(10 marks)**

OR

IX. (a) The diameter of an impeller of a centrifugal pump at the inlet and outlet are 30cm and 60cm respectively. The velocity of flow at outlet is 2.5m/s and the vanes are set back at angle of 45^0 at outlet. Determine the minimum starting speed if the manometric efficiency is 75%. **(10 marks)**

(b) A centrifugal pump is to discharge $0.118m^3/s$ at a speed of 1450 rpm against a head of 25m. The impeller diameter is 250mm, its width at outlet is 50mm and manometric efficiency is 75%. Determine the vane angle at the outer periphery of the impeller. **(10 marks)**