



JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular/Backlog), April-May 2015

B. Tech in Civil Engineering, Semester IV...

Roll No.....

CE 406:Fluid Mechanics-II

Time: 3 hours

Max. Marks: 100

Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.

Q.1A	Objective type multiple choice questions (10 questions @ 1 mark)	10
i.	In 1 in 50 model of a spillway, discharge is $3 \text{ m}^3/\text{sec}$. Find the corresponding discharge in the prototype in m^3/sec	
ii.	In a submerged orifice flow, the discharge is proportional to which one of the following parameters? (a) Square root of the downstream head (b) Square root of the upstream head (c) Square of the upstream head (d) Square root of the difference between upstream and downstream heads	
iii.	A model of a boat is built to a scale of 1/100. It experiences a resistance of 0.10 N when simulating a speed of 5 m/s of the prototype. Water is the fluid in both the cases. Neglecting frictional forces, corresponding resistance in the prototype is: (a) 1000 kN (b) 10 kN (c) 100 kN (d) 1 kN	
iv.	The performance of a hydraulic structure during a flood has been investigated in a 1/25 model based on Froude law of similarity. A flood wave passing through the model in 2 hrs. corresponds to a prototype period of: (a) 50 hr (b) 12.5 hr (c) 10 hr (d) 0.4 hr	
v.	For a hydraulically efficient rectangular section the ratio of width to normal depth is (a) 0.5 (b) 1.0 (c) 2.0 (d) $2\sqrt{3}$	
vi.	A 1: 25 model of a naval ship is towed at a velocity of 1.2 m/s to determine each of the two components of the total drag of that may be experienced by the prototype. The wave making drag of the model is duly estimated to be 0.37 kgf. What would wave making drag on the prototypes ship? (a) 1250.44 kgf (b) 1875.22 kgf (c) 5781.25 kgf (d) 4625.98 kgf	
vii.	A1:256 scale model of a reservoir is drained in 4 minutes by opening the sluice gate. The time required to empty the prototype will be:	
viii	Coefficient of contraction is the ratio of (a) actual velocity of jet at vena contracta to the theoretical velocity (b) loss of head in the orifice to the head of water available at the exit of the orifice (c) actual discharge through an orifice to the theoretical discharge (d) area of jet at vena contracta to the area of orifice	

ix	The Reynold's number of a ship is _____ to its velocity and length. (a) directly proportional (b) inversely proportional	
x	The discharge over a rectangular notch is (a) inversely proportional to $H^{3/2}$ (b) directly proportional to $H^{3/2}$ (c) inversely proportional to $H^{5/2}$ (d) directly proportional to $H^{5/2}$	
Q.2	Short answer type questions (4 questions @ 2.5 marks)	10
i.	Determine the two depth having specific energy of 1.83 m for 2.80 m ³ /s-m.	
ii.	A model of a torpedo is tested in a towing tank at a velocity as 26 m/s whilst the prototype is run at 6.5 m/s. What model scale has been used? for water $\nu = 1.13 \times 10^{-4} \text{ m}^2/\text{s}$.	
iii.	Define the velocity distribution in open channel with diagram.	
iv.	Derive the expression for Most Economical section for Trapezoidal channel.	
Q.3A	Derive the differential equation for steady gradually varied flow in open channel and list all the assumptions: $\frac{dy}{dx} = \frac{Sb - S_o}{1 - \frac{Q^2 T}{g A^3}}$	05
Q.3B	What do you mean by dimensionless number .Define and explain Reynold's number, Froude number and Mach number. Based on the two model laws obtain the scale ratios for length, velocity and time.	05
Q.4A	Explain the term hydraulic jump .Derive an expression for the depth of hydraulic jump in terms of the upstream Froude number.	05
Q.4B	Draw and explain the specific energy diagram for various constant and show the alternate and critical depth.	05
Q.5A	A spillway model is to be built to a geometrically similar scale of 1/50 across a flume of 600 mm width. The prototype is 15 m high and maximum head on it expected to be 1.5 m. 1. What height of model and what head on the model should be used? 2. If the flow over the model a particular head is 12 l/s, what flow per meter length of the prototype is expected? 3. If the negative in the model is 200 mm, what is the negative pressure in the prototype? It is practicable?	05
Q.5B	An orifice meter having orifice diameter of 10cm is fitted in a 200 mm dia. pipe which is laid horizontally. The manometer reads 30cm of height of mercury. Determine the discharge of oil flow of sp.gr. 0.8 .consider coeff. of discharge 0.6.	05
Q.6A	What do you understand by 'Flow in open channel'? Differentiate between (i) Steady and unsteady flow (ii) laminar and turbulent flow and (iii) critical, subcritical and supercritical flow in open channel.	05
Q.6B	A trapezoidal channel with a base width of 6 m and side slope of 2H: 1V carries a flow of 60 m ³ /s at a depth of 2.5 m. there is smooth transition to a rectangular	05

Section 6 m wide accompanied by gradual lowering of the channel bed by 0.6m. find the depth of water within the rectangular section and the change in the water surface level. what is amount by which the bed must be lowered for the upstream flow to be possible as specified?

OR

Q.6B Find the expression for the thrust F on the propeller of a ship or a motor boat. This thrust will be a function of ρ and μ of the liquid and diameter d , speed of advance v and rotational speed n of the propeller. 05

Q.7A A trapezoidal channel made out of brick with bottom width 2 m, bottom slope 0.001 is to carry 17 m³/s. calculate the dimension of channel such that least number of brick are required. $n=0.0125$. 05

Q.7B A rectangular weir channel 1.3 m wide has a rectangular weir at the end. if the length of the weir is 1.1 m and its sill is 0.3 m from the bottom find the discharge when the measured head over the crest is 0.3 m. take $C_d = 0.65$ and $\alpha = 1.20$. 05

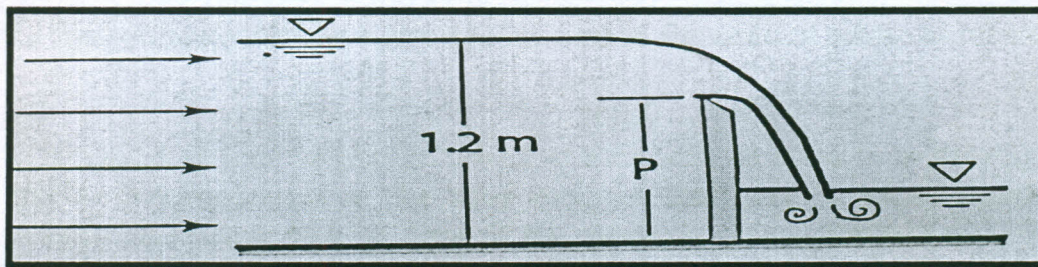
OR

Q.7B How are weir classified? Define velocity of approach. derive an equation for discharge over a rectangular weir taking velocity of approach. 05

Q.8A State the chezy's, bazin, kutter and manning formulas for uniform flow through a channel. differentiate between open channel flow and pipe flow. Why is bed slope provided in channel flow? 05

Q.8.B A district has a drainage area of 10 square kilometer with a population of 4000 per square km. the daily water supply to the district is 175 liter per head. During dry weather it is found that 8 percent of the total water supply passes along the sewer between the hours 12 noon and 1 PM. Assuming a maximum rainfall of 2 cm in 24 hours over the whole area determine the diameter of the circular sewer which will carry the maximum dry weather flow and the rainfall without the sewer becoming more than half full. Assume bed slope 1 m in 2500 and chezy's constant $C = 60 \text{ m}^{1/2}/\text{S}$. 05

Q.9A 10



An engineer is considering the feasibility of a small hydroelectric power plant, and she wishes to design a rectangular weir to measure the discharge of a small creek. The weir will span creek, which is 1.5 m wide, and engineer estimates that the maximum discharge will be 0.5 m³/s. if the creek level cannot rise above 1.2m. Calculate the height of the weir.



Q.9B	A spillway discharge a flood flow at a rate of $7.75 \text{ m}^3/\text{s}$ per meter width. At the downstream horizontal apron the depth of flow was found to be 0.50 m . what tailwater depth is needed to from a hydraulic jump? If a jump is formed, find its (a) type (b) length (c) head loss (d) energy loss as percentage of initial energy and (e) profile.	(2×5)10
OR		
Q.9B	A wind-tunnel test is performed on a $1/20$ scale model of a supersonic aircraft. The prototype aircraft flies at 480 m/s in conditions where the speed of sound is 300 m/s and the air density is 1.0 kg/m^3 . The model aircraft is tested in a wind tunnel in which the speed of sound is 279 m/s and the air density is 0.43 kg/m^3 . The drag force on the model is 100 N . What speed must the flow in the wind tunnel be for dynamic similitude, and what is the drag force on the prototype?	10

