

# Mah. Civil Engineering services Main Exam - 2009

ASV

2009

106352

## CIVIL ENGINEERING (Paper III)

Time allowed : 3 Hours }

{ Maximum Marks : 200

### Note :

- (i) Solve one question from each section.
- (ii) If more than one question are attempted in a section, the excess will be ignored.
- (iii) Figures to the right indicate the number of marks for the question / sub-question.
- (iv) Make suitable assumptions, if necessary and state the same.
- (v) Use of log-tables, non-programmable calculators is permitted.
- (vi) Use of any kind of I.S. Codes and Steel Table Codes is NOT permitted.
- (vii) Candidate should not write roll number, any name (including their own), signature, address or any indication of their identity anywhere inside the answer book otherwise he/she will be penalised.

### SECTION - A

1. (a) Briefly explain classification of fluids based on viscosity. 12  
Calculate the capillary effect in mm in a glass tube 1 mm in diameter when it is immersed in water. Take surface tension of water as 0.08 N/m and angle of contact as zero. If the same tube is immersed in mercury of specific gravity 13.6 and surface tension of 0.5 N/m, angle of contact between glass and mercury 140°, what will be rise/depression in the level in the tube ?
- (b) What is meant by stability of a floating body ? Explain with reference to its metacentric height. 11  
A vertical sluice gate 4 m wide and 2 m deep is hinged at the top. Liquid of specific gravity 1.5 stands to a height of 2 m above the top of the gate on the upstream side. On the downstream side water stands to a height of 1m above the top of the gate. Find resultant force acting on the gate and point at which the resultant force acts.
- (c) Determine the stream function if the velocity components of a two dimensional incompressible fluid flow are given as : 11

$$u = \frac{y^3}{3} + 2x - x^2y$$

$$\vartheta = xy^2 - 2y - \frac{x^3}{3}$$

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2. (a) Explain the energy variation in a short hydraulic jump using specific energy equation. For a constant specific energy of 1.8 N-m/N calculate the maximum discharge that may occur in a rectangular channel 5.0 m wide. **12**
- (b) What are repeating variables? What points are important while selecting repeating variables? A pipe 50 mm diameter is 6 m long and the velocity of flow of water in the pipe is 2.4 m/s. What loss of head and corresponding power would be saved if the central 2 m length of pipe is replaced by 75 mm diameter pipe? The change of section is sudden. Take  $f=0.04$  for pipes of both diameters. **11**
- (c) What are different types of hydraulic jump. Mention uses of hydraulic jump. **11**
- A Hydraulic type of energy dissipater is designed to have energy loss of 8.5 m. The froude number upstream of the jump is 7.2. Find the sequent depths of flow. What is efficiency of jump?

## SECTION - B

3. (a) Describe the principle of working of a tipping bucket type raingauge with a neat sketch. What are its advantages and disadvantages? **12**
- (b) Define raingauge density. Explain various methods available for the estimation of missing precipitation records. **11**
- Raingauge station X did not function for a part of a month during which a storm occurred. The storm produced rainfall of 84, 70 and 96 mm at three surrounding stations A, B, and C respectively. The normal annual rainfalls at the stations X, A, B and C are 770, 882, 736 and 944 mm respectively. Estimate the missing storm rainfall at station X.
- (c) Discuss various factors affecting evapo transpiration. Explain the use of lysimeter in measuring evapo transpiration. **11**
4. (a) List the various methods of estimating flood. Describe the velocity area method used for stream gauging. What return period you would adopt in the design of a culvert on a drain if you are allowed to accept only 5% risk of flooding in the 25 years of expected life of the culvert. **12**
- (b) What is Unit Hydrograph. List the assumptions involved in the theory of Unit Hydrograph? What are the uses and limitations? **11**
- (c) Why is recharging of ground water necessary? Design a tube well for the following data. **11**
- Yield required = 0.08 cumec, thickness of confined aquifer = 30 m, radius of circle of influence = 300 m permeability coefficient = 60 m/day, drawdown = 5 m.

## SECTION - C

5. (a) Define irrigation and explain its necessity in a tropical country like India. What are the advantages and ill effects of assured irrigation ? 11
- (b) What is meant by Bandhara irrigation ? Give briefly the advantages and disadvantages of Bandhara irrigation. 11
- (c) A stream of 125 lit/s was diverted from a canal and 100 lit/s were delivered to the field. An area of 1.6 Hect was irrigated in 8 hours. Effective depth of root zone was 1.7 m. The runoff loss in the field was 420 cum. The depth of water penetration varied linearly from 1.7 m at the head end of the field to 1.3 m at the tail end. Available moisture holding capacity of the soil is 20 cm per metre depth of soil. Determine water conveyance water application, water storage and water distribution efficiencies. The irrigation was started at a moisture extraction level of 50% of the available moisture. 11
6. (a) List various causes of failures of earth dams. Explain the Swedish circle method of slope stability analysis. 11
- (b) What is the necessity of river training works ? What is meandering of rivers ? What are its causes ? Explain the role of cut-off in the meandering of rivers. 11
- (c) Differentiate between low gravity dam and a high gravity dam. How does the practical profile of a low gravity dam differs from that of the theoretical profile and why ? Discuss step by step the analytical procedure adopted for stability analysis of gravity dams. 11

## SECTION - D

7. (a) State the objects of widening pavements on horizontal curves ? Explain the factors on which the design of widening depends. 11
- Calculate the extra widening required for a pavement of width 7.0 m on a horizontal curve of radius 250 m, if the longest wheel base of vehicle expected on the road is 7.0 m. Design speed is 70 kmph.
- (b) Explain the engineering surveys needed for locating a new highway. Discuss the special care to be taken while aligning hill roads. 11
- (c) Discuss briefly the different causes of traffic accidents. Explain various measures that may be taken to prevent accidents. 11

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8. (a) Calculate the stresses at interior, edge and corner regions of a cement concrete pavement using Westergaard's stress equation using the following data. **11**
- Wheel load  $P = 4100$  kg.  
Modulus of elasticity of cement concrete  $= 3.0 \times 10^5$  kg/cm<sup>2</sup>.  
Pavement thickness = 15 cm.  
Poissons ratio for concrete = 0.15  
Modulus of subgrade reaction = 3.0 kg/cm<sup>3</sup>.  
Radius of contact area = 15 cm.
- (b) Specify the material required for the construction of WBM roads. Write down the construction steps for water bound macadam road. **11**
- (c) What are the advantages and disadvantages of traffic signals ? What are various types of signals ? Explain the various traffic signal systems used for co-ordination of signals in a road network. **11**

## SECTION - E

9. (a) What factors are taken into consideration for deciding the location of a bridge. List various methods of subsurface investigations. Give the data needed for the design of a bridge. **11**
- (b) Draw the sketch (plan and elevation) of a bridge showing its component parts ? Give function of each component. Give classification of permanent bridges. **11**
- (c) What is a cofferdam ? What are the requirements of a cofferdam ? What are the types of cofferdam ? **11**
10. (a) Explain the various problems encountered and their remedial measures to be taken during the well sinking. **11**
- (b) Describe with sketches the construction of superstructures of steel suspension bridge. List the items you will inspect for the maintainance of bridges. **11**
- (c) Write short notes on : **11**
- (i) IRC Bridge loading.
- (ii) Pope culvert, High level causeway.

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## SECTION - F

11. (a) Explain three different methods of forecasting the future population of a town. Explain the factors affecting the water demand. **11**
- (b) Give advantages and disadvantages of pressure filter. **11**  
Design set of three rapid gravity filters for treating water at a water works, which has to supply the water to a town of population 1,00,000. The per capita demand of the town is 270 lit/day. The rate of filtration of the rapid gravity filters may be taken as 4500 lit/hour/sq. m.
- (c) Explain the characteristics of following air pollutants. **11**  
Natural contaminant, Aerosols, Dust, Smoke, Mist.
12. (a) What are the various methods of disinfecting water ? What are the requirements of good infectants ? **11**
- (b) Write short notes on : **11**  
(i) Drop manhole.  
(ii) Layout of sewage treatment plant.
- (c) What is air pollution ? What are effects of air pollution ? Explain in brief air pollution control methods. **11**

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