Total No. of Questions : **03**

No. of Printed Pages : **08**

M-SFS-II-2017 (10)
CIVIL ENGINEERING
(Optional Subject)
Second Paper

Time : **3 Hours**]

[Total Marks : **200**

Instructions to the candidates :

1. This question paper consists of **three** questions and all questions are compulsory.

2. Marks for each question have been indicated on the right hand margin.

3. There is no internal choice in Question No. 1, remaining questions carry internal choice.

4. The first question is of very short-answer type consisting of **15** compulsory questions. Each one is to be answered in one or two lines. Question No. 2 is short answer type, word limit is **100**. Question No. 3 is long answer/Essay type, word limit is **300**.

5. Wherever word limit has been given, it must be followed to.

6. Question should be answered exactly in the order same as mentioned in the question paper. Answer to the various parts of the same question should be written together compulsorily and no answer of the other question should be inserted between them.
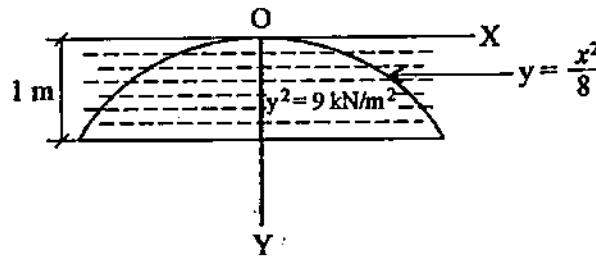
1. Answer the following short questions. $15 \times 4 = 60$

    (A) Determine the total force acting on one side of the plate OABCO submerged vertically in a fluid of unit weight 9 kN/m³ as shown in figure.

    (B) Define Duty and Delta of a crop. Give relation between them.

    (C) What is difference between infiltration and percolation ?

    (D) What is Darcy's Law ? Discuss the conditions of its validity.

    (E) Differentiate between dam and weir.

    (F) What do you mean by hydraulic jump ? What are its practical application ?

    (G) What do you mean by canal regulation structures ? Why is it necessary to provide these structures ?

    (H) What do you understand by water logging ? Write various conditions of water table governing degree of water logging.

    (I) What should be the value of dip at equator ? The Azimuth and magnetic bearing of a line AB is 60° 30' 20" and 40° 10' 30" respectively. What is the declination ?

    (J) What are check rails ? Write down the uses of check rails.

(K) Briefly mention the objectives of transition curves in a highway or railway alignment.

(L) What do you mean by afflux ? Write down the Molesworth formula for calculating afflux.

(M) Define average annual traffic and average daily traffic.

(N) What do you understand by Quick Sand Condition ? State the situation where this condition arise.

(O) A sample of saturated cohesionless soil tested in a drained triaxial compression test showed an angle of internal friction of 30°. Show the orientation of plane of failure on Mohr's Stress Circle. Calculate deviator stress at confining pressure of 200 kPa.

2. Answer the following questions : $10 \times 8 = 80$

(A) A model of submarine is sealed down to 1/20 of the prototype and is to be tested in a wind tunnel. The speed of the prototype at which we are to estimate the drag is 8 m/sec. What should be the free stream velocity of the air ? What will be the ratio of drag between model and prototype ?

Relevant data : $v_{sea\text{-}water} = 1.21 \times 10^{-2}$ cm/sec

$v_{air} = 1.64 \times 10^{-1}$ cm/sec

$\rho_{sea\text{-}water} = 1027$ kg/m^3

$\rho_{air} = 1.34$ kg/m^3

(B) A water channel has culturable command area of 1100 hectares. The intensity of crop A is 40% and crop B is 35%. Crop A has kor period of 20 days and crop B has kor period of 15 days. Determine the design discharge of the channel if kor depth for crop A is 11 cm and for crop B is 17 cm.

(C) Define drought. What are its causes ?

OR

Determine the thickness of boundary layer at the trailing edge of smooth plate of length 4 m and of width 1.5 m, when the plate is moving with a velocity of 4 m/s in stationary air. Take kinematic viscosity of air as $1.5 \times 10^{-5} \text{ m}^2/\text{s}$.

(D) A test well of 0.5 m diameter and two observation wells at a distance of 10 m and 60 m from the test well are drilled through an aquifer of 20 m average thickness overlain by an impermeable layer of 30 m thickness. After pumping at a rate of 0.1 m³/sec for a long time the following draw down is stabilised :

First observation well   4 m

Second observation well   3 m

Show the arrangement in a diagram. Determine the permeability. What is the draw down in the test well ?

(E) Check the safety of the dam against sliding, if the coefficient of friction between the base of the dam and founding structure is 0.75. The profile of the dam is shown in figure. The unit weight of concrete is 2.4 T/m³.

(F) What is cross drainage work in canal system ? In which situation necessity for providing syphon aqueduct arise ? Draw a typical sketch of syphon aqueduct and explain its function briefly.

(G) The field level book readings from a fly level are as follows :

Staff Station	RL	BS	FS	Remarks
BM-1	100.00	3.635	–	
A	X	X	2.375	
B	104.150	4.220	1.030	
C	106.650	3.990	X	
BM-2	108.00	–	X	

Find out the missing values marked (X) and perform arithmetic check-up.

(H) Write short notes on the following :

(i) Scabbing of rails

(ii) Wheel burns

(iii) Pre-cast rail sleepers

(I) The following are the data for designing a horizontal curve of a proposed highway passing through built up area in a plain terrain. The radius of curve is 400 m :

Design speed = 80 km/h

Length of wheel base of largest vehicle = 6.1 m

Pavement width = 10.5 m (3 lanes)

Find (a) Superelevation

      (b) Length of transition curve

      (c) Stopping sight distances

(J) Calculate the seepage through an earthen dam resting on impervious foundation. The relevant data are given below :

Height of dam = 60 m

Upstream slope = 2.75 : 1 (H : V)

Down stream slope = 2.5 : 1 (H : V)

Free board = 2.5 m

Crest width = 8.0 m

Length of drainage blanket = 120 m

Coefficient of permeability of the embankment earth in

    x-direction = 8×10^{-7} m/sec

    y-direction = 2×10^{-7} m/sec

3. Answer the following questions : $3 \times 20 = 60$

(A) A rectangular channel 2.4 m wide carries uniform flow of water at a rate of 7 cumec at a depth of 1.5 m. If there is a local rise of 15 cm in bed calculate the discharge in water level. What is maximum rise in bed that will be permissible so that there is no change in upstream flow ?

OR

Two straights T_1V and VT_2 having bearings of 45° 30' and 105° 30' respectively, are to be connected by a 4° curve (based on chord of 20 m). Due to inaccessible intersection, the following traverse is run from a point P on the rear tangents to a point S on the forward tangent.

Line	Length (m)	Bearing
PQ	110	60° 30'
QR	95	130° 45'
RS	185	30° 15'

The chainage of P is 1718.8 metres. Determine the chainage of PI, PC and PT.

(B) A cylindrical specimen of dry sand was tested in a triaxial test. Failure measured under a cell pressure of 1.2 kg/cm^2 and at a deviator stress of 4 kg/cm^2.

(i) What is the angle of shear resistance of the soil ?

(ii) What were the normal and shear stresses on failure plane ?

(iii) What angle did the failure plane maker with the minor principal plane ?

(iv) What was the maximum shear stress on any plane in the specimen at failure and how was the plane in question, oriented with the major principal plane ?

Calculate the above quantities with the help of Mohr's diagram.

(C) A retaining wall 6 m high retains sand with $\phi = 30°$ and $\gamma = 24$ kN/m^3 upto a depth of 3 m from top. From 3 m to 6 m the material is a cohesive soil with $C = 20$ kN/m^3 and $\phi = 20°$. Unit weight of cohesive soil is 18 kN/m^3. A uniform surcharge of 100 kN/m^2 acts on top of the soil. The force of the wall on earth side is vertical. Determine the total lateral force per unit length acting on the wall and its point of application.

———————