501762

Roll No.

Candidate should write his/her Roll No. here.

Total No. of Questions : **5** No. of Printed Pages : **7**

SEM–2017(02)–II

CIVIL ENGINEERING

Paper—II

Time : **3** Hours] [*Total Marks* : **300**

Instructions to the candidates :

Please read each of the following instructions carefully before attempting questions.

*Candidates should attempt **ALL** questions. Question No. **1** does not have internal choice, while Question Nos. **2** to **5** have internal choice.*

All questions carry equal marks. The number of marks carried by a part of a question is indicated against it.

*Answers must be written in **ENGLISH** only.*

Unless otherwise mentioned, symbols and notations have their usual standard meanings.

Assume suitable data, if necessary and indicate the same clearly.

Neat sketches may be drawn, wherever required.

All parts and sub-parts of a question are to be attempted together in the answer book.

Any pages left blank in the answer book must be clearly struck out.

Only non-programmable scientific calculator is allowed.

No codes/special publications/Tables published by BIS or otherwise are allowed.

1. Answer the following questions : 6×10=60

(a) What do you understand by seepage pressure and quicksand condition?

(b) Write short notes on the following :

(i) Thixotropy

(ii) Sensitivity

(iii) Activity

(c) Describe about the under-reamed piles.

(d) The following data refer to the proposed longitudinal section of runway :

End-to-end runway	*Gradient*
0·0 to 5·0 chains	+1·0%
5·0 to 15·0 chains	−1·0%
15·0 to 30·0 chains	+0·8%
30·0 to 40·0 chains	+0·2%

If one metric chain is of 20 mm length, determine the effective gradient of runway.

(e) Classify IRC class loadings as per IRC : 6 (1966) while designing highway bridge.

(f) Describe substructure, abutments and wing walls.

(g) Write notes on the following :

(i) Beacon lighting

(ii) Runway threshold lighting

(iii) Apron hangar lighting

(h) What are the factors affecting evaporation from water surfaces? Describe briefly the method of estimating the evaporation from weather data.

(i) A hydraulic structure is sized for a 50-year recurrence interval design discharge. What is the risk that the flow capacity will be exceeded during any future 20-year period? What is the probability that the 50-year recurrence interval peak flow rate will be exceeded in the next 50 years?

(j) What are different types of cross-drainage works that are required when a canal crosses a natural drainage? Draw an aqueduct showing all details.

2. Answer any *three* of the following questions : 20×3=60

(a) A raft foundation is supported by pile group consisting of 18 piles arranged in 3 rows. The diameter and length of each pile are 300 mm and 15 m. The spacing between the piles is 1·25 m. The foundation soil consists of a soft clay layer having cohesion as 30 kN/m^3 and unit weight of soil is 18 kN/m^3. Determine the capacity of the pile group. The factor of safety is 2·5. Take $\alpha = 0 \cdot 9$.

(b) Soil is to be excavated from borrow pit to make an embankment of 6 m height and 2 m top width with side slope of 1V :1H. The unit weight of undisturbed soil in moisture condition at pit is 18 kN/m^3 and its natural moisture content is 8%. The dry density required in embankment is 20 kN/m^3 with water content of 10%. The specific gravity of soil solid, G is 2·7. Estimate the quantity of soil required to be excavated from borrow pit for construction of 1 m length of embankment. If each truck has a capacity to carry 95 kN per trip, then what is the number of trips required to transfer soil from pit to the embankment?

(c) A 5 m high rigid retaining wall has to retain a backfill of dry cohesionless soil having the following properties :

Specific gravity, $G = 2 \cdot 68$
Poisson's ratio, $\mu = 0 \cdot 36$
Void ratio, $e = 0 \cdot 74$
Friction angle, $\phi = 30°$

(i) Determine the magnitude, point of application and resultant thrust, and also plot the earth pressure diagram.

(ii) Compute the % change in the lateral thrust, if the water table rises from a great depth to the top of the backfill.

(d) The following results were obtained from a laboratory tri-axial test with arrangements for pore pressure measurements :

Sample No.	*Cell pressure* $(kN/m^2) \times 10^{-2}$	*Deviator stress at failure* $(kN/m^2) \times 10^{-2}$	*Pore pressure at failure* $(kN/m^2) \times 10^{-2}$
1.	1·0	2·0	0·5
2.	1·5	2·2	0·6

Determine the shear parameters of the soil considering *(i)* total stresses and *(ii)* effective stresses.

3. Answer any *three* of the following questions : 20×3=60

(a) An intersection controlled by traffic signal is formed by two roads running north to south and east to west. There is a heavy turning movement of 500 vehicles per hour from south to east. The flow from north to south is 800 vehicles per hour through an approach width at stop line of 8 m. The cycle time is 70 seconds and the effective green time for the flow from north is 32 seconds. The effective right turning saturation flow is 450 vehicles per hour for an opposing flow of 800 vehicles per hour, related to minimum headway of 2½ seconds for the right turning stream. Calculate the early cut-off period required to allow for right turning movement.

(b) For a broad gauge track in a transition zone, in order to allow locomotives with a maximum permissible speed of 130 kmph, calculate the following :

(i) Radius of curvature

(ii) Degree of curvature

(iii) Superelevation

(iv) Length of transition

(c) For a given section of a road, the relationship between speed (u in kmph) and density (k in vehicle/km) is obtained as $u = 100 - 1 \times k$. Estimate the maximum flow, mean speed and mean density. Sketch the plots of three flow relationships and mark the values as obtained. State the significance of these values.

(d) On a two-way traffic road, the speed of overtaking and overtaken vehicles are 65 kmph and 40 kmph respectively. If the average acceleration of overtaking vehicle is 0·92 m/sec^2, determine—

(i) safe overtaking sight distance, indicating the details of overtaking operation by a sketch;

(ii) minimum length of overtaking zone;

(iii) desirable length of overtaking zone.

4. Answer any *three* of the following questions : 20×3=60

(a) During the passage of flood, the following data were estimated at two sections 500 m apart :

Section	*Water surface elevation* (in m)	*Area of flow section* (in m^2)	*Hydraulic mean depth* (in m)
Upstream (*P*)	85·233	91·746	2·835
Downstream (*R*)	85·176	84·354	2·917

The Eddy loss coefficient for gradual contraction is to be taken as 0·1 and for gradual expansion as 0·35. Estimate the flood discharge passing through the river reach. Take Manning's coefficient, $n = 0 \cdot 022$.

(b) Design an irrigation channel in an alluvial soil from the following data using Lacey's theory :

$Q = 15$ cumec

Silt factor, $f = 1$

Side slope $\frac{1}{2} : 1$

(c) Obtain a unit hydrograph for a basin of 315 km^2 of area using the rainfall and stream-flow data tabulated below :

Time (in hr)	0	1	2	3	4	5	6	7	8	9	10	11
Observed hydrograph (in m^3/sec)	100	100	300	700	1000	800	600	400	300	200	100	100

Time (in hr)	0–1	1–2	2–3	3–4
Gross precipitation (in cm/hr)	0·5	2·5	2·5	0·5

(d) An unlined irrigation canal has its bed and side composed of cohesionless material having mean diameter 6 mm. Angle of repose of the material is 40°. The bed width of the canal is 5 m and the side slope 1·5(H) : 1(V). Determine the minimum discharge that can be admitted into the canal without any sediment movement. Take longitudinal slope of the canal as 1 in 5000 and Manning's coefficient, n as 0·025.

5. Answer any *six* of the following questions : 10×6=60

(a) In falling head permeability test on a sample 0·122 m high and $44 \cdot 41 \times 10^{-4}$ m^2 in cross-section area, the water level in a standpipe of 6·25 mm internal diameter dropped from a height of 0·75 m to 0·247 m in 900 seconds. Find the coefficient of permeability.

(b) A 20 mm thick laboratory soil sample reaches 60% consolidation in 32·5 seconds under double drainage condition. How much time will be required for a 10 m thick layer in the field to reach the same degree of consolidation, if the clay layer is sandwiched between a sandy layer and an impermeable layer?

(c) For a flexible foundation with sides 2 m and 3 m and Young's modulus of soil, $E = 9 \cdot 8$ MPa and Poisson's ratio $\mu = 0 \cdot 37$, if the maximum possible elastic settlement at site is 15 mm, calculate the maximum possible axial load, P for this system. The influence factor, I is 0·68.

(d) Calculate the stresses at edge and corner region of the concrete pavement using Westergaard's stress equations, using the following data :

(i) Wheel load, $P = 80$ kN

(ii) Modulus of elasticity of cement concrete, $E = 3 \cdot 3 \times 10^7$ kN/m^2

(iii) Pavement thickness, $h = 0 \cdot 18$ m

(iv) Poisson's ratio of concrete, $\mu = 0 \cdot 15$

(v) Modulus of subgrade reaction, $k = 2 \cdot 5 \times 10^5$ kN/m^3

(vi) Radius of contact area, $a = 0 \cdot 12$ m

(e) What are the functions of railway stations? Describe the factors that influence the selection of site for railway station.

(f) Determine the radius of a taxiway for a supersonic aircraft to negotiate the curve at a turning speed of 50 kmph. The wheel base is 35 m and the tread of main loading gear is 7·5 m. The airport is of type *A* as per ICAO. Assume the coefficient of friction between tyre and pavement surface is 0·13.

(g) A contractor has compacted the base course for a new road and found the mean value of the test samples as $w = 14 \cdot 6\%$, $G_s = 2 \cdot 81$ and $\gamma = 18 \cdot 2\ kN/m^3$. The specification requires that $e \leq 0 \cdot 8$. Has the contractor compiled with specifications?

(h) An aquitard of 1 m thick covers an aquifer of 20 m. Pumping test confirmed a leakage of 40 mm/year. Piezometer surface in the semi-confined aquifer is 15 m below the water table of the unconfined aquifer located above the aquitard layer. Determine the leakage, hydraulic resistance and leakage factor. The permeability of the aquifer is 15 m/day. A well located in the system pumps 4000 m^3/day. How much area will be affected in the recharge?

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