

1(CCE-M)6

CIVIL ENGINEERING - II

[06]

Time Allowed -3 Hours

Maximum Marks-300

INSTRUCTIONS

- i) Answers must be written in English
- ii) The number of marks carried by each question is indicated at the end of the question.
- iii) The answer to each question or part thereof should begin on a fresh page.
- iv) Your answer should be precise and coherent.
- v) The part/parts of the same question must be answered together and should not be interposed between answers to other questions.
- vi) Candidates should attempt question nos. 1 compulsory, Candidates shall attempt **three** questions from any **two** parts.
- vii) If you encounter any typographical error, please read it as it appears in the text book.
- viii) Candidates are in their own interest advised to go through the General Instructions on the back side of the title page of the Answer Script for strict adherence.
- ix) No continuation sheets shall be provided to any candidate under any circumstances.
- x) Candidates shall put a cross (X) on blank pages of answer Script.
- xi) No blank page be left in between answer to various questions.
- xii) No programmable Calculator is allowed.
- xiii) No stencil (with different markings) is allowed.
- xiv) In no circumstances help of scribe will be allowed.

1. Answer any **Three** of the following subdivisions

- a) A project consists of seven activities. Time estimates and inter - dependence of each activity is given in the following table. Draw network diagram and show critical path. Determine the probabilities of completing the project in 28 days and 35 days. (25)

Activity	A	B	C	D	E	F	G
Activity Times (days)	6-9-18	5-8-17	4-7-22	4-7-16	4-7-10	2-5-8	4-10-22
Preceding activity	.....	.....	A	B	A	B	C&D
Succeeding activity	C & E	D & F	G	G	.....	.....	.....

Z(+)	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2
%Probability	65.54	69.15	72.57	75.80	78.81	81.59	84.13	86.43	88.49

- b) Design the length of transition curve for 100 Km/h design speed at a horizontal curve of 450 m radius on a double lane National Highway passing through a rolling terrain in a heavy rain fall area. (25)
- c) Determine overall removal obtained for a sedimentation tank having surface flow rate of 32.6 m/day. Assume specific gravity of particles = 1.2, dynamic viscosity = 1.027 centipoise and unit weight of water = 0.997g/cm³.

Particle Size (mm)	0.10	0.08	0.07	0.06	0.04	0.02	0.01
Weight Fraction greater in size(%)	10	15	40	70	93	99	100

Use Stoke's law to find out settling velocity. (25)

- d) The unit discharge in a rectangular channel is given as 18m³/sec. If the head loss across the hydraulic jump that forms in this channel is 1.1 m, estimate the pre-jump and post-jump depths. (25)

PART - A

2. a) i) Briefly discuss the tests that are used to determine properties of bricks (10)
- ii) Activity duration and their inter relationship are given below for a project. Draw network and number the events by Fulkerson rule. Find critical path and its duration. Calculate total float, free float and independent float of all non-critical activities (15)

Activity	Duration	Can star after
A	10	.....
B	8	A
C	14	.....
D	6	.....
E	12	A
F	8	B & G
G	12	D
H	7	C

- b) i) Briefly discuss various methods of prevention of dampness in buildings. (10)
- ii) Calculate the quantity of earthwork for 200 m length of a road in a uniform

ground with heights of banks at the two ends being 1 m and 1.6m. The formation width is 10 m and side slopes 2 : 1. (15)

- c) i) Describe briefly the procedure of carrying out the plaster work with cement mortar in three coats. (10)
- ii) Calculate optimum and minimum duration and associated cost of the project. Indirect cost of the project is Rs. 90 per day. The details of activities are as given below. (15)

Activity	Normal Time in Days	Normal cost in Rs.	Crash Time in Days	Crash cost in Rs.
1-2	5	60	4	90
1-3	7	150	5	250
2-3	3	30	2	60
3-5	6	150	4	250
2-4	3	100	3	100
1-5	9	115	7	175
4-5	4	100	2	240

3. a) i) Discuss the properties and uses of polymer concrete (10)
- ii) Calculate the quantities of cement, sand and coarse aggregate required to produce one cubic meter of concrete for mix proportion of 1:1.4:2.8 (by volume) with water cement ratio of 0.8 (by mass). Bulk densities of cement, sand and coarse aggregate are 14.7, 16.66 and 18.68 kN/m³ respectively. Percentage of entrained air is 2. Specific gravities of cement, sand and aggregate are 3.15, 2.6 and 2.5 respectively. (15)
- b) i) What are the purposes of painting? State the characteristics of a good paint (10)
- ii) What are the basic parts of a building? Briefly discuss the main requirements for each part to fulfil their primary functions. (15)
- c) i) Describe briefly the fire resisting properties of stone, brick, steel, glass and concrete. (10)
- ii) A one room building has internal size 6 m by 6 m with load bearing walls of 0.30 m thickness. Plinth height above ground level is 0.60 m. Width and length of plinth wall are 0.40 m and 0.80 m respectively. Footing is provided with four steps of 0.10 m height and 0.05 m projection each. A 0.30 m thick PCC of 1.00 m width is laid in the foundation. General specification of materials and works may be assumed. Estimate the quantities of the following items using long wall and short wall method

- i) Earthwork in excavation in foundation
- ii) PCC in foundation
- iii) Brickwork in foundation and plinth
- iv) Brickwork in Plinth
- v) 25 mm Damp proof Course

PART - B

4. a) i) Discuss the functions of sleepers. Write the expression of sleeper density if the rail length used in B.G. track is 19 m and there are 22 sleepers under one rail length. (10)
- ii) Determine the steepest gradient in a track on a 2° curve for a train with 22 wagons with the following data :
 Weight of each wagon = 20 tonnes
 Rolling resistance of each wagon = 3.2 kg/tonne
 Speed of train = 50 km/h
 Weight of locomotive = 150 tonnes
 Rolling resistance of locomotive = 4.0 kg/tonne
 Tractive effort of locomotive = 10 tonnes (15)
- b) i) What would be the gradient for a broad gauge track when the grade resistance together with curve resistance due to a curve of 3° shall be equal to the resistance due to a ruling gradient of 1 in 200? (10)
- ii) Design a turnout on a broad gauge track for the following given data:
 Heel divergence = 13.33 cm
 Angle of switch = $1^\circ 34' 27''$
 Angle of crossing = $6^\circ 42' 35''$ (15)
- c) i) Calculate the super elevation and permissible speed on branch line curve which diverge from main line curve in opposite direction in the layout of broad gauge yard. Following design data is given :
 Radius of branch line curve = 215 m
 Radius of main line curve = 344 m
 Maximum speed on main line = 45 km/h
 Permissible cant deficiency = 7.6 cm (10)
- ii) Calculate the maximum permissible speed on a curve of high speed broad gauge track having the following design data :
 Degree of curve = 1°
 Super elevation = 80 mm
 Length of transition curve = 120 m
 Maximum sanctioned speed on the section = 180 km/h (15)

5. a) i) What do you understand by traffic sign? Discuss different categories of

traffic signs with their examples. (10)

ii) The following data were obtained from spot speed studies carried out at a city road having mixed traffic condition. Determine

i) Upper Speed limit ii) Lower speed limit

iii) Design speed iv) Mean speed (15)

Speed group kmph	No. of vehicles	Speed group kmph	No. of vehicles
0 - 10	12	50 - 60	255
10-20	18	60 - 70	119
20 - 30	68	70 - 80	43
30 - 40	89	80 - 90	33
40 - 50	204	90 - 100	9

b) i) The speeds of overtaking and overtaken vehicles are 100 km/h and 80 km/h respectively. Assuming rate of change of speed of overtaking vehicle as 2.5 km/h per second. determine the safe passing sight distance. Also draw Overtaking Zone showing all the details. (10)

ii) On a National Highway for the design speed of 100 km/h, design the length of vertical curve at the junction of a level stretch and ascending gradient of 1 in 30. Assume allowable rate of change of centrifugal acceleration $C = 0.6 \text{ m/sec}^3$. (15)

c) i) Design the reinforcement for a 12 cm thick RCC pavement. The contraction joints are spaced at 12 m intervals. The pavement width is 7.5 m, comprising of two lanes. Allowable stress for steel is 3000 kg/cm². Take coefficient of friction $f = 1.5$ (10)

ii) Write assumptions of westergaard's analysis. Calculate radius of relative stiffness and equivalent radius of resisting section for the following data. Modulus of subgrade reaction = 7.5 Kg/cm³ (15)

Modulus of elasticity of concrete = 0.3 million kg/cm²

Poisson's ratio of concrete = 0.15

Radius of wheel contact area = 15 cm

Thickness of pavement = 20 cm

PART - C

6. a) i) Determine the dimensions of an economical trapezoidal section for a water discharge of 32 cum per sec. Channel's side slopes = 2H : 1V and Chezy's coefficient $C = 50$ are given (10)

ii) Design a regime channel for a discharge of 90 cum per sec in a soil having a silt factor of 1.1 using Lacey's theory. Assume side slopes of the channel as 1 H:2V (15)

b) i) The annual average rainfall of four stations A, B, C and D in an area were recorded as 105, 125, 98 and 100 cm respectively. In a particular year station C did not function and the rainfall figures of A, B and D were 90,

99 and 80 cm respectively. Compute the missing precipitation at station C. (10)

ii) In a confined aquifer 18 cm diameter well penetrates fully. If the length of the strainer is 20 m. What will be the yield of a tube well under 5 m drawdown? Assume coefficient of permeability = 30 m/day and radius of influence = 300 m (15)

c) i) Estimate the return period of a rainfall whose probability of exceedance is 5%. Also determine the probability that this rainfall may occur in the next 10 years (10)

ii) The stage values of a flood resulting from a uniform effective rainfall of 4 hour duration were measured at the catchment outlet at two hourly intervals as given below. The area of the catchment is 2000 km² and rating curve is given by the expression $Q = 100 (H - 0.18)^2$ where Q is flood discharge in cum per sec and H is stage in meter. Compute the ordinates of 4 hour unit hydrograph. Assume constant base flow of 10.2 cum per sec. (15)

Time. hr	0	2	4	6	8	10	12	14	16	18	20	22
Stage. m	0.50	2.95	4.45	4.60	4.25	3.30	2.80	3.20	1.85	1.20	1.00	0.50

7. a) i) An evaporation pan 1.2 m in diameter was used to find out evaporation from a reservoir. The pan was initially filled up with water to a depth of 8 cm. During the period of observation a rainfall of 4 cm was recorded. To keep the water level same in the pan - an amount of water equivalent to 2 cm depth had to be removed. At the end of the period of observation, the depth of water in the pan was recorded as 8.5 cm. If the pan coefficient is 0.75. estimate the evaporation from the surface of reservoir. (10)

ii) A river cross section measurements by surface float method are given in the following table. Estimate the discharge passed through the section at the gauging site, assuming velocity factor of 0.89. (15)

Sl. No.	Width of section (m)	Mean depth of section (m)	Surface velocity observed (m/sec)
1	30	1.00	1.00
2	30	0.40	0.40
3	30	0.30	0.46
4	30	1.40	0.68
5	30	2.40	0.68
6	30	1.70	0.98
7	30	1.20	0.75
8	30	1.20	0.94
9	30	2.30	0.98
10	30	2.43	1.07
11	30	2.27	1.00
12	24	1.60	0.80

b) i) Mention the salient properties of flow net. In the flow net of an earthen dam of height 25 m and length 2000 m with a free board of 2 m. there are

10 equipotential drops and 4 number of flow channels. The dam has a horizontal filter of 30 m at the downstream end and the coefficient of permeability of the dam material is 0.5×10^{-3} cm/sec. Calculate the discharge through the dam (10)

- ii) A rectangular channel 3.6 m wide carries water to a depth of 1.8 m. channel width is contracted to 2.4 m with a hump of 0.5 m height. Calculate the discharge if water surface in contracted section drops by 0.15 m. Assume there is no losses. (15)
- c) i) Mention the advantages and disadvantages of rock fill dams. (10)
- ii) A canal takes off from a reservoir to irrigate the areas as per details given in the table below. Determine the capacity of reservoir if it is filled only once in a year. Assume reservoir losses as 10% and channel conveyance losses as 15%. It is also given that 45% of the irrigation demand is directly met by precipitation. (15)

Crop	Base period	Duty of field	Area under corp
Wheat	120	1600	600
Rice	120	750	400
Sugarcane	300	850	1000
Cotton	210	1200	1000
Bajra	90	1000	500

PART - D

8. a) i) Briefly describe various types of water demand. Mention the requirements that must be met for the fire demand. (10)
- ii) A town is to be supplied water at a rate of 220 litre per person per day in 2021. Calculate the domestic water requirement of this town by forecasting population using incremental increase method. The population figures as per census record are given below : (15)

Year	1971	1981	1991	2001	2011
Population	23798624	46978325	54786437	63467823	69077421

- b) i) Discuss sedimentation aided with coagulation. Mention the most common coagulants used in water supplies. (10)
- ii) A coagulation treatment plant with a flow of $0.5 \text{ m}^3/\text{s}$ is dosing alum at 23 mg/l. No other chemicals are being added. The raw water suspended solid concentration is 37 mg/l. The effluent suspended solid concentration is 12 mg/l. Sludge content is 1% and specific gravity of sludge is 3.01. Estimate the volume of sludge that has to be disposed per day. (15)
- c) i) A rectangular settling tank treats 1 million litre raw water per day. It is designed for a detention period of 2.5 hours, flow velocity of 8 cm/min and the depth of water and sediment as 4.5 m. Determine length and

- width of the tank if an allowance of 1.5 m is to be provided for sediment. Also determine overflow rate of the tank. (10)
- ii) For water supply of a town, the distribution main 30 cm diameter pipe was required. As pipes above 25cm diameter were not available, it was decided to lay two parallel mains of same diameter. Determine the diameter of mains. (15)
9. a) i) Discuss a suitable disinfection technique for water supplies in rural areas with open dug wells as the source of water (10)
- ii) A low lying campus having population of 6000 generates an average sewage flow of 0.006 cum. An air ejector is to be installed to lift the entire sewage. The velocity of sewage flow in main sewer is 1 m/s and velocity of compressed air is 6 m/s. The height of ejector is 2m. The ejector fills every 12 minutes. Calculate diameters of the circular ejector chamber, main sewer and air pipe. (15)
- b) i) A circular sewer of 45cm is designed for a town of population 50,000. The sewer is designed to carry 3.5 times of dry weather flow. Determine the slope that is to be provided when running full. Water supply per capita is 135 litre per day. Sewage is generated as 80% of the supplied water to the town. Assume manning's coefficient $n = 0.012$ (10)
- ii) Design the dimension of an oxidation pond required for the treatment of sewage from an industrial area having population of 3500. The sewage flow is 125 litre per capita per day. The 5 - day BOD of the sewage is 350 ppm. Assume effective depth 1.2 m and length to be double of the width. (15)
- c) i) Explain refuse and give its classification. Describe various methods of disposal of the refuse (10)
- ii) Determine the dimension of a high rate trickling filter for sewage flow of 3 MLD. The BOD of raw sewage is 250 mg/l and it is desired to be 30 mg/l of final effluent. Circulation ratio is given as 1.5 and 25% BOD is removed in primary tank. By what % diameter of the filter will have to be modified if it was to be designed as a standard rate trickling filter. (15)
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