

CBCS SCHEME

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15CV71

Seventh Semester B.E. Degree Examination, Dec.2018/Jan.2019 Municipal and Industrial Wastewater Engineering

Time: 3 hrs.

Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. Explain the need for Good sanitation. Describe types of sewerage system and their suitability. (10 Marks)
- b. Explain factors affecting wet weather flow and the effects of flow variations on the design of sewerage system. (06 Marks)

OR

- 2 a. Define Sewer Appurtenances and explain with neat sketch construction and working of manhole. (06 Marks)
- b. What do you understand by the term Low – cost treatment? (02 Marks)
- c. Explain the following with sketches : (08 Marks)
 - i) Septic tank
 - ii) Oxidation pond.

Module-2

- 3 a. Explain briefly the dilution method of disposal of sewage. What are the factors which influence the choice of the method to be adopted? (06 Marks)
- b. Design a sewer to serve a population of 36,000, the daily per capita water supply allowance being 135 lt, of which 80%, find its way into the sewer. The slope available for the sewer to be laid is 1 in 625 and the sewer should be designed to carry four times the dry weather flow, when running full. What would be the velocity of flow in the sewer when running full? (10 Marks)

OR

- 4 a. Discuss in details the process Deoxygenation and Reoxygenation with respect to self – purification of Natural water with a neat sketch. (08 Marks)
- b. Write short notes on : (08 Marks)
 - i) Sewage sickness
 - ii) Sewage farming.

Module-3

- 5 a. Write the flow diagram employed for a municipal wastewater treatment plant. Indicate the importance of each unit indicated in the flow diagram. (10 Marks)
- b. Explain the importance of screens and types of screens in the sewage treatment process. (06 Marks)

OR

- 6 a. Determine the size of the High rate Tricking Filters for the following data : (08 Marks)
 - i) Sewage flow = 4.5 MLD
 - ii) Recirculation ratio = 1.5
 - iii) BOD of Raw sewage = 250 mg/L
 - iv) BOD removal in primary tank = 30%.
 - v) Final effluent BOD desired = 30 mg/L.
- b. Explain briefly the different stages of sludge digestion process in a “Digester”. With a neat sketch, explain the constructional details of sludge digestion tank. (08 Marks)

Module-4

- 7 a. Differentiate between Domestic sewage and Industrial waste. (08 Marks)
b. Explain the methods used for Neutralization of Acidic and Alkaline waste. (08 Marks)

OR

- 8 a. Briefly explain the effects of Industrial wastewater on sewage treatment plants. (08 Marks)
b. Explain different methods of Strength Reduction. (08 Marks)

Module-5

- 9 a. With process flow diagram, explain the cotton textile mill wastes origin. (08 Marks)
b. Enumerate the effects of discharging paper and pulp industrial wastes into water bodies or sewers. (08 Marks)

OR

- 10 a. With process flow diagram, explain the origin of wastes from Cane Sugar mill. List its characteristics. (08 Marks)
b. With a flow diagram, explain the units used for treatment of Dairy waste on receiving stream. (08 Marks)

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15CV72

Seventh Semester B.E. Degree Examination, Dec.2018/Jan.2019 Design of RCC and Steel Structures

Time: 3 hrs.

Max. Marks: 80

Note: 1. Answer any TWO full questions, choosing one full question from each module.
2. Use of IS-456, IS-800 SP (6) and Steel tables are permitted.

Module-1

- 1 Design a slabtype rectangular combined footing for two columns of size 300mm × 450mm and 300mm × 600mm, subjected to axial loads of 650 kN and 900 kN respectively. The columns are spaced at 3.6 m c/c. The width of the footing is restricted to 1.8 m. Use M20 grade concrete and Fe415 grade steel. Assume SBC of soil = 160 kN/m². (40 Marks)

OR

- 2 Design a Cantilever retaining wall to retain an earth embankment with a horizontal top 3.50 m above ground level. The unit weight of back fill is 18 kN/m³. Angle of internal friction $\phi = 30^\circ$. SBC of soil = 180 kN/m². Take coefficient of friction between soil and concrete = 0.55. Adopt M20 grade concrete and Fe415 grade steel. Depth of foundation = 1.0 m. (40 Marks)

Module-2

- 3 Design a roof truss shown in Fig. Q3 with forces in each member of the truss are given in table Q3. The size of RC column supporting the truss is 300mm × 300mm. Use M20 grade concrete for column. Design the truss using bolt of M16, property class 4.6 for connections and also design anchor bolts. (40 Marks)

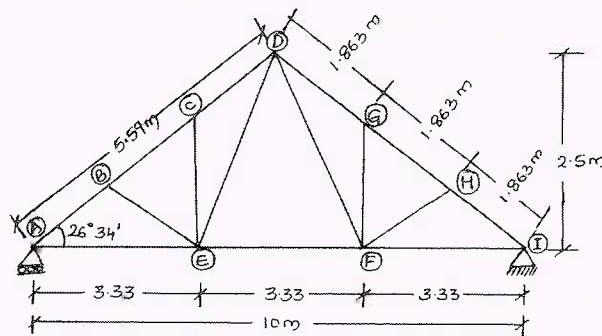


Fig. Q3

Member	Design force in kN	
	Compression	Tension
Top chord member	54.25	-
Bottom chord member	-	48.31
Diagonal member (DF, DE)	14.35	-
Member BE, HF	-	24.50
Member CE, GF	12.40	-

OR

- 4 Design a simply supported crane gantry girder for the following data: The crane is electrically operated. Yield stress of steel is 250 N/mm^2 .

- (i) Span of Crane girder = 20 m
- (ii) Effective span of gantry girder = 7.4 m
- (iii) Capacity of crane = 220 kN.
- (iv) Self weight of Crane girder excluding crab = 200 kN.
- (v) Weight of Crab = 60 kN.
- (vi) Wheel base distance = 3.4 m
- (vii) Minimum hook approach = 1.2 m.
- (viii) Self weight of rail = 300 N/m
- (ix) Height of rail = 75 mm

Gantry girder is to be supported on RCC column bracket of size $300\text{mm} \times 450\text{mm}$. Size of column $300\text{mm} \times 600\text{mm}$. (40 Marks)

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15CV73

Seventh Semester B.E. Degree Examination, Dec.2018/Jan.2019
Hydrology and Irrigation Engineering

Time: 3 hrs.

Max. Marks: 80

Note: 1. Answer FIVE full questions, choosing one full question from each module.
 2. Assume missing data suitably.

Module-1

- 1 a. With engineering representation, explain hydrologic cycle along with processes involved in it. (06 Marks)
- b. Explain how consistency of rainfall data is checked using double mass curve technique. (05 Marks)
- c. The average annual rainfall of 5 raingauge stations in a basin are 89, 68, 54, 45, 41 and 55 cm. If the error in the estimation of basin rainfall should not exceed 10%. How many additional raingauges should be installed in the basin. (05 Marks)

OR

- 2 a. Define precipitation. List its types and explain with neat sketch how its amount is measured using Symon's raingauge. (08 Marks)
- b. What are the importances of hydrology? With neat sketch explain mass curve of rainfall and rainfall hyetograph. (08 Marks)

Module-2

- 3 a. Explain how evaporation amount is measured using IS class-A pan? List the factors affecting it. (08 Marks)
- b. What is evapotranspiration? Write its measurement using Lysimeter method, with sketch. (05 Marks)
- c. List the factors affecting evapotranspiration. Write Blaney-Criddle equation used to estimate ET. (03 Marks)

OR

- 4 a. Define infiltration. With neat sketch, explain double ring infiltrometer. (06 Marks)
- b. Write a Horton's infiltration equation used to estimate infiltration rate. (02 Marks)
- c. For a storm of 3 hr duration the rainfall rates are as follows:

Time Period (minutes)	30	30	30	30	30	30
Rainfall rate (cm/hr)	1.4	3.4	4.8	3.2	2.0	1.2

If the surface run off is 3.4 cm determine the ϕ -index and W-index assume initial ϕ -index is more than 1.4 cm/hr. (08 Marks)

Module-3

- 5 a. What is runoff? List and explain factors affecting it. (08 Marks)
- b. Define hydrograph. With sketch explain component parts of hydrograph. (08 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
 2. Any revealing of identification, appeal to evaluator and /or equations written eg, $42+8=50$, will be treated as malpractice.

OR

- 6 a. The hourly ordinates of a two hour unit hydrograph are given below. Derive a 6-hours unit hydrograph for the same catchment. (08 Marks)

Time (hours)	00	01	02	03	04	05	06	07
Discharge (Cumecs)	00	1.0	2.7	5.0	8.0	9.8	9.0	7.5

Time (hours)	08	09	10	11	12	13	14	15
Discharge (Cumecs)	6.3	5.0	4.0	2.9	2.1	1.3	0.5	00

- b. Find out the ordinates of a storm hydrograph resulting from a 3 hour storm with rainfall of 3, 4.5 and 1.5 cm during subsequent 3 hour intervals. The ordinates of unit hydrograph are given in the table below.

Hours	00	03	06	09	12	15	18
OVH (cumecs)	00	90	200	350	450	350	260

Hours	21	24	03	06	09	12
OVH (cumecs)	190	130	80	45	20	00

Assume an initial loss of 5 mm infiltration index of 5 mm / hr and base flow of 20 cumecs.

(08 Marks)

Module-4

- 7 a. Define Irrigation. List and explain benefits and ill effects of irrigation. (08 Marks)
b. What are Duty, delta and base period? Explain factors affecting Duty of water. (08 Marks)

OR

- 8 a. What is Irrigation efficiency? Define different efficiencies of Irrigation water. (05 Marks)
b. What are flow Irrigation and Lift Irrigations. Explain types of flow irrigations. (08 Marks)
c. (i) Give relationship between Duty, delta and base period.
(ii) Write a short note on frequency of Irrigation. (03 Marks)

Module-5

- 9 a. What is canal? List its types and explain with neat sketch its classification based on Alignment. (08 Marks)
b. Explain different storage Zones of reservoir with neat sketch. (08 Marks)

OR

- 10 a. The Channel section is to be designed for the following data:

Discharge, $Q = 5$ cumecs

Lacy's silt factor, $f = 1$

Side slope = $1 \frac{1}{2} H$ to $1 V$

Also determine the bed slope of the channel.

(08 Marks)

- b. Explain hydrological investigations of reservoir planning. List the points to be considered for selection of site for a reservoir. (08 Marks)

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15CV741

Seventh Semester B.E. Degree Examination, Dec.2018/Jan.2019 Design of Bridges

Time: 3 hrs.

Max. Marks: 80

*Note: 1. Answer any FIVE full questions, choosing
ONE full question from each module.*

*2. Use of IS-456, IRC-5, IRC-6, IRC-21, IS1343, Pigeaud's
curves and relevant charts allowed.*

Module-1

- 1 a. How are the bridges classified, briefly explain. (10 Marks)
- b. List the various loads to be considered in the design of bridges. (06 Marks)

OR

- 2 Briefly explain the following terms:
 - i) Linear waterway
 - ii) Economic span
 - iii) Afflux
 - iv) Scour Depth. (16 Marks)

Module-2

- 3 Design a deck slab for the following details:
 - Carriage way = Two lane (7.5m wide)
 - Foot paths = 1m on either side
 - Clear span = 6m
 - Wearing coat = 80mm
 - Width of bearing = 400mm
 Materials : M25 grade concrete and Fe415 grade HYSD bars
 Loading : IRC class AA tracked vehicle. (16 Marks)

OR

- 4 Design a SKEW slab culvert to suit the following data:
 - Clear span = 6m
 - Width of bearing = 370mm
 - Width of carriage way = 7.5m
 - Overall depth of slab = 540mm
 - Wearing coat = 80mm
 - Skew angle = 30°
 Loading : IRC class AA tracked vehicle
 Materials : M20 grade concrete and Fe415 HYSD bars. (16 Marks)

Module-3

- 5 Design the 'Deck slab only' for the T-beam bridge for the following data:
 - Effective span = 16m; Live Load – IRC class AA tracked; Materials – M25 grade concrete and Fe415 steel; spacing of the cross girders 4m c/c ; width of carriage way = 7.5m ; thickness of wearing coat = 80mm ; Kerbs on either side = 600mm wide × 300mm deep ; width of main girder = 300mm ; width of cross girder = 300mm ; spacing of main girders = 2.5m c/c ; sketch reinforcement details. (16 Marks)

1 of 2

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
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OR

- 6 Design T-beam bridge "cross girder" for the data given in Q5 and sketch the reinforcement details. (16 Marks)

Module-4

- 7 Design a Reinforced concrete box culvert having a clear vent way 3m by 3m. The super imposed dead load on the culvert is 12.8 kNm^2 . The Live Load is estimated as 50 kN/m^2 . Density of soil at site is 18 kNm^2 . Angle of repose = 30° . Adopt M20 grade concrete and Fe415 steel. Sketch the details of reinforcement. (16 Marks)

OR

- 8 Design a suitable reinforced concrete pipe culvert to suit following data:

Discharge through pipe culvert = $1.57 \text{ m}^3/\text{s}$

Velocity of flow through pipe = 2 m/s

Width of road = 7.5 m

Top width of embankment = $1.5:1$

Bed level of stream = 100.00 m

Top of embankment = 103.00 m

Loading : IRC class AA Wheeled vehicle.

(16 Marks)

Module-5

- 9 Verify the stability of the abutment shown in Fig.Q9. The other salient details are given below:

Material = Concrete

Density of soil = 18 kNm^3

Coefficient of friction = 0.6

Angle of repose of soil = $\phi = 30^\circ$

Live Load on bridge = IRC class AA tracked

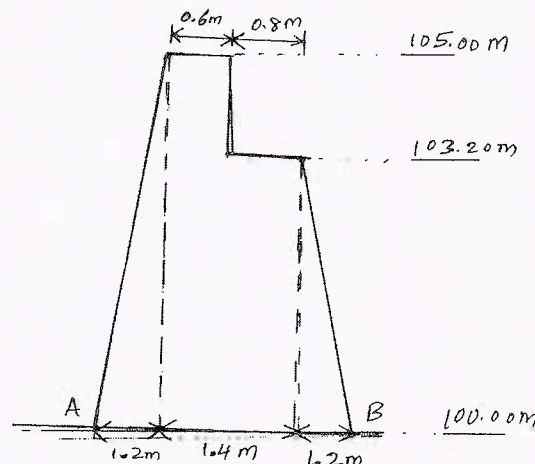
Span of bridge = 15 m

Angle of friction between the soil and concrete = 18°

The bridge deck consists of three longitudinal girders of 1.4 m depth with a deck slab of 200 mm depth.

(16 Marks)

Fig. Q.9



OR

- 10 Write short notes on:

- Bridge bearings
- Hinges
- Expansion Joints

(16 Marks)

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Seventh Semester B.E. Degree Examination, Dec.2018/Jan.2019 Ground Water and Hydraulics

Time: 3 hrs.

Max. Marks: 80

**Note: Answer any FIVE full questions, choosing
ONE full question from each module.**

Module-1

- 1 a. Explain the vertical distribution of ground water with a neat sketch. (06 Marks)
- b. Define the terms : i) Juvenile water ii) vadose water iii) connate water iv) meteoric water. (06 Marks)
- c. Write a note on the importance of ground water. (04 Marks)

OR

- 2 a. What is an aquifer? Explain the different types of aquifers with neat sketches. (12 Marks)
- b. Define the terms : i) aquifuge ii) aquiclude with example. (04 Marks)

Module-2

- 3 a. Explain Darcy's Law and discuss the validity and limitations. (06 Marks)
- b. Explain storage coefficient with a neat diagram and derive an expression for storage coefficient of an confined aquifer. (10 Marks)

OR

- 4 a. What is permeability? Explain the determination of permeability by constant head permeameter. (08 Marks)
- b. An artesian aquifer of 20m thick has a porosity of 20% and bulk modulus of compression 10^8 N/m^2 . Estimate the storage coefficient of the aquifer. What fraction of this is attributable to the expansibility of the water? Take elasticity of water $K_w = 2.13 \times 10^9 \text{ N/m}^2$. (08 Marks)

Module-3

- 5 a. Derive an equation for discharge for the case of steady radial flow into an unconfined aquifer using Dupuit's theory. List the assumptions and limitations. (12 Marks)
- b. A tube well of 300mm diameter penetrates fully a confined aquifer. The length of the strainer is 25m. Calculate the yield from the well under a drawdown of 4m. The coefficient of permeability of aquifer is 50m/day. Assume radius of circle of influence $R = 200\text{m}$. (04 Marks)

OR

- 6 a. Explain Thei's method to determine aquifer constants S and T for unsteady radial flow towards well. (10 Marks)
- b. A well is located in a 25m confined aquifer of permeability 30m/day and storage coefficient 0.005. If the well is being pumped at the rate of 1750 liters per minute, calculate the drawdown at a distance of 100m from the well after 20hrs of pumping. Take $W(u) = 3.35$. (06 Marks)

Module-4

- 7 a. List the various surface and subsurface methods of ground water exploration. (04 Marks)
b. Describe in detail, the exploration of groundwater by electrical resistivity method. (12 Marks)

OR

- 8 a. Enumerate the groundwater exploration by seismic refraction method. (10 Marks)
b. Briefly explain any two methods of logging. (06 Marks)

Module-5

- 9 a. Explain in brief the advantages and disadvantages of open wells and tube wells. (06 Marks)
b. What are the factors considered for the selection of pumps for shallow and deep wells? (04 Marks)
c. Design an open well in fine sand to give a discharge of 0.003 cumec when worked under a depression head of 2.5m Take fine sand value = $0.5 \text{ m}^3/\text{hr}/\text{m}^2$. (06 Marks)

OR

- 10 a. With the help of a neat sketch, explain the working of a submersible pump. (10 Marks)
b. What is importance of artificial recharge? Explain various methods of ground water recharge. (06 Marks)

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15CV751

Seventh Semester B.E. Degree Examination, Dec.2018/Jan.2019
Urban Transportation and Planning

Time: 3 hrs.

Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. What is urbanization? State the causes of urbanization. (08 Marks)
 b. Explain the problems in the urban transportation in the present scenario. (08 Marks)

OR

- 2 a. Explain the classification of transit system with example. (08 Marks)
 b. Write a note on the following :
 (i) BRTS
 (ii) Metro trains (08 Marks)

Module-2

- 3 a. Define external cordon line. What factors should be given due weightage in the selection of external cordon line. (06 Marks)
 b. What is zoning? Discuss the points to be kept in mind while doing zoning. (10 Marks)

OR

- 4 a. What are the methods of origin and destination study? Explain home interview method in detail. (08 Marks)
 b. What is sampling? Discuss various types of samplings. (08 Marks)

Module-3

- 5 a. Explain in detail the factors governing trip generation and attraction rates. (06 Marks)
 b. The following data shows average household size and total trips made per day for a particular zone of study area. Develop the trip production equation and also compute co-efficient of correlation. (10 Marks)

Average Household size	Total trips/day
2	4
3	6
4	7
5	8
6	10

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
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OR

- 6 a. Enlist the different methods of trip distribution. Explain in detail average growth factor method. (06 Marks)
- b. Estimate the future trip distribution by Furness method (up-to two iteration) from the following data: (10 Marks)

O/D	1	2	3	4	Future trips
1	-	50	60	30	280
2	40	-	70	20	390
3	20	60	-	40	300
4	50	70	30	-	220
Future trips	200	500	340	150	

Module-4

- 7 a. Write a short note on opportunity models. (06 Marks)
- b. The total trips produced in and attracted to the three zones A, B and C of a survey area in the design year area tabulated as

Zone	Trips Produced	Trips attracted
A	2000	3500
B	3500	4800
C	4800	2000

It is known that the trips between two zones are inversely proportional to the second power of the travel time between zones, which is 25 minutes. If the trip interchange between zones B and C is 300. Calculate the trip interchange between zones A and B, A and C, B and A, C and B. (10 Marks)

OR

- 8 a. Define modal split and explain in brief the factors affecting modal split. (10 Marks)
- b. Draw the flow diagram for modal split carried out between trip generation and trip distribution. (06 Marks)

Module-5

- 9 a. List the various assignment techniques and explain any two methods. (10 Marks)
- b. Explain the application of the traffic assignment. (06 Marks)

OR

- 10 a. Discuss the points for the selection of land - use transport model. (06 Marks)
- b. Write a flow chart of fundamental structure of Lowry model and explain the principal components of the model. (10 Marks)

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15CV72

Seventh Semester B.E. Degree Examination, June/July 2019 Design of RCC and Steel Structures

Time: 3 hrs.

Max. Marks: 80

- Note: 1. Answer any TWO full questions, choosing one full question from each module.
2. Use of IS456, IS800, IS3370, SP(6)-steel tables is permitted.
3. Any missing data may be assumed suitably.*

Module - 1

- 1 a. Name the different types of retaining walls. (04 Marks)
b. Design a combined footing for two interior columns carrying axial loads 1000kN and 1200kN. Column A is 400mm × 400mm in size and column B is 450mm in diameter. They are reinforced with 20mm bars and are spaced 4m centre to centre as for a bearing capacity of the soil is 120 kN/m². Use M20 mix and Fe 415 grade steel. Sketch it. (36 Marks)

OR

- 2 a. Name the different classification of liquid retaining structures. (04 Marks)
b. Roof of a 8m wide hall is supported on a portal frame spaced at 4m intervals. The height of the portal frame is 4m. The continuous slab is 120mm thick. Live load of roof is 1.5 kN/m², SBC of soil is 150 kN/m². The columns are connected with a plinth beam and the base of the column may be assumed fixed. Design the slab, column, beam members for the columns of the portal frame. Use M20 and Fe415 grade steel. Sketch the details. (36 Marks)

Module - 2

- 3 a. Name any 4 various types of roof trusses. (04 Marks)
b. Design a welded plate girder for an effective span of 20m to support a Udl of 80 kN/m in addition to a pair of point loads of 870 kN each of 5m from end of beam (10m apart @ center). Design the plate girder. (36 Marks)

OR

- 4 a. What are the advantages of plate girder over trusses? (04 Marks)
b. Design a simply supported crane girder for the following data. The girder is electrically operated. Take yield stress of steel as 250MPa.
i) Span of the crane girder = 20m
ii) Span of the gantry girder = 7m
iii) Capacity of the crane = 250kN
iv) Self weight of crane excluding crab = 200kN
v) Weight of crab = 60kN
vi) Wheel base distance = 3.4m
vii) Minimum hook approach = 1.1m
viii) Self weight of rail = 0.3 kN/m
ix) Height of rail = 75mm. (36 Marks)

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Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
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15CV73

Seventh Semester B.E. Degree Examination, June/July 2019 Hydrology and Irrigation Engineering

Time: 3 hrs.

Max. Marks: 80

**Note: Answer any FIVE full questions, choosing
ONE full question from each module.**

Module-1

- 1 a. Define precipitation. Explain various forms of precipitation. (05 Marks)
 b. Explain with a neat sketch, Symon's rain gauge. (06 Marks)
 c. Rain gauge station 'X' did not function for a part of a month during which a storm occurred. The storm produced rain fall of 84, 70 and 96 mm at three surrounding station's A, B and C respectively. The normal annual rainfalls at the stations X, A, B and C are respectively 770, 882, 736 and 944 mm. Estimate the missing rainfall at station X. (05 Marks)

OR

- 2 a. Explain Horton's engineering representation of hydrologic cycle, with a neat sketch. (08 Marks)
 b. Describe double mass curve techniques used to check consistency of rainfall data and adjust rainfall records. (08 Marks)

Module-2

- 3 a. Define evaporation, with a neat sketch, explain measurement of evaporation using ISI standard pan. (08 Marks)
 b. Distinguish between the potential and actual evapotranspiration. (04 Marks)
 c. Explain the factors affecting infiltration capacity. (04 Marks)

OR

- 4 a. Explain how the evapotranspiration can be estimated using the Blaney – Criddle method. (05 Marks)
 b. With the neat sketch, explain double ring infiltrometer. (05 Marks)
 c. A seven hour storm produced the following rainfall intensities (in mm/hr) at half an hour interval over a basin of area 1830 km².
 4, 9, 20, 18, 13, 11, 12, 2, 8, 16, 17, 13, 6 and 1
 If the corresponding observed run off is 36.6 million m³, estimate the ϕ – index for the storm. (06 Marks)

Module-3

- 5 a. Define runoff. Enlist the factors affecting runoff. (04 Marks)
 b. Describe any two methods of separating the base flow from total runoff. (04 Marks)
 c. The ordinates of 4h UH in m³/sec is given at a time interval of 2h after separating from the base flow :
 0, 12.52, 21.32, 23.54, 17.84, 14.79, 12.18, 10.04,
 8.26, 6.51, 4.98, 3.95, 3.05, 2.26, 1.60, 1.07, 0.53, 0
 Derive the 8h unit hydrograph. (08 Marks)

1 of 2

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OR

- 6 a. Define unit hydrograph. What are the assumptions underlying the unit hydrograph theory? How do they limit the applicability of unit hydrograph? (08 Marks)
- b. Given below are the ordinates of a 4h unit hydrograph of a basin in m^3/sec at one hour intervals :
 4, 25, 44, 60, 70, 61, 52, 45, 38, 32, 27, 22, 18, 14, 11, 8, 6, 4, 2, 1
 Construct the s-curve hydrograph using the 4h UH. Hence derive the 2 hour unit hydrograph. Area of the basin is 195.84 km^2 . (08 Marks)

Module-4

- 7 a. Define the term irrigation. Briefly describe the factors which necessitate the irrigation. (04 Marks)
- b. Write a note on : flow and lift irrigation. (04 Marks)
- c. Explain in detail irrigation efficiency and add a note on crop seasons of India. (08 Marks)

OR

- 8 a. Define : duty, delta and base period. Derive the relationship between them. (05 Marks)
- b. Write a note on Bandhora irrigation. (03 Marks)
- c. A water course has culturable commanded area of 2600 hectares, out of which the intensities of irrigation for perennial sugar – cane and rice crops are 20% and 40% respectively. The duty for these crops at the head of water course are 750 hectares/cumes and 1800 hectares/cumes respectively. Find the discharge required at the head of water course if the peak demand is 120% of the average requirement. (08 Marks)

Module-5

- 9 a. Define canal. Explain different types of canal based on alignment. (08 Marks)
- b. What is meant by design of canal? Bring out the difference between Kennedy's and lacey's theory. (08 Marks)

OR

- 10 a. With a neat sketch, explain zones of storage in a reservoir. (08 Marks)
- b. A channel section has to be designed for the following data :
 Discharge $Q = 30$ cumes
 Silt factor $f = 1.00$
 Side slope $= \frac{1}{2} : 1$
 Find also the longitudinal slope. (08 Marks)

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15CV81

Eighth Semester B.E. Degree Examination, June/July 2019 Quantity Surveying and Contracts Management

Time: 3 hrs.

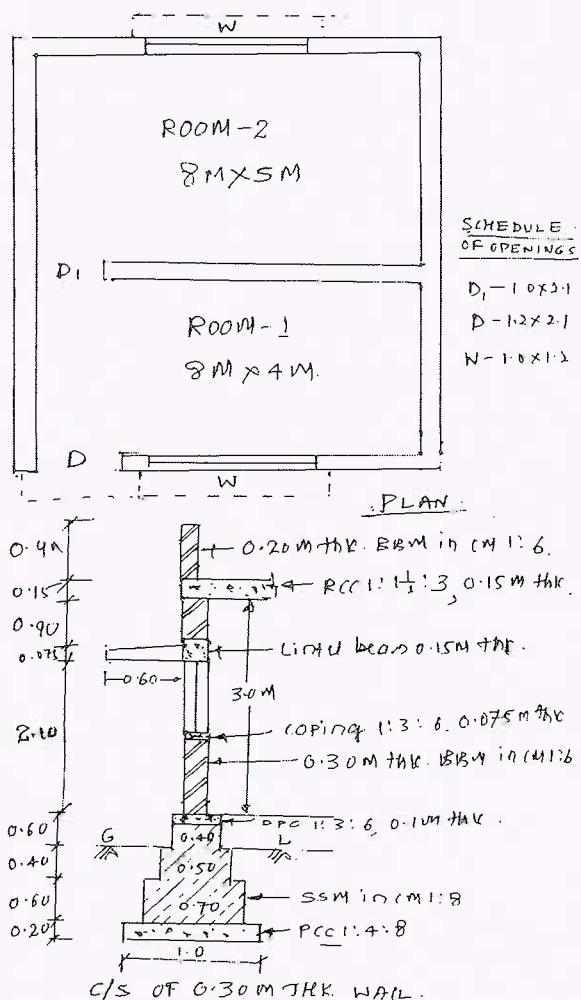
Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 The details of the two room building are shown in the Fig.Q.1. Estimate the quantities and cost of the following items of works:
- Earth work excavation for foundation in ordinary soil at Rs.300/m³.
 - Cement concrete bed 1:4:8 for wall foundations at Rs.2500/m³.
 - SSM (Size Stone Masonry) in CM 1:8 for footings and basement foundation at Rs.1800/m³.
 - First class BBM (Burst Brick Masonry) work for super structure in CM 1:6 at Rs.2000/m³.
 - RCC 1:1 $\frac{1}{2}$:3 root slab at Rs.3000/m³.
- (16 Marks)

Fig.Q.1



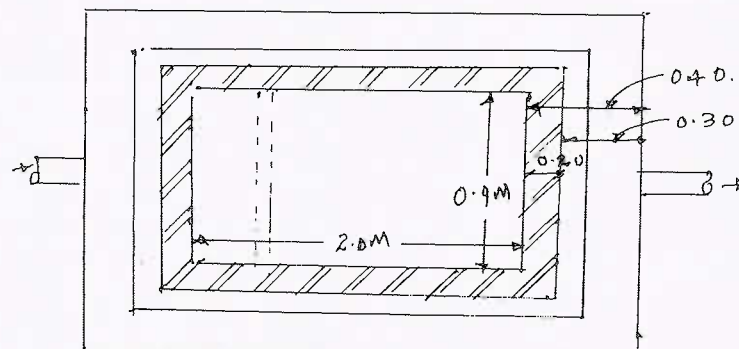
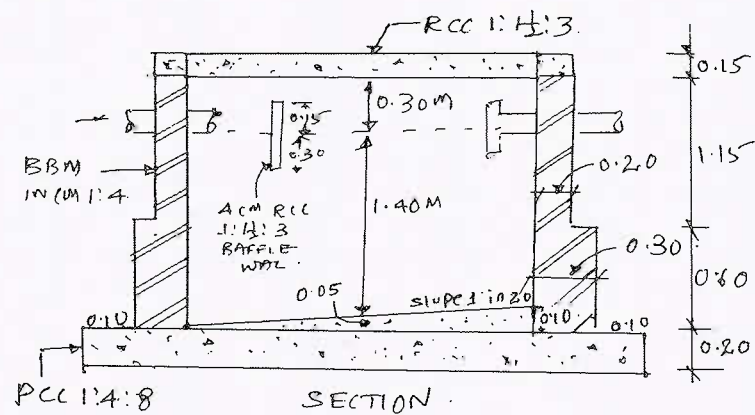
OR

- 2 What are the different types of estimates? Explain any three different types of estimation. (16 Marks)

Module-2

- 3 The details of septic tank are shown in the Fig.Q.3. Estimate the quantities for the following items of work and cost of abstract:

- Earthwork in excavation for foundation hard soil at Rs.400/m³
 - PCC 1:4:8 for bed concrete at Rs.2500/m³
 - BBM in CM 1:4 for side walls at Rs.2200/m³
 - RCC 1:1 $\frac{1}{2}$:3 for cover slab at Rs.3000/m³
- (16 Marks)



PLAN

Fig.Q.3

OR

- 4 Estimate the quantities and cost of earth work for a portion of the road from the following data. Formation width of the road is 10m side slopes are 2:1 in filling and 1.5:1 in cutting. The cost of filling is Rs.180/m³ and cutting Rs.120/m³.

Ch. (m)	0	40	80	120	160	200	240	280
RL of GL (m)	100.60	100.20	99.80	100.20	100.80	101.90	102.40	102.50
RL of FL (m)	101.00	← Raising Gradient 1 in 400 →						

(16 Marks)

Module-3

5 Write the detailed technical specifications for the following:

- i) Earth work excavation for foundation
- ii) Burnt Brick Masonry in CM 1:6
- iii) Plastering in CM 1:6 to interior surface
- iv) RCC work proportion 1:2:4.

(16 Marks)

OR

6 Carryout the rate analysis for the following:

- i) Earth work excavation for foundation in ordinary soil.
- ii) P.C.C. 1:4:8 for foundation using 40mm and down size aggregate.
- iii) Coursed rubble masonry in CM 1:6.
- iv) RCC $1:1\frac{1}{2}:3$ for roof slab.

(16 Marks)

Module-4

7 Explain the procedure of tendering and award of works in civil engineering projects.

(16 Marks)

OR

8 What are the different types of contracts? Explain any three types of contracts.

(16 Marks)

Module-5

9 Write short notes about any four of the following:

- i) Performance security
- ii) Liquidated damages
- iii) Contract management
- iv) Breach of contract
- v) Mobilization and equipment advances.

(16 Marks)

OR

10 a. What is the difference between the cost, estimate and value?

(06 Marks)

b. Explain the methods of valuation.

(10 Marks)

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Eighth Semester B.E. Degree Examination, June/July 2019
Design of Pre-Stressed Concrete Elements

Time: 3 hrs.

Max. Marks: 80

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of IS 1343 is permitted.

Module-1

- 1 a. Define pre-stressed concrete. Write any three differences between pre-tensioning and post-tensioning. (05 Marks)
- b. Explain with neat sketch Gifford Udal system of pre-stressing. (05 Marks)
- c. What is pressure line? plot the pressure line for a simply supported rectangular beam of size $b \times h$ subjected to uniformly distributed load and pre-stressed by a force P at a constant eccentricity of $h/6$ such that bottom fibre stress at midspan due to all loads and P equal to zero. (06 Marks)

OR

- 2 a. Explain the concept of load balancing in pre-stressed concrete design. (06 Marks)
- b. A concrete beam of symmetrical I section of simply supported span 10m has width and thickness of flange 250mm and 80mm respectively. thickness of web is 80mm and overall depth of section is 500mm. The beam is pre-stressed by a parabolic cable with an eccentricity of 150mm below centriodal axis at midspan and concentric at supports. The initial and final pre-stressing force in the cable is 250 kN and 200 kN respectively. The beam supports a live load of 3 kN/m. Calculate the fibre stress in concrete at transfer and at working loads sketch the stress distribution. (10 Marks)

Module-2

- 3 a. List the various types of losses in pre-stressed concrete members. Explain the types of loss of pre-stress in post tensioned members only. (06 Marks)
- b. A PSC beam $200\text{mm} \times 300\text{mm}$ is pre-stressed with wires of area 300mm^2 located at an eccentricity of 100mm below centriodal axis at midspan and zero at supports. Initial pre-stress in the wires is 1 kN/mm^2 . The span of the beam is 10m. Calculate the loss of pre-stress and total percentage of loss of pre-stress in wires if i) the beam is pre-tensioned ii) the beam is post tensioned, using the following data :
 Grade of concrete M_{40} , $E_s = 210\text{ kN/mm}^2$ shrinkage strain in concrete for pre tensioned member $= 300 \times 10^{-6}$. Age of concrete at transfer for post tensioned beam = 8 days, creep coefficient = 1.6. Slip at anchorage = 2mm coefficient of friction between concrete and cable duct = 0.55. Friction coefficient for wave effect = $0.0015/\text{m}$. (10 Marks)

OR

- 4 a. What are the factors affecting deflection of a PSC beam? (04 Marks)
- b. A PSC beam span supported over a span of 8m is of rectangular section of size 150mm × 300mm. The beam is pre-stressed by a parabolic cable having an eccentricity of 80mm below centriodal axis at mid span and 30mm above the centriodal axis at the ends. The initial pre-stressing force in the cable is 350 kN. The beam supports a concentrated load of 10kN at midspan and uniformly distributed load of 2 kN/m over the entire span. Grade of concrete is M₄₀. Estimate the following deflection :
- Short term deflection due to pre-stress and self weight
 - Long-term deflection due to pre-stress, self weight and imposed loads, allowing 20% loss of pre-stress and taking creep coefficient of 1.80
 - Check the deflection as per IS 1342-1980 requirements. (12 Marks)

Module-3

- 5 a. A post tensioned unbounded beam section 120mm × 300mm is pre-stressed by 7 wires of 5mm diameter with an effective cover of 50mm and effective stress of 1200 N/mm². The beam is of 7.5m span. If M₄₀ concrete is used and $f_p = 1600$ MPa, find the ultimate flexural strength of the section. (08 Marks)
- b. A post tensioned bounded Tee section has a flange width of 800mm and thickness of 250mm. The thickness of web is 200mm. The area of high tensile wire is 4000 mm² located at 1200mm from top of flange. The characteristic strength of steel and concrete are 1500 N/mm² and 40 N/mm² respectively. Calculate the ultimate moment capacity of the section using IS 1343 recommendation. (08 Marks)

OR

- 6 Design a pre-stressed concrete beam as Type-1 member to carry a superimposed load of 12 kN/m over a simply supported span of 25m. The permissible stress in compression for concrete at transfer and working loads are 14 N/mm² and 12 N/mm² respectively. Initial stress in pre-stressing cable is 1000 N/mm². Loss of pre-stress is 20%. Adopt Freyssenet cables each of 12 wires of 5 mm diameter. (16 Marks)

Module-4

- 7 a. Explain different methods of improving shear resistance of PSC members. (05 Marks)
- b. Explain the mechanism of shear failure in PSC beams. (05 Marks)
- c. The support section of PSC beam 120mm × 250mm is required to carry an ultimate shear force of 70kN. The compressive stress at the centriodal axis is 5MPa and $f_{ck} = 40$ MPa, $f_y = 415$ MPa cover to reinforcement = 50mm. Design the suitable shear reinforcement at the section as per IS -1343 recommendation. (06 Marks)

OR

- 8 a. Differentiate between web shear, flexural and flexure shear cracks in PSC members with neat sketches. (06 Marks)
- b. A PSC beam $300\text{mm} \times 1000\text{mm}$ is subjected to a shear force of 500kN under working loads near support section. The effective pre stressing force in the tendon is 800kN . The cable is parabolic with zero eccentricity at support and 300mm below centriodal axis at midspan. The span of the beam is 12m . If M_{40} concrete is used estimate the principal tension in concrete at support section and if required design the shear reinforcement. (10 Marks)

Module-5

- 9 a. Write a note on anchorage zone stresses. (05 Marks)
- b. Explain end zone reinforcement. (05 Marks)
- c. The end block of a post tensioned beam $500\text{mm} \times 1000\text{mm}$ is pre-stressed 2 cables each comprising of 5 wires of 7mm diameter. The cable is anchored by square anchor plates $400\text{mm} \times 400\text{mm}$ with their centre located at 250mm from the top and bottom edges of the beam. The jacking force in the cable is 3000kN . Design a suitable anchorage zone reinforcement as per IS-1343 code provisions. (06 Marks)

OR

- 10 A pre tensioned rectangular beam of size $120\text{mm} \times 240\text{mm}$ is simply supported over a span of 6m . The beam is prestressed by tendons carrying on initial pre-stress force of 225 kN at a constant eccentricity of 40mm . The loss of pre-stress is assumed to be 15% . The beam is incorporated in a composite T-beam by casting a top flange of 450mm wide and 40mm thick. Live load on composite beam is 8kN/m^2 . Calculate the resultant stress developed in the beam assuming the pre tensioned beam is unpropped during casting of top flange if the modulus of elasticity of the flange portion and the pre tensioned beam are 28 kN/mm^2 and 35kN/mm^2 respectively. Also check the composite T-beam for limit state of deflection. (16 Marks)

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Eighth Semester B.E. Degree Examination, June/July 2019 Earthquake Engineering

Time: 3 hrs.

Max. Marks: 80

*Note: 1. Answer any FIVE full questions, choosing
ONE full question from each module.
2. IS1893-2016 code is permitted.*

Module-1

- 1 a. Explain the concept of plate tectonic theory and with a neat figure explain the concept of elastic rebound theory. (06 Marks)
- b. What are the seismic waves? Explain the significant characteristics of seismic waves. (06 Marks)
- c. How the classifications of earthquakes are made? (04 Marks)

OR

- 2 a. Explain the difference between magnitude and intensity. What are the isoseismals? (08 Marks)
- b. What are the different earthquake ground motion characteristics? (04 Marks)
- c. A seismograph located 1200km from the epicenter of an earthquake, records a maximum ground displacement of 15.6mm for surface waves having a period of 20 seconds. Determine the surface wave magnitude. (04 Marks)

Module-2

- 3 a. Derive and plot the response for SDOF system with free vibration undamped case. (08 Marks)
- b. Derive and plot the vibration DAF with damping and frequency ratio of an SDOF system subjected to harmonic excitation. (08 Marks)

OR

- 4 a. Explain the dynamic step by step dynamic response procedure for linear acceleration method. (08 Marks)
- b. What is response spectrum? And what are the steps involved in construction of design spectrum. (08 Marks)

Module-3

- 5 a. Explain the different vertical irregularities. (05 Marks)
- b. What are the lessons learnt with references to seismic behaviour of structural damages during past earthquakes. (05 Marks)
- c. Illustrate with the neat sketches the problems associated with the configuration of building and its possible remedial measures. (06 Marks)

OR

- 6 a. Summarize the different philosophy adopted in seismic design. (06 Marks)
- b. What are the different types of structural modules to simulate the seismic behaviour of a framed building? (05 Marks)
- c. Explain the different code-based methods for seismic design. (05 Marks)

Module-4

- 7 For an RCC-SMRF building frame for office, the seismic weights on the floors are $W_1(\text{roof}) = 3000 \text{ kN}$, $W_2 = W_3 = W_4 = 42000 \text{ kN}$. The storey heights are ground storey = 4.2m, other storey each of 3.2m. The building is founded on hard soil and situated in zone-IV. Find the seismic force by equivalent lateral force procedure. (16 Marks)

OR

- 8 For the RCC-SMRF frame building with importance factor = 1. Founded on soft soil and situated in Zone-V. Seismic weights on the floors are $W_3(\text{Roof}) = 392 \text{ kN}$, $W_2 = 784 \text{ kN}$, $W_1 = 1568 \text{ kN}$. Determine the seismic forces by dynamic analysis method. The free vibration results for the buildings are. (16 Marks)

Natural Period (sec)	Mode – 1	Mode – 2	Mode – 3
Roof	1.000	1.000	1.000
2 nd FL	0.791	0.000	-0.791
1 st FL	0.250	-1.000	0.250

Module-5

- 9 a. Explain with neat figure of typical failure of RC framed structure. (06 Marks)
 b. Explain with neat sketches of the ductile detailing provisions for columns as per IS-code methods. (06 Marks)
 c. Explain the different methods of retrofitting of structures. (04 Marks)

OR

- 10 a. Explain the different elastic properties of masonry structures. (06 Marks)
 b. Explain the major steps of the lateral load analysis of masonry building. (06 Marks)
 c. How to make stone masonry buildings earthquake resistant. (04 Marks)

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Eighth Semester B.E. Degree Examination, June/July 2019

Pavement Design

Time: 3 hrs.

Max. Marks: 80

- Note:** 1. Answer any FIVE full questions, choosing ONE full question from each module.
 2. Missing data, if any may be assumed.
 3. Use of relevant charts is permitted.

Module-1

- 1 a. Draw neat sketch of cross section of a flexible pavement and describe the functions of each layer. (08 Marks)
- b. Determine the deflection values under a wheel load of 60kN and contact pressure 0.7 N/mm^2 in a homogeneous mass of soil at a depth of $Z = 2.5a$ upto a radial distance of $r = 5a$. Take modulus of elasticity of subgrade as 8 N/mm^2 . Sketch the deflection curve. Use Fig.Q.1(b). (08 Marks)

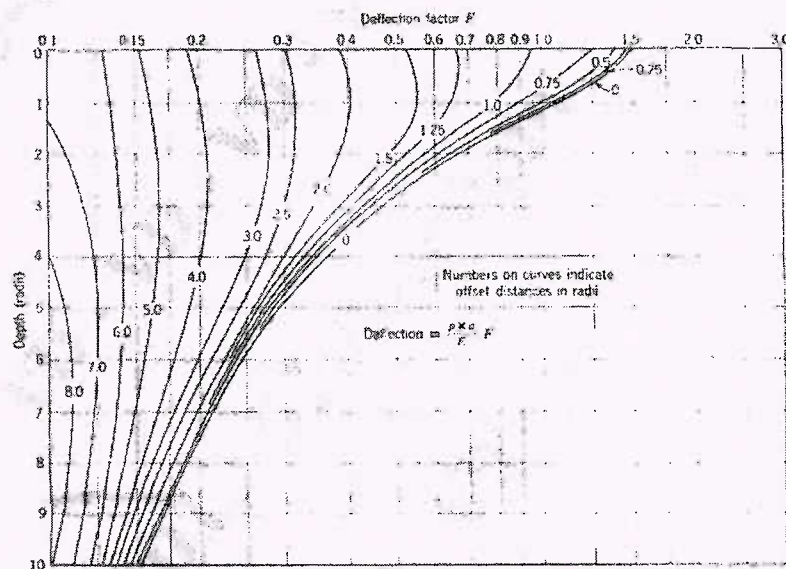


Figure 16: Vertical Deflection w due to Circular Loading (Foster and Ahlvin, 1954)

Fig.Q.1(b)

OR

- 2 a. Compare the salient features of flexible and rigid pavements. (08 Marks)
- b. A plate load test was carried out on subgrade using 300mm diameter plate and corresponding to a deflection of 5mm, the load sustained on the plate per unit area was 0.08 N/mm^2 . The test was repeated on base course of thickness 300mm and unit load sustained was 0.45 N/mm^2 at the same deflection. Find:
 - i) Elastic modulus of subgrade and the ratio E_P/E_S .
 - ii) What should be the thickness of base course as to sustain wheel load of 50kN and contact pressure 0.6 N/mm^2 so that maximum deflection does not exceed 5mm. Use Fig.Q.2(b). (08 Marks)

- b. Design the pavement by triaxial method using the following data:
 Wheel load = 51 kN, radius of contact area = 150 mm
 Traffic coefficient = 1.5,
 Rainfall coefficient = 0.9
 Design deflection = 2.5mm
 E of subgrade = 10 N/mm^2
 E of base course = 40 N/mm^2
 E of 75mm thick bituminous concrete surface = 100 N/mm^2 .

(08 Marks)

Module-3

- 5 a. List the general causes of flexible pavement failures and describe the failures in sub base and base courses. (08 Marks)
 b. Explain the step by step procedure of conducting Benkleman Beam deflection studies for evaluation of flexible pavement surface condition. (08 Marks)

OR

- 6 a. Briefly explain the typical types of flexible pavement failures. (08 Marks)
 b. Existing black top pavement was tested using Benkleman beam. The observations recorded at a pavement temperature of 43°C are given below. Compute the thickness of bituminous concrete overlay taking allowable deflection as 1.25mm, factor of subgrade moisture as content as 2 and accuracy 84%.
 1.46, 1.52, 1.56, 1.76, 1.96, 1.74, 1.68, 1.74, 1.96, 1.42, 1.56, 1.62mm. (08 Marks)

Module-4

- 7 a. As per IRC 58-2002, explain the procedure of design of rigid pavements. (08 Marks)
 b. Calculate the wheel load stresses at edge and corner regions of a CC pavement using modified equations and the following data: wheel load = 51 kN $E = 3 \times 10^4 \text{ N/mm}^2$
 $\mu = 0.15$ pavement thickness = 180mm, radius of contact area = 150mm and modulus of subgrade reaction = 0.06 N/mm^3 . (08 Marks)

OR

- 8 a. Explain, how warping stresses are formed in cc pavements. Describe the Bradbury's equations to calculate warping stresses at critical locations. (08 Marks)
 b. The design thickness of a CC pavement is 26cm, considering a design axel load (98th percentile load) of 12000 kg on single axel and M40 concrete with characteristic compressive strength of 400 kg/cm^2 , radius of relative stiffness 62.2 cm, elastic modulus of dowel / steel $2 \times 10^6 \text{ kg/cm}^2$, modulus of dowel concrete interaction 41500 kg/cm^3 and joint width 1.8cm, design the dowel bars for 40% load transfer considering edge loading. Take diameter of dowel bar = 3cm, spacing = 25cm. (08 Marks)

Module-5

- 9 a. What are the factors considered in design of rigid pavements? Explain any three factors. (08 Marks)
 b. List the typical failures in rigid pavements and explain any three of them. (08 Marks)

OR

- 10 a. With sketches, describe the various types of joints and their requirements, in rigid pavements. (08 Marks)
 b. Determine spacing between contraction joints for a 3.5m slab width having thickness of 200mm, friction 1.5, for the following two conditions:
 i) Planche cement concrete, allowable $S_c = 0.08 \text{ N/mm}^2$
 ii) Reinforced cement concrete, 10mm diameter bars at 0.3m spacing. (08 Marks)

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3 of 3

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Eighth Semester B.E. Degree Examination, June/July 2019
Advanced Concrete Technology

Time: 3 hrs.

Max. Marks: 100

**Note: 1. Answer any FIVE full questions, selecting
atleast TWO questions from each part.
2. Use of IS 10262-2009 is permitted.**

PART – A

- 1
 - a. Enumerate the importance of Bogue's compounds in ordinary Portland cement. (08 Marks)
 - b. Explain in brief, the factors affecting the strength and elasticity of concrete. (06 Marks)
 - c. Explain the Rheology of concrete in terms of Bingham's parameters. (06 Marks)
- 2
 - a. Explain with a sketch the mechanism of deflocculation of cement particles when plasticizer is used in making concrete. (08 Marks)
 - b. Explain the procedure adopted to determine the optimum dosage of superplasticizer. (06 Marks)
 - c. What is the effect of fly ash on the fresh and hardened properties of concrete? (06 Marks)
- 3

Using BIS 10262-2009, design a concrete mix of M25 grade. Given

 - (i) Minimum cement content : 300 kg/m³
 - (ii) Maximum cement content : 450 kg/m³
 - (iii) Maximum water/cement ratio : 0.5
 - (iv) Exposure condition : Moderate
 - (v) Workability : 100 mm slump
 - (vi) Admixture : Superplasticizer of G = 1.12
 - (vii) Quality control : Good
 - (viii) Assume any missing data required. (20 Marks)
- 4
 - a. Describe chlorine induced corrosion of steel in concrete. (08 Marks)
 - b. Explain Alkali-Aggregate reaction. (06 Marks)
 - c. List the factors affecting the Durability of concrete. (06 Marks)

PART – B

- 5
 - a. Mention the need, properties and applications of self-compacting concrete. (08 Marks)
 - b. What are the advantages of Ready Mix concrete? (06 Marks)
 - c. Explain under water concreting. (06 Marks)
- 6
 - a. List the different types of fibers. Explain any one type of fiber used in concrete. (08 Marks)
 - b. List and explain the various applications of Ferro-Cement. (06 Marks)
 - c. Explain the behaviour of Fiber Reinforced Concrete in compression and Tension. (06 Marks)
- 7
 - a. Explain High Density Concrete. (08 Marks)
 - b. Explain Light-Weight Concrete. (06 Marks)
 - c. What is High performance concrete? What are the properties of high performance concrete? (06 Marks)
- 8
 - a. List the non-destructive tests on hardened concrete. Why is it required? (08 Marks)
 - b. Explain with neat sketch Pulse Velocity test. (06 Marks)
 - c. Explain with neat sketch Rebound Hammer test. (06 Marks)

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Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg. 42+8 = 50, will be treated as malpractice.

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Eighth Semester B.E. Degree Examination, June/July 2019

Pavement Design

Time: 3 hrs.

Max. Marks:100

**Note: Answer any FIVE full questions, selecting
atleast TWO questions from each part.**

PART – A

- 1
 - a. Draw a neat sketch of flexible pavement section and show the components and their functions. (06 Marks)
 - b. Distinguish between highway and airport pavements. (06 Marks)
 - c. Mention the various factors to be considered in design of pavements. Explain any two of them. (08 Marks)
- 2
 - a. Explain frost action. What are the measures adopted to reduce its effects. (08 Marks)
 - b. A plate load test conducted with 0.3m diameter plate on subgrade and on a pavement of thickness 0.4m, sustained pressure of 0.1 MN/m^2 and 0.40 MN/m^2 respectively at 5mm deflection. Design the pavement section for 50kN wheel load and contact pressure of 0.7 MN/m^2 for an allowable deflection of 8mm using Burmister's approach. If you want to maintain the deflection of 6.5mm. What would be the required thinness? [Use the chart in Fig.Q2(b)]. (12 Marks)

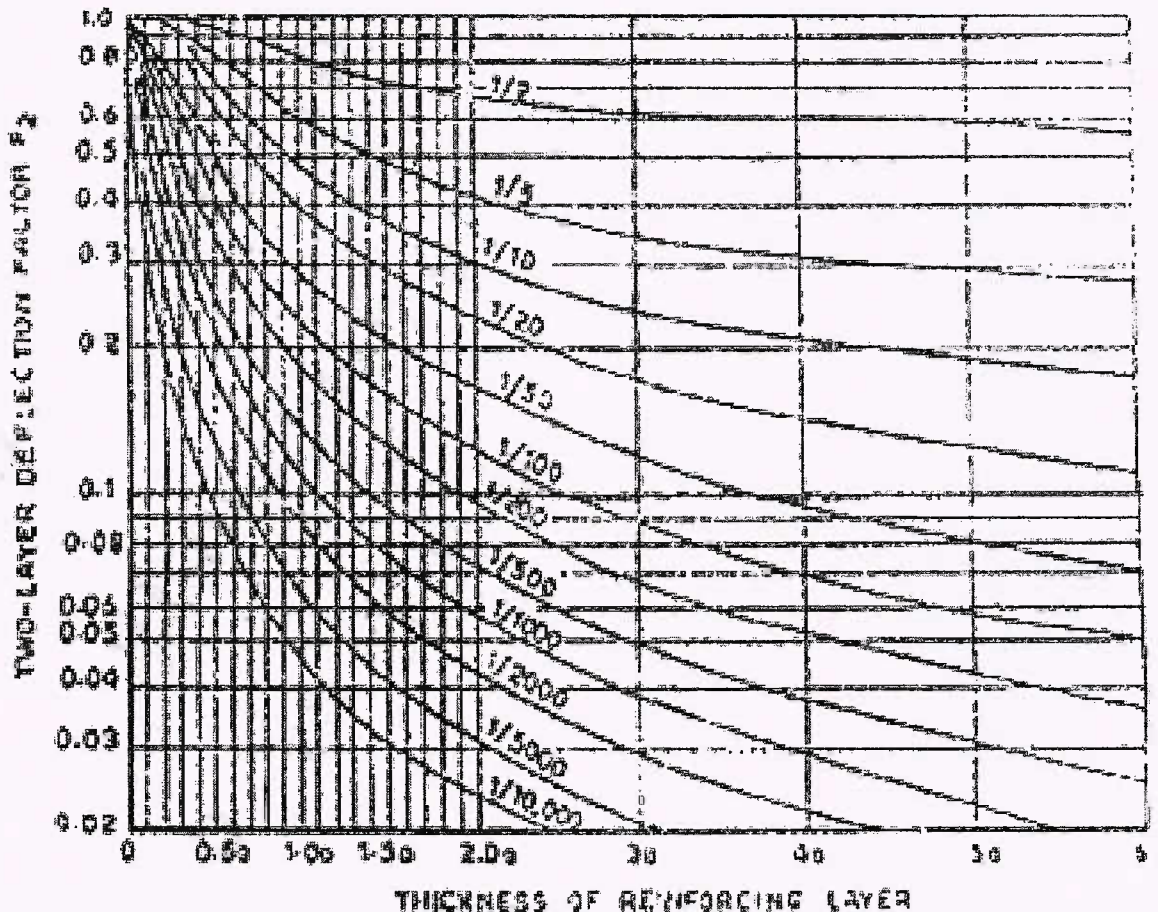


Fig.Q2(b)

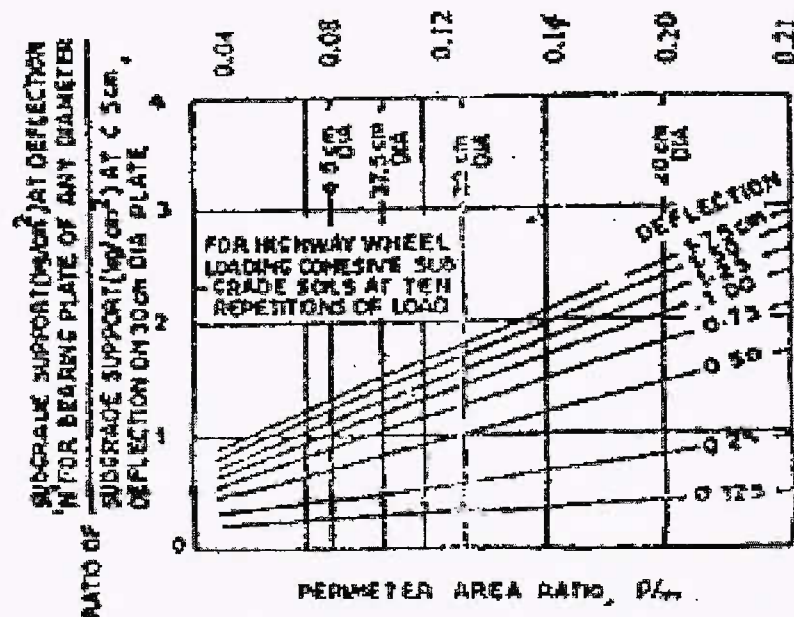
1 of 3

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, $42+8=50$, will be treated as malpractice.

- 3 a. What is ESWL? Calculate the ESWL of a dual wheel assembly carrying 2004 kg each for pavement thickness of 15, 20 and 25 cms, center to center of tyre spacing = 27cm and distance between the walls of tyres is 11 cms. Use graphical method. (08 Marks)
- b. Calculate the design repetitions for 20 years period for various wheel loads equivalent to 22.68 kN wheel load using the following data on a four lane road. (08 Marks)

Load, kN	22.68	27.22	31.75	40.82	45.36	49.90	54.43
Volume/day	30	25	20	15	10	5	1

- c. Differentiate between tyre pressure and contact pressure. (04 Marks)
- 4 a. Briefly explain the procedure of CSA method for the flexible pavement design as per IRC : 37 : 2001 (10 Marks)
- b. Design a highway pavement for a wheel load of 4100 kgs with a tyre pressure of 5 kg/cm² by McLeod method. The plate bearing tests carried out on subgrade soil using 30cm diameter plate yielded a pressure of 2.5kg/cm² after 10 repetitions of load at 0.5 cm deflection. [Use Fig.Q4(b)(i) and Fig.Q4(b)(ii)]. (10 Marks)



Relationship of Subgrade Support with P/A ratio

Fig.Q4(b)(i)

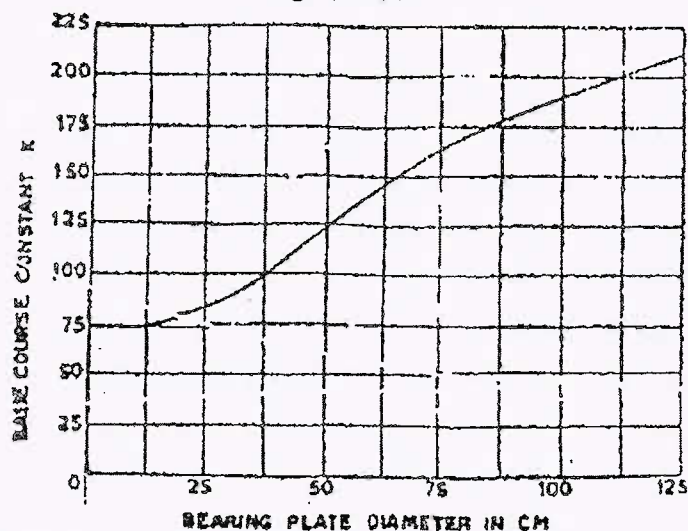


Fig.Q4(b)(ii)

PART - B

- 5 a. Define the terms :
 i) Modulus of subgrade reaction
 ii) Radius of relative stiffness
 iii) Radius of resisting section. (06 Marks)
- b. Calculate the warping stresses at interior, edge and corner regions in a 25 cm thick concrete pavement with transverse joints at 11m interval and longitudinal joints at 3.6m intervals. The modulus of subgrade reaction is 6.9 kg/cm^3 . Assume temperature differential for day conditions to be 0.6°C per cm slab thickness. Assume radius of loaded area as 15cm for computing warping stress at corner. [Use Fig.Q5(b)].
 Assume $e = 10 \times 10^{-6}$ per $^\circ\text{C}$, $E = 3 \times 10^5 \text{ kg/cm}^3$, $\mu = 0.15$. (14 Marks)

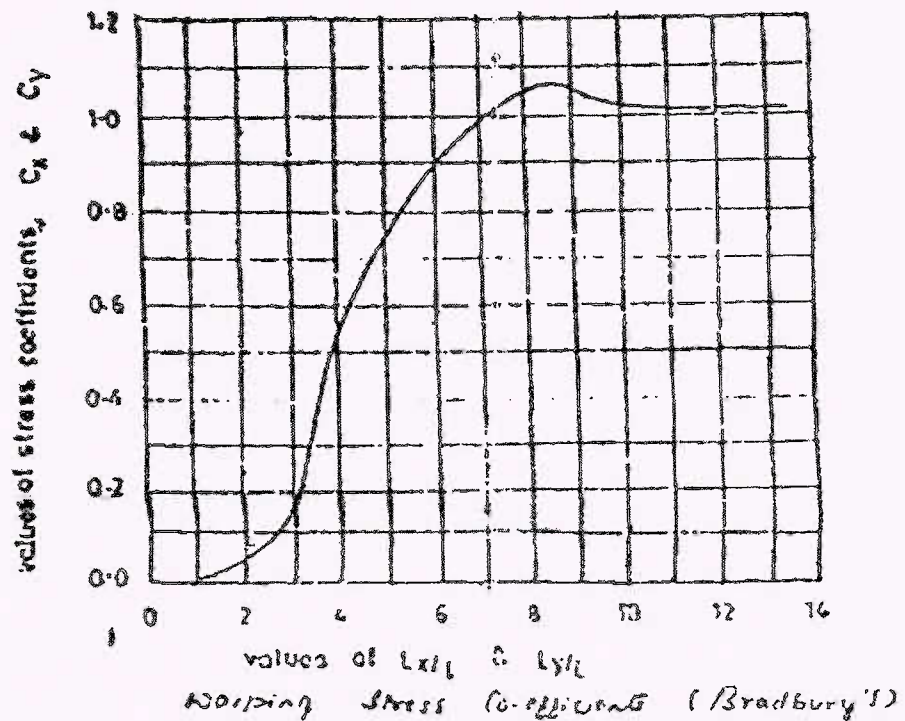


Fig.Q5(b)

- 6 a. Write a brief note on spacing of expansion and contraction joints. (06 Marks)
- b. Design the size and spacing of dowel bars at the expansion joints of a cement concrete pavement of thickness 25cm with radius of relative stiffness 80cm, for a design wheel load of 5000kg. Assume load capacity of the dowel system as 40% of the design wheel load. Joint width is 2cm, permissible shear and flexural stresses in dowel bar are 1000 and 1400 kg/cm^2 respectively and permissible bearing stress in CC is 100 kg/cm^2 . (14 Marks)
- 7 a. Explain Benkelmen beam deflection method for structural evaluation of flexible pavement and subsequent determination of overlay thickness. (10 Marks)
- b. Describe the types of failures in flexible pavements. (10 Marks)
- 8 a. Explain the common type of failures in rigid pavements. (10 Marks)
- b. Write a short note on :
 i) Functional evaluation of pavement by visual inspection
 ii) Measurement of pavement unevenness. (10 Marks)

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