

Total No. of Questions: 6

Total No. of Printed Pages:3

Enrollment No.....



Faculty of Engineering  
End Sem (Even) Examination May-2018  
CE3CO09 Transportation Engineering

Programme: B.Tech.

Branch/Specialisation: CE

Duration: 3 Hrs.

Maximum Marks: 60

Note: (a) All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.

(b) Assume suitable data according to IRC if not given.

- Q.1
- i. The max. value of co-efficient of friction along lateral direction is: **1**  
(a) 1 (b) 0.5 (c) 0.07 (d) 0.15
  - ii. The primary object of providing camber is **1**  
(a) Improved appearance  
(b) Easy separation of up and down traffic  
(c) Easy drainage  
(d) Easy overtaking facility
  - iii. A Bitumen bound macadam pavement is best suited where **1**  
(a) Rainfall is heavy  
(b) Ground water table is at shallow depths  
(c) The climate is hot and humid  
(d) Rainfall is less
  - iv. Formula for G.I. value is **1**  
(a)  $0.002a + .0005ac + 0.01bd$   
(b)  $0.2a + .005a c + 0.01bd$   
(c)  $0.002a + .0005ab + 0.01cd$   
(d)  $0.2a + .005a b + 0.01cd$
  - v. Find Equivalent radius of resisting section of 20 cm slab , given **1**  
that the radius of contact area of wheel load is 15 cm;  
(a) 23.37cm (b) 746.5cm (c) 14.07cm (d) 18.08cm
  - vi. Compute radius of relative stiffness for the following data;  $h =$  **1**  
15cm,  $E = 2.1 \times 10^5 \text{ kg/cm}^2$ ,  $u = 0.13$ ,  $k = 3 \text{ kg/cm}^3$   
(a) 66.89cm (b) 53.34cm (c) 72.37cm (d) 89.89cm

P.T.O.

[2]

[3]

- vii. Warping Cracks is type of; **1**  
 (a) Rigid Pavement Failure (b) Flexible Pavement Failure  
 (c) Both (a) and (b) (d) None of these
- viii. The removal and diversion of surface water from the roadway is called **1**  
 (a) Cross slope (b) Sub surface drainage  
 (c) Surface drainage (d) None of these
- ix. The Airport reference temperature is given by **1**  
 (a)  $T_a + (T_m + T_a)/3$  (b)  $T_a + (T_m - T_a)/3$   
 (c)  $T_m + (T_m - T_a)/3$  (d)  $T_a + (T_a - T_m)/3$
- x. The Threshold markings are: **1**  
 (a) 4m wide  
 (b) 45m in length  
 (c) 1m clear space between adjacent  
 (d) All of these
- Q.2 i. Explain PIEV Theory with diagram. **2**  
 ii. Write steps for Super elevation design in brief. **3**  
 iii. Calculate the Safe overtaking sight distance for a design speed of 96 kmph. If given that speed of Overtaken Vehicle is 80 kmph, reaction time 2 Sec, acceleration of overtaking vehicle is 2.5kmph/sec and two way traffic road. **5**
- OR iv. Calculate the Stopping Sight distance on a highway at a descending gradient of 2% for a design speed of 80 kmph. If given that reaction time  $t = 2.5$  Sec,  $g = 9.81$  m/sec<sup>2</sup>, design coefficient of friction is 0.35. **5**
- Q.3 i. Define WBM and WMM. **2**  
 ii. Explain in detail Marshall Mix Design Method of Bituminous mix with diagrams and graphs. **8**
- OR iii. Explain in detail California Bearing Ratio method of flexible pavement design with diagrams. **8**
- Q.4 i. Differentiate between Rigid pavement and Flexible pavement. Briefly. (Minimum 4 points) **2**

- ii. (a) Explain in brief design of Dowel bar. **3**  
 (b) Determine the spacing between contraction joints for 3.5 meter slab width having thickness of 20 cm and  $f = 1.5$ , for the following two cases:  
 (I) For plain cement concrete, allowable  $Sc = 0.8$  kg/cm<sup>2</sup>  
 (II) For reinforcement cement concrete, 1.0 cm diameter bars at 0.3 meter Spacing. **5**
- OR iii. Explain with diagram the following terms : **8**  
 (a) Warping stresses and Frictional stresses  
 (b) Contraction joint and Expansion joint  
 (c) Tie bars
- Q.5 i. Briefly explain the causes of failure of flexible pavement. (Minimum 6 points) **3**  
 ii. Explain Flexible and Rigid Pavement Failures with diagram. **7**
- OR iii. What are different types of Overlay? Explain overlay Design by Benkelman Beam deflection Studies. **7**
- Q.6 Attempt any two:  
 i. What are the important points to be considered while selecting the suitable site for Airport? **5**  
 ii. Explain different features of Wind Rose Diagram. **5**  
 iii. Write short note on Taxiways and geometrical elements of Runway with diagram. **5**

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## Marking Scheme

### CE3CO09 Transportation Engineering

Q.1	i.	The max. value of co-efficient of friction along lateral direction is : (d) 0.15	1
	ii.	The primary object of providing camber is (c) Easy drainage	1
	iii.	A Bitumen bound macadam pavement is best suited where (d) Rainfall is less	1
	iv.	Formula for G.I. value is (b) $0.2a + .005a c + 0.01bd$	1
	v.	Find Equivalent radius of resisting section of 20 cm slab , given that the radius of contact area of wheel load is 15 cm; (c) 14.07 cm	1
	vi.	Compute radius of relative stiffness for the following data; $h = 15\text{cm}$ , $E = 2.1 \times 10^5 \text{ kg/cm}^2$ , $u = 0.13$ , $k = 3 \text{ kg/cm}^3$ (a) 66.89cm	1
	vii.	Warping Cracks is type of; (a) Rigid Pavement Failure	1
	viii.	The removal and diversion of surface water from the roadway is called+ (c) Surface drainage	1
	ix.	The Airport reference temperature is given by (b) $T_a + (T_m - T_a)/3$	1
	x.	The Threshold markings are: (d) All of these	1
Q.2	i.	Explain PIEV Theory with diagram. 1 mark for explanation 1 mark for diagram	2
	ii.	Write steps for Super elevation design in brief. 3/4 marks for each step (4 steps) <span style="float: right;">(¾ mark *4)</span>	3
	iii.	Calculate the Safe overtaking sight distance for a design speed of 96 kmph. If given that speed of Overtaken Vehicle is 80 kmph, reaction time 2 Sec, acceleration of overtaking vehicle is 2.5kmph/sec and two way traffic road.	

		<p><b>Solution</b></p> <p>O.S.D = <math>(d_1 + d_2)</math> for one-way traffic            = <math>(d_1 + d_2 + d_3)</math> for two-way traffic</p> <p><math>V = 96 \text{ kmph}</math></p> <p>Assume <math>V_b = V - 16 = 80 \text{ kmph}</math> and  <math>A = 2.5 \text{ kmph/sec. (from Table 4.7); } t = 2 \text{ secs.}</math></p> <p><math>d_1 = 0.28 V_b t = 0.28 \times 80 \times 2 = 44.8 \text{ m}</math></p> <p><math>d_2 = 0.28 V_b T + 2.s</math></p> <p><math>s = (0.2 V_b + 6) = 0.2 \times 80 + 6 = 22 \text{ m}</math></p> <p><math>T = \sqrt{\frac{14.4 s}{A}} = \sqrt{\frac{14.4 \times 22}{2.5}} = 11.3 \text{ secs.}</math></p> <p><math>d_2 = 0.28 \times 80 \times 11.3 + 2 \times 22 = 297 \text{ m}</math></p> <p><math>d_3 = 0.28 V T = 0.28 \times 96 \times 11.3 = 303.7 \text{ m}</math></p> <p>O.S.D. on one-way traffic road = <math>d_1 + d_2 = 341.8 \text{ m; say } 342 \text{ m}</math></p> <p>O.S.D. on two-way traffic road = <math>d_1 + d_2 + d_3 = 645.5 \text{ m; say } 646 \text{ m}</math></p>	1 1 1 1 1
OR	iv.	Calculate the Stopping Sight distance on a highway at a descending gradient of 2% for a design speed of 80 kmph. If given that reaction time $t = 2.5 \text{ Sec}$ , $g = 9.81 \text{ m/sec}^2$ , design coefficient of friction is 0.35.	5

		<p><b>Solution</b></p> <p>Total reaction time t may be taken as 2.5 seconds and design coefficient of friction as <math>f = 0.35</math>.</p> $V = 80 \text{ kmph}; n = -2\% = -0.02, G = 9.8 \text{ m/sec}^2$ $v = \frac{80}{3.6} = 22.2 \text{ m/sec}$ <p>SSD on road with gradient is given in Eq. 4.3 and 4.4.</p> <p>From Eq. 4.3, <math>SSD = vt + \frac{v^2}{2g(f \pm n\%)} = 2.2 \times 2.5 + \frac{22.2^2}{2 \times 9.8(0.35 - 0.02)}</math></p> $= 55.5 + 76.2 = 131.7 \text{ m say } 132 \text{ m}$ <p>Alternatively, using Eq. 4.4</p> $SSD = 0.278 V.t + \frac{V^2}{254(f \pm 0.01)n}$ $= 0.278 \times 80 \times 2.5 + \frac{80^2}{254(0.35 - 0.02)} = 55.6 + 76.4 = 132 \text{ m}$	<p><b>1</b></p> <p><b>2</b></p> <p><b>2</b></p> <p><b>OR</b></p> <p><b>3</b></p> <p><b>2</b></p>
Q.3	i.	Define WBM and WMM. 1 mark for each explanation. (1 mark *2)	<b>2</b>
	ii.	Explain in detail Marshall Mix Design Method of flexible pavement with diagrams. 5 marks for explanation and procedure, 3 marks for diagram	<b>8</b>
OR	iii.	Explain in detail California Bearing Ratio method of flexible pavement design with diagrams. 5 marks for explanation, 2 marks for diagram and 1 mark for formula.	<b>8</b>
Q.4	i.	Differentiate between Rigid pavement and Flexible pavement. ½ mark for each point (½ mark * 4)	<b>2</b>
	ii.	Explain in brief design of Dowel bar. ¾ mark for each step (¾ mark *4)	<b>3</b>
	iii.	Determine the spacing between contraction joints for 3.5 meter slab width having thickness of 20 cm and $f = 1.5$ , for the following two cases: (a) for plain cement concrete, allowable $S_c = 0.8 \text{ kg/cm}^2$ (b) For reinforcement cement concrete, 1.0 cm diameter bars at 0.3 meter Spacing.	

		<p><b>Solution</b></p> <p>Case (i) For Plain Cement Concrete Slab (without reinforcement)</p> <p>Assume unit weight of CC, <math>W = 2400 \text{ kg/m}^3</math></p> <p>Using Eq. 7.30 spacing between contraction joints.</p> $L_c = \frac{2S_c}{Wf} \times 10^4 = \frac{2 \times 0.8 \times 10^4}{2400 \times 1.5} = 4.44 \text{ m}$ <p>Case (ii) For Reinforced Cement Concrete Slab</p> <p>Total cross sectional area of steel, <math>A_s</math> in one direction along the slab width</p> $A_s = \frac{3.5 \times \pi \times 1.0^2}{0.3 \times 4} = 9.16 \text{ cm}^2$ <p>Using Eq. 7.29, spacing between contraction joints,</p> $L_c = \frac{200S_s A_s}{b h W f} = \frac{200 \times 1200 \times 9.16}{3.5 \times 20 \times 2400 \times 1.5} = 8.72 \text{ m}$	<p><b>0.5</b></p> <p><b>2</b></p> <p><b>1</b></p> <p><b>1.5</b></p>	
OR	iv	Explain the following terms : (a) Warping stresses and Frictional stresses (b) Contraction joint and Expansion joint (c) Tie bars	<p>2 marks</p> <p>2 marks</p> <p>1 mark</p>	<b>5</b>
Q.5	i.	What are general causes of Pavement Failures? ½ mark for each point (½ mark * 6)		<b>3</b>
OR	ii.	Explain Flexible and Rigid Pavement Failures with diagram. 1 mark for each point with diagram.		<b>7</b>
	iii.	What are different types of Overlay? Explain overlay Design by Benkelman Beam deflection studies.	<p>2 marks</p> <p>5 marks</p>	<b>7</b>
Q.6	i.	Attempt any two.		
	ii.	What are the important points to be considered while selecting the suitable site for Airport? 1 mark for each point (1 mark * 5)		<b>5</b>
	iii.	Explain different features of Wind Rose Diagram. 1 mark for each point (1 mark * 5)		<b>5</b>
	iv.	Write short note on Taxiways and geometrical elements of runway. 2.5 marks for each (2.5 marks * 2)		<b>5</b>

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