B. E. CIVIL ENGINEERING 3RD YEAR 2ND SEMESTER EXAMINATION 2019
TRANSPORTATION ENGINEERING – II

Time: 3 Hours **Full Marks: 100**

Answer Question No 1 and one each from each group

1. Draw a typical schematic plan of layout of an airport and name the major components. Explain one major function of each of the components. 1+3+6

GROUP – A

2. Illustrate the following - 5×5
   a. Analysis of Parking Survey Data
   b. Representation of Accident Data
   c. Delay & Its types
   d. External Cordon Line and its characteristics
   e. Automatic method of Volume Study

3. a) From the following observations of a moving car study determine the Average Density of flow (considering journey speed) of each direction AD & DA. 15

Section	Length (m)	Running Time (sec)	Delay (sec)	Vehicles met with		
				Opposite Direction	Overtaking	Overtaken
AB	600	156	23	19	9	8
B	---	---	48	28	--	--
BC	400	190	17	17	14	6
C	---	---	58	16	--	--
CD	500	184	15	11	12	11
D	---	---	50	11	--	--
DC	500	150	15	20	10	13
C	---	---	49	19	--	--
CB	400	190	25	29	7	10
B	---	---	50	17	--	--
BA	600	171	15	30	14	11

b) Determine Overall Parking Load, Average Parking Index, Parking Volume, Average Turnover, and Average Duration from the following parking survey data collected in 10minutes frequency. 10

Time	1	2	3	4	5	6	7	8	9	10	11	12
0-10	7007	7402	2292	6725	2482	7197	---	9339	8191	9609	3040	5070
10-20	7007	7402	2292	6725	2482	7197	9484	9339	8191	9609	3040	5070
20-30	7007	7402	2292	6725	2482	7197	9484	9339	8191	---	3040	5070
30-40	7007	7402	2292	6725	0968	7197	9484	9339	5162	---	3040	5070
40-50	7007	--	3483	6725	0968	7197	--	7305	5162	--	3040	5070
50-60	7007	---	---	--	0968	7197	--	7305	8313	--	--	5070

GROUP – B

4. Two roads spreading in North-South and East-West direction both having dual 3-lane carriageway in each direction intersect each other perpendicularly at point X. Without considering any pedestrian movement, draw neatly the possible two cases of 4-phase signalling and solve the optimum of the two cases considering the intersection as good and approach traffic as given below. Assume a single right turning lane with 30m turning radius, amber phase and starting delay for all phases as 4secs and 3secs respectively. 20

From	North			South			East			West		
To	E	S	W	W	N	E	S	W	N	N	E	S
flow	94	554	43	41	804	41	36	557	72	40	516	54

5. a) Explain in detail how design traffic is computed for turning streams while designing an optimum signal cycle. 6
   b) Explain clearly the difference between regulatory and cautionary type of road signage and write short notes on different types of regulatory signage. 2+6
   c) Explain different types of along the road markers based upon colours and line types. 6

GROUP – C

6. a) Draw a neat and typical structural cross section of a flexible pavement. Explain the major functions of the topmost layer. 3+3
   b) Explain the phenomenon called *rutting* and its significance in flexible pavement design following IRC 2012 4
   c) Explain briefly the different applications of Bitumen in flexible pavement construction 10

7. a) Name the major two types of pavement and state the basic difference among them on the basis of load transfer mechanism and failure character. 8
   b) Explain the significance of providing spacer discs in a CBR mould 2
   c) Determine the CBR value of subgrade soil from the following laboratory test observations 10

Penetration (mm)	0.0	0.5	1.0	1.5	2.0	2.5	3.0	4.0	5.0	7.5	10.0	12.5
Load (kg)	0	5	17	29	42	50	58	70	78	92	102	108

GROUP – D

8. a) Explain where and why Dowel Bars are provided. With a neat sketch describe the construction process of Dowel system 3+4
   b) Without elaborating on the equations involved, explain the principle of determination of thickness of a rigid pavement slab. 4
   c) Explain why contraction joints are provided in rigid pavement 2
   d) Applying IRC (2002) methods, design the required joints and reinforcements at joints for a 300mm thick rigid pavement, considering the following data and the formulas –
   Design wheel load = 10,200Kg, Maximum permissible joint spacing = 25mm, Maximum seasonal temperature variation = 30°c, Modulus of sub-grade reaction= 8kg/cm^3, Width of Slab= 3500mm, Coefficient of friction = 1.5, Diameter of dowel = 20mm, Diameter of tie = 12mm, Radius of equivalent contact area = 150mm, Modulus of elasticity of concrete = 3×10^5kg/cm^2, Coefficient of thermal expansion of concrete = 1×10^{-5}/°c, Unit weight of concrete = 2400kg/cm^3, Poisson's ratio of concrete = 0.15, Flexural strength of concrete = 40kg/cm^2, Tensile strength of

concrete = 0.8kg/cm^2, Bearing strength of concrete = 100kg/cm^2, Load transfer through dowel = 40%, Flexural strength of dowel = 1400 kg/cm^2, Shear strength of dowel = 1000 kg/cm^2, Bond strength of deformed bar= 24.6 kg/cm^2. 12

- Radius of Relative Stiffness, $l = \left[\frac{E.t^3}{12k(1-\nu^2)}\right]^{1/4}$
- Effective Length of Dowel $L_d = 5d\left[\frac{f_{st}}{f_{bc}} \times \frac{L_d+1.5\delta}{L_d+8.8\delta}\right]^{1/2}$
- Capacity of a Dowel: Shear = $0.785d^2 f_{ss}$; Bending = $\frac{2d^3 f_{st}}{L_d+8.8\delta}$; Bearing = $\frac{dL_d^2 f_{bc}}{12.5(L_d+1.5\delta)}$
- Area of Tie = $\frac{L_Y \mu \gamma_c t}{f_{st}}$
- Length of Tie = $\frac{d_{tie} f_{st}}{2f_{bc}}$

৭. a) Explain Vehicle Distribution Factor – how it can be computed for a known axle category and its significance in IRC method of Design of Flexible Pavements 4

b) Explain the basic failure mechanism of a flexible pavement against which the structural design is made. 3

c) How is the design traffic calculated from present day traffic survey data? Explain why different equations are used to calculate traffic at the end of construction and design life. 3+3

d) Applying IRC (2012) method and the given pavement design catalogue, design suitable flexible pavement section and draw neatly a scaled cross-section diagram of it for a dual 3-lane carriageway in each direction considering Subgrade CBR 4.5%; Annual traffic growth rate 7.5%, construction period of 2 years and design life 20 years. The present day traffic as recorded is as follows – 12

Direction of flow	Traffic Volume (in veh/day)					
	Tandem Axle		Single Axle			
	12.0t	10.0t	8.0t	6.0t	5.0t	3.0t
Onward	1000	2500	5000	4500	2500	1300
Return	1500	1500	7500	4000	3000	1200

Pavement Design Catalogue (IRC:37 – 2012)

Cumulative Traffic (in msa)	PAVEMENT COMPOSITION (Thickness in mm)					
	Wearing Course	Base Course	Subgrade CBR 4%		Subgrade CBR 5%	
			Surface Course	Sub-base Course	Surface Course	Sub-base Course
1	20	225	--	255	--	205
2	20	225	50	265	50	215
3	20	250	50	280	50	230
5	25	250	60	285	55	250
10	40	250	80	330	70	300
20	40	250	110	330	100	300
30	40	250	130	330	120	300
50	40	250	160	330	140	300
100	50	250	170	330	150	300
150	50	250	190	330	170	300