Seat No. _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE – SEMESTER IV (NEW SYLLABUS) EXAMINATION - SUMMER- 2018

Subject Code: 2144003 Date: 28/05/2018

Subject Name: Basics of Transportation Engineering

Time: 10:30 am to 1:00 pm Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Use Arithmetic Graph paper for Q5 (b) for plotting the PDF and CDF.**

Q.1	**(a)**	What are the advantages of road transport? Describe the various classifications of roads in India by Nagpur Road Plan.	**07**
	(b)	What are the objectives of highway geometric design? Explain the various geometric elements to be considered in highway design.	**07**
Q.2	**(a)**	Explain camber. What are the objects of providing camber? Discuss the factors on which amount of camber depends. Also Explain camber and show the various shapes of camber with the help of neat sketch. Explain in brief objectives to provide on pavement surface. also discuss factors on which amount of camber depends	**07**
	(b)	Design the superelevation required to maintain the speed on a horizontal curve with a radius of 300 m on national highway. Safe limit of lateral friction is 0.15.	**07**
		OR	
	(b)	Calculate the minimum sight distance required to avoid head on collision of two cars approaching from the opposite directions on a highway at a descending gradient of 3 %. In this case, Car 'A' is moving with a speed of 80 kmph, reaction time of driver is 2.5 sec, coefficient of friction of 0.75 and break efficiency of 80 percent. Similarly, Car 'B' is moving with a speed of 60 kmph, reaction time of driver is 2.0 sec, coefficient of friction of 0.70 and break efficiency of 70 percent.	**07**
Q.3	**(a)**	What are the various tests carried out on bitumen? Explain ductility test and its significance.	**07**
	(b)	Explain various types of failures in cement concrete pavements & their causes.	**07**
		OR	
Q.3	**(a)**	Enlist the various tests to be conducted on aggregates. Explain crushing value test for aggregate and its significance.	**07**
	(b)	Design a new flexible pavement for a two lane undivided carriageway using the following data: (a) Design CBR value of subgrade = 4 % (b) Initial traffic on completion of construction = 300 cv per day (c) Average growth rate = 6 % per year (d) Design life = 10 years (e) VDF value = 2.5 Use figure 1, table no. 1 for calculating composition of pavement component (as per IRC guidelines).	**07**

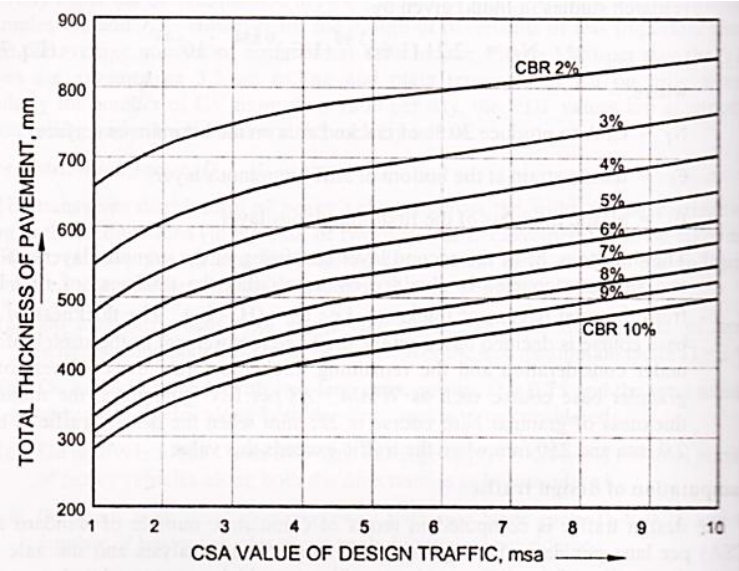

Fig.1. CBR design chart for determination of total pavement thickness for traffic with CSA of 1.0 to 10 msa

Table 1. Pavement design with recommended component layers for cumulative traffic range 1 to 10 msa

CBR, %	CSA, msa	Total pavement thickness, mm	Granular sub-base course, mm	Granular base course, mm	Binder course, mm	Surface course, mm
3	1	550	435	225		20 PC
	2	610	335	225	50 BM	20 PC
	3	645	335	250	60 BM	20 PC
	5	690	335	250	60 DBM	25 SDBC
	10	760	335	250	90DBM	40 BC
4	1	480	255	225		20 PC
	2	540	265	225	50 BM	20 PC
	3	580	280	250	50 BM	20 PC
	5	620	285	250	60 BM	25 SDBC
	10	700	330	250	80 BM	40 BC
6	1	390	165	225		20 PC
	2	450	175	225	50 BM	20 PC
	3	490	190	250	50 BM	20 PC
	5	535	210	250	50 BM	25 SDBC
	10	615	260	250	65 BM	40 BC
8	1	375	150	225		20 PC
	2	425	150	225	50 BM	20 PC
	3	450	150	250	50 BM	20 PC
	5	475	150	250	50 DBM	25 SDBC
	10	550	200	250	60 DBM	40 BC
10	1	375	150	225		20 PC
	2	425	150	225	50 BM	20 PC
	3	450	150	250	50 BM	20 PC
	5	475	150	250	50 DBM	25 SDBC
	10	540	200	250	50 DBM	40 BC

Q.4 **(a)** Table 2 is the Traffic volume data collected for the peak AM hour (9:00 AM to 10:00 AM) traffic count data for Path2 collected on 03-02-2018 on a weekend: Shantigram to Sarkhej (Two lane One Way). What is the composition of Traffic distribution and which of the particular vehicular group are major contributor for the Traffic congestion in this Path. Calculate the LOS for this path for 2018 and comment on the LOS achieved (Refer to relevant Tables presented in Appendix). Also, suggest a mitigation solution for improving the existing public transport system facility- Metro Rail Transport to improve from existing LOS to LOS C. If we assume each metro rail system of 5 bogies per trip which is equivalent to 50 PCU trips then calculate the number of metro rail trips for Path2? If a constant annual growth rate of 15% is assumed for this path. Estimate the future traffic volume for **07**

2025 and also calculate the LOS and comment in terms of Metro Rail Transport mitigation.

Table2: Peak AM Traffic count for path2: Shantigram to Sarkhej. (Time: 9:00 to 10 AM), 03-02-2018, Saturday.

Time	Fast Moving Vehicle						Slow Moving Vehicles	
	Two Wheeler	Three Wheeler	Four Wheeler	L.C.V.	H.C.V.	Bus	N.M.V.	Others
9:00-9:15	224	6	90	5	2	4	0	0
9:15-9:30	190	13	94	10	1	4	0	1
9:30-9:45	132	13	108	19	3	3	0	0
9:45-10:00	145	10	113	20	5	10	0	0

(b) Explain in detail the "ASI" mitigation approach to tackle Transport pollution for creating sustainable Urban Transport Management System? Clearly mention the mitigation solution and how to Implement ASI policy in Indian Scenario? **07**

OR

Q.4 **(a)** List out any four Intelligent Transportation System Technologies and explain them in brief with a neat sketch? **07**

(b) List out any four Intelligent Transportation System Applications and explain them in brief with a neat sketch? **07**

Q.5 **(a)** Explain Greenshield's Macroscopic Stream model. What is the relationship in terms of Traffic parameters v, k and q. Plot the relationships. Also, mention the boundary conditions for determining optimal density and optimal velocity for maximum traffic flow? **07**

(b) For the following data on speed and density, determine the parameters of the Greenshield's model. Also find the maximum flow and density corresponding to a speed of 30 km/hr. For the linear equation of the form : y = a + bx , coefficients $a = \bar{y} - b\bar{x}$ and $b = \frac{\sum_{i=1}^{n}(x_i-\bar{x})(y_i-\bar{y})}{\sum_{i=1}^{n}(x_i-\bar{x})^2}$, **07**

K (veh/km)	**V (km/hr)**
171	5
129	15
20	40
70	25
100	21
50	31

Compare the maximum flow obtained through Greenshield's model with the maximum flow obtained in Q4 (a) by calculating Mean Square Error. Does the Traffic flow at Path2 of Vaishnov Devi circle follow Greenshield's model comment accordingly?

OR

Q.5 **(a)** Explain the philosophy of Macroscopic stream model development? Explain Greenberg's Macroscopic, Underwood's exponential and Pipe's generalized model by comparing with Greenshield's model? Mention the assumptions clearly? **07**

(b) Determine Speed Characteristics from a Set of Speed Data given for two wheeler **07**

vehicle class based on the spot speed studies carried out at Pashawnath Jain mandir, Ahmedabad. Table 7 (Appendix) shows the data collected on a Sub-arterial highway during a speed study. Develop the frequency histogram and the frequency distribution of the data and determine:

(a). Average Speed
(b). Design Speed
(c). Safe Speed,
(d). Modal Speed and
(e). Pace Speed.

Appendix:

Table 4: Recommended PCU factors for various Types of Vehicles on Urban Roads (Taken from IRC 106-1990)

Vehicle Type	Equivalent PCU Factors	
	Percentage composition of Vehicle type in traffic stream	
	5%	10% and above
Fast Vehicles		
1. Two wheelers Motor cycle or scooter etc.	0.5	0.75
2. Passenger car, pick-up van	1.0	1.0
3. Auto-rickshaw	1.2	2.0
4. Light commercial vehicle	1.4	2.0
5. Truck or Bus	2.2	3.7
6. Agricultural Tractor Trailer	4.0	5.0
Slow Vehicles		
7. Cycle	0.4	0.5
8. Cycle rickshaw	1.5	2.0
9. Tonga (Horse drawn vehicle)	1.5	2.0
10. Hand cart	2.0	3.0

Table 5: Recommended design service volume (PCU's per hour)

S. No.	Type of carriageway	Total Design Service Volumes for Different Categories of Urban Roads		
		Arterial*	Sub-arterial**	Collector***
1.	2-Lane (One-Way)	2400	1900	1400
2.	2-Lane (Two-Way)	1500	1200	900
3.	3-Lane (One-Way)	3600	2900	2200
4.	4-Lane Undivided (Two-Way)	3000	2400	1800
5.	4-Lane Divided (Two-Way)	3600	2900	—
6.	6-Lane Undivided (Two-Way)	4800	3800	—
7.	6-Lane Divided (Two-Way)	5400	4300	—
8.	8-Lane Divided (Two-Way)	7200	—	—

Table 6: LOS TABLE SHOWING V/C RATIO

LOS	K (veh/km/lane)	FFS (Km/hr)	v/c
A	0-7	120	0.35
B	7-11	120	0.55
C	11-16	114	0.77
D	16-22	99	0.92
E	22-28	85	1.0
F	> 28	< 85	> 1.0

Table 7: Two Wheeler Speed data collected at Pashawnath Jain Mandir, Ahmedabad

Two Wheeler No.	Speed (km/hr)	Two Wheeler No.	Speed (km/hr)
1	25	11	38.3
2	26	12	44.6
3	30	13	45.2
4	33	14	41.1
5	36	15	55.1
6	54	16	69
7	42.1	17	54.3
8	50.1	18	45.4
9	51.8	19	55.2
10	65	20	45.7

GOODLUCK

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