Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME – SEMESTER-1 (NEW) EXAMINATION – WINTER 2016

Subject Code: 2711302 Date:04/01/2017

Subject Name: Traffic Engineering

Time: 2:30 pm to 5:00 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 the attached tables wherever necessary.**

Q.1 **(a)** What are the basic elements of road traffic? Briefly explain road user's characteristics. **07**

(b) Explain Greenshield's traffic flow model with speed-flow-density curves. Derive the relationship for maximum flow condition. **07**

Q.2 **(a)** Define: AADT, DDHV, SMS, PHF, Space headway, Freeway, Capacity. **07**

(b) The driver of vehicle travelling at 60kmph requires 8m less to stop after applying the brakes up a grade than when travelling down the same grade. If the coefficient of friction is 0.4, calculate: (i) % of the gradient, (ii) braking distance on the downgrade **07**

OR

(b) Derive the condition for maximum flow for the Greenberg's traffic flow model. The speed-density relationship of traffic on a section of a freeway lane was estimated to be $v_x = 18.2 \ln (220/k)$ as per Greenberg's model. (a) Find flow, speed and density at Maximum flow, (b) Find jam density. **07**

Q.3 **(a)** What are the purposes of conducting spot speed study? Enlist various methods of spot speed study survey and describe any one of them with sketch. **05**

(b) From the following data of spot-speed study, draw graphs for frequency (%) – vs- Speed range and Cumulative frequency (%) - vs- Speed. Also, calculate: Modal speed, Median speed, TMS, SMS, speed to be used in geometric design, speed for traffic regulation, standard deviation and coefficient of variation. **09**

Speed range (kmph)	1-10.9	11-20.9	21-30.9	31-40.9	41-50.9	51-60.9	61-70.9	71-80.9	81-90.9
No. of vehicles	3	8	15	22	28	20	14	7	2

OR

Q.3 **(a)** Explain with sketch floating car method for travel time and delay study. **05**

(b) Develop speed-density relationship from the following data. Determine Maximum flow, Jam density, Free flow speed, Optimum speed for maximum flow. Draw speed-flow and speed-density graphs. **09**

Density (vpk)	10	20	30	40	50	60	70	80	90	100
Speed (kmph)	84	75	68	62	56	52	40	33	28	20

Q.4 **(a)** Discuss briefly about various TSM techniques. **04**

(b) On the right angled crossing of four arm signalized intersection, design 4 phase signal cycle for the given data using Webster's method and IRC recommendations. Assume, amber = 3 sec/phase, lost time = 2 sec/phase, saturation flow rate=525W [W= Width of approach (m)], pcu value for the left and right turning vehicles are 25% and 75% more respectively. All left (L), straight (S) and right (R) turning vehicles on an approach are allowed to depart simultaneously during a green interval. Road AB crosses road CD at right angle. **10**

Approach	A			B			C			D		
Width(m)	10			10			9			9		
Turning	L	S	R	L	S	R	L	S	R	L	S	R
Volume (pcu/hr)	400	800	300	280	700	150	100	380	60	120	350	50

OR

Q.4 **(a)** Discuss briefly about parking accumulation and duration study. **04**

(b) Using HCM-2000 methodology and attached Tables, determine the LOS during the peak hour of existing four-lane freeway in rural area, for very restricted geometry, rolling terrain and 110 kmph speed limit. Assume: 2 lanes in each direction, 3.5m lane width, 0.9m lateral clearance, commuter traffic, 2000 veh/hr peak hour volume in one direction, 10 % trucks, 0.9 PHF, 0.5 interchanges/km, no buses and recreational vehicles, base free flow speed 120 kmph, and driver population factor is 1. **10**

Q.5 **(a)** Discuss briefly about applications of simulation in traffic engineering. **05**

(b) Briefly explain safety measures for road accidents. **04**

(c) Briefly explain preventive measures for air and noise pollution caused by road traffic. **05**

OR

Q.5 **(a)** Explain with sketch design elements of a Rotary Intersection. **07**

(b) The width of a carriage way approaching an intersection is given as 15 m. The entry and exit width at the rotary is 10 m. The traffic approaching the intersection from the four sides is shown in the figure below in pcu/hr. Find the capacity of the rotary using the given data, follow the IRC guidelines. **07**

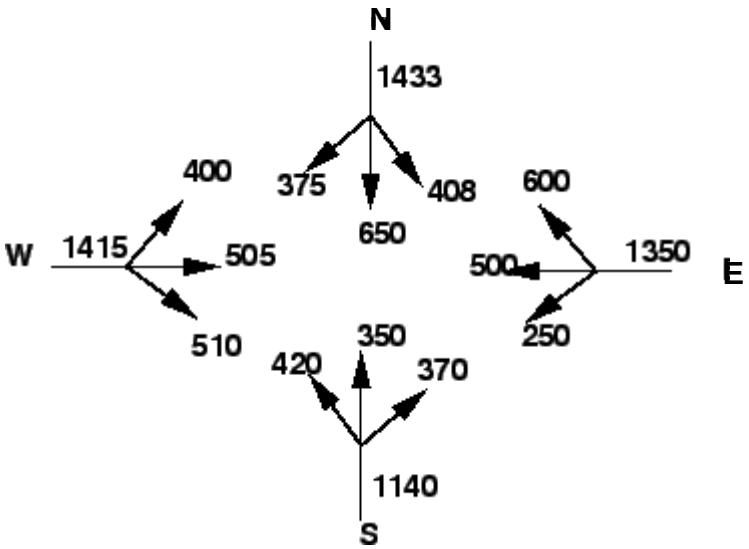

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EXHIBIT 23-2. LEVEL-OF-SERVICE CRITERIA FOR BASIC FREEWAY SEGMENTS

		LOS				
Free-Flow Speed	Criteria	A	B	C	D	E
120 km/h	Max Density (pc/km/ln)	7	11	16	22	28
	Minimum Speed (km/h)	120.0	120.0	114.6	99.6	85.7
	Max v/c	0.35	0.55	0.77	0.92	1.00
	Max Service Flow Rate (pc/h/ln)	840	1320	1840	2200	2400
110 km/h	Max Density (pc/km/ln)	7	11	16	22	28
	Minimum Speed (km/h)	110.0	110.0	108.5	97.2	83.9
	Max v/c	0.33	0.51	0.74	0.91	1.00
	Max Service Flow Rate (pc/h/ln)	770	1210	1740	2135	2350
100 km/h	Max Density (pc/km/ln)	7	11	16	22	28
	Minimum Speed (km/h)	100.0	100.0	100.0	93.8	82.1
	Max v/c	0.30	0.48	0.70	0.90	1.00
	Max Service Flow Rate (pc/h/ln)	700	1100	1600	2065	2300
90 km/h	Max Density (pc/km/ln)	7	11	16	22	28
	Minimum Speed (km/h)	90.0	90.0	90.0	89.1	80.4
	Max v/c	0.28	0.44	0.64	0.87	1.00
	Max Service Flow Rate (pc/h/ln)	630	990	1440	1955	2250

Notes:
The exact mathematical relationship between density and v/c has not always been maintained at LOS boundaries because of the use of rounded values. Density is the primary determinant of LOS. LOS F is characterized by highly unstable and variable traffic flow. Prediction of accurate flow rate, density, and speed at LOS F is difficult. Speed criterion lists speed at maximum density for a given LOS.

EXHIBIT 23-4. ADJUSTMENTS FOR LANE WIDTH

Lane Width (m)	Reduction in Free-Flow Speed f_{LW}(km/h)
3.6	0.0
3.5	1.0
3.4	2.1
3.3	3.1
3.2	5.6
3.1	8.1
3.0	10.6

EXHIBIT 23-5. ADJUSTMENTS FOR RIGHT-SHOULDER LATERAL CLEARANCE

Right-Shoulder Lateral Clearance (m)	Reduction in Free-Flow Speed f_{LC} (km/h)		
	Lanes in One Direction		
	2	3	4
≥ 1.8	0.0	0.0	0.0
1.5	1.0	0.7	0.3
1.2	1.9	1.3	0.7
0.9	2.9	1.9	1.0
0.6	3.9	2.6	1.3
0.3	4.8	3.2	1.6
0.0	5.8	3.9	1.9

EXHIBIT 23-6. ADJUSTMENTS FOR NUMBER OF LANES

Number of Lanes (one direction)	Reduction in Free-Flow Speed f_N (km/h)
≥ 5	0.0
4	2.4
3	4.8
2	7.3

Note: For all rural freeway segments, f_N is 0.0.

EXHIBIT 23-7. ADJUSTMENTS FOR INTERCHANGE DENSITY

Interchanges/Kilometer	Reduction in Free-Flow Speed f_{ID} (km/h)
≤ 0.3	0.0
0.4	1.1
0.5	2.1
0.6	3.9
0.7	5.0
0.8	6.0
0.9	8.1
1.0	9.2
1.1	10.2
1.2	12.1

EXHIBIT 23-8. PASSENGER CAR EQUIVALENTS ON EXTENDED FREEWAY SEGMENTS

Factor	Type of Terrain		
	Level	Rolling	Mountainous
E_T (Trucks and Buses)	1.5	2.5	4.5
E_R (RVs)	1.2	2.0	4.0

(Source: HCM-2000)

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