Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–V (NEW) EXAMINATION – WINTER 2020

Subject Code:3154008 Date:29/01/2021

Subject Name:Highway and Traffic Engineering

Time:10:30 AM TO 12:30 PM Total Marks: 56

Instructions:

1. **Attempt any FOUR questions out of EIGHT questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

			Marks
Q.1	**(a)**	State the merits of road transport over other modes of transportation.	**03**
	(b)	Discuss briefly different road users' characteristics affecting traffic performance.	**04**
	(c)	Draw a typical sketch of NH (Rigid pavement) in embankment. Show its all components and boundaries. Describe their significance.	**07**
Q.2	**(a)**	Describe briefly various factors controlling the highway alignment.	**03**
	(b)	Explain with sketch the Overtaking Manoeuvre and derive expression for OSD.	**04**
	(c)	The speeds of overtaking and overtaken vehicles are 80 and 65 kmph respectively. If the acceleration of the overtaking vehicle is 2.5 kmph per second, calculate the safe OSD for (i) One way traffic, and (ii) Two way traffic.	**07**
Q.3	**(a)**	Briefly explain with sketches Specific Gravity Test for the aggregates.	**03**
	(b)	Explain following terms with a sketch of volumetrics of bituminous mix: VMA, VFB, V_V, V_{ba}	**04**
	(c)	An ascending gradient of 1:40 meets a descending gradient of 1:50. Determine the length of summit curve to provide ISD, for a design speed of 80 kmph. Assume all other data.	**07**
Q.4	**(a)**	Briefly explain with sketches Softening Point Test for the bitumen.	**03**
	(b)	Briefly describe with sketches 'Marshall Stability Test' for bituminous mix design.	**04**
	(c)	The CBR test carried out on a subgrade soil gave the following readings.	**07**

Penetration (mm)	Load (kg)	Penetration (mm)	Load (kg)	Penetration (mm)	Load (kg)
0	0	2.0	43.0	5.0	78.0
0.5	3.5	2.5	54.0	7.5	94.5
1.0	14.5	3.0	60.0	10.0	104.5
1.5	32.0	4.0	72.0	12.5	112.4

Determine the CBR value of soil sample

Q.5	**(a)**	Briefly describe: ESWL, EWLF, BUC	**03**
	(b)	Determine the total thickness of flexible pavement assuming single layer elastic theory and using the data: Design wheel	**04**

load = 5100kg, Tyre pressure=7kg/cm2, Elastic modulus= 160kg/cm2, permissible deflection=0.25cm.

(c) Design a suitable bituminous pavement section for a two-lane road with a Single carriageway. The traffic expected is 520 commercial vehicles per day in both directions with average vehicle damage factor of 1.6. Design subgrade CBR is 5%. The assumed design life of the pavement is 10 years. Use Guidelines, graphs and plate of IRC 37-2001. **07**

Q.6 **(a)** Describe with sketches special considerations for Hill Roads construction. **03**

(b) Discuss with sketches any three types of failures and its remedial measures in rigid pavements. **04**

(c) Calculate the stress at corner region of cement concrete pavement using Westergaard's stress equation modified by Kelly. **07**

Take wheel load = 5000 kg, Ec = 3 x 10^5 kg/cm^2 , Pavement thickness = 19 cm, μ = 0.15, Modulus of subgrade reaction k = 5 kg/cm^3, Radius of contact area = 15 cm.

Q.7 **(a)** Derive Greenshield's equations for maximum flow condition. **03**

(b) Explain with sketch 'Enoscope method' of Spot-Speed study. **04**

(c) From the following data of spot-speed study, draw graphs for frequency (%) –vs- Speed range and Cumulative frequency (%) - vs- Speed. Determine TMS, SMS, Speed for traffic regulation. **07**

Speed range (kmph)	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90
No. of vehicles	7	11	18	25	32	24	16	10	6

Q.8 **(a)** Briefly describe: Traffic density, Time headway, Basic Capacity **03**

(b) Explain with sketches: Rotary Intersection, Full Cloverleaf Interchange. **04**

(c) 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=600W [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. **07**

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	900	300	300	800	150	100	480	60	120	450	60

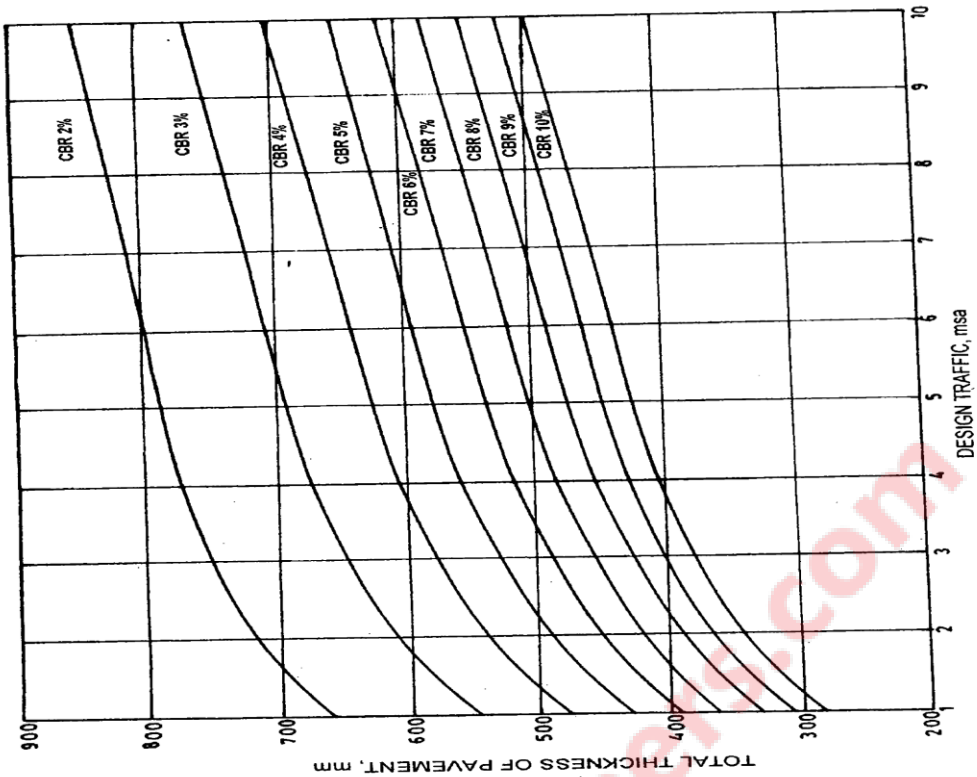


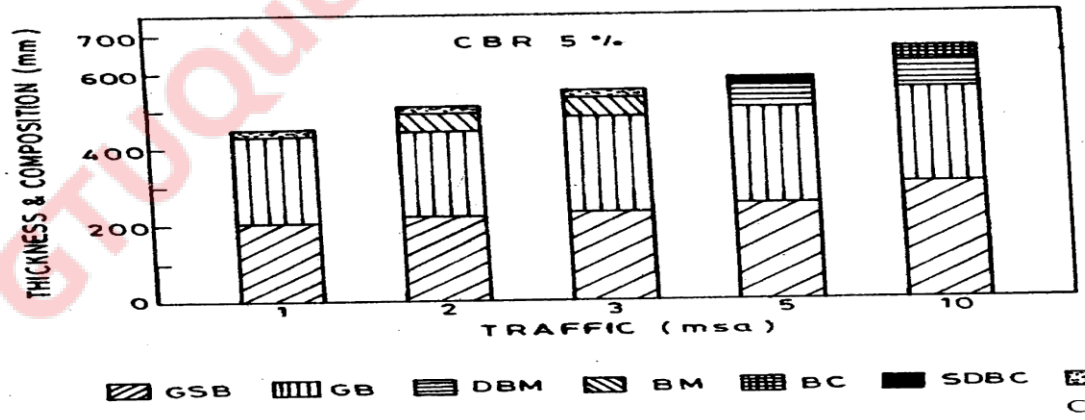
Fig. 1. Pavement Thickness Design Chart for Traffic 1-10 msa

IRC:37-2001

PAVEMENT DESIGN CATALOGUE

PLATE 1 – RECOMMENDED DESIGNS FOR TRAFFIC RANGE 1-10 msa

CBR 5%					
Cumulative Traffic (msa)	Total Pavement Thickness (mm)	PAVEMENT COMPOSITION			
		Bituminous Surfacing		Granular Base (mm)	Granular Sub-base (mm)
		Wearing Course (mm)	Binder Course (mm)		
1	430	20 PC		225	205
2	490	20 PC	50 BM	225	215
3	530	20 PC	50 BM	250	230
5	580	25 SDBC	55 DBM	250	250
10	660	40 BC	70 DBM	250	300



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