Exam.		Back	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Transportation Engineering II *(CE 703)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt **All** questions.
✓ The figures in the margin indicate **Full Marks**.
✓ Assume suitable data if necessary.

1. What are the critical characteristics of road users? Explain the factors affecting road user's characteristics. [8]

2. The following table gives the particulars collected by floating car method on a stretch of road of length 3.5 km. Determine the flow, density and average speed of the streams along each direction. [8]

Trip	Direction of trip	Average travel speed (kmph)	No of vehicles		
			Overtaking	Overtaken	From opposite direction
1	E - W	28	7	4	238
2	W - E	25	5	3	156
3	E - W	28	3	5	250
4	W - E	23	2	1	170
5	E - W	30	5	3	220
6	W - E	23	2	2	140
7	E - W	28	5	2	260
8	W - E	25	3	2	130

3. Give your arguments on the selection of intersection at grade and grade separated intersection. Suggest measures for improving night visibility on highways. [4+4]

4. An isolated signal with pedestrian's indication is to be installed on a right angles intersection with road H of 18 m wide and road F of 12 m wide. The heaviest volume per hour for each lane of road H and F are 500 and 350 respectively. The approach speeds are 60 and 45 Kmph, for H and F roads respectively. Design the timings of traffic and pedestrians signals. [8]

5. Define axle load, Legal axle load, standard axle, ESAL and ESWL. Draw the sketch of different layers of flexible pavement and their explain functions. [5+3]

6. List the different activities in road construction works. Describe the requirements of equipment, materials and construction steps for earthen road. [8]

7. Write down the construction procedure of double bituminous surface treatment including details on material requirement. [8]

8. What is pavement evaluation? How the defects of cement concrete road can be maintained? [4+4]

9. Discuss the temperature stresses in rigid pavement. Design spacing and dowel bars of expansion joint for a concrete pavement with following details using IRC method: [3+5]

a) Design wheel load = 5100 kg
b) Design load transfer = 40%
c) Slab thickness = 25 cm
d) Expansion joint width (δ) = 2 cm
e) Maximum seasonal variation of temperature = 40°C
f) Coefficient of thermal expansion of concrete = 10×10^{-6} / °C
g) Modulus of elasticity of concrete = 3×10^5 kg/cm^2
h) Poisson's ratio of concrete = 0.15
i) Permissible flexural stress in dowel bar (F_f) = 1400 kg/cm^2
j) Permissible shear stress in dowel bar (F_s) = 1000 kg/cm^2
k) Permissible bearing stress in concrete (F_b) = 100 kg/cm^2
l) Modulus of subgrade reaction = 8 kg/cm^2
m) Diameter of dowel bar (d) = 2.5 cm

Bradbury's formulae to determine load transfer capacity of one dowel bar in flexure (P_f), shear (P_s) and bearing (P_b) with length of embedment (L_d) are given by:

$$P_f = \frac{2d^3 F_f}{L_d + 8.8\delta}; \quad P_s = 0.785 d^2 F_s; \quad P_b = \frac{F_b L_d^2 d}{12.5(L_d + 1.5\delta)}$$

10. How ventilation is managed in tunneling? Discuss the river training works carried out for the protection of road.

[4+4]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Bhadra

Exam.		Regular	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Transportation Engineering II *(CE 703)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt *All* questions.
✓ *The figures in the margin indicate Full Marks.*
✓ *Assume suitable data if necessary.*

1. Explain Vehicle Damage Factor (VDF) used in design of flexible pavements. An existing two-lane single carriageway highway is proposed to be widened to a 4-lane divided highway. Design a new flexible pavement for the proposed highway for the following information using provided design catalogues: [2+6]

   (i) 4-lane divided carriageway
   (ii) The expected traffic in the year of completion of construction is 4000 commercial vehicles per day in both direction with 30% heavy trucks of 100kN axle load, 50% light trucks of 80kN axle load, and 20% tractors of 70kN axle load.
   (iii) Design life = 15 years
   (iv) Percentage CBR values obtained from seven different locations along the stretch of the highway are 9, 7, 8, 5, 4, 5, 6.5 respectively.
   (v) Traffic growth rate = 8%

CBR 4%				
Cumulative traffic (msa)	Total Payment thickness (mm)	Pavement Composition		
		bituminous surfacing		Granular base and sub base (mm)
		BC(mm)	DBM(mm)	
10	700	40	80	
20	730	40	110	
30	750	40	130	base = 250 subbase = 330
50	780	40	160	
100	800	50	170	
150	820	50	190	

CBR 5%				
Cumulative traffic (msa)	Total Payment thickness (mm)	Pavement Composition		
		bituminous surfacing		Granular base and sub base (mm)
		BC(mm)	DBM(mm)	
10	660	40	70	
20	690	40	100	
30	710	40	120	base = 250 subbase = 300
50	730	40	140	
100	750	50	150	
150	770	50	170	

2. Discuss tools, equipment and plants used in road construction. List out the characteristics of Mass haul Diagram. [4+4]

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3. Describe the construction procedure of bituminous concrete road and check needed for quality control.

[8]

4. Describe pavement maintenance and its types with examples.

[8]

5. What are the methods of providing tunnel ventilation? Explain the factors controlling the selection of bridge sites.

[8]

6. Describe driver's characteristics and their influence in traffic performance.

[8]

7. Two vehicles approaching at right angles, A from West and B from South, collide with each other. After the collision, vehicle A skids in a direction 51° North of West and vehicle B, 61° East of North. The initial skid distances of the vehicles A and B are 39m and 21m respectively before collision. The skid distances of vehicles A and B after collision are 15m and 36m respectively. If the weights of vehicles B and A are 6 and 4.4 tonnes respectively, calculate the original speeds of the vehicles. Take average skid resistance as 0.55.

[8]

8. At right angled crossing of road A and road B isolated signal with pedestrain indicators is to be installed. The road is 14.4m wide and road B is 12m wide and the peak hour volumes are 280 and 230 PCU per hour and the approach speeds are 50 and 35 kmph respectively. Design the vehicular and pedestrian signal timing.

[8]

9. Explain the design factors to be considered in rotary intersection design.

[8]

10. Explain the temperature stresses in rigid pavement. Write down the design procedure of dowel bar in expansion joints.

[8]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Ashwin

Exam.		Back	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Transportation Engineering II *(CE 703)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt *All* questions.
✓ The figures in the margin indicate *Full Marks*.
✓ *Necessary charts are attached herewith.*
✓ Assume suitable data if necessary.

1. A bicycle racer practices everyday in the morning. Her route includes a ride along 800 m bikeway and back. Since she is traffic engineer, she has made it a habit to count the numbers of cars in lane A that she meets while riding southward, the number of cars in lane A that overtake her while riding northward and the number of cars in lane A that she overtakes while riding northward as shown in table below. Find average traffic flow and time of lane A.   [8]

Average Travel speed (km/hr)	Nos. of Vehicle met	Nos. of Overtaken Vehicle	Nos. of Overtaking Vehicle
32	117	10	74
34	93	25	41
32	30	15	5
33	70	18	9

2. Explain in detail about different physical characteristics of Driver that affect design of traffic facilities.   [8]

3. List out the importance of parking and ill effect of illegal parking. Explain about different types of On-Street and Off-street parking facilities with their pros and cons.   [8]

4. What are the factors affecting Night Visibility? What are the different types of road marking and traffic island used to regulate and control traffic flow? Explain.   [2+3+3]

5. A 4-lane divided highway is to be constructed on a new alignment Traffic volume forecasts indicate that the AADT in both directions during the first year of operation will be 12,000 with 50% Passenger cars (5 kN/axle), 33% of two axle single unit trucks (25 kN/axle) and 17% of three axle single unit trucks (30 kN/axle) = 17%. The vehicle mis is expected to remain the same throughout the design life of the pavement. If the expected annual traffic growth rate is 4% for all vehicles, design pavement with AC of thickness 7.5 cm, base and sub base. CBR of subgrade = 6.5%, $E_{sub\ base}$ = 275 MPa, E_{base} = 500 MPa and $E_{surface}$ = 2400 MPa.   [8]

6. Write down the assumption and analysis of Westargard Theory. How the warping stress and friction stress are developed in the Rigid pavement?   [8]

7. What are the factors affecting soil stabilization? What do you mean by mechanical method of soil stabilization? Write down the procedure of constructing cement soil stabilized road base.   [8]

8. Write down material selection and construction procedure of double surface treatment pavement. [8]

9. Differentiate between Repair and Rehabilitation of highways. Explain about different types of typical rigid pavement failures. Draw a sketches wherever applicable. [8]

10. What are the importance of tunnel? With neat sketch, describe different components of tunnel and tunnel cross sections? [8]

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Exam.		Regular / Back	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

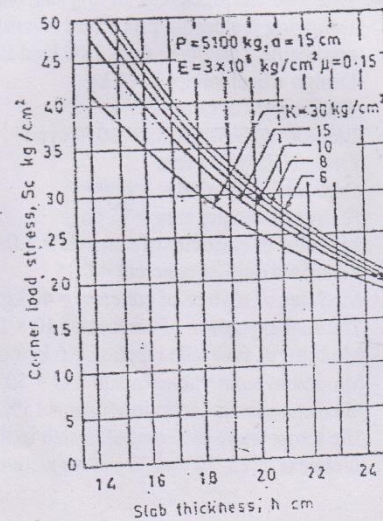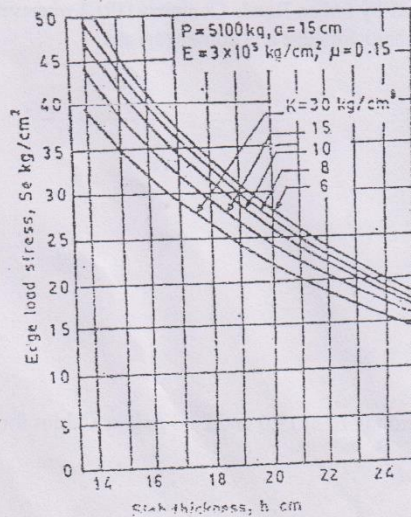## Subject: - Transportation Engineering II (CE 703)

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt **All** questions.
✓ **All** questions carry equal marks.
✓ **Necessary charts and tables are attached herewith.**
✓ Assume suitable data if necessary.

1. What are the basic requirements of intersection at grade? Write down the design steps of rotary intersection.

2. In a field survey of spot speed measurement, the following twenty observations were taken. Find time mean speed, and space mean speed.

    50, 40, 60, 54, 45, 31, 72, 58, 43, 52, 46, 56, 43, 65, 33, 69, 34, 51, 47, 41.
    Also, assuming these vehicle speeds are fixed over a half km segment, calculate the corresponding travel times and show that the space mean speed calculated using travel times is equal to the point estimate.

3. What are the causes of accident and how accident can be prevented? Describe briefly the factors influencing street light design.

4. The average normal flow of traffic on cross roads A and B, of width 7m both, during design period are 400 and 250 PCU per hour; the saturation flow values on these roads are estimated as 1250 and 1000 PCU per hour respectively. The all-red time is provided for pedestrian crossing with speed 1 m/sec and initial walk time 6 sec. Design two phase traffic signal.

5. Explain the followings:

    a) Traffic and loading factors controlling pavement design
    b) Lane distribution factors and Vehicle damage factors

6. Estimate the thickness of a plain cement concrete pavement for a 7m wide highway following the design procedure recommended by Indian Roads Congress (IRC) wherever applicable. Use given data, IRC load stress charts for edge and corner regions.
    Design wheel load = 5100 kg
    Traffic growth rate = 7.5%
    Present traffic intensity = 1050 cvpd
    Design life = 20 years
    Construction period = 3 years
    Radius of contact area = 15 cm
    Modulus of elasticity of concrete = 3.0×10^5 kg/cm^2
    Poisson's ratio of concrete = 0.15
    Modulus of rupture of concrete = 40 kg/cm^2
    Thermal expansion of concrete = 10×10^{-6}/°C
    Modulus of subgrade reaction = 6 kg/cm^3
    Maximum temperature in summer = 50°
    Maximum temperature in winter = 15°C
    The temperature differential in slab in the region is 17.3, 19.0 and 20.3 degree Celsius for thickness of 15, 20 and 25 cm respectively.

7. What are the various activities involved in road construction? Write the plants and equipment required for bituminous and cement concrete road constructions.

8. Explain construction procedure of water bound macadam road.

9. Explain the maintenance of bituminous surfaces. Describe the typical types of rigid pavement failures.

10. Enumerate the factors to be considered for selecting the bridge site. Why is ventilation important in tunnel?

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Traffic Classification	Design Traffic Intensity at the End of Design Life (CVPD)	Adjustment in Design Thickness of CC Pavement, (cm)
A	0 -15	-5
B	15 - 45	-5
C	45 -150	-2
D	150 - 450	-2
E	450 -1500	0
F	1500 - 4500	0
G	> 4500	+2

$\frac{L}{l}$ or $\frac{B}{l}$	C	$\frac{L}{l}$ or $\frac{B}{l}$	C
	Table for Determination of Coefficient, C		
1	0.000	7	1.030
2	0.040	8	1.077
3	0.175	9	1.080
4	0.440	10	1.075
5	0.720	11	1.050
6	0.920	12	1.000

P = 5100 kg, a = 15 cm
$E = 3 \times 10^5$ kg/cm², μ = 0.15
K = 30 kg/cm³
15
10
8
6
Edge load stress, Se kg/cm²
Slab thickness, h cm

P = 5100 kg, a = 15 cm
$E = 3 \times 10^5$ kg/cm², μ = 0.15
K = 30 kg/cm³
15
10
8
6
Corner load stress, Sc kg/cm²
Slab thickness, h cm

10

Exam.		**Back**	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Transportation Engineering II *(CE703)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt **All** questions.
✓ **All** questions carry equal marks.
✓ **Necessary figures are attached herewith.**
✓ Assume suitable data if necessary.

1. What are the basic requirements of intersection at grade? Mention the importance of street lighting.

2. Explain different types of traffic islands? How accident study is carried out?

3. Two vehicles A and B approaching at right angle. Vehicle A from West and vehicle B from south collides each other. After the collision, vehicle A skids in 49° N of W and vehicle B Skids 27°E of N. The initial skid distance of vehicle A and B are 37 m and 19 m respectively before collision. If weight of vehicle A is 4 tonne and weight of vehicle B is 6 tonne. The skid distances after collision for vehicle A is 15 m and for vehicle B is 36 m. calculate the initial speeds of vehicles if the average skid resistance of the pavement is found to be 0.55.

4. A four-legged right angled intersection is to be signalized with a fixed time 2-phase signal. The design hour flow and saturation flow are as under:

-	North (N)	South (S)	East (E)	West (W)
Design hour flow	900	500	800	700
Saturation flow	2500	2000	3200	3000

The lost time is 2 seconds per phase due to starting delays and amber time for north-south and east-west are 3 seconds and 4 seconds respectively. Determine the optimum cycle time. Allocated the green times to the two phases.

5. Explain the factors that controlled the pavement design?

6. Design the flexible pavement for 4-lane single carriage way road with the following parameters:

i) Initial traffic in each direction = 2000 CVPD
ii) Design life = 15 years
iii) Construction period = 3 years
iv) Traffic growth rate = 8%
v) Design CBR value = 6%
vi) Modulus of elasticity of asphalt concrete surface course = 2500 MPa
vii) Modulus of elasticity of bituminous treated base = 1200 MPa
viii) Modulus of elasticity of granular subbase course = 125 MPa
ix) Axle load distribution of commercial vehicles on the road is as follows:

Axel Load (kN)	No. of Axles (%)
10	15
30	15
50	20
70	30
90	10
110	10

7. Describe the materials required and construction procedure of water Bound Macadam road.

8. Describe the construction steps of cement concrete pavement.

9. Describe briefly maintenance, rehabilitation and reconstruction. Describe the methods of pavement evaluation.

10. Draw a neat sketch of bridge with its components. Explain the methods of river bank protection?

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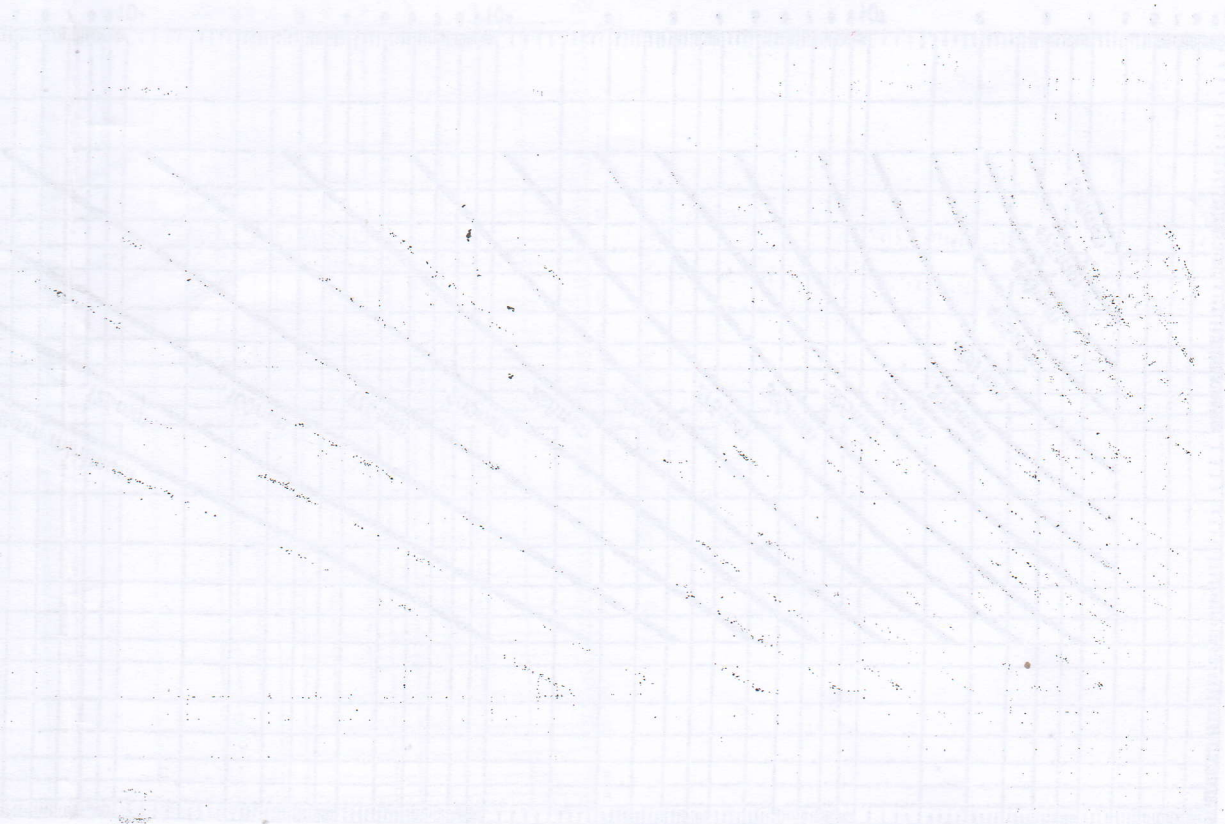
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Ashwin

Exam.		Back	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Transportation Engineering II *(CE703)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt **All** questions.
✓ **All** questions carry equal marks.
✓ **Necessary figures are attached herewith.**
✓ Assume suitable data if necessary.
✓ Normal graph paper should be provided.

1. What are the basic requirements of intersection at grade? Describe grade separated intersection with its advantages and disadvantages.

2. Spot speed observation at a particular link provides the following data, calculate maximum speed limit, minimum speed limit, design speed and modal speed for regulation of traffic.

Speed range (kmph)	Frequency
6-10	1
10-14	4
14-18	7
18-22	20
22-26	44
26-30	80
30-34	82
34-38	79
38-42	49
42-46	36
46-50	26
50-54	9
54-58	10
58-62	3

3. Describe highway capacity. Explain the factors which affect capacity and level of service.

4. Assuming linear Speed-density relationship of $V = 60-0.43K$
   a) Draw V-K, V-Q and Q-K diagram showing critical value
   b) Find the saturation flow?
   c) Find speed and density at flow of 1000veh /hr

5. What are factors affecting pavement design? Write down the steps of IRC design guidelines for rigid pavement.

6. Design a flexible pavement by using asphalt institute method from the following data of a stretch of existing two lane road.

   a) Current traffic of 80KN equivalent single axle load = 0.95×10^3 EAL/day
   b) Traffic growth rate = 7.5%
   c) Design period = 15 yrs
   d) construction period = 16 months
   e) CBR of sub-grade to be taken = 5%
   f) Elastic modulus of asphalt concrete surface course = 2500 MPa
   g) Elastic modulus of bituminous treated base = 1200 MPa
   h) Elastic modulus of granular sub base course = 125 MPa

   Also draw the neat sketches of the pavement layers.

7. What is Mass Haul Diagram? What are the equipment and plants needed for the accomplishment of various activities of road construction?

8. What are various types of bituminous pavements? Explain the construction procedure of Asphalt Concrete pavement.

9. What is highway maintenance? Explain the general causes of pavement failures.

10. What are the factors affecting the choice of location of bridge site? Discuss the river bank protection structures.

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Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Transportation Engineering II *(CE703)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt **All** questions.
✓ **All** questions carry equal marks.
✓ **Necessary figures are attached herewith.**
✓ Assume suitable data if necessary.

1. Define traffic engineering. Explain road user characteristics and human-vehicle-environment system.

2. The average normal flow of traffic on cross roads H and F during design period are 400 and 250 PCU per hour, the saturated headway on these roads are estimated as 3 secs and 4 secs respectively. The all red time required for pedestrian crossing is 15 secs. Design two phase traffic signal by Webster's method.

3. What is the importance of parking studies? Describe different types of parking.

4. A vehicle hits a bridge abutment at a speed estimated by investigations as 20kmph. Skid marks of 30 m on the pavement (f=0.35) followed by skid marks of 60 m on the gravel shoulder approaching the abutment (f=0.50). What was the initial speed of vehicle?

5. Explain the concept of cumulative standard axle load. What are the advantages of rigid pavement over flexible pavement?

6. Design a flexible pavement by using Asphalt Institute Method for a two lane two way pavement carrying traffic of 1500pcu/day with growth rate of traffic 5% per annum. The design life is 15 years. The vehicle damage factor is 2.5 and CBR value of sub grade soil is 5%. The modulus of asphalt concrete surface course, bituminous treated base course and granular sub-base course are 2500MPa, 1200MPa and 125 MPa respectively. Assume construction period of 18 months. Draw a neat sketch of pavement layers.

7. What is surface dressing? Write down the construction procedure of DBSD?

8. What are the equipment and plants needed for the various activities of road construction? Describe prime coat, tack coat and seal coat with their usefulness.

9. Explain the typical failures of flexible pavement with neat sketches?

10. Show the various component parts of bridge with a neat sketch. How drainage and ventilation problems are managed while tunneling?

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Subject: - Transportation Engineering II *(CE703)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt **All** questions.
✓ **All** questions carry equal marks.
✓ **Necessary figures are attached herewith.**
✓ Assume suitable data if necessary.

1. Describe various types of traffic control devices. Write down the advantages and disadvantages of traffic signal.

2. What are the importances of street lighting? Describe the factors affecting street light design.

3. Assuming a linear speed-density relationship, the mean free speed is observed to be 80 km/h near zero density and the corresponding jam density is 130 veh/km. Assume that the average length of vehicles is 6 m.

   i) Write down the speed-density and flow-density equations
   ii) Compute speed and density corresponding to flow of 1000 veh/hr.
   iii) Compute the average headways, spacing, clearance and gaps when the flow is maximum

4. The following data collected for a section of road 25.5 km long during the floating car method study. Assuming the equivalency factor of 1, 2 and 3 for each car bus and truck respectively, Calculate the flow in per/hr journey speed and running speed in both direction of flow.

Direction	Journey time		Stopped delay		No. of vehicles from opposite direction			Vehicles in the same direction	
	Min	Sec	Min	Sec	Car	Bus	truck	Overtaking	Overtaken
N-S	4	25	1	2	40	2	4	3	1
S-N	4	21	1	5	21	2	3	2	3
N-S	4	10	1	3	15	1	2	4	2
S-N	4	14	1	5	20	5	1	6	1
N-S	4	30	1	45	21	3	2	3	3
S-N	4	16	1	15	25	2	1	2	2
N-S	4	12	1	18	27	4	2	5	2
S-N	4	10	1	55	28	1	3	1	1
N-S	4	10	1	13	20	3	2	2	3
S-N	4	20	1	50	29	2	1	4	3
N-S	4	50	1	42	26	1	3	2	2
S-N	4	40	1	35	25	3	3	1	1

5. Differentiate between flexible pavement design and rigid pavement design. Describe Weatergaad's concept for temperature stresses.

6. A road pavement is to be designed for a stretch of road with the following pavement layers:

   (i) Minimum thickness of asphalt concrete on the surface course = 50 mm.

   (ii) Well graded crushed stone aggregate for base course, CBR value = 90%

   (iii) Fairly graded graved for sub-base course, CBR Value= 20%

   (iv) Compacted Soil, CBR value = 10%

   (v) 90th percentile sub grade CBR Value = 4%

   The road has single lane carriage way & caters present ADT of 1200 commercial vehicle per day with annual growth of 6%. The pavement is to be designed for 10 years period. Design the pavement section using IRC recommendation for CBR method. The road is to be compacted with 6 months from initial traffic count

7. What are the various activities involved in road construction? Explain the construction procedure of otta seal.

8. Describe the materials required and construction procedure of Water Bound Macadam (WBM) road.

9. Describe the causes of failures in flexible pavement.

10. Explain the methods of river bank protection? Explain the methods of tunneling in hard soil.

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05   TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Chaitra

Exam.		Regular	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Transportation Engineering II *(CE703)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt *All* questions.
✓ *All* questions carry equal marks.
✓ Normal graph paper should be provided.
✓ *Necessary figures are attached herewith.*
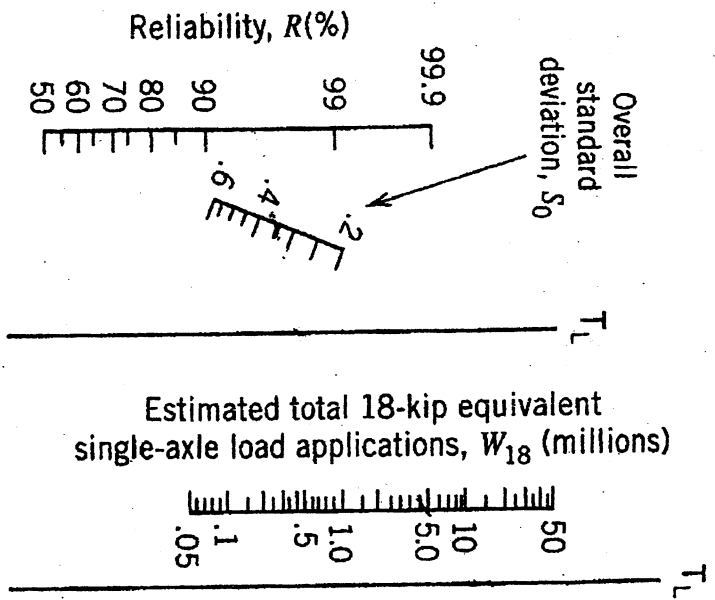✓ Assume suitable data if necessary.

1. Define traffic engineering. Describe road users and vehicular characteristics.

2. What are the uses of origin and destination study? Briefly explain the methods of conducting this study.

3. Average trip time for office is 30 minutes with standard deviation of 5 min. Assuming normal distribution of trip time, calculate the followings:
   a) Probability of trip time being at least 35 minutes
   b) If the working hour starts at 10:00 AM and trip starts at 9:40 AM what is the probability of being late?

4. An isolated signal with pedestrians indication is to be installed on a right angled intersection with road A 15 m wide and road B 12 m wide. The heaviest volume per hour for each lane of road A and road B are 300 and 250 respectively. The amber times for roads A and B are 3 and 2 seconds respectively. Design the timings of traffic and pedestrian signal.

5. What do you understand by legal axle load and standard axle load? Describe the stresses induced in the rigid pavement slab. How spacing between contraction joints is calculated in jointed plain concrete pavement?

6. In the figure below, a pavement system with the resilient moduli, layer coefficient of surface course and drainage coefficients are shown. If predicted ESAL= 15×10^6, R = 90%, S_o = 0.4 present serviceability index = 4.2 and terminal serviceability index = 2.7, select the thickness of D_1, D_2 and D_3.

E_1 = 450,000 psi	a_1 = 0.44	D_1
E_2 = 25,000 psi	m_2 = 1.2	D_2
E_3 = 15,000 psi	m_3 = 1.2	D_3

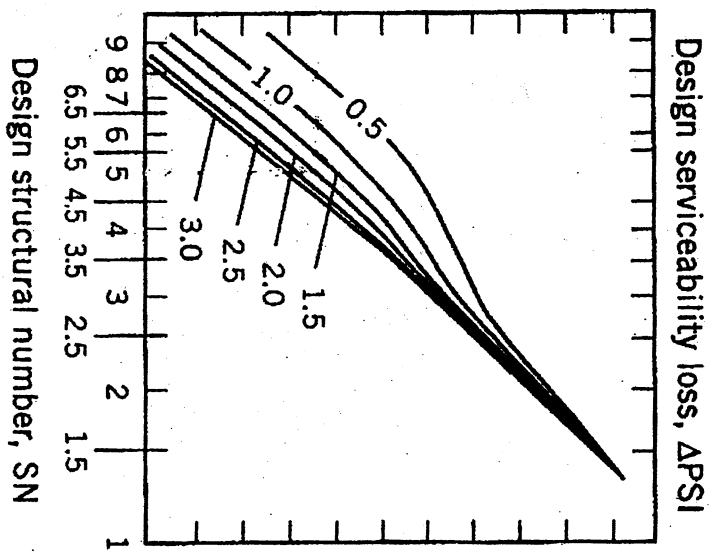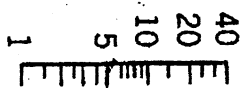M_R = 5000 psi

7. Draw a neat sketch of typical pavement structures. Explain in detail the construction methodology of Otta Seal.

8. Explain with a neat diagram the characteristics of mass haul diagram, including free haul, over haul, economic haul, shrinkage and swelling factor.

9. Define road maintenance. Describe the failures of the flexible pavement.

10. What are the methods of providing tunnel ventilation? Explain the major factors controlling the selection of bridge sites.

***

AAHSTO Flexible Pavement Nomograph

Reliability, $R(\%)$

Overall standard deviation, S_0

99.9

99

90
80
70
60
50

.6 .4 .2

T_L

Estimated total 18-kip equivalent single-axle load applications, W_{18} (millions)

50

10
5.0

1.0
.5

.1
.05

T_L

Effective roadbed soil Resilient modulus, M_R (ksi)

40
20
10
5

1

Design serviceability loss, ΔPSI

0.5

1.0

1.5

2.0

2.5

3.0

9 8 7 6 5 4 3 2 1
6.5 5.5 4.5 3.5 2.5 1.5
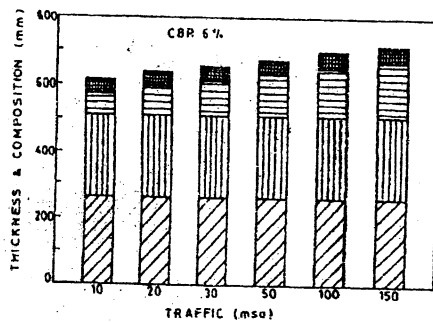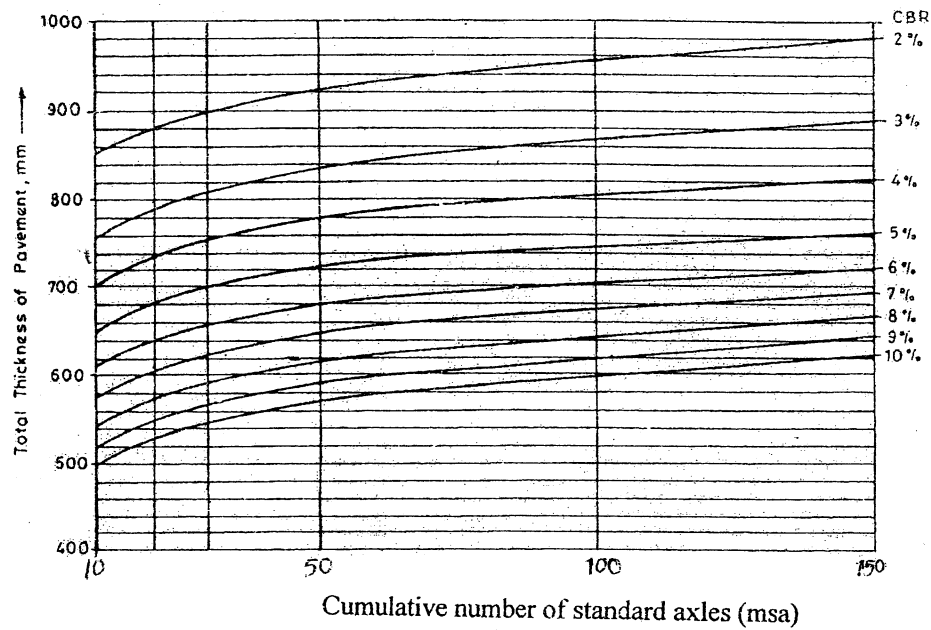
Design structural number, SN

Subject: - Transportation Engineering II *(CE703)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ *Attempt __All__ questions.*
✓ *__All__ questions carry equal marks.*
✓ *__Necessary figures are attached herewith.__*
✓ *Assume suitable data if necessary.*

1. List the objectives of accident study. Explain briefly causes and preventive measures of accident.

2. Describe channelized intersections with their advantages and disadvantages.

3. The data collected after speed and delay studies by floating car method on a stretch of road 3.2 km long are given below. Determine the average values of volume, journey speed and running speed of the traffic stream along either direction.

Trip	Direction of trip	Journey time (min)	Total stopped delay (min)	No. of vehicles		
				Overtaking	Overtaken	From opposite direction
1	C - D	6.50	1.58	4	7	270
2	D - C	7.48	1.72	5	4	250
3	C - D	6.92	1.62	5	4	300
4	D - C	7.82	1.82	3	3	275
5	C - D	6.33	1.40	3	2	295
6	D - C	8.13	2.10	2	1	280
7	C - D	6.71	1.73	4	4	300
8	D - C	7.40	1.85	3	3	230
9	C - D	6.23	1.60	4	2	275
10	D - C	6.98	1.78	2	1	242

4. An isolated signal with pedestrians indication is to be installed on a right angled intersection with road H of 12 m wide and road F of 9.6 m wide. The heaviest volume per hour for each lane of H and F are 475 and 325 respectively. The approach speeds are 60 and 45 kmph for road H and road F respectively. Design the timings of traffic and pedestrian signals. Assume amber times for road H and road F as 5 and 4 secs respectively.

5. Explain how design traffic is calculated from the data obtained from traffic surveys. Give at least three different examples in various design methods.

6. Design the pavement for an existing two lane single carriageway road with the following details.
   a. Initial traffic in both direction in the year of completion of construction = 5640 CVPD
   b. Design life = 10 years
   c. Design CBR value = 6%
   d. Axle load using the road (CV) = 118 KN

7. Define road construction technology. Describe the various activities to be performed for the road construction.

8. Describe the construction procedure of bituminous concrete road and check needed for quality control.

9. Define road maintenance. Explain different measure to be taken for gully control works.

10. What are the factors to be considered in tunnel lighting? What are the different methods of river bank protection work?

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Chart for question no. 6

Total Thickness of Pavement, mm

CBR
2 %
3 %
4 %
5 %
6 %
7 %
8 %
9 %
10 %

Cumulative number of standard axles (msa)

CBR 6 %

THICKNESS & COMPOSITION (mm)

TRAFFIC (msa)

GSB   GB   DBM   BC

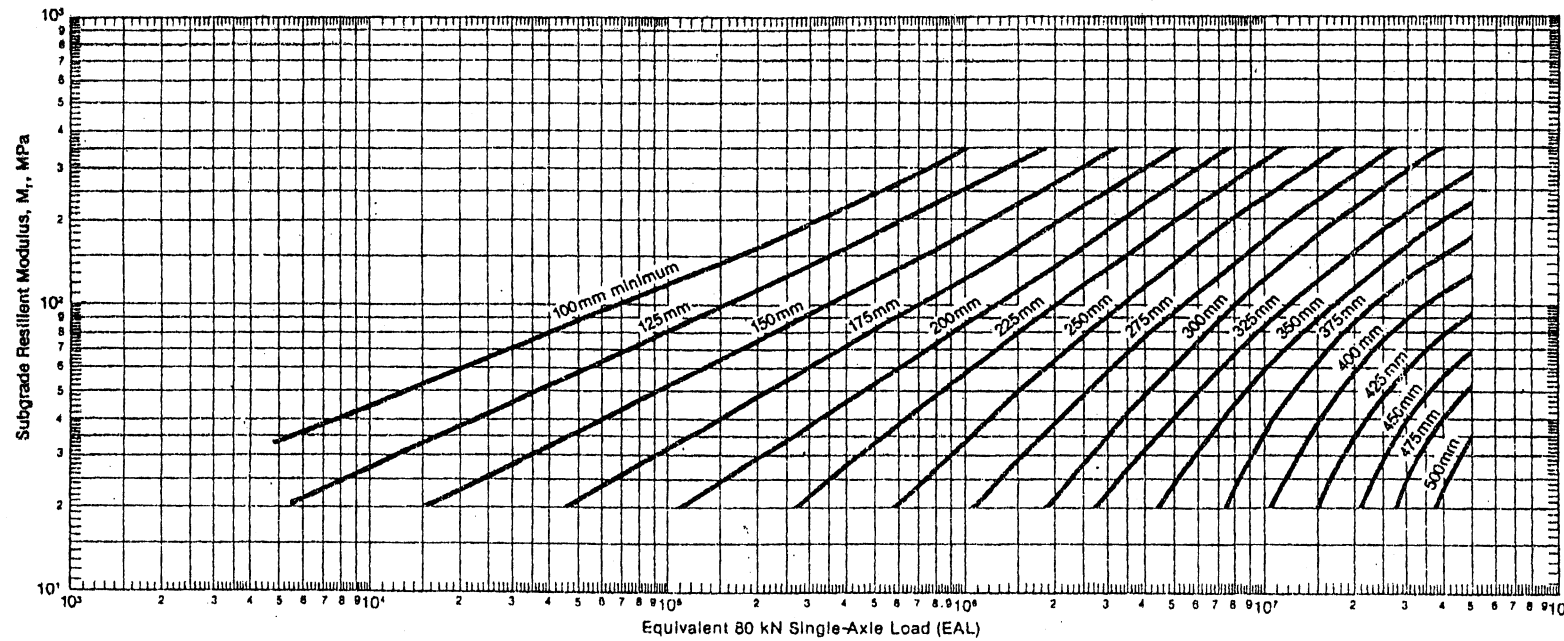| cumulative traffic (msa)	Total pavement thickness (mm)	pavement composition		Granular base and sub base (mm)
		bituminous surfacing		
		BC (mm)	DBM (mm)	
10	615	40	65	base = 250 subbase = 260
20	640	40	90	
30	655	40	105	
50	675	40	125	
100	700	50	140	
150	720	50	160	

CBR 6%

Subject: - Transportation Engineering II *(EG723CE)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ *Attempt any **Five** questions.*
✓ *The figures in the margin indicate **Full Marks**.*
✓ ***Necessary figures are attached herewith.***
✓ *Assume suitable data if necessary.*

1. a) What do you mean by Origin and Destination Study? Explain the various applications of Origin and Destination studies. (8)

   b) What do you mean by Traffic Control Device? Explain in short about the types of Traffic Signs. (8)

2. a) Compare on-street and off-street parking. Draw neat sketches showing parallel and angle kerb (on-street) parking geometry. (6)

   b) An isolated signal with pedestrian indicators to be installed on a right angled intersection with road A of 15 m and road B of 7 m respectively. The heaviest volume per hour for each lane of road A and road B are 350 and 250 respectively. The approaching speeds for road A and road B are 60 kmph and 45 kmph. Design the traffic and pedestrian signal timings. (Take amber period for yellow light signal as 2 to 4 secs and pedestrian walking speed of 1.0 m /sec (10)

3. a) Explain the various types of stresses needed to be considered in the design of rigid pavement. (8)

   b) An existing single lane road has to be upgraded by bituminous pavement for a certain length by the following considerations. (8)

   i) Base traffic of 80 kN equivalent single axle load (ESAL) = 5.11×10^4 ESAL per year
   ii) Design period $= 12$ years
   iii) Construction period $= 1$ year
   iv) Traffic growth rate $= 6\%$
   v) 87.5^{th} percentile CBR value of sub-grade soil from 7 sample locations $= 4\%$
   vi) Elastic modulus of asphalt concrete for surface course, $E_{ac} = 2900$ MPa
   vii) Elastic modulus of emulsified stabilized base, $E_b = 1600$ Mpa
   viii) Elastic modulus of granular sub-base, $E_{sb} = 125$ Mpa

   You are required to design the pavement from **Asphalt Institute Method**. Draw the cross section of final pavement layers considering the thickness of asphalt concrete on surface course is not less than 50 mm.(**Full depth AC curve attached herewith**)

4. a) What is Mass Haul Diagram? Explain its importance in road construction with diagram. (10)

   b) Discuss the construction procedure of premix bituminous carpet in brief. (6)

5. a) What are the causes that result the failure of cement concrete pavement. Explain briefly. (8)

   b) Explain pavement evaluation. (8)

6. Write short notes on any four of the following: (4×4)
   a) Components of a bridge
   b) Importance of ventilation in tunneling
   c) Importance of road lighting
   d) Thirtieth highest hourly traffic volume
   e) Construction procedure of gravel road

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Full-Depth Asphalt Concrete

Design Chart VI-1.

The chart axes are labeled:
- Vertical axis: Subgrade Resilient Modulus, M_r, MPa (logarithmic, from 10^1 to 10^3)
- Horizontal axis: Equivalent 80 kN Single-Axle Load (EAL) (logarithmic, from 10^3 to 10^8)

Thickness design curves labeled: 100mm minimum, 125mm, 150mm, 175mm, 200mm, 225mm, 250mm, 275mm, 300mm, 325mm, 350mm, 375mm, 400mm, 425mm, 450mm, 475mm, 500mm

Subject: - Transportation Engineering II

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt any *Five* questions.
✓ The figures in the margin indicate *Full Marks*.
✓ *Necessary design chart is attached herewith.*
✓ Assume suitable data if necessary.

1. a) Define traffic capacity. Describe the factors affecting capacity and level of service. [6]

   b) Design the timing of traffic and pedestrian signals of an isolated signal to be installed at a right angle intersection when road P and Q cross. The data available are: [10]
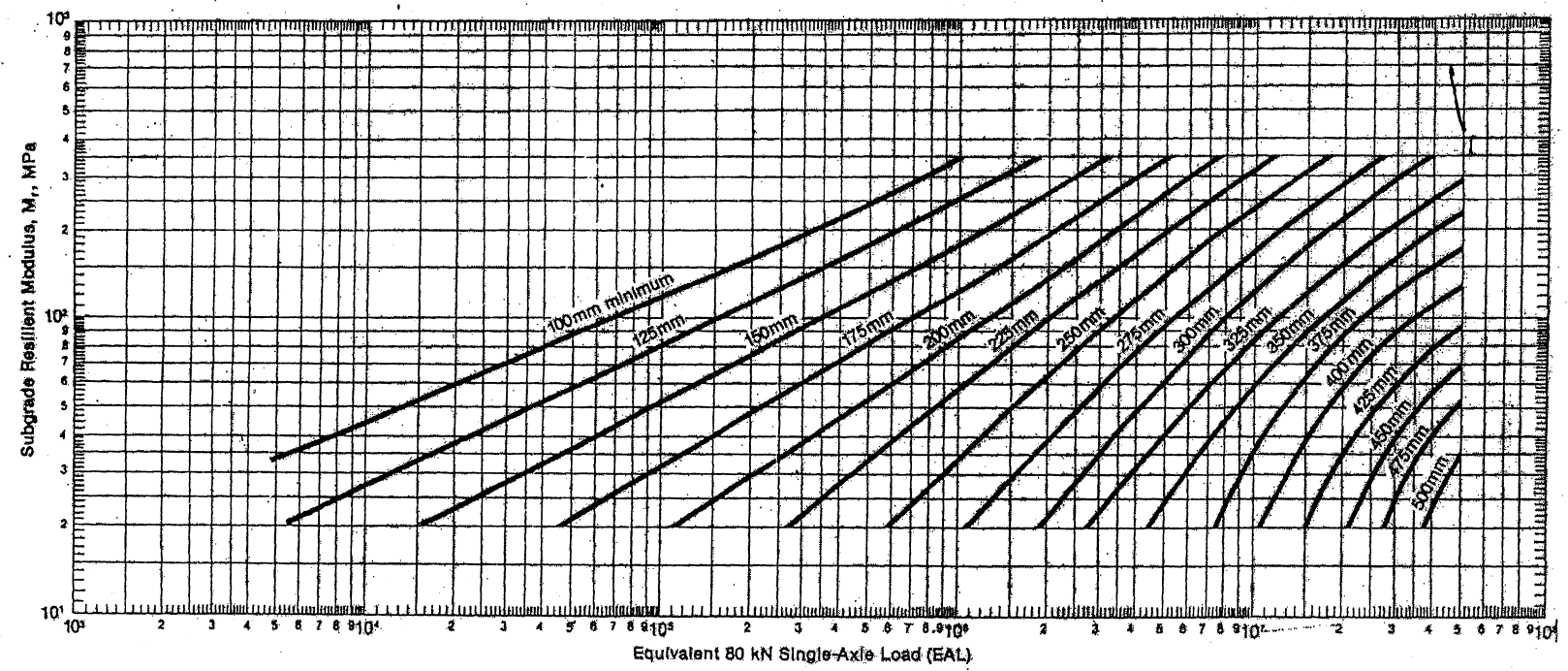
	Road P	Road Q
i) Width	14.00	10.50
ii) Peak hour traffic volume, Vehicle/hour/lane	210	120
iii) Approach speed, Kmph	50	35

2. a) Define rotary intersection. What are the advantages and disadvantages of rotary intersection? [8]

   b) A vehicle skids through a distance of 40m before colliding with another parked vehicle, the weight of which is 75 percent of the former. After collision both the vehicles skid through 14m before stopping. Compute the initial speed of moving vehicle. Assume coefficient of friction of 0.62. [8]

3. a) An existing two lane single carriageway gravel road has to be upgraded by bituminous pavement, to cater the growing traffic demand. Present traffic in terms of ESA is 0.8×10^3 per day. The regional traffic growth rate is taken as 6.5% per annum. Data required for pavement design are as given below. [8]
   i)   Design period = 10 years
   ii) Construction period = 1 year
   iii) 87.5 percentile CBR value of sub grade soil from 7 sample locations = 5%
   iv) Elastic modulus of asphalt concrete for surface course E_{ac} = 2000MPa
   v)   Elastic modulus of crushed stone base E_{base} = 350 MPa
   vi) Elastic modulus of granular sub- base $E_{sub-base}$ = 250MPa

   You are required to design the pavement by Asphalt Institute Method. Draw the cross section of final pavement layers considering the minimum thickness of asphalt concrete on surface course equal to 50mm.

   b) What are the factors affecting pavement design? Write down the steps of IRC design guidelines for rigid pavement. [8]

4. a) What is Mass Haul Diagram? What are the equipments and plants needed for the accomplishment of various activities of road construction? [2+6]

   b) Distinguish between prime coat and tack coat. Explain construction method of surface dressing. [2+6]

5. a) Explain the importance of road maintenance. Describe the maintenance of bituminous pavement. [2+6]

   b) Classify the bridges according to types of super structure and span length. Make a sketch of a bridge section (longitudinal and cross) and plan indicating its elements. [8]

6. Write short note on: (any four) [4×4]
   a) Fixed delay and operational delay   b) Spacing and head way
   c) Typical failures of the rigid pavement   d) Gravel road construction
   e) Radius of relative stiffness

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Full-Depth Asphalt Concrete

Chart with Y-axis labeled "Subgrade Resilient Modulus, M$_r$, MPa" ranging from 10^1 to 10^3, and X-axis labeled "Equivalent 80 kN Single-Axle Load (EAL)" ranging from 10^3 to 10^7. Curves are labeled: 100mm minimum, 125mm, 150mm, 175mm, 200mm, 225mm, 250mm, 275mm, 300mm, 325mm, 350mm, 375mm, 400mm, 425mm, 450mm, 475mm, 500mm.

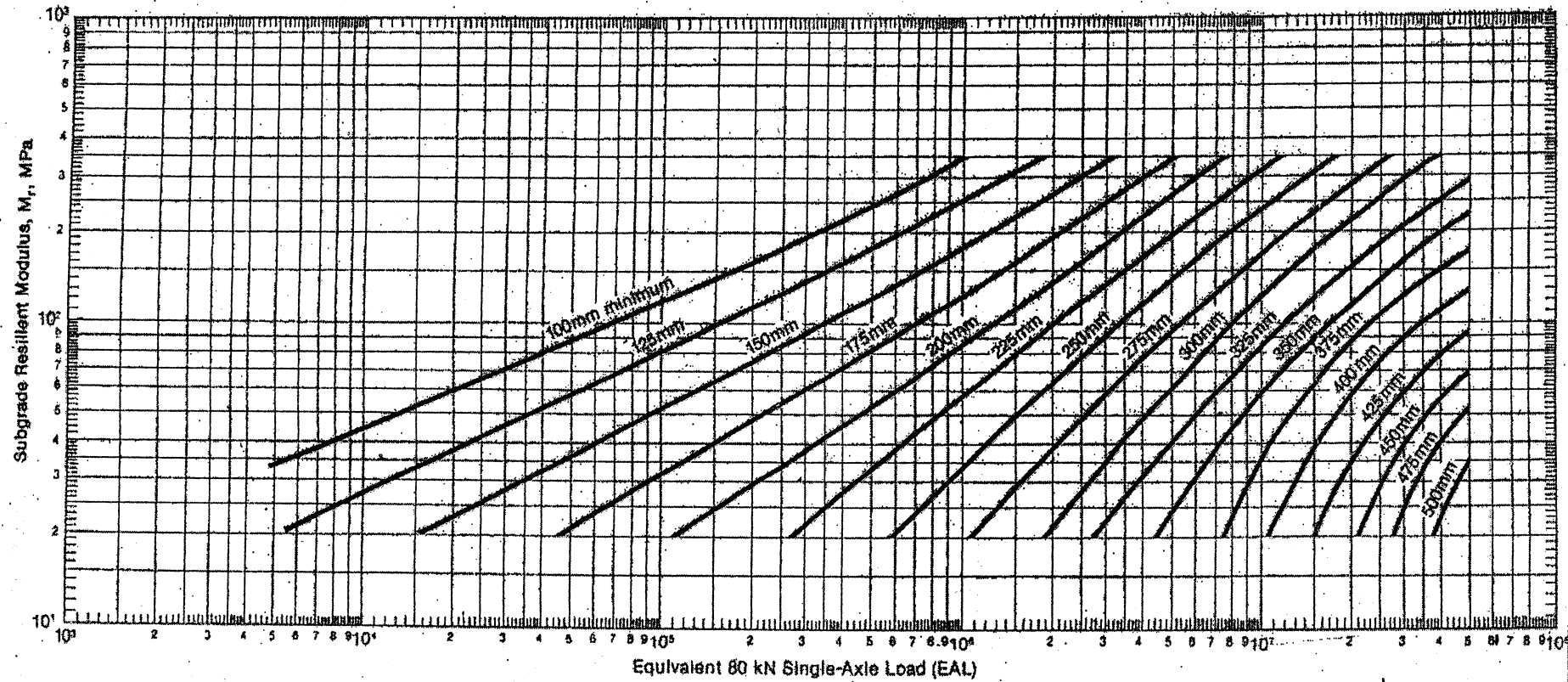| Exam.		Regular / Back	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Transportation Engineering II

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt any **Five** questions.
✓ The figures in the margin indicate **Full Marks**.
✓ **Necessary charts are attached herewith.**
✓ Assume suitable data if necessary.

1. a) Describe the road user characteristics. Explain their importance in traffic engineering. [4+2]

   b) The following speed data were collected during a two-minute segment of a spot speed study (speed in Kmph). [3+3+4]

   45, 55, 48, 52, 60, 48, 60, 42, 52, 65, 64, 63, 58, 56, 68, 54, 68, 64, 66, 70

   Calculate: (i) The time mean speed; (ii) The space mean speed.

   What will be the average density of the above traffic stream if the mean headway is 4.5 sec?

2. a) What is grade separation? Mention their types with sketches. Draw a right angle four legged intersection of two roads and show their various types of conflict points if (i) both roads are with two way movements; (ii) one road is with one-way and another is with two way movements. [1+3+4]

   b) What are different methods of traffic control at an intersection? The average normal flow of traffic on cross roads A and B during design period are 400 and 300 PCU per hour; the saturation flow values on these roads are estimated as 1450 and 1150 PCU per hour respectively. The all-red time required for pedestrian crossing is 12 sec. Design two phase traffic signal by Webster's method. [2+6]

3. a) Classify pavement and explain the functions of different layers of flexible pavement. [6]

   b) An existing single lane gravel road has to be upgraded by bituminous pavement for a specified length as it is the demand for catering the increment in volume of heavy traffic. In order to estimate the base traffic, traffic survey was carried out at two points on the existing roads. The pavement design is based on the following assumptions. [10]

   i)   Base traffic of 82 kN equivalent single axle load (ESAL) = 1.888×10^3 ESAL per day
   ii) Design period = 10 years
   iii) Construction period = 18 months
   iv) Growth rate = 6%
   v)   87.5 percentile CBR value of sub-grade soil from 7 sample locations = 5%
   vi) Elastic modulus of asphalt concrete for surface course E_{ac} = 2000 MPa
   vii) Elastic modulus of crushed stone base E_{base} = 250 MPa
   viii) Elastic modulus of granular sub-base $E_{subbase}$ = 125 MPa

   You are asked to design the pavement by Asphalt Institute Method. Draw the cross section of final pavement layers considering the minimum thickness of asphalt concrete on surface course where is equal to 50mm. Chart is provided.

4. a) Explain the features of mass-haul diagram with neat sketches. Describe free haul, over-haul and economic-haul. [8]

   b) Write down the explanatory note on bituminous constructions types: interface treatment; surface dressing; premixed carpet; asphalt concrete. [2×4]

5. a) Write down the methods of structural evaluation of pavement. A number of deflection readings were taken on a pavement. The mean and standard deviation were 1.5 and 0.2 respectively. The allowable deflection is 1.0mm. Determine overlay thickness. [2+6]

   b) Classify the bridges according to their structure, material and loading. Draw a sketch of the bridge with all its components. [4+4]

6. Write short note on (any four): [4×4]

   a) Traffic flow parameters
   b) Maintenance in bituminous road
   c) Construction procedure of WBM road
   d) Importance of lighting in tunnel
   e) Reverse or tidal flow operation

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Full-Depth Asphalt Concrete

Design Chart VI-1.