ADVANCED TRANSPORTATION ENGINEERING (SEMESTER - 8)

CS/B.Tech(CE-NEW)/SEM-8/CE-801/1/09
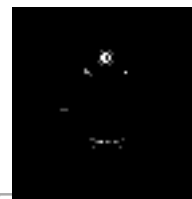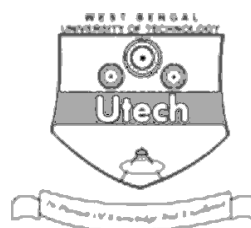
1. ....
Signature of Invigilator

2. ....
Signature of the Officer-in-Charge

Reg. No.

Roll No. of the Candidate

- -

CS/B.Tech(CE-NEW)/SEM-8/CE-801/1/09
ENGINEERING & MANAGEMENT EXAMINATIONS, APRIL – 2009
ADVANCED TRANSPORTATION ENGINEERING (SEMESTER - 8)

Time : 3 Hours]   [Full Marks : 70

INSTRUCTIONS TO THE CANDIDATES :

1. This Booklet is a Question-cum-Answer Booklet. The Booklet consists of **36 pages**. The questions of this concerned subject commence from Page No. 3.
2. a) In **Group – A**, Questions are of Multiple Choice type. You have to write the correct choice in the box provided **against each question**.
    b) For **Groups – B** & **C** you have to answer the questions in the space provided marked 'Answer Sheet'. Questions of **Group – B** are Short answer type. Questions of **Group – C** are Long answer type. Write on both sides of the paper.
3. **Fill in your Roll No. in the box** provided as in your Admit Card before answering the questions.
4. Read the instructions given inside carefully before answering.
5. You should not forget to write the corresponding question numbers while answering.
6. Do not write your name or put any special mark in the booklet that may disclose your identity, which will render you liable to disqualification. Any candidate found copying will be subject to Disciplinary Action under the relevant rules.
7. **Use of Mobile Phone and Programmable Calculator is totally prohibited in the examination hall.**
8. You should return the booklet to the invigilator at the end of the examination and should not take any page of this booklet with you outside the examination hall, **which will lead to disqualification**.
9. Rough work, if necessary is to be done in this booklet only and cross it through.

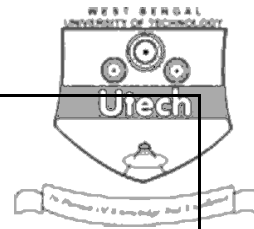#### No additional sheets are to be used and no loose paper will be provided

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FOR OFFICE USE / EVALUATION ONLY
Marks Obtained

	Group – A								Group – B		Group – C			Total Marks	Examiner's Signature
Question Number															
Marks Obtained															

....
Head-Examiner/Co-Ordinator/Scrutineer

8808-1/5 (20/04)

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ENGINEERING & MANAGEMENT EXAMINATIONS, APRIL – 2009

ADVANCED TRANSPORTATION ENGINEERING

SEMESTER - 8

Time : 3 Hours]   [Full Marks : 70

GROUP – A
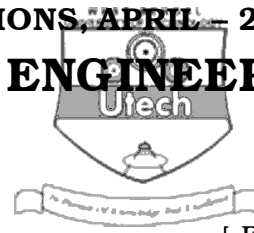
(Multiple Choice Type Questions)

1.   Choose the correct alternatives for any *ten* of the following :   10 × 1 = 10

i)   15000 repetitions of 10,000 kg axle load are equivalent to *N* nos. of repetitions of 8000 kg axle load where *N* =

a)   30000   b)   35621

c)   36621   d)   None of these.   ☐

ii)   Equivalent wheel load factor, F_j , in terms of stress caused by a vehicle *j* with respect to the stress caused by standard vehicle *s* is

a) $F_j = \left(\dfrac{\sigma_j}{\sigma_s} \right)^2$ b) $F_j = \left(\dfrac{\sigma_j}{\sigma_s} \right)^3$

c) $F_j = \left(\dfrac{\sigma_j}{\sigma_s} \right)^4$ d) $F_j = \left(\dfrac{\sigma_s}{\sigma_j} \right)^4$.   ☐

iii)   Structural number SN of a flexible pavement is a function of

a)   layer co-efficient

b)   depth of the layer

c)   product of layer co-efficient and depth of the layer

d)   product of layer co-efficient, depth of layer and drainage co-efficient.

☐

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iv) A bituminous pavement over a lean cement concreate base is a

    a)   flexible pavement

    b)   rigid pavement

    c)   semi-rigid pavement

    d)   none of these.

v) The vertical compressive stress due to a wheel load P at a very large depth is

    a)   contact pressure, p

    b) $0.5\,p$

    c)   negligible p

    d)   none of these.

vi) The equivalent single wheel load of two tyre loads, each being P, when the clear distance between the tyres is negligibly small is
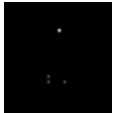
    a) P b) $2P$

    c)   0   d)   none of these.

vii) As per AASHTO, average running speed for intersection is taken as

    a)   75% of the design speed

    b)   80% of the design speed

    c)   90% of the design speed

    d)   none of these.

viii) When the design speed of highway is 100 km/h, the taper length is

    a)   57 m   b)   69 m

    c)   81 m   d)   90 m.

ix) The length of acceleration lane depends upon

    a) the design speed of the entrance curve

    b) acceleration at which the vehicle will merge with preferential flow

    c) the design speed of the preferential flow

    d) all of these.

x) The grade separator having facility to change direction is known as

    a) fly over

    b) rotary

    c) interchange

    d) intersection.

xi) Weaving length depends on

    a) width of the weaving section

    b) width of entry

    c) total traffic and proportion of weaving traffic

    d) all of these.

xii) No. of vehicles that occupy an unit length of a roadway at any given instant is known as

    a) volume

    b) capacity

    c) spacing

    d) density.
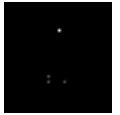
GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following.   3 × 5 = 15

2. Determine the thickness of a 1-layer base course if the maximum permissible stress of the sub-grade is 1.5 kg/cm^2 . The wheel load is 4.5 tones and dia-pressure is 6.5 kg/cm^2 .

3. Two wheels each carrying a load P at centre to centre distance of S have a clear distance d between them. Obtain an analytical expression for the equivalent single wheel load, P_{eq} . Following the relation given by Boyd and Foster, if the clear distance between the tyres tends to zero, what will be P_{eq} ?

4. A flexible pavement is subjected to the following repetitions of single axle loads during the design period :

Signle axle load (kg)	No. of repetitions
2000 – 4000	3400
4001 – 6000	8000
6001 – 8000	20000
8001 – 10000	12000
10001 – 12000	9000.

Find the equivalent single axle load repetitions during the design period considering 10,000 kg as the standard axle.

5. What are types of speed change lanes ? Explain with neat sketch.

6. Describe the classification of intersection with neat sketches.

7. Give the neat sketch of a rotary with all the lables.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

8.   a)   Discuss briefly Burmister's two layer theory for design of base course of a flexible pavement.

     b)   Determine the thickness of a flexible pavement base course to sustain a wheel load of 16000 kg. The contact pressure between the tyre and the base course is 7 kg/cm^2 . The plate bearing test on the sub-grade produces 0·5 cm deflection at 1·05 kg/cm^2 on a 75 cm dia plate. The plate bearing test on a test section of stabilized gravel base course 15 cm thick yielded under 2·8 kg/cm^2 pressure, 0·5 cm deflection.

          (Burmister's deflection factor curve is given below).

Dia.

9. A pavement is to be designed to last 10 years. Initial PSI = 4·2 and TSI = 2·5. The subgrade has a CBR of 10. Reliability is 95% with an overall standard deviation of 0·4. The daily traffic consists of the following :

   a) 30,000 nos. of cars, pickups, light vans of 2 – 8·9 kN (2000 lb) single axles.

      For SN = 3, 4, 5 ; equivalency factors = 0·0003, 0·0002, 0·0002 respectively.

   b) 1000 passes of single-unit tracks of

      i) 35·6 kN (8000 lb) steering single axle

         For SN = 3, 4, 5 ; equivalency factors = 0·051, 0·041, 0·034 respectively.

      ii) 97·9 kN (22000 lb) drive single axle

         For SN = 3, 4, 5 ; equivalency factors = 2·17, 2·09, 2·18 respectively.

   c) 350 passes of tractor semi-trailer tracks of

      i) 44·5 kN (10000 lb) steering single axle

         For SN = 3, 4, 5 ; equivalency factors = 0·118, 0·102, 0·088 respectively.

      ii) 71·2 kN (16000 lb) drive tandem axle

         For SN = 3, 4, 5 ; equivalency factors = 0·070, 0·057, 0·047 respectively.

      iii) 195·7 kN (44000 lb) trailer, triple axle

         For SN = 3, 4, 5 ; equivalency factors = 0·781, 0·769, 0·723 respectively.

   Design the pavement.

10. Design a concrete pavement corresponding to the following axle load spectrum.

98 percentile axle load is 16 ton. Concrete is of M-40 grade with flexural strength of 45 kg/cm^2. Present traffic is 3000 CVPd. Design life is 20 years and annual traffic growth is 7·5 per cent.
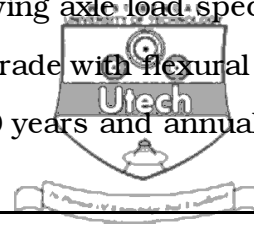
| Single axle loads			Tandem axle loads		
Axle load class, tons	Percentage of axle loads	Flexural edge stress (kg/cm^2) for 1·2 ∞ mean axle load, for 32 cm thick pavement	Axle load class, tons	Percentage of axle loads	Flexural edge stress (kg/cm^2) for 1·2 ∞ mean axle load, for 32 cm thick pavement
19 – 21	0·4	25·19	34 – 38	0·3	20·07
17 – 19	1·5	22·98	30 – 34	0·3	18·40
15 – 17	4·9	20·73	26 – 30	0·6	—
13 – 15	10·8	18·45	22 – 26	1·8	—
11 – 13	22·1	—	18 – 22	1·5	—
9 – 11	23·3	—	14 – 18	0·5	—
Less than 9	30·0	—	Less than 14	2·0	—
Total	93·0			7·0	

11. a) A one lane one way minor road from the left merge with a two lane major road with design speed of 60 kmph. Acceleration lane is to be provided to facilitate merging at low relative speed. The design speed of the entrance curve is 30 kmph. Design acceleration lane if the acceleration is 3·28 kmph/sec. 7

b) A 20 m road X meets with 8 m road Y. The corner of a monumental building is 5 m from the nearest vehicle path of X and 10 m from the furthest vehicle path Y. The design speed on the vehicle on X is 80 kmph. Find the restricted speed on Y. What is your recommendation on the sight distance requirement on the intersection ? 8

12. a)   Define flow & density of a traffic stream.   3

     b)   From the following relation find out the maximum velocity of vehicle :

          $V = 60 - 0.43\ K$
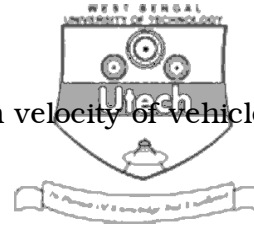
          Where, V is the speed of the vehicle

               K is the density of traffic stream.   5

     c)   From a moving vehicle survey following are obtained :

Direction	Travel time	No. of Vehicle		
		Travelling in opposite direction	Overtaking test vehicle	Overtaking by test vehicle
North bound	T_n	N_n		
1	3·20	75	3	1
2	2·80	80	2	2
3	3·25	85	0	1
4	3·01	70	2	1
South bound	T_s	N_s		
1	3·20	78	4	0
2	3·25	74	2	2
3	3·40	79	0	2
4	3·35	82	3	3

     Find out   i)   Flow of traffic stream

                ii) Mean time of north bound and south bound.   7

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13. a)   Define time mean speed & space mean speed.   3

     b)   From the following chart find out :   7

          i)   Space mean speed

          ii) Time mean speed.

Vehicle No.	Time for 100 m	Speed (kmph)
1	5·95	60·50
2	5·92	60·81
3	5·23	68·83
4	5·04	71·43
5	5·90	61·02
6	5·18	69·50
7	5·45	65·93
8	5·51	65·34

     c)   Peak hour volume at two locations are counted and found to be equal. However

          PHF is 0·85 on 1st location and 0·60 at the 2nd location. Describe the difference

          in condition of traffic flow between the two locations.   5

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END