Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech (CE-NEW)/SEM-8/CE-801/1/2010

2010

ADVANCED TRANSPORTATION ENGINEERING

Time Allotted : 3 Hours Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : $10 \times 1 = 10$

   i) PSI of a rigid pavement decreases with

      a) slope variance and rut depth

      b) rut depth and cracking and patching

      c) slope variance and cracking plus patching

      d) slope variance, rut depth and cracking plus patching.

   ii) Terminal serviceability index is a parameter in the AASHTO method of designing of

      a) flexible pavement

      b) rigid pavement

      c) both flexible and rigid pavements

      d) not considered.

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iii) The load carrying capacity of a rigid pavement depends on

a) modulus of elasticity of concrete

b) thickness of pavement slab

c) modulus of subgrade reaction and μ of concrete

d) all of these.

iv) The ESWL of two wheels having centre to centre distance of S and clear distance of d between the tyres each carrying a load of P is obtained by plotting on log-log scale the following co-ordinates :

a) (d, P) and ($2d$, $2P$) b) (d, P) and (S, $2P$)

c) ($\frac{d}{2}$, P) and ($2S$, $2P$) d) ($\frac{d}{2}$, P) and (S, $2P$).

v) 10000 rep. of 160 kN axle load is equivalent to N nos. of rep. of 80 kN axle load, where N =

a) 8×10^5 b) 16×10^5

c) 16×10^4 d) 8×10^4.

vi) Structural number, SN of a multilayer (n) flexible pavement is

a) $\sum_{i=1}^{n} a$ b) $\sum_{i=1}^{n} D$

c) $\sum_{i=1}^{n} aD$ d) $\sum_{i=1}^{n} \frac{D}{a}$,

where a is layer coefficient and D is thickness of layer.

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vii) A bituminous pavement over a lean cement concrete base is a

a) flexible pavement b) rigid pavement

c) semi-rigid pavement d) none of these.

viii) No. of conflicts for a three-lagged intersection is

a) 8 b) 9

c) 10 d) none of these.

ix) Diamond interchange is the simplest form of

a) 3-leg interchange b) 4-leg interchange

c) multi-leg interchange d) none of these.

x) The level of service used for design of rural highways is

a) L.O.S A b) L.O.S B

c) L.O.S C d) L.O.S D.

xi) At the place where the different roads cross each other at different levels is known as

a) interchange

b) flyover

c) at grade intersection

d) grade separator intersection.

xii) The average running speed at intersection must be

a) design speed b) 75% of design speed

c) 80% of design speed d) none of these.

xiii) For 65 kmph design speed on major load, the recommended taper length by AASHTO must be

a) 57 m b) 60 m

c) 69 m d) none of these.

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GROUP – B

(Short Answer Type Questions)

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

2. A total road of 90kN was applied on the surface of a two-layer system through a rigid plate of 300 mm in dia. Layer 1 has a thickness of 200 mm and layer 2 has an elastic modulus of 45 MPa. Both layers are incompressible with a Poisson ratio of 0·5. If the deflection of the plate is 2·5 mm, determine the elastic modulus of layer 1.

THICKNESS OF REINFORCING LAYER

Relationship of F_2 and h in a Two-lane System (Burmister's Method)

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3. What is ESWL ? Derive the equation for ESWL for two wheels, each carrying a load *P*. The clear distance between the wheels is *d* and centre to centre distance between the wheels is S.

4. a) What are the major factors in the design of rigid pavement ?

   b) How would a full depth asphalt pavement behave structurally ? How such pavement can be designed ?

5. Discuss any *two* of the following :

   i) Damage

   ii) Stress ratio

   iii) Endurance limit

   iv) Dynamic modulus.

6. Give the neat sketch of a trumpet interchange.

7. Discuss the principle of planning of intersection.

8. Write short notes on intergreen period and optimum cycle length of a signalling system.

9. Classify intersection with neat sketches.

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GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

10. a) A circular load having 150 mm radius and uniform pressure of 550 kPa is applied on a two layer system. The subgrade has elastic modulus of 35 MPa and can support a vertical stress of 55 kPa. If the HMA has elastic modulus of 3·45 GPa, what is the thickness of a full depth ? If a thin surface treatment is applied on a granular base with elastic modulus of 173 MPa, what is the thickness of base course required ?

Vertical interface stresses for two-layer systems.

b) A cement concrete pavement can take $1{\cdot}575 \times 10^5$ flexure cycles before failure. If the strength of concrete is 35 N/mm^2 what is applied stress ratio ?

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11. A 30 cm thick concrete pavement is subjected to the following axle load spectrum. 98 percentile axle load is 16 tonnes. Concrete is of grade M-40. Present traffic is 3120 commercial vehicles per day. Design life is 20 years and annual traffic growth is 7·5 per cent. Check if the thickness of the pavement is safe against fatigue failure, following the IRC method.

Single axle load spectrum			Tandem axle load spectrum		
Mean axle load (tonnes) class	Percentage of axle load	Flexural edge stress (kg/cm^2) for 1·2 × mean axle load	Mean axle load (tonnes) class	Percentage of axle load	Flexural edge stress (kg/cm^2) for 1·2 × mean axle load
20	0·39	25·19	36	0·3	20·07
18	1·51	22·98	32	0·3	18·40
16	5·0	20·73	28	0·6	—
14	10·7	18·45	24	1·8	—
12	22·4	—	20	1·5	—
10	23·0	—	16	0·5	—
Less than 9	30·0	—	Less than 14	2·0	—
Total	93·00			7·0	

Assume reasonable value of any other data, if necessary.

12. a) What is equivalent wheel load factor ? Derive an expression for EWLF for asphalt pavement.

b) On a three layer flexible pavement system, vehicle *A* causes a tensile strength of 240 micro mm/mm at the bottom of the asphalt-bound layer while the standard vehicle causes a strain of 253 micro mm/mm under the same elastic layered conditions. Compute the EWLF (F_j) for vehicle *A* assuming *C* = 3, 4, 5 and 6. 3 + 6 + 6

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13. a) Write a short note on deceleration lane.

    b) Design a deceleration lane from a 20 m wide divided road with design speed of 100 kmph. The design speed of exist curve is 45 kmph. The comfortable deceleration is 7 kmph/sec. 5 + 10

14. a) Discuss intersection sight distance according to AASHTO recommendation.

    b) A 20 m road *A* meets 7·5 m road *B*. The corner of a monumental building is 15 m from nearest vertical path *A* and 5 m from the furthest vehicle path *B*. The design speed of vehicle on *A* is 100 kmph. Find the restricted speed on *B*. What is your recommendation on the sight distance requirement on the intersection ? 8 + 7

15. A fixed time two phase signal is to be provided at an intersection having north-south and east-west roads, where only straight ahead traffic is permitted. The daily hourly flows from the various arms and saturation flows for these arms are given in the following table :

	North	**South**	**East**	**West**
DHF (PCU/hr)	800	400	750	600
Saturation flow (PCU/hr)	2400	2000	3000	3000

Calculate the optimum cycle time and green time for the minimum overall delay. Lost time per phase due to straight delay can be assumed to 2 secs. The value of amber period 3 secs. Sketch the time diagram for each phase.

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