



Kafrelsheikh University  
 Faculty of Engineering  
 Department of Civil Engineering  
 Year: Fourth

Subject: Highway Engineering  
 Final Exam

Date: 2/1/2020  
 Time allowed: 3 hrs  
 Full Mark: 75 points  
 AC. No. CES 4125

**Question ( 1 ) : - ( 10 points )**

A) Why the soil classification is made for subgrade soil ?

- Define the group index.

B) Classify the following soils according to AASHTO classification system . Determine their group index and comment on their probable use as subgrade .

%passing \ sieve	NO. 10	NO. 40	NO. 200	L . L	P . L
Soil A	100	91	1	-	NP
Soil B	95	82	58	48	36

**Question ( 2 ) : - ( 10 points )**

A) What is the purpose of placing surcharge weights during the C.B.R test ?

B) Find the California bearing ratio ( C.B.R ) for the following soils : -

Penetration ( inch )		0.1	0.2	0.3	0.4	0.5
Standard Load (lb/in <sup>2</sup> )	Soil A	550	700	800	850	900
	Soil B	210	500	700	800	850

C) Determine the surcharge weight which are required for C.B.R test on soil if the estimated pavement thickness will be 18 inches and pavement will have a unit weight of 140 pcf.

**Question ( 3 ) : - ( 15 points )**

A) What are the factors which can be considered in AASHTO design method ?

B) Define E.S.A.L & SN .

C) Determine the required structural number ( S N ) and layers thickness for an urban Highway to carry a design E.S.A.L of 10 million .

The following additional information are available :

Pavement section design reliability = 90 %

Overall standard deviation = 0.35

Design serviceability loss = 2

Material	Mr ( psi )	Layer coefficient	drainage coefficient(m)
Asphalt concrete	400,000	$a_1=0.42$	
Base	30,000	$a_2=0.14$	0.80
Sub base	14,000	$a_3=0.10$	0.70
Sub grade	5,000		

**Question ( 4 ) : - ( 10 points)**

- A) Define : - 30 HV - generated traffic - decision sight distance - directional distribution .  
B) Why AADT is not used in the geometric highway design ?  
C) A simple horizontal curve of a degree of curvature equals  $7^\circ$  , connects two tangents deflecting  $30^\circ$  and intersecting at station 130 + 00 . If the design speed is 80 kph , determine the required superelevation . Draw a neat dimensioned sketch showing the profile of the centerline and each edge of the pavement during the development superelevation by rotating the pavement about its centerline , then Find the dimensions of the cross – section at stations 129 + 50 & 130 + 85 .  
( Note : - The pavement is two lane , each is 3.6 wide , the grade line is horizontal , the normal crown slope is 2 cm/m )

**Question ( 5 ) : - ( 10 points)**

- A) State the benefits of : median – shoulder .  
B) Define : - climbing lane – critical length of grade – transition length.  
C) A -3% grade intersects a +1% grade at station 30+45 and elevation of 160.5m . If the design speed is 80 kph , determine the required length of vertical curve and the elevation of the critical point .

**Question ( 6 ) : - ( 10 points)**

- A) What are the factors that affect the selection of highway profile ?  
B) Briefly explain with sketches the different types of at grade intersection design , stating the advantages and disadvantages of each type ?

**Question ( 7 ) : - ( 10 points )**

- A) Define :- 30 HD – Generated Traffic – decision sight distance ?  
B) The expected traffic composition for a new cut section of a HWY is 30% p.c , 60% trucks (3.5p.c) and 10% buses(2.0p.c). Future ADT is 5700 vph, DHV is 15% ADT and traffic in the predominate direction is 70%. Evaluate:-  
- NO of lanes in both directions if the practical capacity is 250 truck/hr/lane.  
- Stopping sight distance if  $v= 70\text{kph}$  ,  $f_1= 0.32$

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Note:- Assume any missing data may you need.

-Academic standards that the course contribute in achieving  
are(a1,a2,a3,a4,b7,b13,c2,c5,c14&d8)

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With best wishes,,,,,,Dr.Amal Hussien