B.E. (Civil Engineering) Eighth Semester (C.B.S.)

Elective-II : Pavement Analysis & Design

P. Pages : 3 **NRJ/KW/17/4670**

Time : Three Hours * 0 2 3 4 * Max. Marks : 80

Notes :
1. All questions carry marks as indicated.
2. Solve Question 1 OR Questions No. 2.
3. Solve Question 3 OR Questions No. 4.
4. Solve Question 5 OR Questions No. 6.
5. Solve Question 7 OR Questions No. 8.
6. Solve Question 9 OR Questions No. 10.
7. Solve Question 11 OR Questions No. 12.
8. Due credit will be given to neatness and adequate dimensions.
9. Assume suitable data whenever necessary.
10. Diagrams and chemical equations should be given whenever necessary.
11. Illustrate your answers whenever necessary with the help of neat sketches.
12. Use of non programmable calculator is permitted.

1. a) Clearly distinguish between Highway and Airfield Pavements. **6**

b) Discuss the effects of repeated application of loads on pavement. Explain equivalent wheel load factors for load repetitions. **7**

OR

2. a) With neat sketches enumerate the function and importance of each component layer both in flexible and rigid pavements. **6**

b) Estimate the ESWL for dual - in tendon wheel assembly for an aircraft Data : **7**
- i) Gear Load = 26800 kg
- ii) Tyre Pressure = $10.6\,kg/cm^2$
- iii) Dual spacing = 225 mm clear
- iv) Tendon spacing = 350 mm clear
- v) Flexible crust thickness = 550, 750, 900 mm

3. a) Estimate the group index of subgrade soil from following data and discuss the rating as subgrade. **7**
- i) Passing 425 micron = 75%
- ii) Passing 75 micron = 60%
- iii) Liquid limit = 51%
- iv) Plastic limit = 28%

b) Calculate the cone bearing value from the following data of North Dakota cone test (Half Angle of cone = $7^o\ 45'$) **7**

Load (kg)	Cone penetration (mm)
4.5	2.91
9.0	4.09
18.0	5.96
36.0	8.35

OR

4. The following results were noted in a laboratory CBR tests conducted on subgrade soil : **14**

Penetration (mm)	0	0.5	1.0	1.5	2.0	3.0	4	5	7	7.5	10	12.5
Load (kg)	0	6	18	32	50	60	65	75	80	90	95	100

It is desired to use the following materials for different pavement layers :

i) Compacted soil subgrade having CBR = 10%

ii) Poorly graded gravels having CBR = 22%

iii) Well graded gravels having CBR = 90%

The traffic survey indicates present ADT of commercial vehicle as 1400 with construction period of 2 years. The design life is 10 years with the expected traffic growth rate of 10%. Suggest the suitable crust composition with neat sketch.

5. a) Explain AASHTO method of flexible pavement design. **5**

b) The pressure for 5 mm deformation in both tests was recorded as $2.5\,kg/cm^2$ and $4.7\,kg/cm^2$ resp. for flexible pavement of 30 cm base course, find the pavement deformation, vertical and radial stress, stress at the subgrade under the load of 6100 kg acting at a tyre pressure of $6.2\,kg/cm^2$. Assume, Poisson's ratio of subgrade as (0.38). A plate load test was conducted on subgrade and also on 20 cm thick base with 30 cm diameter plate. **9**

OR

6. Design a flexible pavement for design traffic volume of 3770 CVD, if the permissible deflection of 0.5 cm by Triaxial method. Data Given : **14**

i) Wheel load = 6200 kg.

ii) Tyre pressure = $6.6\,kg/cm^2$

iii) Annual Rainfall = 92 cm.

iv) Modulus of elasticity of: subgrade = $80\,kg/cm^2$

Sub base = $415\,kg/cm^2$, Base = $1950\,kg/cm^2$

v) Bituminous surfacing = $4400\,kg/cm^2$

vi) Traffic coefficient = 8/6

vii) Rainfall coefficient = 0.9

7. a) Explain P.C.A. method of design of rigid pavement with neat sketches of charts. **6**

b) Write short note on LCN method of Airfield pavement design. **7**

OR

8. Estimate the load factor at all the regions of runway concrete pavement of 275 mm thickness under ESWL = 26,000 kg at $10.5\,kg/cm^2$ tyre pressure. Assume grade of concrete M : 300 and K for subgrade soil = $8.0\,kg/cm^3$. Also locate the position of failure and draw failure pattern. **13**

9. a) Design a pavement in M : 300 concrete for 2 lane highway expected to carry projected traffic of 1870 CVD of ESWL = 5100 kg at $6.8\,kg/cm^2$ tyre pressure from following data: **9**

i) K for subgrade = $5.7\,kg/cm^2/cm$
ii) E for concrete = $3.1\times10^4\,kg/cm^2$
iii) Poisson's ratio of concrete = 0.18
iv) Contraction joint spacing = 5.25 m
v) Temperature gradient = $0.95^oC/cm$
vi) Subgrade Restraint Coefficient = 1.35
vii) Temperature coefficient :

Lx; y	4	5	6	7	8	9	10	11	12 & more
Cx, y	0.44	0.72	0.92	1.03	1.07	1.08	1.07	1.05	1.02

b) Explain in detail design of expansion joint and longitudinal tie bar joint for rigid pavement. **4**

OR

10. a) Design a bituminous overlay for a pavement section 3 km long the Benkelman Beam test is conducted at a rate of one test for 250 m length over a two section. The following valves of deflection are recorded 1.38, 1.52, 1.67, 1.31, 1.7, 1.92, 1.68, 1.2, 1.84, 1.93, 1.46, 1.55 mm. The test temp, of pavement is 26ºC. Present traffic volume is 750 CVD. Assume growth rate of 9.5% per year for service life of 10 years with delay of 1 year. **6**

b) A plate load test with 30 cm dia plate conducted a subgrade give following data : **7**

Deformation (mm)	0.25	0.5	0.75	1.0	1.25	1.50	1.75	2.0
Load on plate (kg)	200	480	730	1005	1240	1475	1720	1975

Estimate the modulus of Subgrade Reaction.

11. Design a rigid pavement for 2 - lane highway from following data : **13**

i) Design wheel load = 5100 kg
ii) Tyre pressure = $6.2\,kg/cm^2$
iii) Modulus of subgrade reaction = $7.5\,kg/cm^2$
iv) Grade of concrete = M 250
v) Temp gradient = $0.6^oC/cm$
vi) Panel dimensions = $3.0\,m\times6.0\,m$
vii) Initial traffic volume = 860 CVD
viii) Design Life = 20 years.

OR

12. Check the Adequacy of rigid pavement from IRC criteria.

i) Slab thickness 150 mm
ii) 'E' for concrete = $3\times10^5\,kg/cm^2$
iii) Poisson's ratio of concrete 0.15
iv) Thermal Expansion coeff. $10\times10^{-6}/^oC$
v) MOR of concrete $48\,kg/cm^2$
vi) Anticipated thermal Gradient across slab $0.5^oC/cm.$
vii) 'K' for subgrade soil $6.5\,kg/cm^2/cm$
viii) Cx and Cy 0.82 and 0.45 respectively.
ix) Wheel load (ESWL) 5100 kg.
x) Tyre pressure = $6.0\,kg/cm^2$

Assume any other data suitable if necessary.

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