L-4/T-1/CE **Date : 26/07/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2014-2015

Sub : **CE 401** (Project Planning and Construction Management)

Full Marks : 280 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **SEVEN** questions in this section. Answer **Q. No. 1** and any **FOUR** from the rest.

1. Answer any five of the following: **(5×8=40)**

   (a) "Equipment make it possible" – Explain the statement and state the importance of equipment in construction.

   (b) State the safety measures that should be taken for earth excavation.

   (c) Explain needs for Inspection and Quality Control in construction project.

   (d) Differentiate between "Single" and "Two stage" tendering.

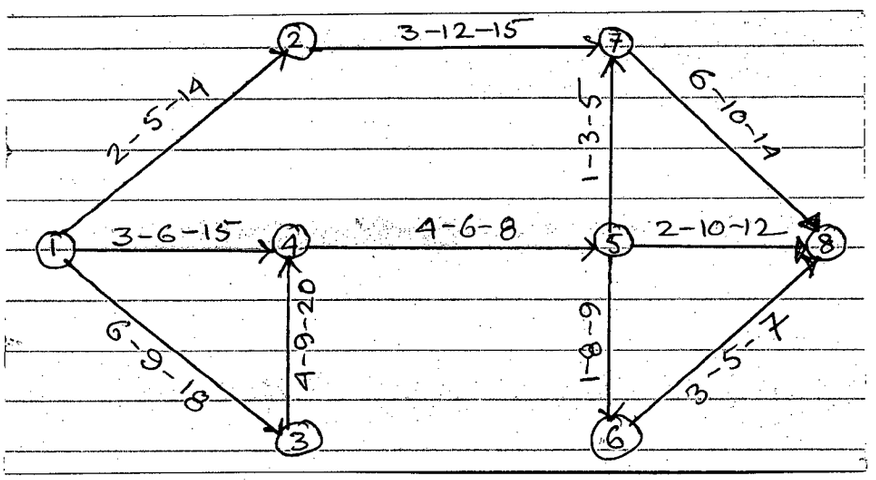
   (e) What is a milestone chart? How does it differ from a bar chart?

   (f) Differentiate between "Activity oriented network diagram" and "Event oriented diagram".

   (g) What do you understand by "Cost-Slope"? How do you determine it?

2. (a) Explain how beta distribution is suitable for PERT analysis. Explain how do you determine the expected time and standard deviation of activity in PERT method. **(12)**

   (b) The network for a construction project is shown in the following Figure. Determine the expected time for each path. Which path is critical? **(13)**



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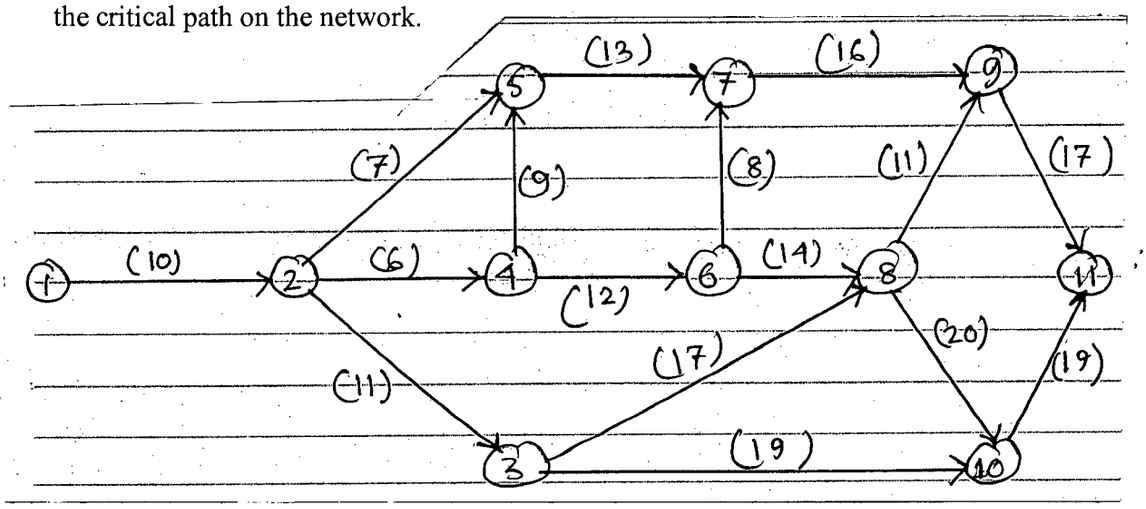
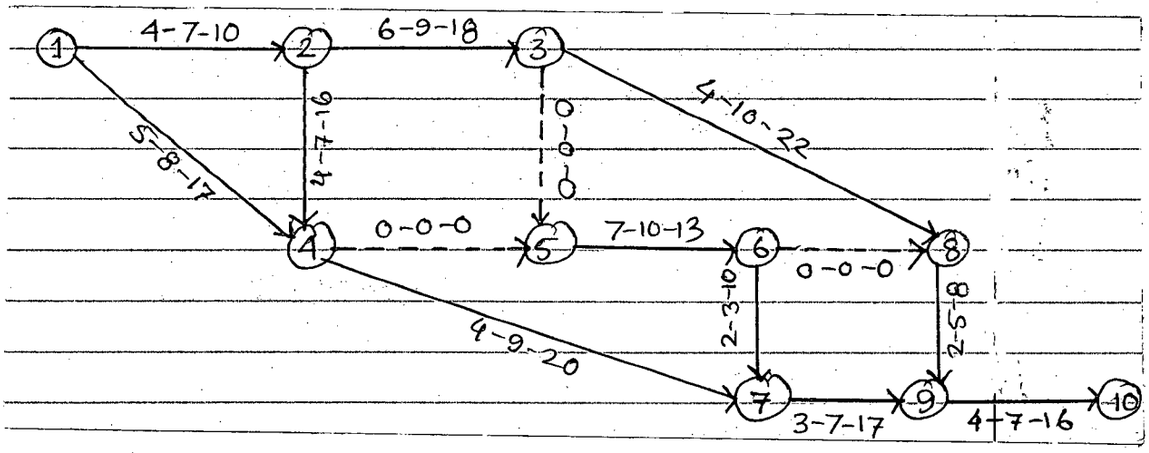
3. The network of a building project is shown in the following Figure along with the duration of each activity. Compute activity time and total float of each activity. Locate the critical path on the network. **(25)**



4. A construction company has an opportunity to submit a bid for the construction of a new factory building. From the specification provided by the client, the PERT network along with these time estimate (in week) for each activity are shown in the following Figure. **(25)**



Determine:

(i) Critical path and its standard deviation.

(ii) Probability of completing the work in 52 weeks.

(iii) Completion time duration for which the company should bid to provide 90% probability of completing the project in time.

5. The following table gives the data about durations and cost of various activities of the network shown in the Figure. **(25)**

Activity	Normal durations (weeks)	Normal cost (Tk)	Crash duration (weeks)	Crash cost (Tk)
1 – 2	4	4000	2	12000
2 – 3	5	3000	2	7500
2 – 4	7	3600	5	6000
3 – 4	4	5000	2	10000

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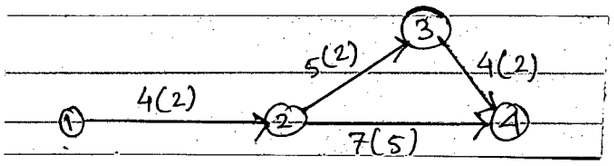
Contd ... Q. No. 5



The project overhead costs are 2000 Tk per week. Find the optimum duration and the cost associated with it.

6. (a) A transportation company has two type of trucks. Type 'A' and type 'B'. Type 'A' has a refrigerated capacity of 20 m^3 and a non-refrigerated capacity of 40 m^3, while type 'B' has the same overall volume with equal sections for refrigerated and non-refrigerated stock. A grocer needs to hire trucks for the transport of 3000 m^3 of refrigerated stock and 4000 m^3 of non-refrigerated stock. The cost per km of a type 'A' is $ 30 and $ 40 for type 'B'. How many trucks of each type should the grocer rent to achieve the minimum total cost? (Use LP model and graphical method). **(15)**

(b) State the basic steps on formulating a linear programming model. What are the advantages and limitations of linear programming? **(10)**

7. (a) What are the risks of poor tender documentation? "Late tenders must not be accepted" why? What are the good practices during evaluation phase of tendering process? **(15)**

(b) What are the information required to prepare an adequate tender? Explain project management cycle. **(10)**

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

Assume values for missing data, if necessary.

8. (a) How to create a perception of justice within the project team? What are the five disfunctions of a team? Describe them. **(13 2/3)**

(b) What are the required behaviours of an external leader for managing a self-managing team? **(13)**

(c) The construction of a bridge requires 1,000 bags of cement per month (assume 30 days per month and 12 months per year). Cost associated with each order is Tk. 3,000 and the annual holding cost per cement bag is Tk. 500. The lead time for the order to arrive is 7 days. Calculate the Economic Order Quantity (EOQ). **(20)**

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9. (a) What are the impacts of relationship conflict on individual and group level? What level of conflicts generally prevails for high performing and low performing teams at various stages of the project? **(13 2/3)**

(b) How to integrate the environmental impact assessment (EIA) and environmental management plan (EMP) at various stages of project development? **(8)**

(c) As the procurement manager for a large housing development company, you order cement in bulk for every quarter. The price for each cement bag is Tk. 400 and a profit charged for each cement bag is Tk. 100 from the project. For maintaining high quality, the company sells all left over cement bags after each quarter for Tk. 360 per bag. You have calculated that the average A/F Ratio is 0.98 with standard deviation of 0.2 for last 10 quarters. Based on information supplied by project managers, the estimated demand for next quarter is 30,000 cement bags. What will be your profit maximizing ordering quantity using the Newsvendor Model? See Appendix 1 for Z-score. **(25)**

10. (a) Define clearly the terms "management" and "Motivation" and in which way management is different from administration. State the main essence/tasks of management and some typical management questions that underlie decisions in each organisation. Define delegation and explain the necessity and key steps in delegation. List the factors which should be taken into consideration in decentralization. **(23 2/3)**

(b) What is meant by Capital Recovery Factor and Sinking Fund Factor? Compare the economics of two alterative material handling system of X and Y. The pertinent data are as follows: **(23)**

System	X	Y
First Cost	$ 80,000	$ 200,000
Economic life	20 years	40 years
Annual cash disbursement	$ 18,000	$ 6,000
Salvage value at end of life	$ 20,000	$ 40,000

Assuming the interest rate of 10% p.a., show which alternative is the best by the:
(i) Annual Cost (A.C.) method and (ii) Present Value method.

11. (a) Explain clearly the purpose and perspectives of a Feasibility report and briefly outline the various essential components that you will require to be examined to carry out a Techno-Economic Feasibility study of a project with due regard to some emerging socio-environmental concerns. Explain the process of leading, directing and guiding and issuing orders. **(24 2/3)**

(b) Explain clearly the meaning and policy implications of Payback Period, NPV and IRR. What is the rate of return for a project where $ 100,000 is invested to produce an annual cash flow of $ 27,000 over 10 years? **(22)**

Standard Normal Distribution Function

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Z (+)	Probability (P_r)(%)	Z (−)	Probability (P_r) (%)
0	50·0	0	50·0
+0·1	53·98	−0·1	46·02
+0·2	57·93	−0·2	42·07
+0·3	61·79	−0·3	38·21
+0·4	65·54	−0·4	34·46
+0·5	69·15	−0·5	30·85
+0·6	72·57	−0·6	27·43
+0·7	75·80	−0·7	24·20
+0·8	78·81	−0·8	21·19
+0·9	81·59	−0·9	18·41
+1·0	84·13	−1·0	15·87
+1·1	86·43	−1·1	13·57
+1·2	88·49	−1·2	11·51
+1·3	90·32	−1·3	9·68
+1·4	91·92	−1·4	8·08
+1·5	93·32	−1·5	6·68
+1·6	94·52	−1·6	5·48
+1·7	95·54	−1·7	4·46
+1·8	96·41	−1·8	3·59
+1·9	97·13	−1·9	2·87
+2·0	97·72	−2·0	2·28
+2·1	98·21	−2·1	1·79
+2·2	98·61	−2·2	1·39
+2·3	98·93	−2·3	1·07
+2·4	99·18	−2·4	0·82
+2·5	99·38	−2·5	0·62
+2·6	99·53	−2·6	0·47
+2·7	99·65	−2·7	0·35
+2·8	99·74	−2·8	0·26
+2·9	99·81	−2·9	0·19
+3·0	99·87	−3·0	0·13

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Appendix 1 for Q.9 (c)

Appendix 1

z	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389

L-4/T-1/CE **Date : 16/07/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2014-2015

Sub : **CE 411** (Structural Analysis and Design II)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Analyse the truss in Fig. 1 by the consistent deformation method. ($E = 2000$ ton/cm^2). The numbers in parentheses are the cross-sectional areas of the members in sq. cm. **(29)**

   (b) Show two possible primary (released) structures and redundants for the structures in Fig. 2. **(6)**

2. (a) Analyse the portal frame (in Fig. 3) under the load and the settlements of support D to the right and downwards in ton-m units are 20/EI and 50/EI respectively. Use the consistent deformation method. Consider the three reaction components at the support D as redundants as indicated in the figure. The (δ_{ij}) matrix, of the released frame, corresponding to the redundants is provided in the figure. (EI = constant). **(25)**

   (b) For the frame in Fig. 4, draw the qualitative influence lines for (i) maximum positive bending moment at Q (ii) maximum negative bending moment at C of the beam BC and (iii) maximum axial force in column CE. Show also the corresponding loading pattern for uniformly distributed live load for each of them. **(10)**

3. (a) Develop the stiffness matrix for the GRID structure (plan shown in Fig. 5). The members are 30 cm in width and 60 cm in depth (along z axis). Consider $E = 120$ ton/cm^2, $C_a = 50$ ton/cm^2 and the torsion constant $K = 369900$ cm^4. Consider the degree of freedom indicated in the figure. **(25)**

   (b) Compute the translational stiffness of joint B in the horizontal direction (K11) for the frame in Fig. 6. (E = constant). **(10)**

4. (a) The truss structure carries a vertical load of 10 ton at A (Fig. 7). Using stiffness method find the displacement of joint A and hence calculate the forces in the members AB and AC. The numbers in parentheses are the cross-sectional areas of the members in sq.cm. Consider $E = 2000$ ton/cm^2. **(29)**

   (b) State the Muller-Breslau principle. **(6)**

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SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

Symbols have their usual meanings.

Assume reasonable values for missing data, if any.

5. (a) Define the following terms: **(3+3)**

   (i) Stiffness (ii) Fixed end moment

   (b) Analyse the beam shown in Figure 8, draw shear force and bending moment diagrams. Use modified stiffness, K for end B of the member BC. **(17)**

   (c) Find the support moments for the continuous beam shown in Figure 9. Given that: θ_A = +0.001 radian clockwise, Δ_A = 0.01 ft downward, Δ_B = 0.04 ft downward, Δ_C = 0.0175 ft downward. E = 30×10^3 ksi, I = 1,000 in^4. **(12)**

6. (a) Figure 10 shows a loaded one-story bent with an inclined leg. The relative k-value for each member is encircled. Analyse the structure using Moment Distribution Method and find the support reactions. **(27)**

   (b) Figure 11 shows a two-story portal frame subjected to vertical and lateral loads. Write down the major steps with schematic diagrams to outline the strategy to analyse the frame using Moment Distribution Method. **(8)**

7. (a) Determine the support reactions of the beam shown in Figure 12. Use Stiffness Method. Given: EI = 1×10^6 k-in^2. **(14)**

   (b) Draw qualitative influence lines for M_A, M_B, V_A, R_B, V_D, Δ_A, R_E for the beam shown in Figure 13. **(21)**

8. (a) Write down the coordinate matrix, connectivity matrix, member property matrix, member stiffness matrices and the global stiffness matrix of the truss shown in Figure 14. Given: E = 30,000 ksi, A = 10 in^2 for all members. **(23)**

   (b) Derive the stiffness equation of the frame shown in Figure 15 in matrix form. Consider axial deformation. Given: A, E and I are constant for all the members. **(12)**

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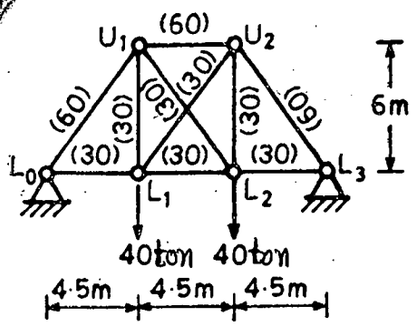


Fig. 1

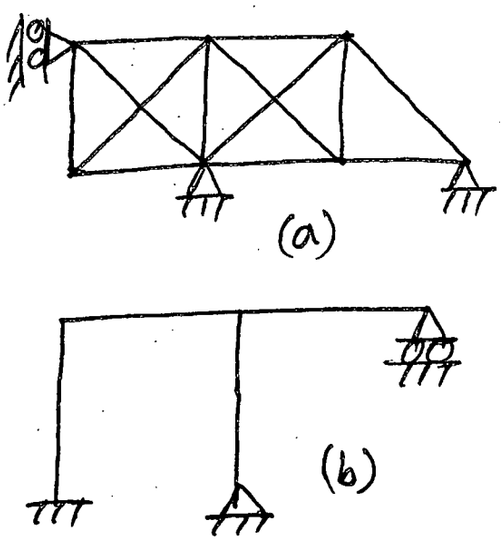
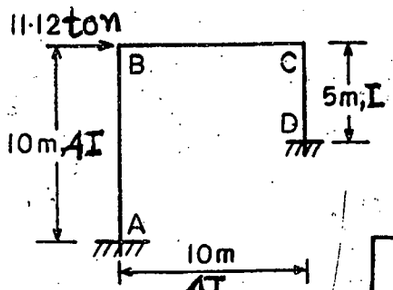
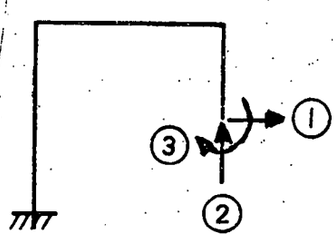


Fig. 2.





$$6EI \begin{bmatrix} 750 & 375 & -150 \\ 375 & 2000 & -225 \\ -150 & -225 & 60 \end{bmatrix}$$

(c) δ_{ij} Matrix

Fig. 3

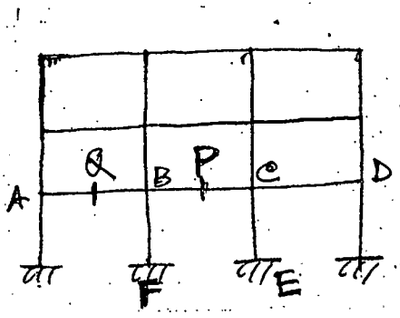


Fig. 4.

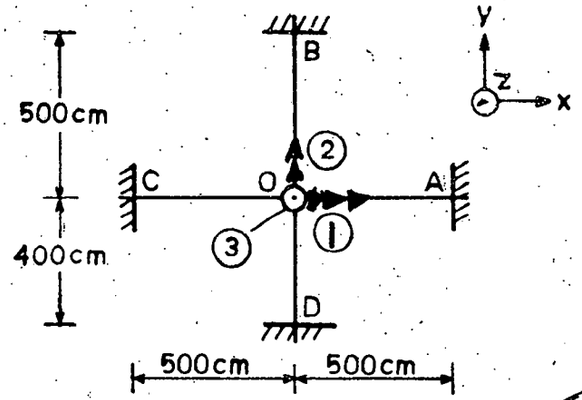


Fig. 5

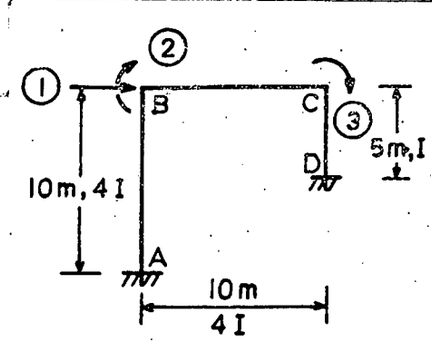


Fig. 6

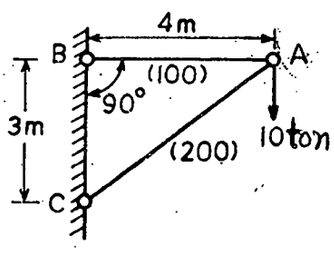


Fig. 7

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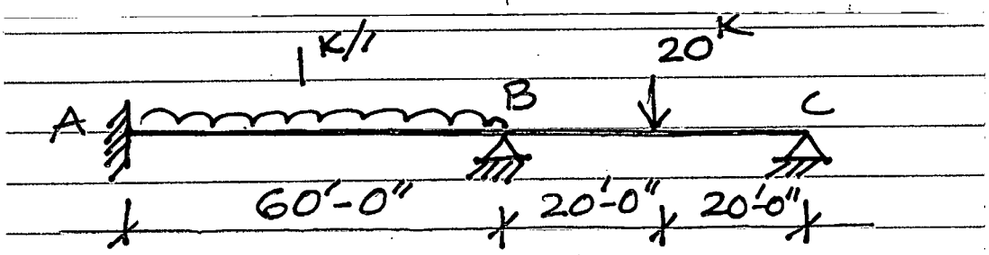


Figure :8 EI Constant

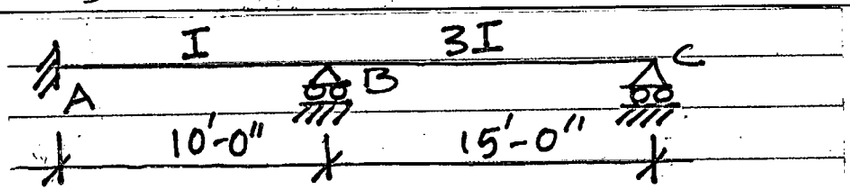
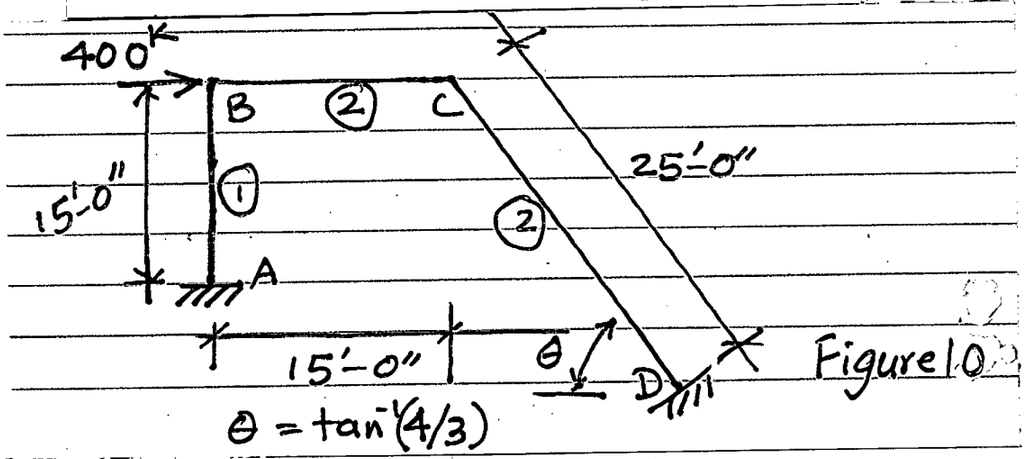


Figure 9



$\theta = \tan^{-1}(4/3)$ Figure 10

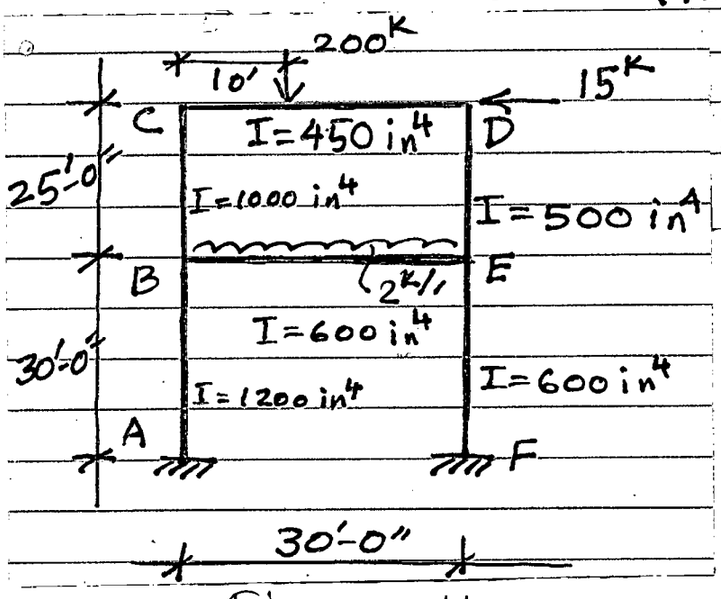


Figure :11

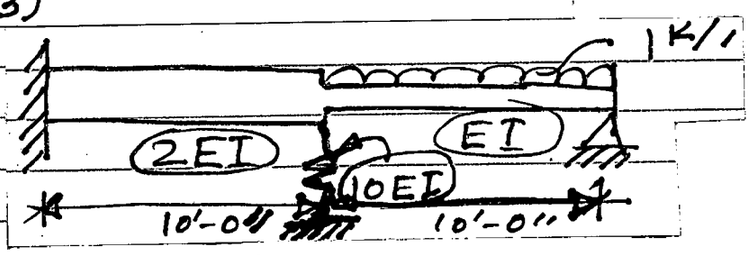


Figure :12

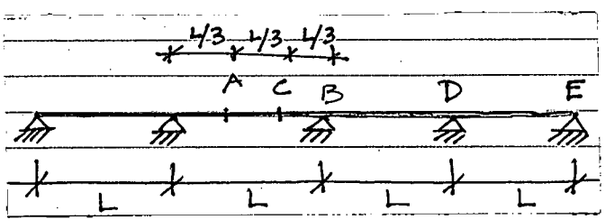


Figure :13

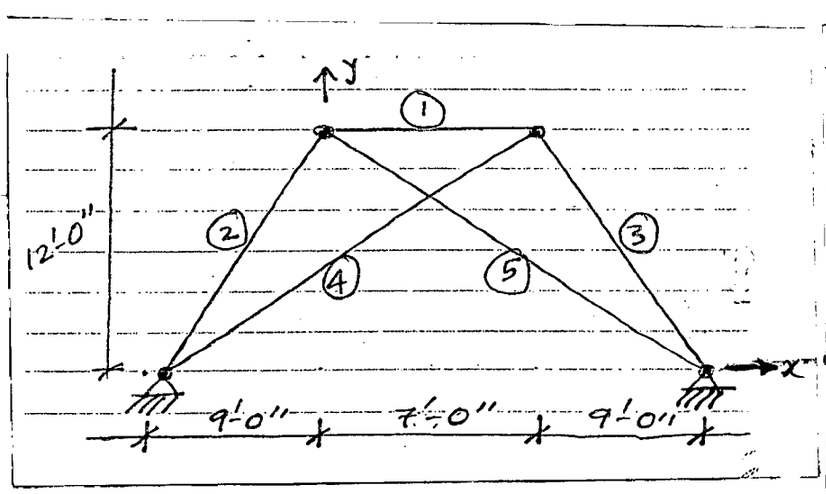


Figure :14

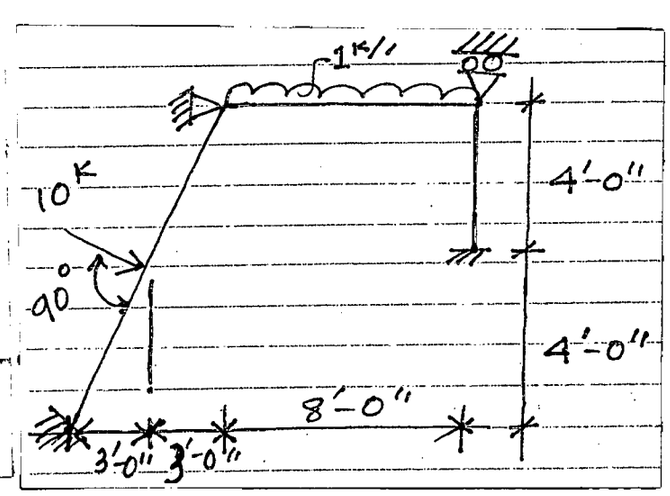


Figure :15

L-4/T-1/CE **Date : 20/07/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2014-2015

Sub : **WRE 451** (Hydrology, Irrigation and Flood Management)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Explain why the actual pressure is taken equal to the saturation vapor pressure at dew point temperature. **(5)**

   (b) Discuss infiltration capacity regarding (i) forest soil, and (ii) water with heavy suspended particles. **(5)**

   (c) Define: (i) Residence time, and (ii) Marshes. **(5)**

   (d) The shape of a drainage basin can be approximated by a polygon whose vertices are located at the following coordinates: (6, 6), (–6, 6), (–6, –6), (0, –12) and (6, –6). The rainfall amounts of a storm were recorded by a number of rain gages as follows: **(20)**

Gage number	Coordinates	Recorded rainfall (mm)
1	(3, 4)	60
2	(–2, 5)	40
3	(–3, –3)	100
4	(2, –3)	50
5	(7, 0)	90

   All the coordinates are expressed in kilometers. Determine the average rainfall on the basis of Thiessen Polygon Method. Use plain graph paper.

2. (a) Calculate the precipitable water for surface temperature of 20°C in the first km of atmospheric column if the surface pressure and lapse rate are 101.3 kPa and 6.5°C/km respectively. Relative humidity is 90% and 100% at surface and 1 km elevation respectively. Assume any reasonable value for data if missing. **(15)**

   (b) Ordinates of 6-h unit hydrograph are given below. Using this, derive the ordinates of 3-h unit hydrograph for the same catchment. **(15)**

Time (h)	0	6	12	18	24	30	36	42	48	54	60
6-h UH (m^3/s)	0	10	20	50	70	60	40	35	15	5	0

   (c) What are the logic behind forming polygons in the Thiessen Polygon Method? **(5)**

3. (a) The design precipitation intensity for a storm with a T-year return period with slope of 0.007 and maximum length of travel of water of 1500 m for the catchment is 2.5 in/hr. Estimate the design return period (T). In addition, estimate the design precipitation volume (m^3) and design peak discharge (m^3/s) using rational method for the catchment. The area of the catchment is 3 km^2 and runoff coefficient is 0.7. Use IDF curves (Figure 1) and Kirpich formula for your estimation. **(15)**

Contd P/2

WRE 451/CE

Contd ... Q. No. 3

(b) In a 210-min storm the following intensities of rainfall were observed in successive 30-min intervals: 4.5, 5, 8, 6, 1.5, 1 and 4 cm/hr. Assuming the ϕ-index value to be 2 cm/hr, determine, (i) total volume of runoff, (ii) total volume of infiltration and (iii) time of rainfall excess. The catchment area is 2 km^2. **(15)**

(c) Explain in brief the process of computing average rainfall in Isohyetal method. **(5)**

4. (a) Following are the ordinates of a storm hydrograph of a river draining a catchment area of 500 km^2 due to 6-h isolated storm. Derive the ordinates of a 6-h unit hydrograph for the catchment. **(15)**

Time from start of storm (h)	0	6	12	18	24	30	36	42	48	54	60	66	72
Discharge (m^3/s)	50	150	300	250	200	150	120	100	85	75	65	55	50

(b) Rainfall magnitudes of 4.8 cm and 3.8 cm occurring on two consecutive 5-h durations on a catchment of area 27 km^2 produced the following Flood hydrograph at the outlet of the catchment. Estimate the rainfall excess and ϕ-index. **(15)**

Time from start of rainfall (h)	–6	0	6	12	18	24	30	36	42	48	54	60	66
Flow (m^3/s)	6	5	13	26	21	16	12	9	7	5	5	4.5	4.5

(c) 'The exceedence probability for a flood with a 10-year return period is 0.1' – explain the sentence in brief. **(5)**

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) Define irrigation and write down the main objectives and importance of irrigation in the context of Bangladesh. **(10)**

(b) Explain the concept of multipurpose project. **(5)**

(c) What is national water policy? Write down its main elements in the national water policy. **(7)**

(d) Write down the physical properties of soil which influences irrigation and hence, show the classes of available water in the soil. **(8)**

(e) What do you understand by consumptive use of water? Write down the main factors affecting consumptive use of water for plants. **(5)**

Contd P/3

WRE 451/CE

6. (a) Describe reclamation measures of saline and alkaline lands. **(10)**

(b) Define soil moisture tension and describe the method for measuring soil moisture tension. **(10)**

(c) Determine the volume of water required to be diverted from the head works to irrigate area of 50 million m^2 using the data given in the table below. Assume 76% as the effective precipitation to take care of the consumptive use of the crop. Also assume 60% efficiency of water in the field and 70% as the conveyance efficiency of canal. **(10)**

Month	Temp (°F)	% hrs of sunshine	Rainfall (mm)	Crop factor, k
June	70.8	9.9	75	0.80
July	74.4	10.2	108	0.85
August	72.8	9.6	130	0.85
September	71.6	8.4	115	0.85
October	69.3	7.86	105	0.65
November	55.2	7.25	25	0.65
December	47.1	6.42	0	0.60
January	48.8	8.62	0	0.60
February	53.9	9.95	0	0.65
March	60.0	8.84	0	0.70
April	62.5	8.86	0	0.70
May	67.4	9.84	0	0.75

(d) Write short note on leaching. **(5)**

7. (a) Show the sources of irrigation water in a flow chart. Differentiate between surface and subsurface methods of irrigation. **(7)**

(b) Define: (i) Management allowable depletion (ii) Reference crop evapotranspiration (iii) Base period (iv) Duty (v) Delta. **(10)**

(c) Wheat is to be grown in a field having a field capacity equal to 27% and the permanent wilting point is 13%. Find the storage capacity in 80 cm depth of the soil, if the dry unit weight of the soil is 14.72 KN/m^3. If irrigation water is to be supplied when the average soil moisture falls to 18%. Estimate the leaching requirement when electrical conductivity (EC) value of a saturated extract of soil is 10 mmho/cm at 25% reduction in the yield of a crop. The EC of irrigation water is 1.2 mmho/cm. What will be the required depth of water to be applied to the field? **(10)**

(d) Write short note on furrow irrigation and drip irrigation. **(8)**

Contd P/4

WRE 451/CE

8. (a) Briefly describe irrigation water quality related problems and write down the name of impurities that are present in irrigation water. **(10)**

(b) Define various irrigation efficiencies and compute the distribution efficiency if the depths of penetrations along the length of a border strip at points 10 meters apart were measured as 2.0, 1.9, 1.8, 1.6 and 1.5 meters. **(10)**

(c) What is flood? Write down the causes and ill effects of flood. **(10)**

(d) What are the approaches and measures for protection from flood? **(5)**

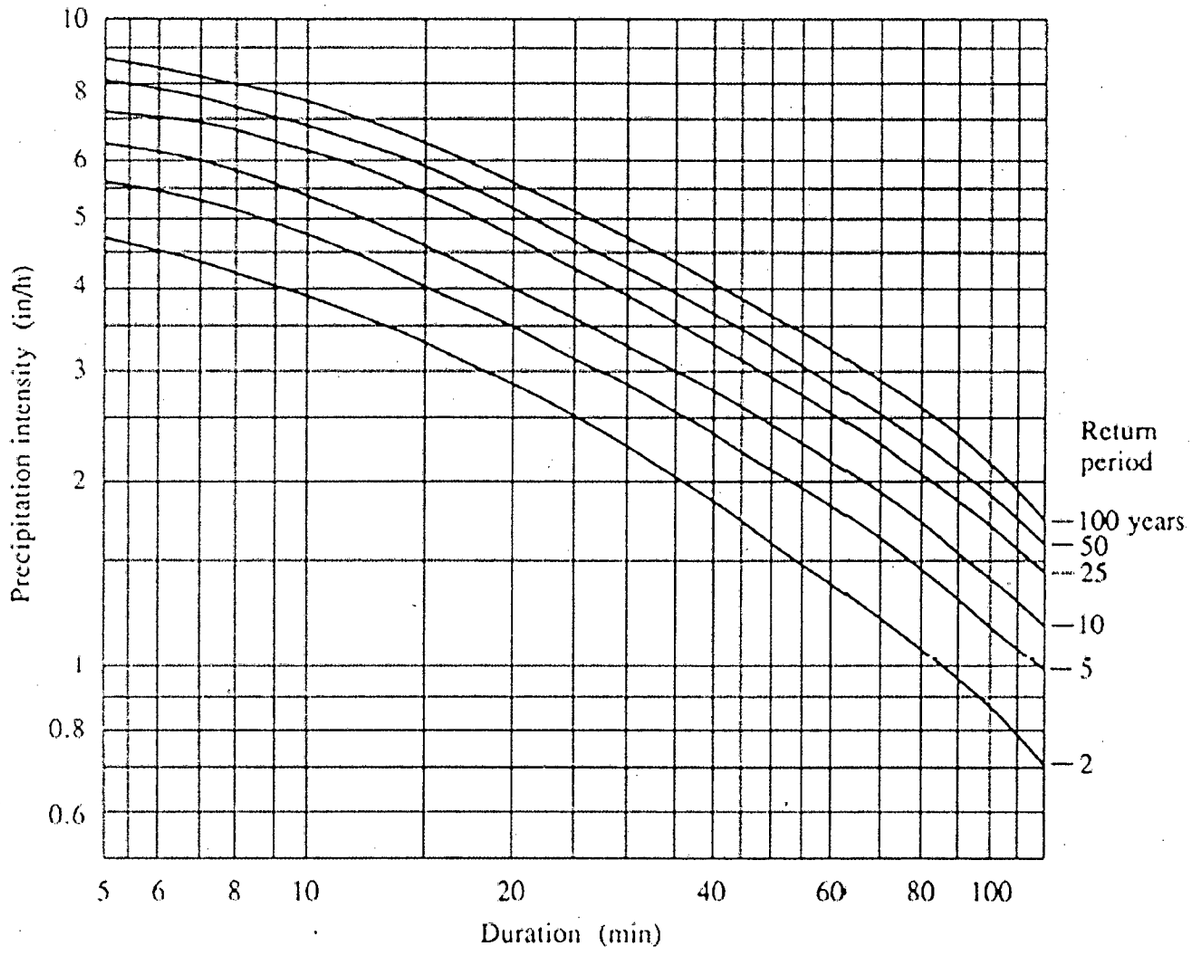


Figure 1 : Intensity - Duration- Frequency (IDF) curves for Q. No. 3(a)

L-4/T-1/CE **Date : 31/07/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2014-2015

Sub : **CE 441** (Foundation Engineering)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **EIGHT** questions in this section. Answer any **SIX**.

Further data required may be reasonably assumed. If doubt exists as to interpretation of any question, the candidate is urged to make a clear statement of any assumption(s) made.

1. A four story reinforced concrete frame office building will be built on a site where the soils are expected to be of average quality and uniformly. The building will have a 30 m × 40 m footprint and expected to be supported on spread footing foundation located about 3 m below the ground surface. The site appears to be in its natural condition, with no evidence of previous grading. Bedrock is 30 m below the ground surface. Determine the required number, location and depth of the borings. **(17.5)**

2. A Standard Penetration Test has been conducted in a loose coarse sand stratum to a depth of 5 m below the ground surface. The blow counts in the field were as follows: **(17.5)**

0 – 150 mm	4 blows
150 mm – 300 mm	6 blows
300 mm – 450 mm	8 blows

The test was conducted using a donut hammer in a 150 mm diameter borehole with a standard sampler and liner. The effective unit weight of the sand stratum is about 16 kN/m^3. Determine and designate the corrected SPT if the testing procedure is assumed to only be 60% efficient. Given that $C_B = 1.05$, $C_S = 1.00$ and $C_R = 0.85$.

3. At a site the soil profile was as follows with water table at ground surface. Design a group of driven pile that has to carry a column load of 4000 kN with a factor of safety of 2.5. **(17.5)**

0 – 10 m depth:	SAND with $\phi' = 33°$, $\gamma = 18$ kN/m^3, $K_s \tan\delta = 1.20$, $N_q = 25$
10 m – 25 m depth:	CLAY with $C_u = 40$ kN/m^2, $\gamma = 16$ kN/m^3
25 m – 40 m depth:	SAND with $\phi' = 40°$, $\gamma = 19$ kN/m^3, $K_s \tan\delta = 2.00$, $N_q = 140$

4. In a two layer cohesive soil bored piles of 450 mm are to be installed. The top layer has a thickness of 6 m and the bottom one is of considerable depth. The shear strength of the top clay layer is 45 kN/m^2 and that of the bottom is 100 kN/m^2. Determine the length of the bored pile required to carry a safe compressive load of 400 kN and uplift load of 200 kN, allowing a factor of safety of 3.0 in both the cases. **(17.5)**

Contd P/2

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5. A pile load test is done on a 300 mm diameter concrete pile with a length of 15 m and the following data are obtained. **(17.5)**

Load in kN	Settlement in mm
0	0
300	1.25
600	3.75
900	7.50
1200	13.75
1500	23.75
1800	36.75

Determine the allowable load on the pile using Davisson's method and a factor of safety of 2.0. Given that $s = 0.012\ B_r + 0.1\ B/B_r + PL/AE$. Assume modulus of elasticity of concrete as 21500 MPa.

6. A building is to be supported on a reinforced concrete raft covering an area of 14 m × 21 m. The subsoil is clay with an unconfined compressive strength of 80 kN/m^2, the pressure on the soil due to weight of the building and loads it will carry, will be 120 kN/m^2, at the base of the raft. If the unit weight of the excavated soil is 15 kN/m^3, at what depth should the bottom of the raft be placed to provide a factor of safety of 3.0? **(17.5)**

7. A 6 m thick layer of medium dense sand overlies a dense sand layer. Series of SPT were undertaken and the top sand layer showed an average N value of 21. From the tests on dense sand layer, the average N value has been found as 42. A round pile of 250 mm diameter is to be driven down to 4 m in dense layer to have adequate end bearing. Taking a factor of safety of 4, determine the allowable load that the pile can carry. **(17.5)**

8. Write short notes on the following using neat sketches where required. **(17.5)**
   (a) Wash boring
   (b) Negative Skin friction
   (c) Sample disturbance.

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

9. (a) Draw a section of circular failure surface for an embankment and write the formula of factor of safety according to Fellenious method for c-ϕ soil. **(10)**
   (b) Following data are given for a Telecom Tower pile foundation with the column at centre". **(15)**

Contd P/3

CE 441

Contd ... Q. No. 9(b)

Pile group consists of 20 piles spacing @ of 4 ft c/c.

Pile cap thickness is 5 ft and extends 2 ft from the centre of edge piles.

Ground level is 2 ft above the pile cap top.

The vertical load is 2000^k downward.

The horizontal load in long direction is 800^k

The horizontal load in short direction is 600^k

The load acts at centre of foundation and at 5 ft above the pile cap top.

Draw a plan and a section of the foundation and calculate the maximum and minimum reaction on the piles.

(c) Briefly discuss the tests performance for Quality Control of drilled piers. **(10)**

10. Calculate the factor of safety and settlement for a shallow footing resting on clay. **(35)**

Given:

Footing size 10′ × 15′, footing thickness 3 ft, depth of footing 7 ft from surrounding ground level.

Unconfined compressive strength of soil is 3 ksf upto a great depth, unit weight is 125 pcf, $e_0 = 0.7$, $C_c = 0.12$, $C_r = 0.03$, past maximum overburden pressure = 6000 psf, water table is 20 ft from ground level.

D_f/B	0	1.0	2.0	3	4.0
N_c	5.14	6.0	6.6	7.0	7.5

11. Calculate the Factor of Safety and Settlement of a raft foundation for following conditions. **(35)**

Size of raft foundation is 100′ × 120′.

Depth of the foundation is 20 ft below ground level.

Gross contact pressure is 4 ksf.

Clay soil exists from ground level to depth 40 ft and below 40 ft dense sand exists.

Water table is 20 ft below ground level.

Unit weight of soil is 125 psf.

Unconfined compression strength is 4 ksf.

$e_0 = 0.8$, $C_c = 0.15$, $C_r = 0.04$

Past maximum overburden pressure = 7000 psf.

Contd P/4

CE 441

12. (a) Explain the methods for calculating pressure under an eccentrically loaded footing using conventional method and Meyerhof's Effective width concept. **(10)**

(b) What are the objectives of pile load test? **(5)**

(c) Write short notes: **(20)**

(i) Fully compensated foundation.

(ii) Engineering News Formula.

(iii) Concreting of Bored piles.

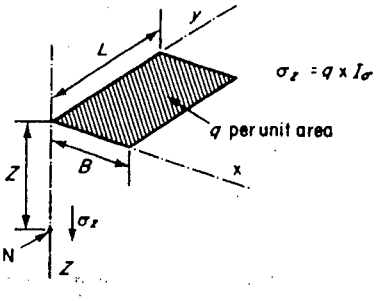
(iv) Lifting stresses of a driven pile.

(v) Dewatering in sandy soil.

Table 2.10 Influence values (I_σ) for vertical normal stress σ_z at point N beneath corner of a uniformly loaded rectangular area

B/z	L/z													
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.6	1.8
0.1	0.004 70	0.009 17	0.013 23	0.016 78	0.019 78	0.022 23	0.024 20	0.025 76	0.026 98	0.027 94	0.029 26	0.030 07	0.030 58	0.030 90
0.2	0.009 17	0.017 90	0.025 85	0.032 80	0.038 66	0.043 48	0.047 35	0.050 42	0.052 83	0.054 71	0.057 33	0.058 94	0.059 94	0.060 58
0.3	0.013 23	0.025 85	0.037 35	0.047 42	0.055 93	0.062 94	0.068 58	0.073 08	0.076 61	0.079 38	0.083 23	0.085 61	0.087 09	0.088 04
0.4	0.016 78	0.032 80	0.047 42	0.060 24	0.071 11	0.080 09	0.087 34	0.093 14	0.097 70	0.101 29	0.106 31	0.109 41	0.111 35	0.112 60
0.5	0.019 78	0.038 66	0.055 93	0.071 11	0.084 03	0.094 73	0.103 40	0.110 35	0.115 84	0.120 18	0.126 26	0.130 03	0.132 41	0.133 95
0.6	0.022 23	0.043 48	0.062 94	0.080 09	0.094 73	0.106 88	0.116 79	0.124 74	0.131 05	0.136 05	0.143 09	0.147 49	0.150 28	0.152 07
0.7	0.024 20	0.047 35	0.068 58	0.087 34	0.103 40	0.116 79	0.127 72	0.136 53	0.143 56	0.149 14	0.157 03	0.161 99	0.165 15	0.167 20
0.8	0.025 76	0.050 42	0.073 08	0.093 14	0.110 35	0.124 74	0.136 53	0.146 07	0.153 71	0.159 78	0.168 43	0.173 89	0.177 39	0.179 67
0.9	0.026 98	0.052 83	0.076 61	0.097 70	0.115 84	0.131 05	0.143 56	0.153 71	0.161 85	0.168 35	0.177 66	0.183 57	0.187 37	0.189 86
1.0	0.027 94	0.054 71	0.079 38	0.101 29	0.120 18	0.136 05	0.149 14	0.159 78	0.168 35	0.175 22	0.185 08	0.191 39	0.195 46	0.198 14
1.2	0.029 26	0.057 33	0.083 23	0.106 31	0.126 26	0.143 09	0.157 03	0.168 43	0.177 66	0.185 08	0.195 84	0.202 78	0.207 31	0.210 32
1.4	0.030 07	0.058 94	0.085 61	0.109 41	0.130 03	0.147 49	0.161 99	0.173 89	0.183 57	0.191 39	0.202 78	0.210 20	0.215 10	0.218 36
1.6	0.030 58	0.059 94	0.087 09	0.111 35	0.132 41	0.150 28	0.165 15	0.177 39	0.187 37	0.195 46	0.207 31	0.215 10	0.220 25	0.223 72
1.8	0.030 90	0.060 58	0.088 04	0.112 60	0.133 95	0.152 07	0.167 20	0.179 67	0.189 86	0.198 14	0.210 32	0.218 36	0.223 72	0.227 36
2.0	0.031 11	0.061 00	0.088 67	0.113 42	0.134 96	0.153 26	0.168 56	0.181 19	0.191 52	0.199 94	0.212 35	0.220 58	0.226 10	0.229 86
2.5	0.031 38	0.061 55	0.089 48	0.114 50	0.136 28	0.154 83	0.170 36	0.183 21	0.193 75	0.202 36	0.215 12	0.223 64	0.229 40	0.233 34
3.0	0.031 50	0.061 78	0.089 82	0.114 95	0.136 84	0.155 50	0.171 13	0.184 07	0.194 70	0.203 41	0.216 33	0.224 99	0.230 88	0.234 95
4.0	0.031 58	0.061 94	0.090 07	0.115 27	0.137 24	0.155 98	0.171 68	0.184 69	0.195 40	0.204 17	0.217 22	0.226 00	0.232 00	0.236 88
5.0	0.031 60	0.061 99	0.090 14	0.115 37	0.137 37	0.156 12	0.171 85	0.184 88	0.195 61	0.204 40	0.217 49	0.226 32	0.232 36	0.237 35
6.0	0.031 61	0.062 01	0.090 17	0.115 41	0.137 41	0.156 17	0.171 91	0.184 96	0.195 69	0.204 49	0.217 60	0.226 44	0.232 49	0.236 71
8.0	0.031 62	0.062 02	0.090 18	0.115 43	0.137 44	0.156 21	0.171 95	0.185 00	0.195 74	0.204 55	0.217 67	0.226 52	0.232 58	0.236 81
10.0	0.031 62	0.062 02	0.090 19	0.115 44	0.137 45	0.156 22	0.171 96	0.185 02	0.195 76	0.204 57	0.217 69	0.226 54	0.232 61	0.236 84
∞	0.031 62	0.062 02	0.090 19	0.115 44	0.137 45	0.156 23	0.171 97	0.185 02	0.195 77	0.204 58	0.217 70	0.226 56	0.232 63	0.236 86

B/z	L/z								
	2.0	2.5	3.0	4.0	5.0	6.0	8.0	10.0	∞
0.1	0.031 11	0.031 38	0.031 50	0.031 58	0.031 60	0.031 61	0.031 62	0.031 62	0.031 62
0.2	0.061 00	0.061 55	0.061 78	0.061 94	0.061 99	0.062 01	0.062 02	0.062 02	0.062 02
0.3	0.088 67	0.089 48	0.089 82	0.090 07	0.090 14	0.090 17	0.090 18	0.090 19	0.090 19
0.4	0.113 42	0.114 50	0.114 95	0.115 27	0.115 37	0.115 41	0.115 43	0.115 44	0.115 44
0.5	0.134 96	0.136 28	0.136 84	0.137 24	0.137 37	0.137 41	0.137 44	0.137 45	0.137 45
0.6	0.153 26	0.154 83	0.155 50	0.155 98	0.156 12	0.156 17	0.156 21	0.156 22	0.156 23
0.7	0.168 56	0.170 36	0.171 13	0.171 68	0.171 85	0.171 91	0.171 95	0.171 96	0.171 97
0.8	0.181 19	0.183 21	0.184 07	0.184 69	0.184 88	0.184 96	0.185 00	0.185 02	0.185 02
0.9	0.191 52	0.193 75	0.194 70	0.195 40	0.195 61	0.195 69	0.195 74	0.195 76	0.195 76
1.0	0.199 94	0.202 36	0.203 41	0.204 17	0.204 40	0.204 49	0.204 55	0.204 57	0.204 58
1.2	0.212 35	0.215 12	0.216 33	0.217 22	0.217 49	0.217 60	0.217 67	0.217 69	0.217 70
1.4	0.220 58	0.223 64	0.224 99	0.226 00	0.226 32	0.226 44	0.226 52	0.226 54	0.226 56
1.6	0.226 10	0.229 40	0.230 88	0.232 00	0.232 36	0.232 49	0.232 58	0.232 61	0.232 63
1.8	0.229 86	0.233 34	0.234 95	0.236 98	0.239 35	0.236 71	0.236 81	0.236 84	0.236 86
2.0	0.232 47	0.236 14	0.237 82	0.239 12	0.239 54	0.239 70	0.239 81	0.239 85	0.239 87
2.5	0.236 14	0.240 10	0.241 96	0.243 44	0.243 92	0.244 12	0.244 25	0.244 29	0.244 32
3.0	0.237 82	0.241 96	0.243 94	0.245 54	0.246 08	0.246 30	0.246 46	0.246 50	0.246 54
4.0	0.239 12	0.243 44	0.245 54	0.247 29	0.247 91	0.248 17	0.248 36	0.248 42	0.248 46
5.0	0.239 54	0.243 92	0.246 08	0.247 91	0.248 57	0.248 85	0.249 07	0.249 14	0.249 19
6.0	0.239 70	0.244 12	0.246 30	0.248 17	0.248 85	0.249 16	0.249 39	0.249 46	0.249 52
8.0	0.239 81	0.244 25	0.246 46	0.248 36	0.249 07	0.249 39	0.249 64	0.249 73	0.249 80
10.0	0.239 85	0.244 29	0.246 50	0.248 42	0.249 14	0.249 46	0.249 73	0.249 81	0.249 89
∞	0.239 87	0.244 32	0.246 54	0.248 46	0.249 19	0.249 52	0.249 80	0.249 89	0.250 00



L-4/T-1/CE **Date : 06/08/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2014-2015

Sub : **CE 451** (Transportation Engineering II: Pavement Design and Railway Engineering)

Full Marks : 280 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Briefly state the important properties of aggregates used for highway construction. What are the requirements of asphalt and aggregates in superpave mix design? **(16⅔)**

   (b) What are the main differences between Marshall and Hveem method of mix design regarding testing of specimens and design criteria? **(15)**

   (c) How do you find Design Asphalt Content, in Hveem method of mix design, after having the value of Approximate Asphalt Content by CKE procedure? An asphaltic concrete sample cut from a completed pavement weighs 3540 gm in air and 1962 gm in water. The laboratory compacted specimen of the same mix has a bulk specific gravity G_{mb} of 2.384 and voids percent of 5.5 percent. Is the mix satisfactory? **(15)**

2. (a) Briefly state the steps for refining crude petroleum in order to get different varieties of asphaltic materials. What are the viscosity grades of asphalt cement? **(18⅔)**

   (b) What are the tests for asphalt cement and aggregates in the specification of asphalt overlay construction? What are the special tests for emulsified asphalt? **(15)**

   (c) What are the especial qualities required for bitumen to be used in road construction of Bangladesh? How are these qualities achieved? **(13)**

3. (a) Define pavement and write down its functions and desirable characteristics. Draw typical sections for flexible and rigid pavements and also show load distribution mechanisms of them. Mention the CBR requirement for different layers of flexible pavement. **(21⅔)**

   (b) Write short notes on 'Semi-rigid or Composite Pavement' and 'Considerations of Perpetual Pavement'. Briefly differentiate between: **(10+5×3=25)**

   (i) Flexible and Rigid pavements.

   (ii) Contraction and construction joints.

   (iii) Jointed Plain Concrete Pavements (JPCP) and Continuously Reinforced Concrete Pavement (CRCP).

   (iv) Tie bars and Dowel bars.

   (v) Pumping and Fitigue (Alligator) Cracking mode of distresses.

Contd P/2

CE 451

4. (a) Draw stress distribution patterns overtime for flexible pavement. List different common mode of distresses for flexible and rigid pavements. **(15)**

(b) Why joints are used in rigid pavements? Write short notes on: Fog-seal, Slurry seal and Micro-seal. **(12)**

(c) Why structural design of pavement is a complex one? Design a flexible pavement by AASHTO method for the data given below. Give one trial and put your comments for the next trial thickness (if any). Solution should be given in the worksheet provided at the end of question paper. **(4⅔+15)**

Given:

Assumed structural Number, $S_N = 6.0$

Estimated Design EASL, $W_{18} = 25.0$ million

Consider:

Design period = 20 years

Initial Serviceability, $P_0 = 4.5$

Terminal Serviceability, $P_t = 2.5$

Reliability, R = 0.95

Overall Std. deviation, $S_0 = 0.35$

$Z_R = -1.645$

Pavement Layer	Material Used	Resilient Modulus M_R (psi)		Layer Coefficients	Drainage Coefficients	
Surface Course (AC)	Asphalt Concrete	E_{AC} =	400,000	$a_1 = 0.169*LN(E_{AC}) - 1.764$	m_1 =	1.0
Base Course (BS)	Granular	E_{BS} =	30,000	$a_2 = 0.249*LOG_{10}(E_{BS}) - 0.977$	m_2 =	1.2
Subbase Course (SB)	Granular	E_{SB} =	11,000	$a_3 = 0.227*LOG_{10}(E_{SB}) - 0.839$	m_3 =	1.2
Roadbed Course (RB)	Compacted soil	E_{RB} =	5,700			

Note: 1. Assume reasonable values for missing data, if any.

2. Write the results in the AASHTO worksheet provided.

3. AASHTO Design Nomograph for flexible pavement is also provided.

Contd P/3

CE 451

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) What are the options for bituminous surfacing on low volume roads? And, in Bangladesh, what are the commonly used low-cost surface treatments? Draw a typical cross-section of Bangladesh LGED implemented Herring Bone Bond (HBB) Brick pavement. Also, write down a list of ten equipment and their uses for highway construction. **(26⅔)**

   (b) Describe the construction steps, material and quality control requirements for cement stabilized road layer construction. Also, compare between penetration macadam and surface dressing treatment for bituminous road. **(20)**

6. (a) Discuss the construction steps and quality control measures for hot rolled bituminous surface layer including standard rolling procedure. Discuss the process of asphalt pavement recycling along with potential advantages. How can you repair following defects in a bituminous pavement: (i) Corrugation and shoving (ii) Local depression and upheaval (iii) Bleeding asphalt and or too rich mix? **(26)**

   (b) What are the important construction measures for quality control of rigid concrete pavement construction? Discuss with sketches dowel bar misalignment during concrete paving. Write down the problems and relevant considerations for hot weather concrete placement for rigid pavements. **(20⅔)**

7. (a) Classify railway system. Make a comparison between railway and roadway. Discuss the advantages and disadvantages of concrete sleeper. Also, state the advantages of coning of wheel and tilting of rails. **(26⅔)**

   (b) Define gauge of railway. What are the problems associated with having single track route? A Broad Gauge (BG) railway track is laid in a rising gradient of 1 in 100. Calculate the compensated grade if a 5° curve is to be laid on the rising gradient. **(20)**
   Again, calculate the minimum depth of ballast for a BG track with wooden sleepers having sleeper spacing = 48.1 cm and width of sleeper = 25.4 cm.

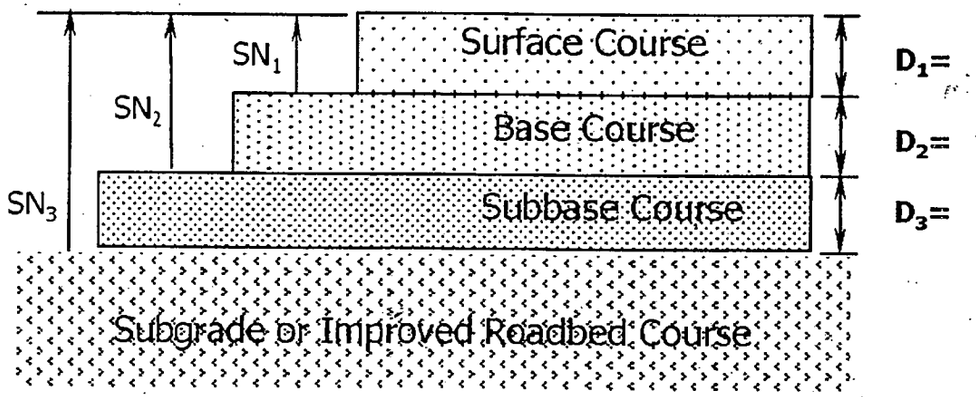
8. (a) What are the desirable properties of ideal ballast? State the possible causes and typical symptoms of embankment failure. In a tabular form state the aspects indicated by various colors of electrical colored light signals. Draw a schematic diagram of a right hand turnout showing the names of all the principal parts. **(26)**

   (b) Classify railway yards and station. Also, state the functions of a railway station. **(20⅔)**

   A 6° curve branches of from a 4° main curve in an opposite direction in a BG track. If the speed restriction on the branch line is 30 kmph, determine the speed restriction in the main line. Assume permissible deficiency in cant as 76 mm.

AASHTO Worksheet For Flexible Pavement Design

Pavement Layer	Material Used	Resilient Modulus M_R (psi)		Layer Coefficients		Drainage Coefficient		Required SN above the layer	Calculations For Layer Thicknessed	Thickness D (inch)
Surface Course	Asphalt Concrete	E_{AC} =	400,000	$a_1 = 0.169*LN(E_{AC}) - 1.764$ =		m_1 =	1.0			
Base Course	Granular	E_{BS} =	30,000	$a_2 = 0.249*LOG_{10}(E_{BS}) - 0.977$ =		m_2 =	1.2			
Subbase Course	Granular	E_{SB} =	11,000	$a_3 = 0.227*LOG_{10}(E_{SB}) - 0.839$ =		m_3 =	1.2			
Roadbed Course	Compacted soil	E_{RB} =	5,700							
Check for SN3 = a1m1D1 + a2m2D2 + a3m3D3 =										



AASHTO Design Nomograph for Flexible Pavement

NOMOGRAPH SOLVES:

$$\log_{10} W_{18} = Z_R * S_o + 9.36 * \log_{10}(SN+1) - 0.20 + \frac{\log_{10}\left[\frac{\Delta PSI}{4.2 - 1.5}\right]}{0.40 + \frac{1094}{(SN+1)^{5.19}}} + 2.32 * \log_{10} M_R - 8.07$$