

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2015-2016

Sub : **CE 425** (Structural Analysis and Design II)

Full Marks: 210

Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

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

1. (a) Analyze the frame in Fig. 1 by the consistent deformation method and draw the bending moment diagram (EI is constant). (27)
- (b) Show the two possible primary (released) structures and redundants for the structures in Fig. 2. (8)
2. (a) Analyze the truss in Fig. 3 by the consistent deformation method (EA = constant for all the bars) (27)
- (b) Draw qualitative influence lines for bending moment at A, B shear force at C and reaction at B of the continuous beam as shown in Fig. 4. (8)
3. (a) For the frame in Fig. 5, draw qualitative influence lines for (8)
  - (i) maximum negative bending moment at B of the beam BC, (ii) maximum positive bending moment at P and (iii) maximum axial force in column QM. Show the corresponding uniformly distributed live load loading pattern for each of them.
- (b) Find the reactions due to the loads and a vertical settlement of 6 mm at the support A of the beam in Fig. 6.  $E = 220 \times 10^6 \text{ kN/m}^2$  and  $I = 160 \times 10^{-6} \text{ m}^4$  for the beam. (27)
4. (a) Compute the translational stiffness of joint B in the horizontal direction ( $K_{22}$ ) for the frame in Fig. 7 (E = constant). (8)
- (b) Compute the bar force in the tie rod (Fig. 8) and draw bending moment diagram for the beam, using the consistent deformation method. Consider both axial and bending (E is constant). (27)

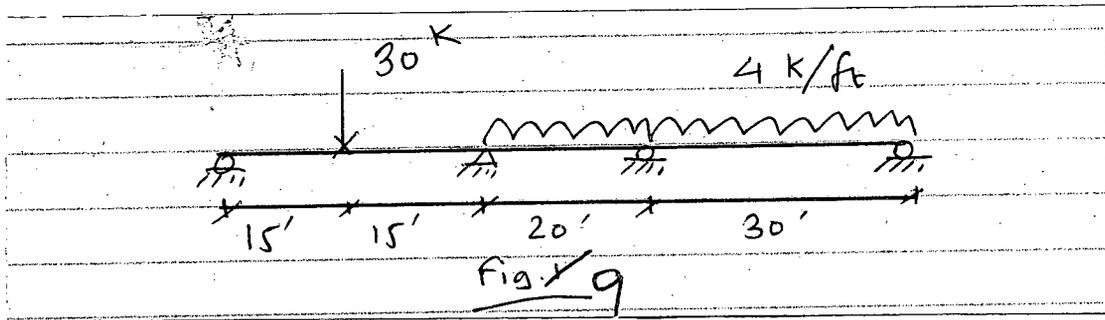
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**CE 425/WRE**

**SECTION - B**

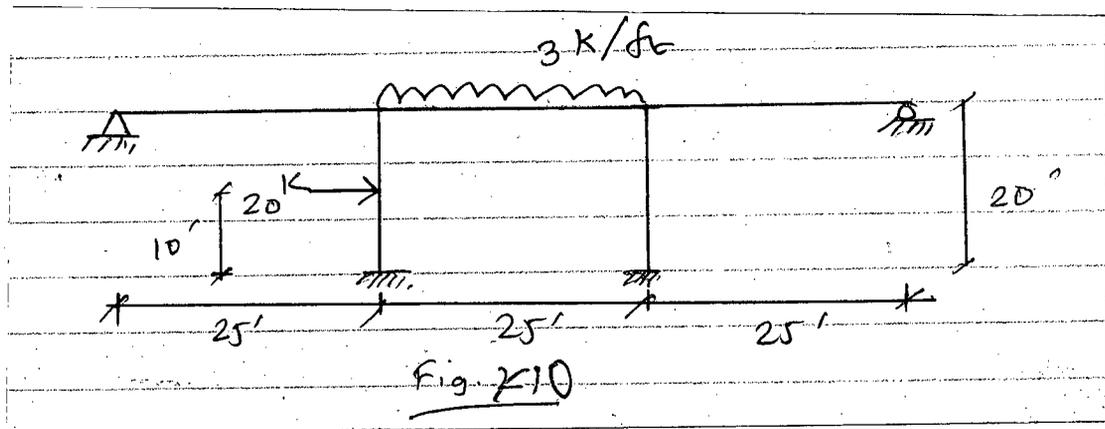
There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) Draw shear and moment diagrams for the structure shown in Fig. 9. EI is constant. (25)

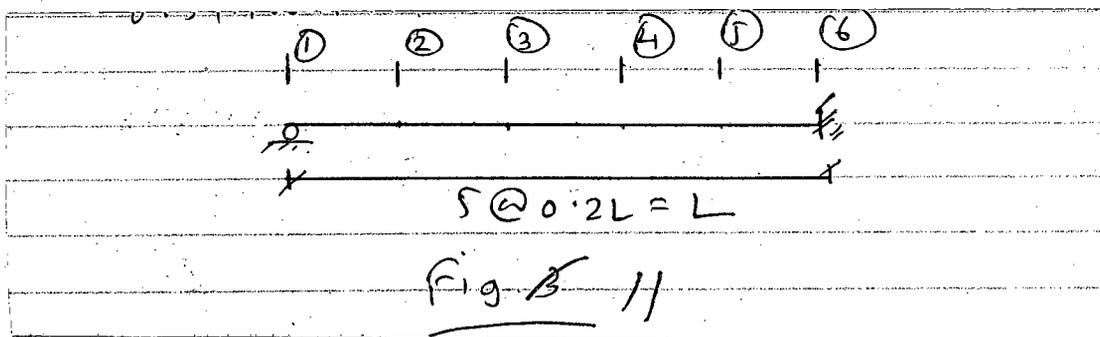


- (b) What is the moment carried over to a fixed end of a member when the other end is subjected to a certain moment? Also determine the carry over moment when the support is hinged. (10)

6. (a) Compute the end moments of the structure shown in Fig. 10. EI is constant for all members. Use moment distribution method. (20)

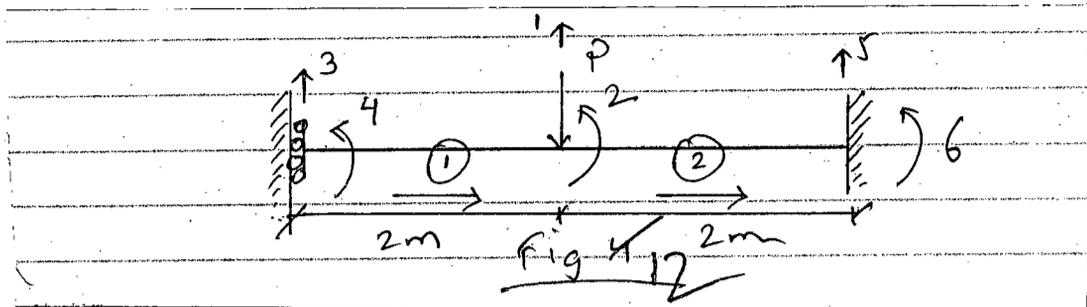


- (b) Construct the influence line for reactions at section 6 of the beam shown in Fig. 11. Determine ordinates at sections 1 to 6 as shown in Fig. 11. Use moment distribution. (15)



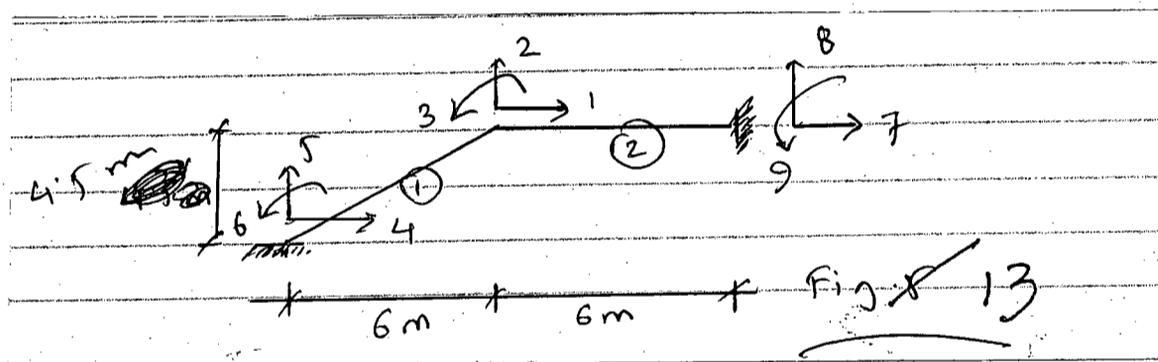
**CE 425/WRE**

7. (a) Determine the deflection at roller support and the reactions on the beam as shown in Fig. 12. EI is constant. (20)



Use stiffness method. Also, use nodal co-ordinates as shown in the Fig. 12.

- (b) Develop member global stiffness matrix for a truss element. (15)
8. (a) Determine the stiffness matrix of the frame shown in Fig. 13. Given  $I = 225 \times 10^6 \text{ mm}^4$ ,  $A = 7500 \text{ mm}^2$  and  $E = 200 \text{ GPa}$  (for both members). (25)



- (b) Define element, nodes, co-ordinates, force, displacement and stiffness regarding matrix method of analysis. (10)

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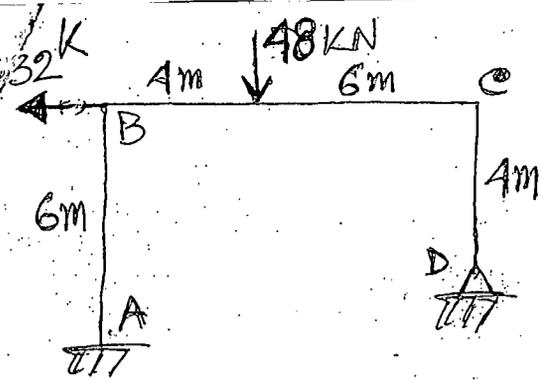
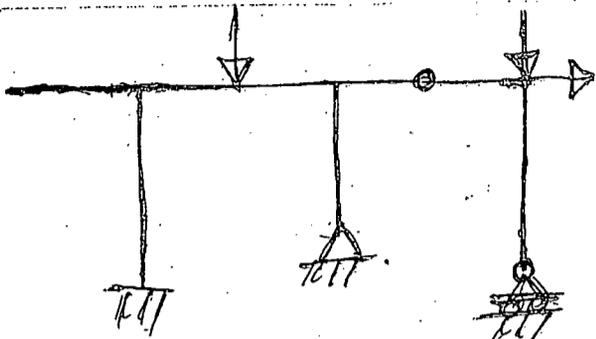
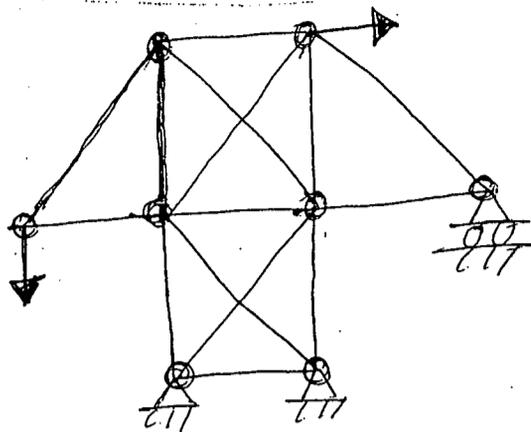


Fig. (1)



(i)



(ii)

Fig. (2)

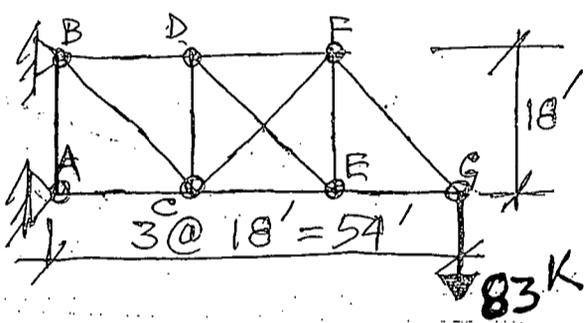


Fig. (3)

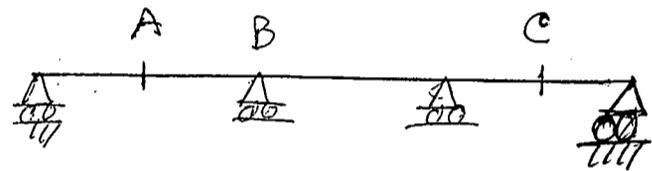


Fig. (4)

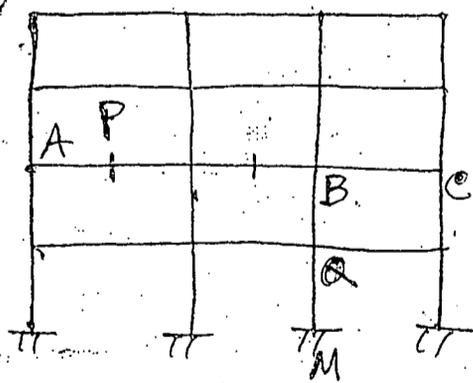


Fig. (5)

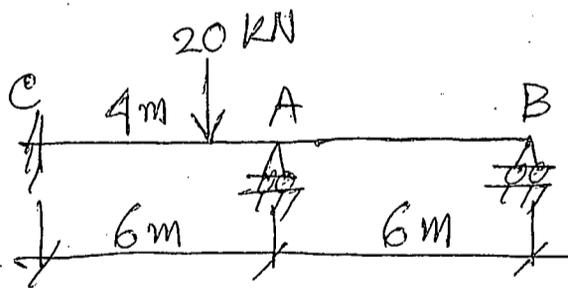


Fig. (6)

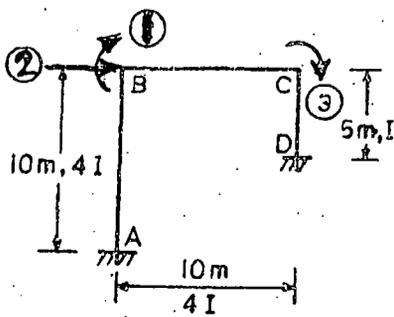


Fig. (7)

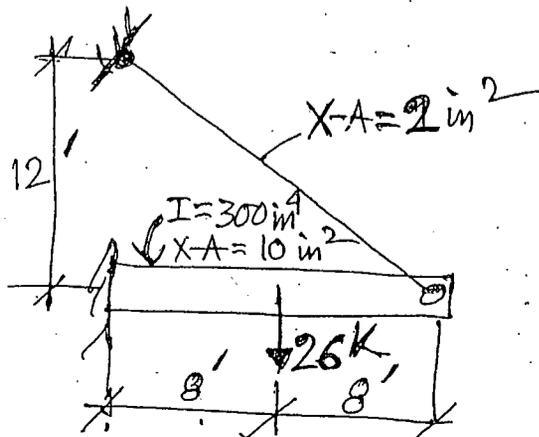


Fig. (8)

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2015-2016

Sub : **WRE 419** (Irrigation and Drainage Engineering)

Full Marks: 210

Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

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

1. (a) Distinguish between (i) mass water content and volumetric water content, (ii) field capacity and permanent wilting point, (iii) soil moisture tension and piezometric head. (9)
- (b) Why is measurement of soil moisture important? Compare Time Domain Reflectometry with Neutron method of soil moisture measurement. (10)
- (c) Consider a vertical soil column of  $0.25\text{m}^2$  cross-sectional area and 1m long. If  $0.3\text{m}^3$  of water percolate through the column in 30h from a supply pipe which permits the water to flow onto the soil just fast enough to keep the soil surface covered, What is the hydraulic conductivity in m/day? (7)
- (d) The field capacity and permanent wilting point of the soil of a field are 27% and 12% respectively. The dry density of the soil is  $1350\text{kg/m}^3$  and the depth of root zone is 80cm. Determine the net depth of irrigation if maximum allowable depletion is 55%. Also determine the area that can be irrigated in 8h with a flow of 30 l/s assuming an application loss of 30%. (9)
2. (a) What are the factors affecting consumptive use? Briefly describe the soil moisture depletion method to determine consumptive use of a crop. (11)
- (b) Discuss why the concept of water-application, water-storage and water-distribution efficiencies should be used to evaluate field irrigation practices. Also explain why these efficiencies of 100 percent are not always desirable. (12)
- (c) Wheat is to be grown at a certain place and the useful data given below. Calculate the monthly consumptive use applying Blaney- Criddle equation. Also calculate the field irrigation requirement assuming water-application efficiency as 70%. (12)

Month	Mean temperature ( $\text{C}^0$ )	Percent day time hours	Crop factor	Effective rainfall (cm)
Nov	18.0	7.15	0.73	1.5
Dec	17.2	7.25	0.85	1.4
Jan	15.5	7.50	0.80	2.5
Feb	14.7	7.10	0.70	2.1

**WRE 419**

3. (a) What conditions favors sprinkler irrigation? Discuss why this method is not widely used in our country. (10)
- (b) What do you mean by irrigation management? Briefly describe the components of an irrigation scheme management. (8)
- (c) What are the different methods of water allocation in an irrigation scheme? Give advantages and disadvantages of each method. (9)
- (d) An area of 0.8ha was irrigated with a flow of 30 l/s in 8h. Depth of root zone was 1m and available water holding capacity of the soil was 15cm/m. Irrigation water was applied when 50% of available water was depleted. Determine the water- storage efficiency of the water-application efficiency was 60%. (8)
4. (a) Define “Flexibility” and ‘Sensibility” of a module and derive a relationship between them. (8)
- (b) What are the purposes of measuring irrigation water? Give a comparison between a Parshall flume and a Cut-throat flume. (9)
- (c) Describe with a diagram the working principle of a centrifugal pump. Give a comparison between a shallow tubewell pump and a deep tubewell pump. (9)
- (d) A pump is to be installed on a well to irrigate rice grown over 15ha of land. The peak irrigation requirement is 9mm/day, total pumping head = 9.5m and peak operating hour =20. Determine (i) the power requirement in KW, (ii) cost of electricity in the month of peak demand if unit electric charge is TK. 5.0. Assume that the efficiency of pump and motor are 70% and 90% respectively. (9)

**SECTION-B**

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

5. (a) Discuss the importance of irrigation. (5)
- (b) Discuss the quality of irrigation water based on salt concentration. (5)
- (c) The culturable command area for a distributary is 15000 ha. The intensity of irrigation for wheat is 40% and for rice is 15%. If the total water requirement of the two crops are 37.5 cm and 120 cm and their periods of growth are 160 days and 140 days respectively, determine the outlet discharge from average demand consideration. (10)
- (d) Write short notes on (5×3=15)
- (i) Salt balance
  - (ii) Disadvantage of irrigation
  - (iii) Intensity of irrigation

**WRE 419**

6. (a) Mention the major causes of flood in Bangladesh. (5)
- (b) What are the purposes of 'berms' served? (5)
- (c) Discuss the engineering measures for flood control by improving the conveyance of natural drainage system. (10)
- (d) Design an earth canal section using Kennedy's theory for the data given below. (15)
- Canal discharge = 4000 cumec
- Canal bed slope = 1 in 5250
- Critical velocity ratio = 1.085
- Manning's  $n = 0.021$ .
7. (a) mention the various factors affecting canal seepage losses. (5)
- (b) Draw a neat sketch of the different types of sub-surface drainage lay out. (5)
- (c) Design a concrete lined channel to carry a discharge of 30 cumec at a slope of 10cm/km. The side Slopes of the channel are 1:1. The value of  $n$  may be taken as 0.015. (10)
- (d) Briefly describe the following flood fighting measures: (5\*3=15)
- (i) Ringing of sand boils
- (ii) Heightening to stop overtopping
- (iii) Closure of crevasses and breaches.
8. (a) What is leaching? Derive the equation for leaching requirement. (5)
- (b) What is 'balancing depth' and how is it determined? (5)
- (c) What are the merits and demerits of watershed canal, contour canal and side slope canal. (10)
- (d) An irrigated area has to be provided with the drains so that the water table lies at least 2m below the ground surface. Find the maximum rate of flow in each of the drains if they are 200m in length. Depth of the impervious stratum below ground surface is 5m and  $k = 0.001$  cm/sec. (15)
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## BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2015-2016

Sub : WRE 451 (Hydrology, Irrigation &amp; Flood Management)

Full Marks: 210

Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

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

1. (a) Ordinates of 4-h unit hydrograph are given below. Using this, derive the ordinates of 6-h unit hydrograph for the same catchment. (15)

Time (h)	0	4	8	12	16	20	24	28	32	36	40
4-h UH (m <sup>3</sup> /s)	0	10	20	50	70	60	40	35	15	5	0

- (b) Calculate the precipitable water for surface temperature of 25<sup>0</sup> C in the first 2 kms of atmospheric column if the surface pressure and lapse rate are 101.3 Kpa and 6.5<sup>0</sup> C/km respectively. Relative humidity is 80% and 95% at surface and 2 km elevation respectively. Assume any reasonable value for data if missing. (15)

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

2. (a) Consider the following two catchment areas:

Catchment A	Catchment B
Slope = 0.002	Slope = 0.02
L = 1500 m	L = 2000 m
Sandy Soil	Clay Soil
High vegetative cover	No vegetative cover
Area = 2 km <sup>2</sup>	Area = 3 km <sup>2</sup>

Where, L = Maximum length of travel of water. (15)

- (i) Two runoff coefficients of 0.3 and 0.8 are given for the two catchments. Which runoff coefficients will be applicable to which catchment and why?
- (ii) Find out the time of concentration for catchment-B.
- (iii) Compute peak discharge for catchment B for a return period of 50 years using rational method. Use IDF curves shown in Fig.1.
- (b) In a 210-min storm, the following intensities of rainfall were observed in successive 30-min intervals: 3.3, 3.6, 9.0, 6.6, 0.6, 0.9 and 6.0 cm/hr. Assuming  $\phi$  - index value as 3.0 cm/hr, determine, (i) total volume of runoff, (ii) total volume of infiltration and (ii) time of rainfall excess. The catchment area is 3 km<sup>2</sup>. (15)
- (c) Compare between Thiessen Polygon Method and Isohyetal Method regarding relative advantages and disadvantages. (5)

**WRE 451**

3. (a) The following are the ordinates of Flood Hydrograph from a catchment area of 489 km<sup>2</sup> due to a 4-h rainfall. Derive the ordinates of a 4-h unit hydrograph. (15)

Time (h)	0	4	8	12	16	20	24	28	32	36	40	44	48	52	56
Discharge (m <sup>3</sup> /s)	20	30	50	80	110	150	130	110	80	60	50	40	30	20	20

- (b) The ordinates of a 6-h unit hydrograph of a catchment is given below: (15)

Time (h)	0	6	12	18	24	30	36	42	48	54
UH ordinates (m <sup>3</sup> /s)	0	50	125	170	150	100	60	40	15	0

The average storm rainfall values over that catchment in three successive 6-h intervals are known to be 7.8, 5.3 and 2.8 cm. The  $\phi$ -index for the catchment is estimated to be 0.3 cm/h. The base flow is 10 m<sup>3</sup>/s at the beginning of storm and increases by 2 m<sup>3</sup>/s every 12 h. Estimate the resulting flood hydrograph.

- (c) Classify and explain streams according to annual hydrograph. (5)
4. (a) Differentiate between relative humidity and specific humidity. (5)
- (b) Explain the importance of infiltration index in hydrologic calculations. (5)
- (c) Define : (i) Hydrosphere, (ii) Percolation. (5)
- (d) Four rain gages located within a rectangular area with four corners at (0,0), (0,13), (14,13) and (14,0) having the following coordinates and recorded rainfalls: (20)

Rain gage Location	Rainfall (mm)
(2,9)	18
(7,11)	25
(12,10)	35
(6,2)	42

All coordinates are expressed in kilometers. Compute the average rainfall in the area by Isohyetal Method (use isohyets of 20, 30 and 40 mm)]. Use plain graph papers.

**SECTION-B**

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

5. (a) Define irrigation engineering and write down the advantages and disadvantages of irrigation in the context of Bangladesh. (10)

**WRE 451**

**Contd... Q. No. 5**

- (b) What do you understand by multipurpose project and write down the consideration for developing any water resources project as a multipurpose project. (10)
- (c) What is national water policy? Write down its main elements in the government policy. (7)
- (d) Classify irrigation development in Bangladesh and briefly explain the social and environmental aspect of irrigation development in our country. (8)

6. (a) What do you understand by consumptive use of water? Write down the factor affecting CU or ET and the methods for direct measurement of ET. (7)
- (b) Prove that moisture content by volume is the product of moisture content by weight and bulk density, where symbols have their usual meanings? (7)
- (c) What is meant by C2-S4 water? Discuss its usefulness for irrigating fine textured soils. (6)
- (d) Determine the volume of water required to be diverted from the head works to irrigate area of 5000 ha using the data given in the table below:

Assume 80% as the effective precipitation to take care of the consumptive use of the crop. Also assume 50% efficiency of water in the field and 75% as the conveyance efficiency of canal. (15)

Month	Temp ( <sup>0</sup> 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

7. (a) What is meant by surface and subsurface irrigation? Differentiate between sprinkler and drip irrigation methods. (9)
- (b) Define and explain the following terms: (i) Water right (ii) Field capacity (iii) Crop factor. (6)

**WRE 451**

**Contd... Q. No. 7**

(c) Determine the consumptive use and net irrigation requirement for paddy from the given data: (10)

Dates & periods of growth	Pan evaporation, Ep (cm)	Consumptive use coefficient	Effective precipitation in cm
Oct. 16-31	8.49	0.44	3.42
Nov. 1-30	15.57	0.54	2.19
Dec. 1-31	16.59	0.94	0.54
Jan. 1-31	19.10	0.99	0.15
Feb. 1-2	1.54	0.73	0.02

(d) Write short note on 'land reclamation' in terms of irrigation. (5)

(e) Write down the physical properties of soil which influences irrigation. (5)

8. (a) What do you understand by flood? What are the causes and ill effects of flood in Bangladesh? (10)

(b) Classify and explain the major types of flood in Bangladesh. (8)

(c) Mention the main reasons for the failure of any flood management policy and enlist the possible impacts on water resources system of Bangladesh. (10)

(d) What are the precautions for the use of saline water in irrigation? (7)

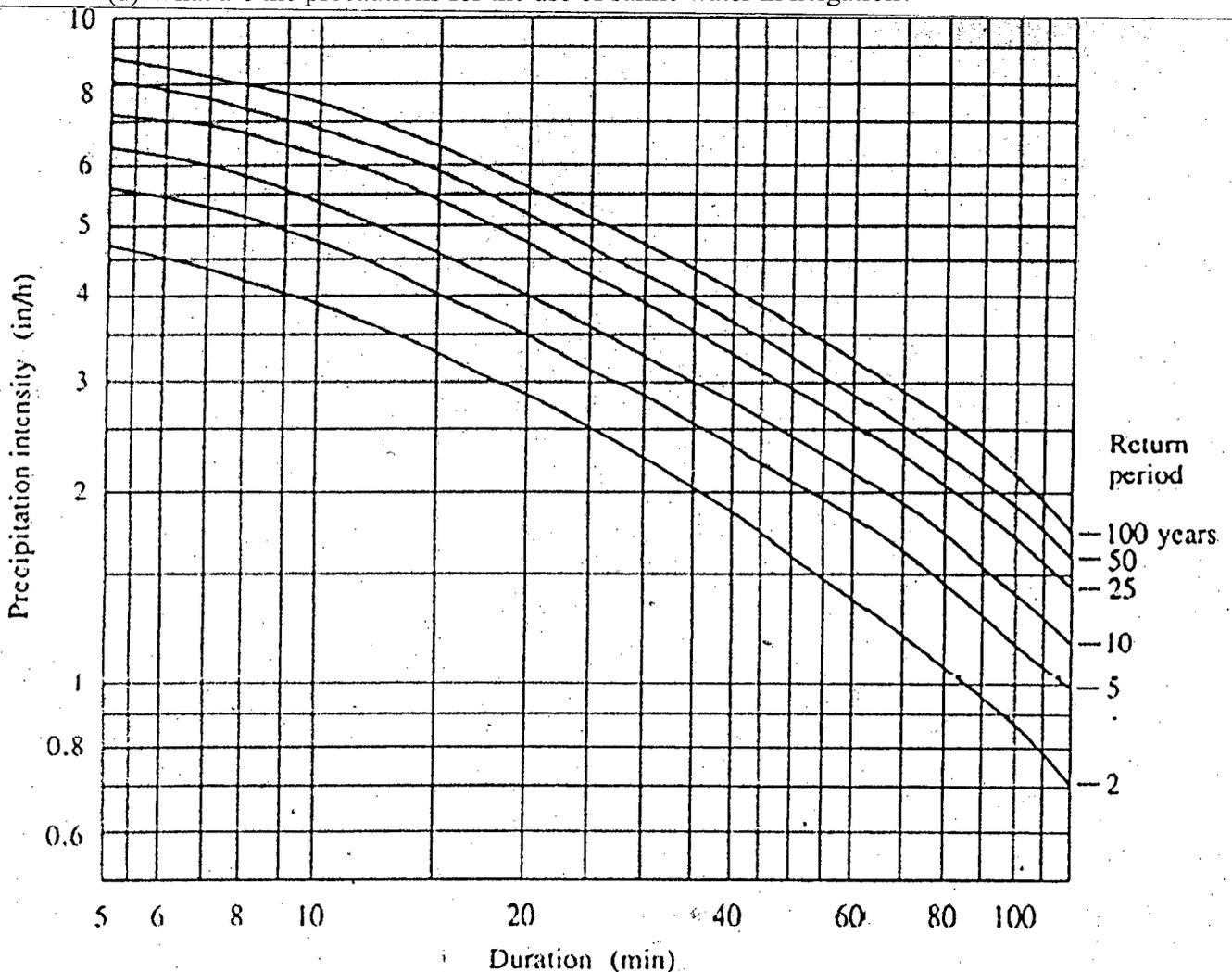


Fig. 1 : Intensity - duration - frequency (IDF) curves

Fig. -1 for Q. No. 2(a)

## BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2015-2016

Sub : **WRE 427** (GIS and Remote Sensing)

Full Marks: 140

Time : 3 Hours

Symbols have their usual meanings.

Assume reasonable value for any missing data

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

1. (a) Define electromagnetic radiation. Write short note on different types of atmospheric scattering. (6)
- (b) Explain Kirchhoff's law and Planck's radiation law? Show the interaction of energy with particles in the atmosphere in a neat sketch. (6)
- (c)
  - (i) Write short notes on spatial resolution and spectral resolution of satellites. (6)
  - (ii) What is the difference between optical satellites and radar? Explain among these two sensors which would be better to monitor root zone soil moisture. Also mention the appropriate wavelength at which images should be acquired for this purpose.
- (d) Define spectral response curve and critical spectral region. How can you differentiate the deciduous and the coniferous trees in a forest in summer using remote sensing data? (5 1/3)
  
2. (a) What is spectra? How can you use the Spectral signature in differentiating different land use? (6)
- (b) The sun radiates maximum energy at 0.483  $\mu\text{m}$ . Determine the emitted energy at this wavelength. (6)
- (c)
  - (i) What are the relative advantages and disadvantages of sensors carried on satellites over those carried on aircraft? (2)
  - (ii) A side looking airborne radar (SLAR) is operating at a height of 6km. Given, depression angle =  $30^\circ$ , pulse length =  $10^{-3}$  microsecond, wavelength = 1 cm, antenna length = 3 m. Calculate the range resolution and along track resolution of the SLAR? What should be the minimum distance between two features on the surface if they are to be resolved as separate object in the image? (4)
- (d) What types of image distortions do you expect in a radar image of a hilly area? Explain with neat sketches. (5 1/3)
  
3. (a) If you want to monitor the river bank migration for several years, what type of platform and sensor characteristics (spatial, spectral and temporal resolution) would be best for this and why? (6)

**WRE 427**

**Contd... Q. No. 3**

- (b) Write short note on a GOES satellite. Mention the spatial resolutions and uses of different bands of this satellite. (6)
- (c) Calculate (i) the land surface temperature and (ii) drought condition based on vegetation health index from a Landsat image acquired over Rajshahi in Low gain state. Following data were obtained from the image.  
Digital numbers in Thermal infrared band, Near-infrared band and red band are 175,235 and 55, respectively. Given  $K_2 = 1282.71$ ,  $K_1 = 666.09$  [ $W/(m^2 \cdot sr \cdot \mu m)$ ];  $NDVI_{max} = 0.85$ ,  $NDVI_{min} = 0.15$ ;  $BT_{max} = 325$  K,  $BT_{min} = 285$  K; atmospheric vapor content =  $1.2$  g/cm<sup>2</sup>, Upwelling atmospheric radiance =  $0.5$  [ $W/(m^2 \cdot sr \cdot \mu m)$ ] and down welling atmospheric radiance =  $0.84$  [ $W/(m^2 \cdot sr \cdot \mu m)$ ], Day of the year = 229, earth-sun distance = 1.01244 (astronomical unit); sun elevation =  $64^\circ$ . Use table 1 for information regarding satellite Land sat 7 ETM. Assume reasonable value if any data is missing. (11  $\frac{1}{3}$ )
4. (a) What types of satellite data are suitable for (i) flood delineation and (ii) crop monitoring and damage assessment? Justify your answers. Why remote sensing is a good choice for those two applications? (6)
- (b) Explain the working principle of Synthetic Aperture Radar. Describe why the use of Synthetic Aperture Radar (SAR) is the only practical option for radar remote sensing from space. (6)
- (c) (i) Calculate soil adjusted vegetation index and enhanced vegetation index from the data given in Q 3 (c). Also given, reflectance of blue band = 0.04. (ii) Calculate the emission temperature of the earth. (3+3)
- (d) Write short note on NOAA AVHRR satellite. (5  $\frac{1}{3}$ )

**SECTION-B**

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

5. (a) Define GIS. Classify GIS data in detail. (2+6  $\frac{1}{3}$ )
- (b) Briefly explain the following types of errors in vector data with schematic diagram: (i) Silver polygon, (ii) Dangling nodes. (6)
- (c) What is GPS constellation? Write down the functions of control segment of GPS? (4)
- (d) What are the advantages and disadvantages of Database Management System? (5)

WRE 427

6. (a) Discuss the following spatial interpolation methods: (i) Kriging, (ii) Inverse Distance Weighted. (6)
- (b) Write short notes on: (i) Geographic Datum, (ii) Georeferencing, (iii) Military grid coordinate system. (2+2+4)
- (c) Distinguish between interval and ratio variables of GIS data. (3)
- (d) Explain different levels of abstraction during model the real-world phenomena in GIS.
7. (a) Briefly describe the classification of Coordinate System. (7)
- (b) Which projection would be suitable to project areas that have a greater east-west extent than north-south? Justify your answer with proper sketch. (3 1/3)
- (c) Explain following types of generalization rules of GIS data: (i) Aggregation, (ii) Refinement, (iii) Collapse. (7 1/2)
- (d) Write down the stages to complete the data collection process while doing the GIS analysis of waterbody changes in Dhaka City. (5 1/2)
8. (a) Give a comparative description between UTM and BTM. (7 1/3)
- (b) "Testing the topological integrity of a dataset is a useful way to validate its geometric quality"- Explain how the validation can be done. (5)
- (c) What do you understand by the resolution of Raster Data in GIS? (3)
- (d) Differentiate between Run Length Encoding and Block Encoding methods. (4)
- (e) How GPS receiver uses triangulation to determine its position on the earth surface? (4)

Table - 1

Table 4: ETM+ spectral range, post-calibration dynamic ranges, and mean exoatmospheric solar irradiance (ESUN<sub>λ</sub>).

Band	Spectral range	Center wavelength	LMIN	LMAX	C <sub>rescale</sub>	B <sub>rescale</sub>	ESUN <sub>λ</sub>
Units	μm		W/(m <sup>2</sup> sr μm)		(W/m <sup>2</sup> sr μm)/DN	W/(m <sup>2</sup> sr μm)	W/(m <sup>2</sup> μm)
<b>Low Gain (LPGS)</b>							
1	0.452-0.514	0.483	-6.2	293.7	1180709	-7.38	1997
2	0.519-0.601	0.560	-6.4	300.9	1209843	-7.61	1812
3	0.631-0.692	0.662	-5.0	234.4	0.942520	-5.94	1533
4	0.772-0.898	0.835	-5.1	241.1	0.969291	-6.07	1039
5	1.547-1.748	1.648	-1.0	47.57	0.191220	-1.19	230.8
6	10.31-12.36	11.335	0.0	17.04	0.067087	-0.07	N/A
7	2.065-2.346	2.206	-0.35	16.54	0.066496	-0.42	84.90
PAN	0.515-0.896	0.706	-4.7	243.1	0.975591	-5.68	1362
<b>High Gain (LPGS)</b>							
1	0.452-0.514	0.483	-6.2	191.6	0.778740	-6.98	1997
2	0.519-0.601	0.560	-6.4	196.5	0.798819	-7.20	1812
3	0.631-0.692	0.662	-5.0	152.9	0.621654	-5.62	1533
4	0.772-0.898	0.835	-5.1	117.4	0.639764	-5.74	1039
5	1.547-1.748	1.648	-1.0	31.06	0.126220	-1.13	230.8
6	10.31-12.36	11.335	3.2	12.65	0.037205	3.16	N/A
7	2.065-2.346	2.206	-0.35	10.80	0.043898	-0.39	84.90
PAN	0.515-0.896	0.706	-4.7	158.3	0.641732	-5.34	1362

For Q.3(c)

**SECTION – A**

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

1. (a) What is meant by integrated water resources management? State its basic principles and elements. (9)
- (b) Enumerate the purposes of water resources development and management. (8)
- (c) Briefly discuss why modern water resources planning is more complex than traditional approach. (8)
- (d) Briefly describe the generalized process of water resources planning. (10)
  
2. (a) List the major environmental impacts of- (12)
  - (i) Filling and draining wetlands
  - (ii) Water storage projects
- (b) Two water supply projects A and B are to be compared in terms of their benefit-cost ratios and net present values. The necessary data are given below. Which is the more economic project? (23)

Item	Project A	Project B
Construction cost, TK	40,000,000	25,000,000 (1 <sup>st</sup> stage) 30,000,000(2 <sup>nd</sup> stage after 20 years)
O & M cost, TK	150,000 per year for 40 years	100,000 per year for 1 <sup>st</sup> 20 years 200,000 per year for next 20 years
Annual benefits, TK	2,850,000	3,000,000
Economic life	40 years	40 years
Period of Analysis	40 years	40 years
Discount rate	6%	6%

3. (a) Distinguish between (i) economic analysis and financial analysis, (ii) direct benefits and indirect benefits. (6)
- (b) Briefly describe the process of environmental impact assessment of water resources project with the help of a flow diagram. (10)

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**Contd... Q. No. 3**

- (c) What are the objectives of public participation in water resources planning? Briefly describe the factors affecting effective public participation. (10)
- (d) A present investment of TK. 10, 00,000 is expected to yield a return of TK. 95,000 a year for 15 years what is the rate of return? (9)
  
- 4. (a) What is meant by project formulation? Briefly discuss the contents of the feasibility report of a single engineering project. (9)
- (b) What is project appraisal? State the criteria for a good plan. (8)
- (c) Suppose two types of crop can be grown in an irrigation project. Relevant data are given below. (18)

Item	Crop 1	Crop 2
Water Requirement (ac-ft/ac)	5	4
Fertilizer requirement (kg/ac)	2	5
Profit (Thousand TK/ac)	7	10

The available water and fertilizer for the project are 25 ac-ft and 15 kg respectively.

- (i) Formulate a linear programming model to determine the acres of land under each crop so that the profit is maximized. Solve the LP model by simplex method.
- (ii) Formulate the dual model and obtain the dual solution.

**SECTION-B**

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

- 5. (a) Define: (i) Project and, (ii) Management. (9)  
What are the objectives of construction management?
- (b) Explain QA, QC and TQM. (8)
- (c) Write short notes on: (i) Components of contract document, (ii) Addenda. (6+3)
- (d) What do you understand by technical specification? Write down a typical index of "Technical Specification" for the construction of a highway project. (9)
  
- 6. (a) List down the levels of 'Work Breakdown Structure' and the guidelines to establish WBS. Explain with an example. (12)
- (b) What aspects of the equipment suitability and site constraints should be considered during selection of construction equipment? (8)

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**Contd... Q. No. 6**

(c) Briefly describe the project management steps? (10)

(d) Explain the necessity of a safety program in construction industry. (5)

7. (a) Write down the advantages and disadvantages of lump-sum contracts and unit price contracts. (12)

(b) "Construction management involves proper assignment of work and motivational tools to increase productivity- Explain. (8)

(c) Given 3 million cubic meters (mcm) of water to be delivered in 1 mcm unit to each of three irrigation projects. Determine the optimal distribution(s) of water if all of the water is to be used. Table below shows the net benefits: (15)

Water delivered (mcm)	Net benefit from irrigation (10 <sup>6</sup> TK)		
	Project 1	Project 2	Project 3
0	0	0	0
1	2	3	5
2	5	3	7
3	4	8	5

8. (a) Discuss the process of evaluation of tenders. (8)

(b) A project consists of activities A through P whose precedence relationship is given below:

- At the beginning, A and F can be started at the same time
- B, M and G can be started in parallel and are immediate successor to A
- H and I run parallel and are immediate successor to both F and G
- C and N can be performed in parallel and are immediate successor to both B and I
- J follows C
- O succeeds both M and N
- D follows O, but cannot be started unless C is completed
- K succeeds both H and J
- E and P run parallel and are immediate successors to D
- L follows P, but can be started only after H and J are completed
- Finally, E, K and L end together.

The time estimates (duration in weeks) are given below: (27)

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**Contd... Q. No. 8(b)**

Activity	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
Optimistic time	1	5	4	1	4	3	2	3	2	3	1	3	6	1	1	1
Most likely time	3	7	6	8	9	6	5	12	4	4	9	4.5	9	2	2.5	3
Pessimistic time	5	9	8	9	20	15	14	15	12	5	11	9	18	3	7	5

Determine:

- (a) The critical path
- (b) Probability of completing the project in 38 weeks.

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**SECTION – A**

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

1. (a) What do you understand by groundwater hydrology? State and explain the Darcy's law of groundwater movement. (10)
- (b) Define the following terms: (8)
  - (i) Darcy velocity (ii) Intrinsic permeability (iii) Transmissivity (iv) Anisotropic aquifer
- (c) Write short note on the impact of groundwater development. (5 1/3)
  
2. (a) An anisotropic aquifer has four different layers of formations. The thickness of the top, middle, lower middle and bottom layers are 12 m, 11.5 m, 15 m and 9 m respectively and the corresponding hydraulic conductivities of the layers are 7 m/d, 0.5 m/h, 3 m/d and 0.06 cm/s respectively. Determine the equivalent horizontal and vertical hydraulic conductivities. (10)
- (b) Explain the factors responsible for groundwater fluctuations. (13 1/3)
  
3. (a) A confined aquifer has a source of natural recharge. Hydraulic conductivity for the aquifer is 200 cm/day, and porosity  $n$  is 0.23. The piezometric head in two wells 1100 m apart is 50 m and 35 m respectively, from a common datum. The average thickness of the aquifer is 12.5 m, and the average width of the aquifer is 5.3 km, determine the rate of flow through the aquifer and the average time of travel from the head of the aquifer to a point 9 km downstream. (10)
- (b) Briefly explain the sources and causes of groundwater pollution. (13 1/3)
  
4. (a) What do you understand by groundwater exploration? Briefly explain the techniques for exploring groundwater. (10)
- (b) Write down the main objectives of artificial recharge of groundwater. (5 1/3)
- (c) Write down the names of the methods of artificial recharge of groundwater and briefly explain two of them. (8)

**SECTION-B**

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

5. (a) Derive the equation of discharge for steady radial flow to a well in a confined aquifer. (8 1/3)

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**Contd... Q. No. 5**

- (b) Write short notes on i) Recovery Test; ii) Step Drawdown Test. (6)
- (c) A well penetrates into an unconfined aquifer having a saturated depth of 100m. The discharge is 250 l/min at 12 m drawdown. Assuming equilibrium flow conditions and a homogeneous aquifer, estimate the discharge at 18 m drawdown. The radius of influence may be taken to be equal for the both the cases. (9)
6. (a) Briefly describe Theis Method of determining aquifer constants S and T from pumping test data. (7 1/3)
- (b) Briefly explain i) Well completion; ii) Well development. (8)
- (c) A well is located in a 30 m thick confined aquifer of permeability 35 m/day and storage coefficient of 0.004. If the well is pumped at the rate of 1500 l/mn, calculate the drawdown at a distance of 40 m from the well after 20 hours of pumping. (8)
7. (a) Describe different methods of well drilling. Also state advantages and disadvantages of each method. (11 1/3)
- (b) Preliminary test shows that a well can yield 1800 l/min from a confined aquifer between 80-120 m below ground level. The aquifer sand has  $D_{10}$ ,  $D_{50}$ , and  $D_{60}$  of 0.23, 0.60 and 0.67 mm respectively. (12)
- (i) Determine the length of the well screen assuming its diameter and effective open area to be 25 cm and 15% respectively.
- (ii) Design the gravel pack.
8. (a) Write down the mechanism of saline water intrusion in aquifer? Discuss the various methods to control saline water intrusion in aquifers. (8)
- (b) Enlist the sequence activities preceding the start of a groundwater management investigation. (6 1/3)
- (c) Derive the Ghyben-Herzberg relation for sea water intrusion. (5)
- (d) Write short notes on i) Upconing; ii) Consumptive use of a study basin. (4)
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