BANGLADESH UNIVERSITY OF PROFESSIONALS

Military Institute of Science and Technology

B.Sc. in Environmental, Water Resources, and Coastal Engineering, Term Final (Spring) Examination 2023: Jul-Sep2023

Student Group: 72<Earned Credit Hours ≤ 108

Subject: EWCE 351, Transportation Engineering

Time: 3.00 hours **Full Marks: 240**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. **Question-1** in **Section-A** and **Question-5** in **Section-B** are compulsory
c. Answer any other **TWO** questions out of **THREE** from each section.
d. Figures in the margin indicate full **marks**.
e. Assume reasonable data if necessary.
f. **Symbols** and **abbreviations** used have their usual meanings.

SECTION-A

Question 1 (Compulsory)

a. Indicate the desirable characteristics of a pavement. Draw a typical cross-section of a flexible pavement showing different layers. Specify the location where rigid pavement is warranted. Define EALF. **12**

b. A two-lane major rural highway has an AADT of 20,000 during the first year of traffic of which 40% are truck. Followings are other total information: **13**

Annual growth rate = 4%
50% traffic are on design lane
Design period = 20years
Truck factor = 0.38
Consider a suitable growth factor.

Compute the ESAL for the above conditions. Assume any missing data.

c. Design a two-phase signal for an isolated cross-junction using the following data. **15**

Amber time in sec = 3
Red-Amber time in sec = 2
Inter-green for, N-S = 6sec; E-W = 7sec
Lost time for, N-S = 3sec; E-W = 2sec

	North	South	East	West
Arrival Flow (PCU/hr)	410	460	550	465
Saturation Flow (PCU/hr)	1820	1790	1840	1785

Assume no traffic or parked vehicle.

Define PCU and effective green time.

Question 2

a. Explain why 30th highest peak hourly volume of the year is used as design hour? What are the uses of AADT and ADT data? **10**

b. What is a design vehicle? Indicate different static and dynamic characteristics of a vehicle affecting the road design. 1(

c. Specify the general requirement of the traffic control device. Compare between road signs and road markings. State the color convention of road markings in Bangladesh context. 10

d. Indicate various physical and regulatory measures used as traffic engineering tools. Name different external factors responsible for congestion in Bangladesh context. 10

Question 3

a. List all the "D" variables of transportation planning. Briefly explain how these variables are related to land use and transportation. 10

b. Illustrate and explain the interaction between land use and transportation system. 10

c. A zone has 275 households with car and 275 households without car and let the average trip generation rates for each group is 5.0 and 2.5 trips per day respectively. 5+5=10

(i) Assuming that in future, all household will have a car, find the growth factor and future trips from that zone, assuming that the population and income remain constant.

(ii) Critique the statement – "Trip rates are stable across time". In a hypothetical scenario, where you have data of population, income, employment and land price of an area, what data would you use to estimate trip production and trip attraction?

d. A commercial center in Dhaka contains several retail establishments and light industries. Employed at the center are 220 retail and 650 non-retail workers. Determine the number of trips per day attracted to the zone. 10

Trip generation rates are as follows:

	Attractions per Household	Attractions per Non retail Employee	Attractions per Retail Employee	Attractions per other Retail Employee
HBW	-	1.7	1.7	1.7
HBO	1.0	2.0	5.0	10.0
NHB	1.0	1.0	3.0	5.0

Question 4

a. Calibrate a singly-constrained (on productions) gravity model using the following home-based work (HBW) base-year trip matrix and impedance (travel time in minutes) matrix. Calculate the three unknown friction factors that fit the observed trip length distribution using bins of 1-10, 11-20 and 21-30 minutes. You can stop iterating when all $|FF_{new}-FF_{old}|< 0.01$. Show your work, including every step and iteration. (Remember, unlike the growth factor model, the gravity model equation uses the original A_j value, not the A_j values from the previous iteration). 20

Base		Attractions			P
	TAZ	1	2	3	Total
Production	1	20	5	85	110
	2	50	20	110	180
	3	5	35	20	60
A	Total	75	60	45	350

Impedance		Attractions		
	TAZ	1	2	3
Production	1	5	15	25
	2	15	5	15
	3	25	15	5

Imp.	FF
1-10	??
11-20	??
21-30	??

b. In your own words, describe the advantages and disadvantages of the following trip distribution methods: 10
(i) Growth factor modes.
(ii) Gravity models.

c. Following information are provided about MIST commutes. 10

Alternative	Time	Cost
Private Car	5 mins	BDT 5.00
Bus 1 (Blue)	15 mins	BDT 2.00
Bus 2 (Red)	15 mins.	BDT 2.00

Utility function: $V_k = (-0.2)x\ time_k + (-1)\ x\ Cost_k$

(i) Predict the mode shares using these alternatives.
(ii) In light of the provided data, explain the terminology "Independence from Irrelevant Alternatives".

SECTION-B

Question 5 (Compulsory)

a. Explain the concept of functional classification of highway. 09

b. List various properties of good aggregates. 06

c. Show in a sketch various cross-sectional elements of a highway. 10

d. Identify major transportation related problems of Bangladesh. How can you make use of ITS to reduce these problems? 3+12=15

Question 6

a. Explain why cross-slope is provided in a road. Show different methods of providing cross-slope with qualitative sketch (both for divided and undivided roads). 10

b. List the importance of shoulder in a highway. 8

c. Illustrate the significance of sight distances in the geometric design of highway. Write the impacts of dry and wet condition, upward and downward grades, and driver's eye height on stopping sight distance. 12

d. Estimate the total passing sight distance for a two lane highway for an average passing speed of 62mph. The initial maneuver time is 4.5sec and average acceleration is 1.5mph/sec. Assume passing vehicle occupying opposite lane for 11.3sec and clearance length is 300ft. 10

Question 7

a. Discuss the importance of parking facilities, frontage/service road and bus lay by in reducing traffic congestion in the metropolitan cities of Bangladesh. 12

b. List the objectives of accident studies. Mention the major causes of accident in Bangladesh. 3+7=10

c. Define green transport. Put forward your recommendation to make green transport popular. 2+8=10

d. Determine the minimum length of a crest vertical curve between a +0.5 grade and a -1% grade for a road with 110km/hr design speed. The vertical curve must provide 200m stopping sight distance. 8

Question 8

a. What are the design principles of A-1 grade intersection? Mention the warrants of Grade separated intersection and interchange. 10+5=15

b. Compare bitumen with tar. Name various types of consistency tests of asphaltic material. 7+3=10

c. What are the purposes of different functional types of traffic islands? 10

d. Calculate the amount of superelevation required (for a 7m wide road) on a curve of 250m radius for permissible speed of 80kmph. Assume coefficient of friction as 0.15. 5

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B.Sc. in Environmental, Water Resources, and Coastal Engineering
Term Final (Spring) Examination 2021: July-Aug 2021

Student Group: 72 < Earned Credit Hours ≤ 108

Subject: EWC-351, Transportation Engineering

Total : **3.00 hours (For Physical Examination)**

Full Marks : 240
Section B : 120

INSTRUCTIONS - PHYSICAL EXAMINATION

a. Use **SEPARATE** answer scripts for each section.
b. **Question -5 Section-B** is compulsory.
c. Answer any **OTHER TWO** questions from **Section-B**.
d. Figures in the margin indicate full **marks.**
e. Assume reasonable data if necessary.
f. **Symbols** and **abbreviations** used have their usual meanings.

SECTION-B

Question – 5 (Compulsory)

a. A design is being prepared for an asphalt concrete mixture in Marshall method. The following ingredients are used in total mixture: **10**

	% of total mix	Specific gravity
Coarse aggregate	50	2.61
Fine aggregate	38	2.69
Mineral filler	7	3.10
Asphalt content	5	1.03

The specimen weight in air and water are 1325.6 gm and 779.6 gm respectively. The maximum specific gravity of mixture is 2.47.Compute % air void, % void in mineral aggregate and % void filled with asphalt.

b. Write short notes on : **3*5=15**
   (i) Traveler management in ITS
   (ii) Dynamic Traffic Management Process (DTHP)
   (iii) ITS structure

c. What are the classifications of road according to function? **05**

d. What are the common vehicular characteristics of a Design Vehicle? **10**
A motorist traveling at 55 mph downgrade of 5 percent on a highway observes an accident ahead of him, involving an overturned truck that is completely blocking the road. If the motorist was able to stop his vehicle 30ft from the over-turned truck, what was his distance from the truck when he first observed the accident? Assume perception-reaction time=2.5 sec and f=0.3.

Question – 6

a. Write short notes on: **3*4=12**
   (i) Absolute and kinematic viscosity of Bitumen
   (ii) Aging behavior of Bitumen
   (iii) Polymer Modified Binder (PMB)

b. What are the steps of the Marshall method of mix design? Write short notes on Apparent and Bulk specific gravity, Stability and Flow test of Bituminous mix. **08**

c. Compare between air blowing of asphalt and destructive distillation of coal. Also make a comparison between Emulsified and Cutback asphalt. **10**

d. What do you mean by Asphalt Grading? Which grades of asphalt are used in our country and why? Between penetration and viscosity grading, which is better? Depict with proper logic.

Question – 7

a. Which factors that should be considered in intersection design? What are the design properties of At Grade Intersection?

b. What are the benefits of Round about Intersection? In our country, for rural highway, which interchange will be more suitable according to your logic? Write in detail.

c. Writes short notes on:
   (i) Single Point Urban Interchange (SPUI)
   (ii) Medians and Curbs of Road X-section
   (iii) Right of Way (ROW)

3*

d. Illustrate a typical cross section of 2 lane highway. Also depict the factors which influence the geometric design of highway.

Question – 8

a. What are the factors affecting the road user characteristics? Write down the visual components of driver characteristic.

b. What is driver perception and reaction time? A driver with 20/20 vision can see a 3 in letter sign from a distance of 200 ft. The design driver has 20/40 vision. How far from an exit ramp should a 10 in direction sign appear? Assume, ramp speed = 300 mph, highway speed = 60 mph, PIEV time = 2.5 sec, f = 0.3.

c. What do you mean by Stopping Sight Distance (SSD)? For sloping ground prove that, SSD $= vt + \frac{v^2}{2g\left(\frac{\alpha}{g}+G\right)}$

d. Differentiate between Decision Sight Distance and Passing Sight Distance. Elaborately describe the overtaking maneuver of vehicle and determine the Passing sight Distance.

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Term Final (Spring) Examination 2021; July-Aug 2021

Student Group: 72 < Earned Credit Hours ≤ 108

Subject: EWC-351, Transportation Engineering

: **3.00 hours (For Physical Examination)**

Full Marks : 240
Section A : 120

INSTRUCTIONS - PHYSICAL EXAMINATION

a. Use **SEPARATE** answer scripts for each section.
b. **Question -1 Section-A** is compulsory.
c. Answer any **OTHER TWO** questions from **Section-A**.
d. Figures in the margin indicate full **marks.**
e. Assume reasonable data if necessary.
f. **Symbols** and **abbreviations** used have their usual meanings.

SECTION-A

Question – 1 **(Compulsory)**

a. Draw a typical cross section of a conventional flexible pavement and briefly discuss the functions and material requirement of each layer. Why a binder course is used? **11**

b. With a clear sketch define different types of rigid pavement. Indicate which type of pavement should you recommend under the following conditions: **10**
   (i) Initial budget is limited.
   (ii) When frequent utility are expected.
   (iii) Subgrade is weak.
   (iv) When there is a possibility of inundation for a prolong period.
   (v) When stage construction is planned.
   (vi) Where street lighting facilities are limited.

c. Label/state the desirable characteristics of a pavement. "Roman roads were not expensive"-justify this comment. **7**

d. Design a two-phase signal of an isolated cross-junction for the following data: **12**

Amber time: 3 sec
Red-Amber time: 2 sec
Inter-green time for N-S approach: 6 sec
Inter-green time for E-W approach: 7 sec
Last time for N-S approach: 3 sec
Last time for E-W approach: 2 sec

	North	South	East	West
Arrival Flow (PCU/hour)	400	450	560	458
Saturation Flow (PCU/hour)	1800	1780	1850	1775

Assume no turning traffic or parked vehicle. Also assume any missing data.

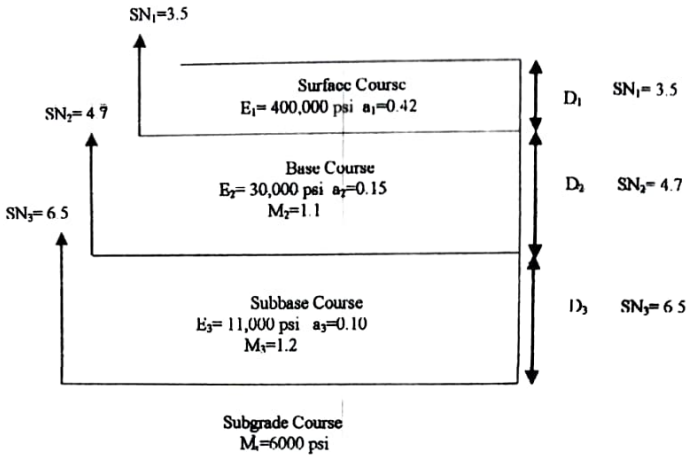
Question – 2

a. Write short notes on : (Any four) **10**
   (i) Serviceability
   (ii) Freeboard requirement as per RHD
   (iii) Resilient Modulus
   (iv) Structural Number
   (v) Limitations of AASHTO method
   (vi) Micro surfacing
   (vii) Seal coat

b. State/Name the common distress of flexible and rigid pavement (At least five for each). Briefly narrate bituminous surface treatment (BST).

c. Why structural design of pavement is a complex one? Briefly discuss the pavement design parameters.

d. From the following pavement system using the given data determine the thickness of base and surface course.



Assume any missing value.

Question – 3

a. Indicate the general requirements of traffic control device. Give two examples each for the following types of signs (Name only):
   (i) Regulatory sign
   (ii) Prohibitory sign
   (iii) Warning sign
   (iv) Informatory sign

b. What are the purposes for conducting traffic volume study? What are the uses of ADT and peak hour (PHV) data?

c. What are the uses of spot speed studies? How data should be collected for spot speed studies? Differentiate between recurrent and non-current delay.

d. A person travels to workplace in the morning from his residence. In the afternoon from workplace he goes to a market, then from the market he goes to a hospital to see his ailing relative. At night from hospital he comes back to his residence. How many production and attractions are generated in the residence, workplace, market and hospital? How many HB and NHB trips are generated?

Question – 4

a. Briefly discuss the causes of congestion with particular reference of Bangladesh.

b. Enumerate different traffic engineering tools.

c. What do you understand by 'travel demand'? Explain the factors influencing travel demand. How travel analysis zones (TAZ) are selected?

d. Indicate the parameters/data to be collected for any three of the following categories of transportation planning studies:

   1) Inventories
   2) Capacity studies
   3) Mass-Transit studies
   4) Parking studies
   5) Origin-destination studies

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Military Institute of Science and Technology
B.Sc. in Environmental, Water Resources, and Coastal Engineering
Student Group: 72 < Earned Credit Hour <= 108, Final Examination (Spring): Feb 2021

Subject: EWC-351: Transportation Engineering

Total: 2.00 hours **Full Marks: 240**
Section A: 1.00 hour **Section A: 120**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. **Question – 1 and Question – 4 (Viva Voce)** in **Section A** are compulsory.
c. Answer any **OTHER ONE** question from this section **(From Q - 2 & Q - 3)**.
d. Figures in the margin indicate full **marks**.
e. Assume reasonable data if necessary.
f. **Symbols** used have their usual meanings.

SECTION-A

Question – 1 (Compulsory)

a. Enumerate the functions and desirable characteristics of a pavement. Draw a typical cross section of a flexible pavement as per RHD design guide 2005. Name the international design standards which were consulted in preparing RHD design guide 2005. How the thickness of improved subgrade is determined as per RHD design guide. **12**

b. Compare between the flexible and rigid pavements in terms of any four of the following parameters: **10**
   i. Design philosophy
   ii. Economy
   iii. Utility shifting
   iv. Glare and night visibility
   v. Environmental consideration
   vi. Effects of temperature

c. Write short notes (Any three) **9**
   i. Equivalent Single Axle Load (ESAL)
   ii. Fatigue cracking
   iii. Micro surfacing
   iv. Jointed Plain Concrete Pavement (JPCP)
   v. Full depth Asphalt pavement

d. Estimate the effective roadbed soil resilient modulus for the data shown below (All in psi) as per AASHTO: **9**
   January: 15000; February: 27000; March: 37000; April: 52000; May and June: 1500; July and August: 2500; September: 3500, October and November: 4500 and December: 5000.

Question – 2

a. Enumerate the existing road classification in Bangladesh as per RHD. Indicate the MRT and BRTs as per RSTP. **10**

b. Enumerate the basic requirements of a transportation plan. Explain the land use transportation cycle. **10**

c. There are four alternative project proposals for four districts: Rangpur (Plan A); Dinajpur (Plan B); Jessore (Plan C) and Barisal (Plan D) with different road length, population and productivity as shown below: **12**

Proposal	Road Length	No of towns and villages serve with population range				Productivity (1000 ton)	
		Up to 5000	5001-10000	10001-20000	>20000	Agriculture	Industry
A	200	150	70	20	06	100	140
B	250	180	80	25	07	110	120
C	275	175	70	30	08	115	110
D	325	200	90	35	10	125	130

Workout the utility per unit length for each of the road project and rate these projects in order of priority based on saturation system. Assume that 1000 tons of agriculture productivity has the same utility of that of towns and villages with more than 20000 population and industrial products yields twice the utility than that of agriculture product.

d. An existing 6.2m regional highway located in an embankment requires full reconstruction. Existing road surface is 1′ (one foot) above the highest flood level for a 50 year return period. CBR of the subgrade is 3%. A 24 hour two way traffic count for the two lane HW for a typical week day are given below with the PCU:

Type of Traffic	Two Way Traffic/ Day	PCU
Large truck (dual axle)	150	3.0
Medium truck (single axle)	200	2.5
Large bus	200	2.0
Utility car	450	1.0
Minibus	100	1.5
Rickshaw	200	2.0
Small truck	100	2.0

Estimate the cumulative ESA for the design period. Does the pavement requires to be raised? If so how much? What should be thickness of improved subgrade? Assume any missing data.

Question – 3

a. A design is being prepared for an asphalt concrete mixture in Marshall method. The following ingredients are used in trial mixtures:

Ingredients	% of Total Mix	Specific Gravity
Coarse Aggregate	50	2.61
Fine Aggregate	38	2.69
Mineral Filler	7	3.10
Asphalt Content	5	1.03

The specimen weight in air and water is 1328.6 gm and 782.9 gm respectively. The maximum specific gravity of mixture is 2.468. Compute % air void; % void in mineral aggregate and % void filled with asphalt.

b. Write short notes on:
1) Dynamic Traffic Management Process (DTMP)
2) Scale of ITS

c. What is stabilization of soil? Write short notes on cutback asphalt.

d. What are advantages and disadvantages of emulsified asphalt? Compare between penetration and viscosity grading of asphalt **8**

e. **What do you mean by polymer modified asphalt?** **4**

Question – 4 **Viva Voce (Compulsory)** **40**

c Following data was collected during a spot speed study

Speed Range (mph)	No of Vehicle
0-5	0
5-10	10
10-15	20
15-20	40
20-25	110
25-30	320
30-35	250
35-40	120
40-45	40
45-50	20
50-55	10
55-60	7
60-65	3
65-70	0

Determine the average speed of traffic stream.

d. What are the general requirements of traffic control devices? Explain the differences between mandatory and cautionary signs.

Question – 7

a. What are the measures of effectiveness that qualitatively define various LOS? Describe various LOS.

b. What are the factors that influence the design of different roadway elements? Also, explain that these factors are often interrelated.

c. What are the advantages of grade separation? Describe a diamond pattern interchange with figure.

d. Design a two phase signal of an isolated cross-junction for the following data:

Amber	3 Sec
Red-Amber	2 Sec

	N-S	E-W
Inter green (Sec)	9	9
Lost time (Sec)	3	2

	North	South	East	West
Arrival Flow (pcu/hr)	700	550	600	750
Sat Flow (pcu/hr)	2100	1900	2000	1850

Question – 8 Viva Voce(Compulsory)

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Military Institute of Science and Technology
B.Sc. in Environment, Water Resources, and Coastal Engineering
Supplementary Examination: July 2019 [Improvement]

Subject: EWC- 351, Transportation Engineering

Time: 3.00 hours **Full Marks: 280**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. Answer any **THREE** questions from each section out of **FOUR.**
c. Figures in the margin indicate full **marks**.
d. Assume reasonable data if necessary.
e. **Symbols** used have their usual meanings.

SECTION-A

Question – 1

a. Describe the desirable properties of aggregate as base material. **10**

b. Differentiate between fractional and destructive distillation process. **10**

c. Show the RHD specification for coarse materials for bituminous mix. **10**

d. What are the special qualities of bitumen required for road construction in Bangladesh? How these qualities can be achieved? What is the specialty of modified asphalt? **$16^2/_3$**

Question – 2

a. Distinguish between straight run bitumen and blown bitumen. **$10^2/_3$**

b. What do you understand by cut back asphalt? Enumerate the advantages and disadvantages of emulsified asphalt. **11**

c. Specify different tests of asphaltic materials for road construction. Why flash point test is conducted? **10**

d. The wet weight of a specimen of soil is 340 gm and dried weight is 230 g. The volume of the soil before drying is 210 cc. of specific gravity of soil particles is 2.75, determine the dry density , porosity and degree of saturation. **15**

Question – 3

a. In a sketch show the different layers of typical flexible pavement and rigid pavement. Enumerate the functions and material requirement of different layers. **20**

b. State the functions and desirable characteristics of pavement. Reveal the classification of road system in Bangladesh. **$16^2/_3$**

c. Briefly indicate the methods and general steps for determining the optimum asphalt content. **10**

Question – 4

a. Briefly discuss the design criteria of "Asphalt Institute" method of flexible pavement designs. **$10^2/_3$**

b. Define a transportation system. Explain the components of the transportation system. **10**

c. "Transportation Engineering is a multidisciplinary area of study" explain with example. **8**

d. Explain land use and transportation cycle. **8**

e. Indicate the major constraints in the development of transportation in Bangladesh. **8**

SECTION-B

Question – 5

a. Draw the geometric cross-section of a two lane highway and show all possible cross-sectional elements within the right of way.

b. What are the design standard and criteria which influence the design of various geometric elements of any highway?

c. Define passing sight distance (PSD). Show various components of PSD with the help of diagram.

d. Explain how do the SSD and PSD varies with weather (dry or wet), grade and vehicle type (large or small)? 1

Question –6

a. Mention the types and causes of accidents. How can you reduce the conflict in the four leg intersection?

b. What are the advantages of traffic surveillance? Write the consequences of flow breakdown.

c. Many of our roads are quite wide, yet congestion is common in these roads. Do you think that traffic system management measures can improve the condition? Explain various types of supply and demand management measures. 2

Question –7

a. What are the general requirements of traffic control devices? Compare road sign with marking.

b. What are the warrants of grade separated intersections and interchanges? Draw the schematic diagram of a trumpet type of interchange showing various directions of traffic flow.

c. Explain the importance of traffic island. Describe different types of traffic islands. (Functional classification of islands.)

d. Differentiate between stop and yield signs in terms of size, shape, color and uses. 1

Question–8

a. What do you mean by transportation planning? Explain the basic elements of transportation planning with the help of a flow chart. 1

b. Define space and time mean speed, design hour volume and density. Illustrate the Greenshields Model with flow, density and speed relationship curves.

c. Write short notes on
   (i) VMS and Retroreffectine masking.
   (ii) Flyover and Interchange.
   (iii)Pelican crossing and Pedestrian scramble.
   (iv)Passing Lane and climbing lane.