

Electronic Devices and Circuits

North East University Bangladesh

Department of Computer Science and Engineering
Semester Final Examination Summer-2023 Semester

Program: B.Sc. (Engg.) in CSE

Course: CSE-06131213 (Electronic Devices and Circuits)

Total Marks: 40

Total Time: 2 Hrs

Instructions: Answer any five (5) of the following questions including question no 1.

Write your answers neatly with only adequate amount of explanations and diagrams where necessary. If not required avoid unnecessary explanation. Unnecessary materials will gain no marks but can lose marks if it contradicts with actual answers. In all mathematical questions you must show all the steps.

Figures in the right margin indicate full marks. Answer parts of a question together.

a) Identify of the following statements are true or false. 7

- i. All transistors are voltage controlled devices.
- ii. FETs are more efficient as switching device than BJTs.
- iii. Ideal OpAmps has infinite open loop gain.
- iv. OpAmp is short for operating amplifier.
- v. Depletion type MOSFET has a channel between drain and source.
- vi. OpAmps are used in amplifier for their ease of controlling the gain.
- vii. Collector is the most heavily doped region of a BJT.
- viii. Ideal OpAmp has a CMRR value of 1.
- ix. In enhancement mode of depletion type MOSFET $V_{GS} > 0$.
- x. Designing OpAmp integrator and differentiator requires same amount of components.
- xi. OpAmps can be used to design pulse shaping circuits.
- xii. The r_e model of BJT is same for any configuration of BJT.
- xiii. The base region of a BJT has the least volume.
- xiv. Transistors are made only using silicon.

b) Fill in the following gaps with appropriate term(s). 5

- i. For Cut-off region of operation of BJT Base-Emitter Junction must be _____ biased and Base-Collector Junction must be _____ biased.
- ii. Ideal OpAmp has _____ open loop voltage gain.
- iii. Phase difference between input and output voltage of fixed bias configuration BJT is _____.
- iv. The operating point of a circuit is also known as the _____ point.
- v. _____ is necessary to establish the proper region of operation for AC amplification.

c) Draw the structure of npn BJT and Enhancement type MOSFET. 3

d) Answer in short, these following questions 5

- i. What is CMRR?
- ii. What is gain bandwidth product?
- iii. What is early voltage?
- iv. What is the necessary condition for approximate analysis of voltage divider bias configuration of BJT?
- v. What is pinch-off of JFET?

(Total for Question 1 = 20 Marks)

2. a) Design a motor controller circuit that can rotate the motor in either direction. 3
b) Explain why during pinch off, current is not 0 in JFET. 2

(Total for Question 2 = 5 Marks)

3. For the circuit in figure A, find i. I_{BQ} ii. I_{CQ} iii. V_{CEQ} iv. V_C v. V_E

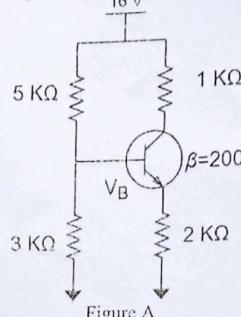


Figure A

(Total for Question 3 = 5 Marks)

4. a) Explain the transistor action of a pnp BJT. 2

- b) For the circuit in figure B, find i. I_{BQ} ii. I_{CQ} iii. V_{CEQ} 3

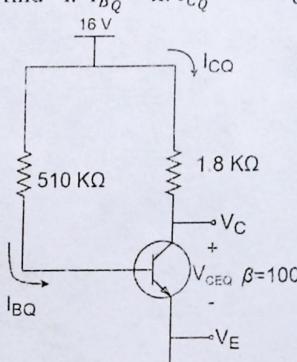


Figure B

(Total for Question 4 = 5 Marks)

5. Consider the circuit in figure C below.

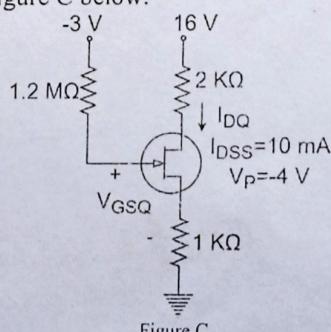


Figure C

- a) Draw the transfer curve for the FET. 2

- b) By drawing a load line on top of the transfer curve find the value of I_{DQ} and V_{GSQ} . 2

- d) Find the drain voltage V_d . 1

(Total for Question 5 = 5 Marks)

- a) Draw the block diagram of a general purpose OpAmp. 2

- b) Design an OpAmp circuit with input v_1 and v_2 such that $v_o = -3v_1 + 5v_2$ 3

(Total for Question 6 = 5 Marks)

7. a) Draw the input and output characteristics of common base configuration of BJT.
 b) For the configuration shown in the circuit in figure D draw the AC equivalent circuit using r_e model.

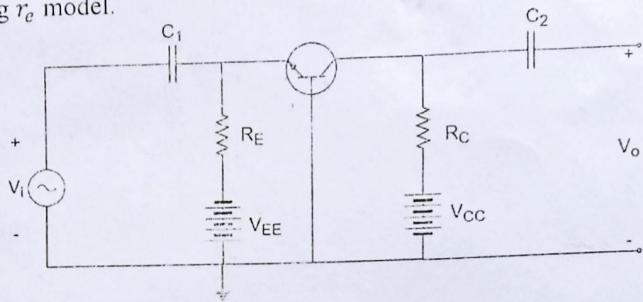


Figure D

(Total for Question 7 = 5 Marks)

8. For the circuit in figure E, find i. I_{DQ} ii. V_{GSQ} iii. V_{DS} iv. V_{DG} v. V_G

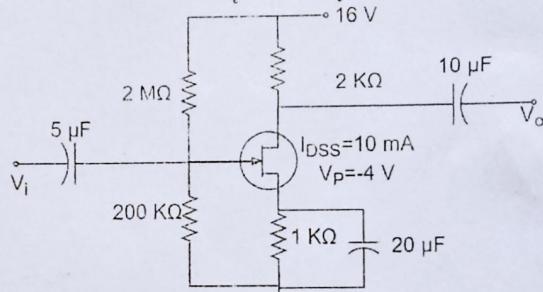


Figure E

(Total for Question 8 = 5 Marks)

9. a) For the circuit in figure F below, find the output voltage.

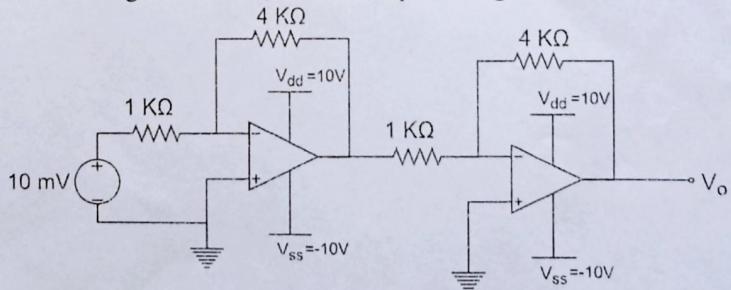


Figure F

- b) Explain why the biasing of transistor is necessary.

(Total for Question 9 = 5 Marks)

10. a) Design a comparator that will show an output of 10V when the input is above the reference voltage and an output of 0V when the input voltage is below the reference voltage. For your design, use reference voltage of 3.33V.
 b) Design full wave rectifier using transistor.

(Total for Question 10 = 5 Marks)

List of data, formulae and relationships

BJT:

$$\begin{aligned}
 I_E &= I_C + I_B, & I_C &= I_{C_{\max}} + I_{CO_{\max}}, & V_{BE} &\cong 0.7 \text{ V} \\
 \alpha_{dc} &= \frac{I_C}{I_E}, & \alpha_{ac} &= \left. \frac{\Delta I_C}{\Delta I_E} \right|_{V_{CE}=\text{constant}}, & I_{CEO} &= \left. \frac{I_{CEO}}{1-\alpha} \right|_{I_B=0_{\mu A}} \\
 \beta_{dc} &= \frac{I_C}{I_B}, & \beta_{ac} &= \left. \frac{\Delta I_C}{\Delta I_B} \right|_{V_{CE}=\text{constant}}, & \alpha &= \frac{\beta}{\beta+1} \\
 I_C &= \beta I_B, & I_E &= (\beta+1)I_B, & P_{C_{\max}} &= V_{CE}I_C, & r_e &= \frac{26 \text{ mV}}{I_E}
 \end{aligned}$$

$$V_{BE} \cong 0.7 \text{ V}, \quad I_E = (\beta+1)I_B \cong I_C, \quad I_C = \beta I_B$$

$$\text{Fixed bias: } I_B = \frac{V_{CC} - V_{BE}}{R_B}, \quad I_C = \beta I_B$$

$$\text{Emitter stabilized: } I_B = \frac{V_{CC} - V_{BE}}{R_B + (\beta+1)R_E}, \quad R_i = (\beta+1)R_E$$

Voltage-divider bias:

$$\text{Exact: } R_{Th} = R_1 \parallel R_2, \quad E_{Th} = V_{R_2} = \frac{R_2 V_{CC}}{R_1 + R_2}, \quad I_B = \frac{E_{Th} - V_{BE}}{R_{Th} + (\beta+1)R_E}$$

Approximate Test: $\beta R_E \geq 10 R_2$

$$V_B = \frac{R_2 V_{CC}}{R_1 + R_2}, \quad V_E = V_B - V_{BE}, \quad I_E = \frac{V_E}{R_L} \cong I_C$$

Transistor switching networks:

$$I_{C_{\max}} = \frac{V_{CC}}{R_C}, \quad I_B > \frac{I_{C_{\max}}}{\beta_{dc}}, \quad R_{sat} = \frac{V_{CE_{sat}}}{I_{C_{\max}}}, \quad t_{on} = t_r + t_d, \quad t_{off} = t_s + t_f$$

CE fixed bias:

$$\begin{aligned}
 Z_i &\cong \beta r_e, & Z_o &\cong R_C & \text{Voltage-divider bias:} & Z_i = R_1 \parallel R_2 \parallel \beta r_e, & Z_o &\cong R_C & \text{Common-base:} & Z_i \cong R_E \parallel r_e, & Z_o &\cong R_C \\
 A_v &= -\frac{R_C}{r_e}, & A_t &= -A_v \frac{Z_o}{R_C} \cong \beta, & A_i &= -\frac{R_C}{r_e}, & A_t &= -A_i \frac{Z_o}{R_C} \cong \beta, & A_v &\cong \frac{R_C}{r_e}, & A_t &\cong -1
 \end{aligned}$$

JFET:

$$I_D = I_{DSS} \left(1 - \frac{V_{GS}}{V_p} \right)^2 \quad V_{GS} = V_p \left(1 - \sqrt{\frac{I_D}{I_{DSS}}} \right) \quad P_D = V_{DS} I_D \quad r_d = \frac{r_o}{(1 - V_{GS}/V_p)^2}$$

$$I_D = I_{DSS} \Big|_{V_{GS}=0 \text{ V}}, \quad I_D = 0 \text{ mA} \Big|_{V_{GS}=V_p}, \quad I_D = \frac{I_{DSS}}{4} \Bigg|_{V_{GS}=V_p/2}, \quad V_{GS} \cong 0.3 V_p \Big|_{I_D = I_{DSS}/2}$$

$$\text{MOSFET (enhancement): } I_D = k(V_{GS} - V_T)^2 \quad k = \frac{I_{D\text{max}}}{(V_{GSS\text{min}} - V_T)^2}$$

JFET/depletion-type MOSFETs: Fixed-bias configuration: $V_{GS} = -V_{GG} = V_G$
Self-bias configuration: $V_{GS} = -I_D R_S$

$$\text{Voltage-divider biasing: } V_G = \frac{R_2 V_{DD}}{R_1 + R_2} \quad V_{GS} = V_G - I_D R_S$$

OpAmp:

$$\text{Inverting amplifier: } \frac{V_o}{V_i} = -\frac{R_f}{R_i}$$

$$\text{Noninverting amplifier: } \frac{V_o}{V_i} = 1 + \frac{R_f}{R_i}$$

$$\text{Unity follower: } V_o = V_i$$

$$\text{Summing amplifier: } V_o = -\left(\frac{R_f}{R_1} V_1 + \frac{R_f}{R_2} V_2 + \frac{R_f}{R_3} V_3 \right)$$

$$\text{Integrator amplifier: } v_o(t) = -\frac{1}{RC} \int v_i(t) dt$$

$$\text{CMRR} = 20 \log_{10} \frac{A_d}{A_t} \quad \text{Slew rate (SR)} = \frac{\Delta V_o}{\Delta t} \quad \text{V}/\mu\text{s}$$

Data Structures and Algorithm

North East University Bangladesh
 Department of Computer Science and Engineering
 Semester Final Examination, Summer-2023
 Program: B.Sc. (Engg.) in CSE
 Course: CSE-06131211 (Data Structures and Algorithms)

Total Marks: 40

Total Time: 2 hours

Instructions: Answer any four questions from the following.

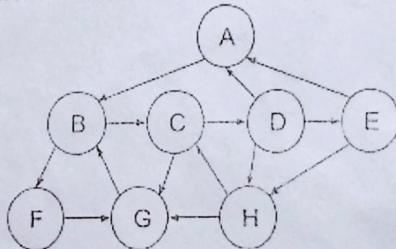
Figures in the margin indicate full marks. Answer parts of a question together.

1. a) What is the average and worst case time complexity of quick sort? 2
 b) Sort the following sequence of numbers in ascending order using quick sort. Show all the steps. 8

30, 45, 10, 20, 75, 15, 85, 40

2. a) Using Huffman's algorithm, find the code for each character of the given text. 8
 b) Compare the result of variable length code-word with fixed length code word. 2

3. a) What are the differences between BFS and DFS? 4
 b) Consider the following graph and run the DFS algorithm to find a path for visiting all the nodes starting from node A. Show all the steps. 6



4. a) What is the priority queue? 1
 b) Write the uses of pre-order, in-order and post-order traversals. 3
 c) The in-order and pre-order traversal of a tree are given below. Construct the binary tree. Show all the steps. 6

In-order: B A C D F H I E G

Pre-Order: F A B D C I H G E

5. a) What are the advantages of using binary search trees? 2
 b) Construct an AVL search tree by inserting the following elements. 8

60, 10, 30, 100, 70, 9, 7, 110, 113

6. a) What is a doubly linked list? 1
 b) What are the different methods used to represent a graph- explain with examples? 3
 c) Build a hash table of length 10 and the keys 1, 3, 12, 4, 25, 6, 18, 20, 8 using open addressing with hash function $h(i) = i^2 \bmod 10$ and linear probing. 6

Linear Algebra

North East University Bangladesh

Department of Computer Science & Engineering

B.Sc. (Engg.) in CSE Program

Semester Final Examination, Summer-2023

Course Code: MAT-05411203, Course Title: Linear Algebra

Full Time: 02 Hours

Credit: 03

Marks: 40

[N.B.: Answer any four (04) from the following questions. Figure in the right margin indicate full marks.
Fraction of all questions must answer sequentially.]

1.
 - a) Mention the two operations of a vector space. Give an example of a vector space. 02
 - b) Let V be a vector space over an arbitrary field F . Then prove that 08
 - (i) For any scalar $\alpha \in F$ and $0 \in V$, $\alpha 0 = 0$.
 - (ii) For $\alpha \in F$ and $v \in V$, $(-\alpha)v = \alpha(-v) = -\alpha v$.
2.
 - a) Define with example of subspace of a vector space. 03
 - b) A non-empty subset W of a vector space V over the field F is a subspace of V if and only if 07
 - (i) $u, v \in W \Rightarrow u - v \in W$
 - (ii) $\alpha \in F, u \in W \Rightarrow \alpha u \in W$. Prove the necessary and sufficient conditions.
3.
 - a) Define linear Dependence and linear Independence of a subset of a vector space. 04
 - b) Show that the vectors $(2, -1, 4)$, $(3, 6, 2)$ and $(2, 10, -4)$ are linearly independent. 06
4.
 - a) Define Eigenvalues and Eigenvectors of a square matrix A . 02
 - b) Find the matrix P that diagonalizes the matrix: 08
$$A = \begin{bmatrix} 1 & 4 \\ 9 & 1 \end{bmatrix}$$
5.
 - a) Define inner product and inner product space. 04
 - b) If $u = (u_1, u_2)$ and $v = (v_1, v_2)$ are vectors in \mathbb{R}^2 , then $\langle u, v \rangle = 3u_1v_1 + 2u_2v_2$ defines an inner product. 06
6.
 - a) Define Linear Span and Orthogonality. 04
 - b) Prove that the intersection of two subspaces S and T of a vector space V is also a subspace of V . 06

Fundamentals of physics



North East University Bangladesh, Sylhet
Department of Computer Science and Engineering
Semester Final Examination Summer-2023
Program: B.Sc. (Engg.) in CSE
Course: PHY-05331201 (Fundamentals of Physics)

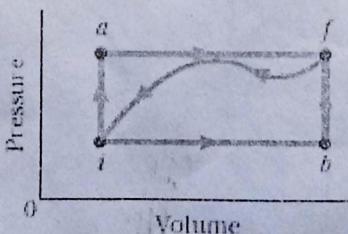
Total Marks: 40

Time: 2 Hours

Instructions: Answer any four questions from the following.

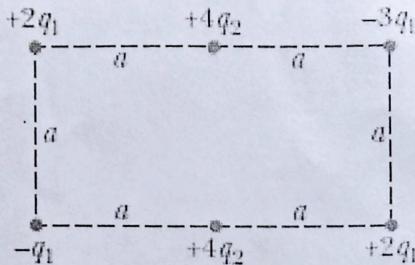
Figures in the margin indicate full marks. Answer parts of a question together.

1. (a) What are constructive interference and destructive interference? (2)
(b) Obtain the expression for mth bright and mth dark fringe in Young's double slit experiment. (4)
(c) A viewing screen is separated from a double-slit source by 1.2m. The distance between the two slits is 0.030mm. The second order bright fringe ($m=2$) is 4.5cm from the center line. (i) Determine the wavelength of the light. (ii) Calculate the distance between adjacent bright fringes. (4)
2. (a) What is diffraction of light? Discuss the Fraunhofer and Fresnel class of diffraction. (3)
(b) obtain an expression for minima in the Fraunhofer class of diffraction at a single slit. (4)
(c) A certain grating has 10^4 slits with a spacing of $d = 2100\text{nm}$. it is illuminated with yellow sodium light ($\lambda = 589\text{nm}$). Find the angular position of all principal maxima observed. (3)
3. (a) What is thermal equilibrium? (1)
(b) The amplification or gain of a transistor amplifier may depend on the temperature. The gain for a certain amplifier at temperature 20°C is 30.0, whereas at 55°C it is 35.2. What would the gain be at 28°C if the gain depends linearly on temperature over this limited range? (3)
(c) At what temperature, if any, do the following pairs of scales give the same reading. (i) Fahrenheit and Celsius, (ii) Fahrenheit and Kelvin, and (iii) Celsius and Kelvin? (6)
4. (a) State and explain the first law of thermodynamics (3)
(b) When a system is taken from state i to state f along path iaf in above Fig. , $Q = 50 \text{ cal}$ and $W = 20 \text{ cal}$. Along path ibf , $Q = 36 \text{ cal}$. (i) What is W along path ibf ? (7)
(b) If $W = 13 \text{ cal}$ for the return path fi , what is Q for this path? (c) If $E_{int,i} = 10 \text{ cal}$, what is $E_{int,f}$? If $E_{int,b} = 22 \text{ cal}$, what is Q for (d) path ib and (e) path bfi ? (3)



5. (a) Write down the entropy postulates. How can you calculate the change in entropy. (1+3)
(b) Two identical copper blocks of mass $m = 1.5 \text{ kg}$; block L at temperature $T_{iL} = 60^\circ\text{C}$ and block R at temperature $T_{iR} = 20^\circ\text{C}$. The blocks are in a thermally insulated box and are separated by an insulating shutter. When we lift the shutter, the blocks eventually come to the equilibrium temperature $T_f = 40^\circ\text{C}$. What is the net entropy change of the two-block system during this irreversible process? The specific heat of copper is 386 J/kg K . (6)

6. (a) Explain the quantization of charge. (3)
 (b) Draw the field lines for (i) a positive charge, (ii) a negative charge and (iii) a pair of positive and negative charge. (3)
 (c) rectangular array of charged particles fixed in place, with distance $a = 39.0\text{cm}$ and the charges shown as integer multiples of $q_1 = 3.40\text{pC}$ and $q_2 = 6.00\text{pC}$. With $V = 0$ at infinity, what is the net electric potential at the rectangle's center? (4)



7. (a) Define magnetic field. (3)
 (b) An electron moves through a uniform magnetic field given by $\vec{B} = B_x\hat{i} + 3B_x\hat{j}$. At a particular instant, the electron has velocity $\vec{v} = 2\hat{i} + 4\hat{j}$ m/s and the magnetic force acting on it is $6.4 \times 10^{-19}\hat{k}\text{N}$. Find B_x ? (3)
 (c) Explain techniques to produce electric field from magnetic field. (4)

THE END

Advanced Functional English

North East University Bangladesh

Program: BSc. (Engineering) in Computer Science

Department of Computer Science and Engineering

Semester Final Examination, Summer 2023

Course Code: ENG 02321201

Course Title: Advanced Functional English

Time: 2 hours

Marks: 40

Read the following passage carefully:

Global Warming

The future level of global warming is uncertain, but a wide range of estimates have been made. Scientist predicts an increase in sea levels worldwide due to the melting of two massive ice sheets in Antarctica and Greenland, especially on the East coast of the US. However, many nations around the world will experience the effects of rising sea levels, which could displace millions of people. One nation, the Maldives, is already looking for a new home, thanks to rising sea levels. The severity of storms such as hurricanes and cyclones is increasing, and research published in Nature has found. "Scientists have come up with the firmest evidence so far that global warming will significantly increase the intensity of the most extreme storms worldwide. The maximum wind speeds of the strongest tropical cyclones have increased significantly since 1981, according to research published in Nature. And the upward trend, thought to be driven by rising ocean temperatures, is unlikely to stop at any time soon."

1. Write the answers to the following questions:

1×5= 05

- ✓ a. What are some of the potential consequences of global warming mentioned in the passage?
- ✓ b. Which two massive ice sheets are highlighted as contributors to the predicted increase in sea levels?
- ✓ c. According to the research published in Nature, what is the evidence suggesting about the intensity of extreme storms worldwide?
- ✓ d. How global warming is linked to the observed increase in maximum wind speeds of the strongest tropical cyclones?
- ✓ e. Which nation is mentioned as already seeking a new home due to rising sea levels?

2. Fill in the blanks with suitable words:

1×5= 05

The future of global warming is uncertain, but estimates indicate alarming trends. (a) —— predict rising sea levels globally, with a focus on Antarctica and Greenland's melting ice (b) —— affecting the East coast of the US. This phenomenon may displace millions worldwide, with the (c) —— actively seeking relocation. Storm severity, notably hurricanes and cyclones, is intensifying, backed by Nature's research revealing a significant increase in (d) —— cyclone wind speeds since (e) ——, linked to rising ocean temperatures with no anticipated halt.

3. Complete the sentences with an appropriate proposition from the box:

1×5= 05

For	On	To	At	Into	About	With
-----	----	----	----	------	-------	------

- a) She burst —— laughter when she heard the joke, unable to contain her amusement.
- b) The team commenced —— their project, eager to make progress despite the challenges ahead.
- c) His zeal —— adventure led him to explore remote and untouched landscapes.
- d) She was anxious —— the upcoming exam, feeling the weight of its importance on her shoulders.
- e) He always heeded —— his grandmother's advice, knowing her wisdom came from years of experience.

4. Identify the nouns from the underlined words:

1×5= 05

- a. The dog barked loudly in the park.
- b. The Necklace was made of shiny gold.
- c. A herd of elephants grazed peacefully near the river.
- d. Sarah visited the Louvre Museum during her trip to Paris.
- e. His kindness and generosity were seen as a true reflection of his character.

5. Read the following sentences and identify the degree of comparison:

1×5= 05

- a. Riya is my elder sister.
- b. This is the oldest church in our city.
- c. Samuel is a good friend.
- d. Your website is more organized than Gabriel's.
- e. Mr. Peter is the most conservative member on the board.

6. Choose the correct form of the verb that agrees with the subject:

1×5= 05

- a. Eight dollars (is/are) the price of a movie these days.
- b. One of my sisters (is/are) going on a trip to France.
- c. The players, as well as the captain, (want/wants) to win.
- d. The president and the headmaster (has/have) joined the meeting.
- e. Everybody (agrees/agree) with his views.

7. Write a composition within 500 words on any of the following topics:

1×10= 10

- a. Wonders of Modern Science.
- b. Environmental Pollution in Bangladesh.

Bangladesh Studies

North East University Bangladesh

Program: BSc. (Engg.) in CSE

Department of Computer Science and Engineering

Semester Final Examination, Summer 2023

Course Code: SSW-03141202

Course Title: Bangladesh Studies

Time: 2 hours

Marks: 40

(Answer any four of the following questions. Figures in the right margin indicate full marks.)

- | | |
|---|---|
| ✓ 1. a) What is social stratification? | 1 |
| b) Explain the major types of social stratification. | 4 |
| c) Write the characteristics of social stratification. | 5 |
| ✓ 2. a) What is poverty? | 1 |
| b) Write the factors affecting poverty in Bangladesh. | 4 |
| c) Explain the causes of the high poverty rate in Bangladesh. | 5 |
| ✓ 3. a) What is urbanization? | 1 |
| b) Write the causes of urbanization. | 4 |
| c) Write the positive and negative impacts of urbanization in Bangladesh. | 5 |
| ✓ 4. a) What is voluntary migration? | 1 |
| b) Explain Everett Lee's theory of migration. | 6 |
| c) Write the advantages of migration. | 3 |
| 5. a) Write the meaning of Executive? | 2 |
| b) Explain the functions of the Executive of Bangladesh. | 5 |
| c) Write the limitations of the Executive organ in Bangladesh. | 3 |
| 6. a) What is governance? | 1 |
| b) Explain the elements of good governance. | 5 |
| c) Write the main problems for ensuring good governance in Bangladesh. | 4 |