SECTION – A

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

1. (a) Urban growth may occur with or without urbanization – Justify the statement. (7)
   (b) Briefly discuss the strategies of rural-urban migration. (14)
   (c) State the differences between Satellite town and New town. (10)
   (d) The rank-size rule is most applicable to countries where the urban size hierarchy has been distorted through concentration of functions in a single paramount centre – Do you agree with the statement? Justify your answer. (4)

2. (a) Briefly explain the TODARO Model of migration with necessary illustration. (13)
   (b) Urbanization is generally regarded as a four-dimensional process – Explain the statement. (10)
   (c) What was the fate of Vertical City concept? (3)
   (d) Describe different determinants of migration. (9)

3. (a) Briefly discuss the fundamental elements of Neighborhood unit. (16)
   (b) How industrial revolution brought changes in the urban settlement? (12)
   (c) Describe the basic structures of “Ciudad Lineal”. (7)

4. Write short notes on the following (any five) – (5x7=35)
   (a) Urban hierarchy
   (b) Advantages and disadvantages of corridor plan
   (c) Urban poor
   (d) Consequences of migration
   (e) Basic elements of Radburn concept
   (f) Causes of urban population growth
   (g) Land use of Vertical city plan.

Contd ………… P/2
5. (a) What do you understand by the term "Human Settlement"? What are the main components of human settlement? (2+2=4)
(b) How agricultural revolution and the resultant social surplus gave birth to early cities in the Neolithic period? (16)
(c) "As the center of social, political, economic, and military activities and as a symbol of spiritual and sacred space citadels, laid the foundation of early cities". Considering this statement, compare the features and functions of the citadels of different ancient cities. Why the citadels of Indus cities were much different from rest of the ancient cities? (10+5=15)

6. (a) "Rise of democracy and the art of city planning brought about remarkable changes in classical Greek cities following the dark age". Justify the statement with proper explanation. (13)
(b) Describe the main features of Greek Agora and Roman Forum. (10)
(c) How the feudal system and rise of Christianity shaped the medieval cities in Europe? (12)

7. (a) What are the main changes evident in the later stages of medieval towns? (12)
(b) How the invention of gun powder brought changes in the defense system of cities? (10)
(c) What are the changes manifested by the Baroque cities compared to the renaissance period? (13)

8. (a) In the context of Indian subcontinent, discuss different evolutionary stages of the cities in the pre-industrial period. (11)
(b) What is the distinct pattern of settlement that evolved in the cities of Indian subcontinent including Dhaka due to colonial intervention? (12)
(c) Discuss the spatial development of human settlement in Dhaka during the Mughal period. (12)
SECTION – A

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

1. (a) Explain the concept of production function. (5)
   (b) What are the various returns to scale of production? Explain graphically. (15)
   (c) Critically analyse the concept of optimization. (15)

2. (a) What are the characteristics of perfectly competitive market? Explain them. (10)
   (b) Explain super normal profit for a perfectly competitive firm in short run. (15)
   (c) In which condition a firm shuts down its business in short run in perfect competition? (10)

3. (a) Illustrate the concept of marginal product, average product, marginal cost and diminishing marginal productivity. (10)
    (b) What is the difference between economic profit and accounting profit? (5)
    (c) Define economies of scale and diseconomies of scale. (5)
    (d) Given the following total revenue (TR) and total cost (TC) functions for a firm
        \[
        TR = 4000Q - 33Q^2 \\
        TC = 2Q^3 - 3Q^2 + 400Q + 5000
        \]
        where Q is quantity of output.
        (i) Set up the profit function. (15)
        (ii) Find out the quantity which makes the profit maximum. (15)
        (iii) Find the maximum profit and verify that it is maximized.

4. (a) Explain the resource allocation process in a society with the help of production possibility frontier. (20)
    (b) Describe three applications of production possibility frontier. (15)
There are FOUR questions in this section. Answer any THREE.
Symbols indicate their usual meaning.

5. (a) Briefly discuss the principles of Economics.
   (b) What do you understand by opportunity cost? Explain with an example.
   (c) What is the difference between equity and efficiency?

6. (a) State the law of demand. What are the factors that can affect demand? Explain how these different factors affect demand with the help of an example.
   (b) Define equilibrium of demand and supply. What are shortage and surplus? Show these in a diagram.
   (c) How will hot weather affect the market of ice-cream? Explain with the help of demand-supply analysis.

7. (a) Write short notes on price elasticity of demand, income elasticity of demand, perfectly elastic demand, perfectly inelastic demand and cross price elasticity of demand.
   (b) Explain the paradox of bumper harvest.
   (c) Suppose the price elasticity of supply of tobacco product is 3. How will you interpret it?

8. (a) What are the properties of indifference curve? Explain these properties.
   (b) What do you understand by a consumer's budget line and indifference curve? How will you interpret the slope of these curves?
   (c) Suppose there are two goods available for a particular consumer. If he has more income than before then how will it affect his optimum point? Show graphically also.
**SECTION – A**

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

Symbols used have their usual meaning.

1. (a) Complete the table so that the graph of \( y = f(x) \) is (i) Odd (ii) Even.

\[
\begin{array}{cccccccc}
 x & -4 & -3 & -2 & -1 & 0 & 1 & 2 & 3 & 4 \\
 f(x) & 5 & 3 & 2 & 0 & 3 & 2 & 0 & 3 & 8 \\
\end{array}
\]

(b) Graph the function \( f(x) = 5 + \frac{3}{2} - x \) by starting with the graph of \( f(x) = \frac{3}{2}x \) and using transformations (shifting, compressing, stretching, and/or reflection).

(c) Analyze the graph of the rational function \( R(x) = \frac{2x^2 - 5x + 2}{x^2 - 4} \).

2. (a) Find the real zeros of \( f(x) = x^5 - 5x^4 + 12x^3 - 24x^2 + 32x - 16 \). Write \( f \) in factored form.

(b) Solve the inequality \( \frac{x^2 (3 + x)(x + 4)}{(x + 5)(x - 1)} \geq 0 \) algebraically, and graph the solution set.

(c) Analyze the graph of the polynomial function \( f(x) = x^2 (x - 4) (x + 1) \).

3. (a) (i) Find the domain of the logarithmic function \( f(x) = -\ln(x - 2) \).

   (ii) Graph \( f \).

   (iii) From the graph, determine the range and vertical asymptote of \( f \).

   (iv) Find \( f^{-1} \).

   (v) Use \( f^{-1} \) to find the range of \( f \).

   (vi) Graph \( f^{-1} \).

(b) Solve \( e^{-x^2} = \left(\frac{e^x}{2}\right)^2 \cdot \frac{1}{e^3} \).

(c) Graph \( f(x) = 2^x - 3 \) and determine horizontal asymptote of \( f \).

4. (a) Prove that \( \cosh^{-1} x = \ln \left( x + \sqrt{x^2 - 1} \right) \).

(b) Find the amplitude, period and phase shift of \( y = 2 \cos(4x + 3\pi) + 1 \) and graph the function.
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Contd ... Q. No. 4

(c) Fruit flies are placed in a half-pint milk bottle with a banana (for food) and yeast plants (for food and to provide a stimulus to lay eggs). Suppose that the fruit fly population after t days is given by

\[ p(t) = \frac{230}{1 + 56.5e^{-0.37t}} \]

(i) State the carrying capacity and the growth rate.
(ii) Determine the initial population.
(iii) What is the population after 5 days?
(iv) How long does it take for the population to reach 180?

SECTION B
There are FOUR questions in this section. Answer any THREE.

5. (a) Define Hermitian matrix, skew-Hermitian matrix. Show that inverse of a non-singular matrix is unique.

(b) If A, B be two non-singular matrices of same order, then AB is also non-singular, show that \((AB)^{-1} = B^{-1}A^{-1}\).

(c) Define upper triangular matrix and lower triangular matrix with examples.

6. (a) Show that \( A \) (adj. \( A \)) = (adj. \( A \)) A = \( |A| \cdot I_n \).

(b) Reduce \( A = \begin{bmatrix} 1 & -2 & 1 & 3 \\ 4 & -1 & 5 & 8 \\ 2 & 3 & 3 & 2 \end{bmatrix} \) to the normal form \( B \) and compute the matrices \( P \) and \( Q \) such that \( PAQ = B \), where \( A \) and \( B \) are equivalent matrices.

7. (a) Use only elementary row transformations, reduce \( A \) to \( I_4 \), hence find inverse of \( A \) where \( A = \begin{bmatrix} 1 & 2 & -2 & -1 \\ -1 & -4 & 4 & 0 \\ 2 & -7 & 4 & -7 \\ 1 & 6 & -5 & 1 \end{bmatrix} \).

(b) Reduce the matrix \( A \) to canonical form and hence find rank when

\[ A = \begin{bmatrix} 1 & 2 & 3 & 4 \\ 2 & 7 & 3 & 5 \\ 3 & 8 & 1 & -2 \\ 2 & 4 & 6 & 8 \end{bmatrix} \]

Contd .............. P/3
8. (a) For what values of $\lambda$, the following linear equations have a solution. Solve them completely for each value of $\lambda$.

\begin{align*}
    x + y + z &= 1 \\
    x + 2y + 4z &= \lambda \\
    x + 4y + 10z &= \lambda^2
\end{align*}

(b) Find the eigenvalues and corresponding eigenvectors of the matrix,

\[
A = \begin{bmatrix}
    4 & 6 & 6 \\
    1 & 3 & 2 \\
    -1 & -4 & -3
\end{bmatrix}
\]
SECTION - A

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

1. (a) Write down the synthesis of melamine. Which health effects are observed in human for melamine consumption? (4+7)
(b) How does hydrogen bonding make nylon-6,6 a good fiber? How phthalate plasticizers and dioxins pollute global environment? (4+8)
(c) Show the biodegradability process of isobutyledene diurea. With reference to N₂-cycle state the effects of synthetic fertilizers on soil ecosystem. (3+9)

2. (a) What is atmosphere? Why is atmosphere essential for life? What are the environmental issues that involve atmospheric chemistry? (3+4+5)
(b) What are the Chapman reactions? Why does wavelength matter for these reactions? (5+3)
(c) The chemical formula of Halon-2402 (a fire suppressant) is C₂F₄Br₂. Do you expect it to deplete O₃ layer? Explain your answer showing the reactions. (7)
(d) The average temperature of the Earth is 15 °C, the magnitude of solar constant is 1372 W/m² and Earth's albedo is 30%, the Stephan-Boltzmann constant is 5.67 x 10⁻⁸ W/(m².k⁴). Calculate by how much the Earth's atmospheric temperature would change if the greenhouse effect, the albedo, and the solar constant are all increased by 1.5%, relative. (8)

3. (a) What is air pollution? What are natural and unnatural causes of air pollution? (4+6)
(b) What do you mean by ground level ozone and upper level ozone? Which one is necessary and which one is harmful for humans? Explain. (4+8)
(c) Describe the effects of particulate matter as air pollutant. (6)
(d) Decreasing the amount of CO₂ in the atmosphere is a big challenge for us. What are the strategies you can think of to decrease CO₂ emissions? (7)

4. (a) What are the three major sources of water pollution? Explain briefly chemical runoff giving two examples. (10)
(b) DDT is used as pesticide to kill insects and other organisms that damage crops. How DDT can biologically be magnified in a food chain? (8)
(c) What are the basic water quality parameters? To understand the quality of drinking water which ones are more important to know? Explain your answer.

(d) Arsenic in ground water is a big problem for Bangladesh. What are the adverse effects of arsenic in water?

SECTION – B

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

5. (a) For the molecules of H₂O and CO₃²⁻ ion
   (i) Draw the lewis structure.
   (ii) Draw the shapes of the molecules according to VSEPR theory.
   (iii) Indicate net polarity in these molecules, if any.
   (iv) Name the electron pair geometry.
   (v) Name the molecular geometry.

(b) Calculate the most probable distance from nucleus to find the electron in Li²⁺ (the numerical value of Bohr radius is 52.9 pm).

(c) Write down the electron configuration of all the isoelectronic species of Ne [z = 10]. Explain which one of them will have smallest radius?

6. (a) Explain what is meant by quantization of energy of an electron according to the Schrödinger wave equation.

(b) Calculate the frequency and wavelength (nm) of the emitted photon, when an electron drops from the n = 4 to n = 2 state (R₆ = 2.18 × 10⁻¹⁸ J). What region of the electromagnetic spectrum is it found?

(c) (i) The radius of O atom is 0.730 Ångstroms, the radius of the O²⁻ ion is 1.40 Ångstroms. Account for the difference.
   (ii) What is the general relationship between the size of the atom and its ionization energy? Explain why F has a larger ionization energy than O?

(d) (i) How many unhybridized p-atomic orbitals are there on an sp-hybridized carbon atom?
   (ii) Explain why there is no 'ionic molecule'?

7. (a) Describe the degradation of organic pesticides by the following chemical methods:
   (i) Photochemical process (ii) Oxidation (iii) Dehalogenation.

(b) How pesticides are transported in air and soil? Write down the factors affecting degradation of pesticides.

Contd ........... P/3
(c) Describe the physical and chemical properties of alkali metals. 

(d) (i) Calculate the bond order for He$_2$, B$_2$ and F$_2$ molecules using molecular orbital theory of bonding. Which of these molecules will show paramagnetic behavior? 

(ii) Draw lewis structure of two molecules which show exceptions to the octet rule.

8. (a) Write down the sources of organic pollutants in water. How organic pollutants pollute our environmental water? 

(b) (i) Distinguish between soaps and detergents. 

(ii) What are the detrimental effects of soaps and detergents to the environment? 

(c) (i) Mention the sources of formaldehyde. 

(ii) Which special precautions should be taken for the safety of human and fish during handling formalin?
There are FOUR questions in this section. Answer Q. No. 1 and any TWO from the rest.

1. Read the following passage carefully and answer the questions that follow:

Three passions, simple but overwhelmingly strong, have governed my life: the longing for love, the search for knowledge, and unbearable pity for the suffering of mankind. These passions, like great winds, have blown me hither and thither, in a wayward course, over a deep ocean of anguish, reaching to the very verge of despair.

I have sought love, first, because it brings ecstasy—ecstasy so great that I would often have sacrificed all the rest of life for a few hours of this joy, I have sought it, next, because it relieves loneliness—that terrible loneliness in which one shivering consciousness looks over the rim of the world into the cold unfathomable lifeless abyss, I have sought, and thought it might seem too good for human life, this is what at last—I have formed.

With equal passion I have sought knowledge. I have wished to understand the hearts of men. I have wished to know why the stars shine. And I have tried to apprehend the Pythagorean power by which number holds sway above the flux. A little of this, but not much, I have achieved.

Love and knowledge, so far as they were possible led upward toward the heavens. But always pity brought me back to earth. Echoes of cries of pain, reverberate in my heart. Children in famine, victims tortured by oppressors, helpless old people a hated burden of their sons, and the whole world of loneliness, poverty, and pain make a mockery of what human life should lie. I long to alleviate the evil, but I cannot, and I took suffer.

This has been my life. I have found it worth living, and world gladly like it again if the chances were offered me.

Questions:

(i) What passions has the writer mentioned in the essay?
(ii) What changes have the passions brought in the writer?
(iii) What is the purpose of love that has been mentioned first?
(iv) What is the writer's quest as expressed in the third paragraph of the essay?
(v) What is the writer's point of view in the essay?
(vi) Give meaning of the following words as used in the essay?
   Anguish, ecstasy, apprehend, reverberate, mockery
2. (a) Suppose you are the chief engineer of a firm. Draft a suitable complaint letter about having received sub-standard and defective goods from your suppliers. (Provide other details of your own). (10)

(b) Write phonetic transcriptions of the following words: (Any five) (10)

Among, hunger, shout, care, thing, colonel

3. (a) Write a dialogue between two resident BUET students about the condition of the daily meals in the dining halls. (10)

(b) Write a short essay on any one of the following topics: (10)

(i) Housing Problems in Bangladesh
(ii) My Dream
(iii) Historic sites in Dhaka city.

4. (a) Transform the following sentences as directed. (Any five) (10)

(i) He was terribly unhappy but he didn’t blame the girl. (Simple)
(ii) A little learning is a dangerous thing. (Complex)
(iii) In addition to his valuable advice, he gives them financial assistance. (Compound)
(iv) You can't buy things money you have money. (Compound)
(v) We helped the poor villagers. (Complex)
(vi) He follows the example which was set by his father. (Simple)

(b) Write short notes on any two of the following: (10)

(i) Principles of writing a business letter.
(ii) Annual Confidential Report
(iii) The Diphthongs

SECTION – B

There are FOUR questions in this section. Answer Q. No. 5 and any TWO from the rest. Symbols indicate their usual meaning.

5. (a) Explain with reference to the context any one of the following: (8)

(i) "You have lost reason and taken the wrong path. You have taken lies for and hideousness for beauty.
(ii) "How singular is life, and how full of changes! How small a thing will ruin or save one!"

Contd ........... P/3
(b) Answer any one of the following:

(i) Give a description of how the lawyer spent his fifteen years in jail.
(ii) Mrs. Matilda Loisel suffered more than she deserved. — Discuss according to the story of "The Diamond Necklace".

(c) Answer any three of the following:

(i) What did the Loisel couple decide to do when they found that the necklace missing?
(ii) What was the topic of discussion in the party hosted by the banker?
(iii) What were the things that the lawyer was allowed to enjoy in jail?
(iv) What do you know about Hermes?

6. Recast and correct any ten of the following sentences:

(i) They made less mistakes with the new calculating machine.
(ii) The militia is discussing the battle among itself.
(iii) It is the Robinsons whom, I feel certain, are to come.
(iv) Providing that he is not tried, he will address the group.
(v) The number of books was more adequate than we had expected.
(vi) A trio of boys were scheduled to sing.
(vii) The jury are giving their verdict now.
(viii) That was me whom you saw yesterday.
(ix) Last week our clergyman reminded us that living the upright life was a discipline.
(x) If Mary was here now, she would you how to cook.
(xi) He is something better today.
(xii) He didn't speak but once.

7. (a) Give meanings of any ten of the following words:

Accumulate, blandishment, coerce, diminutive, eulogy, grudge, holocaust, meddle, nadir, ramble, scrape, troupe.

(b) Make sentences with any ten of the following words:

Audacious, brandish, concoct, deride, flip, grouchy, impromptu, lustrous, oblivion, rebut, simulate, tyro.
8. Write a précis of the following passage with a suitable title:

We must build a word of peace, and we cannot do so unless we secure for it a truly moral foundation. We may hold different metaphysical views, adopt different modes of worship, and there are millions today who do not desire to place their faith in any God at all. But everyone of us will feel highly offended if he is pronounced destitute of any moral sense, if he is said to be unfaithful or unloving. All religions or systems of morality are agrees on the point that respect for life, respect for intangible possessions, good name and honour, constitute morality and justice. 'Do not to do others what you would not like to be done to you'. Even primitive sages accept this principle. Only for them its appreciation is limited to their own tribe and race and those outside are not regarded as human beings. As our horizon expands, as our moral sense deepens, we feel that these moral precepts are valid for all human beings. Today the world is like a ship, with no captain, heading for the rocks. It is swept by passion and folly. We do not know whether it is passing through birth pangs or death other. If we adopt the path of greed, hatred and self interest, we will become something less than human. If we take the path of fortitude, un-selfish service and sacrifice we will reach height of splendour in body, mind and spirit of which we can hardly dream. Non-religion is our malady and religion is an adventure of spirit and as a tool radical transformation of human nature is the cure for it.