

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2021-2022

Sub : **BME 101** (Introduction to Biomedical Engineering)

Full Marks : 210

Time : 3 Hours

The figures in the margin indicate full marks.

The symbols have their usual meanings.

USE SEPARATE SCRIPTS FOR EACH SECTION

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

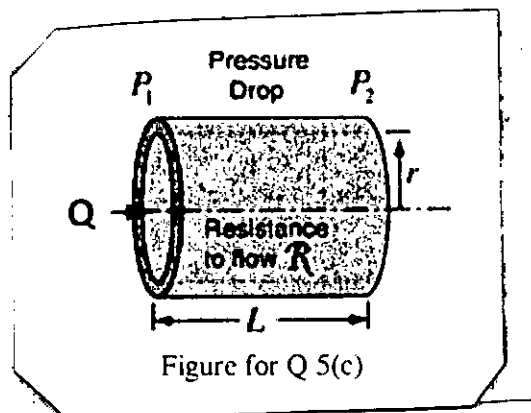
1. (a) How can the knowledge of cell mechanics be used to diagnose diseases? (8)
 (b) Two children are playing on a seesaw, whose arm can incline at a maximum of 30° relative to the horizontal. The mass of one child is 20 kg and the other is 21 kg. They are playing well, giving small push offs from the ground. At a given moment, the child with the smaller mass was up and at rest. (16)
 At this moment, find (i) the pressure exerted by this child on the board, remembering that her or his contact area with the board is 300 cm^2 . (ii) the force exerted on the right knee on this child, when it is known that 88% of body mass is proximal to the knee joints.
 (c) How does bone response to stress? (11)
2. (a) Draw the gait flow chart. (12)
 (b) What is the physical significance of high specific gravity of urine of a patient? What are the factors that affect whole blood viscosity. (12)
 (c) What are the advantages and limitations of metallic implants? (11)
3. (a) Which type of biomaterial would you select for the construction of (i) skin substitute and (ii) total hip joint? Justify your selection of materials. (4+6)
 (b) Which 3D printing process has the highest accuracy? Briefly, describe the working principle of it. (13)
 (c) With example, write short notes on the classes of medical devices.? (12)
4. (a) What are the most important characteristics of stem cells? (5)
 (b) Write down the working principles of (i) the glucose sensor and (ii) the pulse oximeter. (16)
 (c) What are the 12 leads of ECG? Explain how 10 electrodes can be used to measure ECG signals. (14)

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SECTION – B

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

5. (a) Why is an inverted microscope preferred live cell imaging? (8)
- (b) There are many steps in the pathway leading from DNA to protein, and all of them can in principle be regulated. Briefly explain how you can control the gene expression. (15)
- (c) Figure 5(c) illustrate a simplified model of a blood vessel. Given the initial flow rate of 100 mL/sec, calculate the new flow rate if the radius of the vessel is reduced by 20%. State all the necessary assumptions. (12)



6. (a) What is the most important component of an x-ray imaging system? With a schematic, describe the working principle of the component. (15)
- (b) In cell communication, the target cell has specialized proteins called receptors, which are located on the surface and cells communicate with each other directly or indirectly via molecules called ligands. How can you measure the affinity of a receptor for a bound ligand? It is given that different ligand concentrations are measured (free and bound) for a known quantity of receptors through experiment. Derive the necessary expressions. (20)
7. (a) Write down the comparative analysis of linear, curvilinear, and phased array probes. (12)
- (b) If Plasma concentration of inulin = 1 mg inulin/mL plasma and GFR = 125 mL/min: (15)
- (i) What is the filtration rate of inulin?
- (ii) How much inulin is excreted per day?
- (c) Draw a schematic showing different lung volumes and capacities. (8)
8. (a) Defense against microbes is mediated by sequential and coordinated responses of our immune system. Compare and contrast different mechanisms of immunity systems. (12)
- (b) How does the cardiac conduction system cause the heart to contract? Explain both mechanisms with the proper schematic diagram. (10)
- (c) How can you identify the presence of a specific nucleotide sequence in both RNA and DNA? (13)
-

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

1. (a) Investigate the continuity and differentiability of the function (12)

$$f(x) = \begin{cases} x \sin\left(\frac{1}{x}\right); & x \neq 0 \\ 0; & x = 0 \end{cases} \text{ at the point } x = 0.$$

- (b) Evaluate $\lim_{x \rightarrow \frac{\pi}{2}} (\cos x)^{\frac{\pi}{2-x}}$. (11)

- (c) Find the n-th derivative of $y = \sin^5 x \cos^4 x$. (12)

2. (a) State Leibnitz's theorem. If $y = \sin(\sin^{-1} x)$, then find the value of the expression: (12)

$$x^2 y_{n+2} + (2n-1)xy_{n+1}$$

- (b) Applying Taylor's series show that (11)

$$\log(1+x) = x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \frac{x^5}{5(1+z)^5}; 0 < z < x.$$

- (c) Verify Lagrange's mean value theorem for the function $f(x) = 3 + 2x - x^2$ in the interval $[0, 1]$. (12)

3. (a) Discuss the concavity and hence find the point of inflection of $f(x) = x^3 - 3x^2 + x - 2$ and hence find the extrema. (12)

- (b) A battery having fixed voltage V and fixed internal resistance r is connected to a circuit that has variable resistance R . If the power output P is given by $P = I^2 R$, show that the maximum power occurs if $R = r$. (11)

- (c) If $u = f(x, y)$, $x = r \cos \theta$, $y = r \sin \theta$, show that (12)

$$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = \frac{\partial^2 u}{\partial r^2} + \frac{1}{r} \frac{\partial u}{\partial r} + \frac{1}{r^2} \frac{\partial^2 u}{\partial \theta^2}$$

4. (a) Find the equation of the normal to the straight line $3x - 4y + 1 = 0$ that is tangent to the parabola $x^2 + 2y = 8$. (12)

- (b) Show that the radius of curvature at any point (x, y) of the curve $x^{2/3} + y^{2/3} = a^{2/3}$ is three times the perpendicular from the origin to the tangent at (x, y) . (11)

- (c) Find all the asymptotes of the curve $x^3 + x^2 y - xy^2 - y^3 - 3x - y - 1 = 0$. (12)

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SECTION - B

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

5. Workout the following:

(a) $\int \frac{x}{(x-3)\sqrt{x+1}} dx$ (10)

(b) $\int \frac{1}{x(x^2+1)^3} dx$ (10)

(c) $\int \frac{\tan x}{\sqrt{a+b \tan^2 x}} dx$; discuss for $a > b$, $a < b$ and $a = b$. (15)

6. (a) Find a reduction formula for $\int \frac{dx}{(a+b \cos x)^n}$ and hence find $\int \frac{dx}{(2+\cos x)^3}$. (15)

(b) Graph the function $f(x) = 3x - 3$ over the specified interval $[a, x] = [2, x]$. Then use simple area formula from geometry to find the area function $A(x)$ that gives the area between the graph of the specified function $f(x)$ and the interval $[a, x]$. Finally, Confirm that $A'(x) = f(x)$. (10)

(c) Evaluate $\lim_{n \rightarrow \infty} \left\{ \left(1 + \frac{1^2}{n^2}\right) \left(1 + \frac{2^2}{n^2}\right) \dots \dots \left(1 + \frac{n^2}{n^2}\right) \right\}^{1/n}$. (10)

7. (a) Show that, $\int_0^\infty \frac{x}{(1+x)^3} dx = \frac{1}{2} \int_0^\infty \frac{1}{(1+x)^2} dx = \frac{1}{2}$. (15)

(b) Define Gamma function. Using Gamma function evaluate $\int_0^\infty x^m e^{-ax^n} dx$ when m, n and a are all positive constant. (10)

(c) Evaluate $\int_0^1 \frac{dx}{\sqrt{1-x^n}}$. (10)

8. (a) Find the area of the lower portion of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ intercepted by the line $y = c$. (12)

(b) Find the area of the surface of a sphere generated by revolving the semicircle $y = \sqrt{r^2 - x^2}$ about the x -axis. (12)

(c) Find the area of a loop $r = a \cos 4\theta$. Hence find the total area of all the loops. (11)

The figures in the margin indicate full marks.

Symbols have their usual meanings.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) What is spherical aberration? How is it minimized when two thin lenses are placed at a distance from each other? (10)
- (b) Explain the longitudinal chromatic aberration and circle of least chromatic aberration with a suitable diagram. Show that the diameter of the circle of least chromatic aberration depends on the diameter of the lens aperture and dispersive power of the material of the lens. (18)
- (c) Two thin lenses of focal lengths f_1 and f_2 separated by a distance d have an equivalent focal length of 50 cm. The combination satisfies the conditions for minimum spherical aberration and is also achromatic. Find the values of f_1 , f_2 and d . Assume that both the lenses are made of same material. (7)

2. (a) What are Newton's rings? Explain the formation of Newton's ring with a suitable optical diagram. (10)
- (b) Explain with necessary theory how can you determine the radius of curvature of a plano-convex lens by Newton's ring experiment? (18)
- (c) In Newton's ring experiment, the diameters of the n^{th} and $(n+8)^{\text{th}}$ bright rings are 4.2 mm and 7 mm, respectively. Radius of curvature of the lower surface of the lens is 2 meters. Determine the wavelength of light and the ring number n . (7)

3. (a) Explain the phenomenon of double refraction in a calcite crystal. What are ordinary and extraordinary rays? (10)
- (b) What is Nicol prism? Give with details the construction of a Nicol prism and explain how it produces plane polarized light. (18)
- (c) Calculate the thickness of double refracting plate capable of producing a path difference of $\lambda/4$ between the extraordinary and ordinary rays. Given $\lambda = 5890 \text{ \AA}$, $\mu_o = 1.53$ and $\mu_e = 1.54$. (7)

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4. (a) Suppose, at a certain temperature T , a gas container containing N number of molecules. Due to collision with themselves and with the wall of the container, the velocity of the molecule changes. In order to obtain the mean number of molecules with position and momentum of gas molecules, write down the velocity distribution function that was proposed by Maxwell and hence, (17)
- (i) Obtain the mean velocity \bar{C} , root mean square velocity (C_{rms}) and show that, $\bar{C} : C_{rms} = 0.921$.
- (ii) Draw the velocity distribution graph and mention various velocities.
- (b) What is Brownian motion? Write down the characteristics of Brownian motion. (8)
- (c) At what temperature will oxygen molecules have the same root mean square velocity as that of hydrogen molecules at -100°C ? (10)

SECTION – B

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

5. (a) Describe in brief the basic assumption of a thermocouple with proper diagram. In case of a thermocouple, (13)
- (i) Show that, the neutral temperature is constant.
- (ii) Draw the variation of thermo EMF with respect to the temperature.
- (b) What is the basic principle of a Platinum resistance thermometer? For a Platinum resistance thermometer, show that, (12)

$$t - t_p = \delta \left\{ \left(\frac{t}{100} \right)^2 - \frac{t}{100} \right\}$$

Where the symbols have their usual meanings.

- (c) The resistance of a platinum wire at $0, 100$ and 144°C is found to be $5.5, 7.5$ and 14.5 ohm, respectively. The resistance of wire at a temperature $t^\circ\text{C}$ is given by the equation, (10)

$$R_t = R_0 (1 + \alpha t + \beta t^2)$$

Find the values of α and β .

6. (a) What are isothermal and adiabatic processes? In case of adiabatic process show that, (12)

$$TP^{\left(\frac{1-\gamma}{\gamma}\right)} = \text{constant}$$

Where the symbols have their usual meanings.

- (b) Define entropy of a thermodynamic system. (13)
- (i) Show that entropy change depends only upon initial and final states, not on the paths.
- (ii) Analyze the change in entropy for Van der Waals gas.

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Contd ... Q. No. 6

(c) An insulated container of gas has two chambers separated by an insulating partition. One of the chambers has volume V_1 and contains ideal gas at pressure P_1 and temperature T_1 . The other chamber has volume V_2 and contains ideal gas at pressure P_2 and temperature T_2 . If the partition is removed without doing any work on the gases, then show that the final equilibrium temperature of the container is,

(10)

$$T = \frac{T_1 T_2 (P_1 V_1 + P_2 V_2)}{P_1 V_1 T_2 + P_2 V_2 T_1}$$

7. (a) Distinguish between free and forced oscillations.

(5)

(b) What is damped harmonic motion? Derive the differential equation of a damped harmonic motion and solve the equation. Discuss in detail the condition of under-damped motion.

(20)

(c) A damped harmonic oscillator having a mass of 250 g. The force constant is 85 N/m and the damping coefficient is 70 g/s.

(10)

(i) What is the period of the motion?

(ii) How long does it take for the amplitude of the damped oscillations to drop to half of its initial value?

8. (a) Define phase velocity and group velocity.

(7)

(b) Establish the relation between phase velocity and group velocity. What is their relationship for a non-dispersive medium?

(18)

(c) The equation of a progressive wave is represented by, $y = 0.23 \sin \frac{\pi}{65} (64000t - 2x)$ cm.

If the wave is travelling through the medium of density 0.00129 g/cm^2 , find the rate of flow of energy across a square centimeter.

(10)

SECTION – A

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

1. (a) Explain how the photoelectric effect provides evidence for the wave-particle duality of light? (10)
- (b) A particle has a velocity of 3.00×10^6 m/s and a position uncertainty of 2.00×10^{-10} m. Calculate the minimum uncertainty in the momentum of the particle. How does the uncertainty in momentum change if the position uncertainty is decreased by a factor of 10? (10)
- (c) Show the radial distribution function for hydrogenic 1s, 2s and 2p orbitals with nodes. Why 2s gives the electron a greater probability of close approach to the nucleus compared to 2p orbitals? (10)
- (d) Analyze the following observation, "electron in an orbital with $n = 1$ in a hydrogen atom have a lower energy than a free electron ($n = \infty$)". (5)

2. (a) What isoelectronic series arises from fluorine, nitrogen, magnesium, and carbon? Arrange the ions in the series by (i) increasing nuclear charge (ii) increasing size. (10)
- (b) Explain how electron spin contributes to the magnetic properties of atoms. Sketch the shape of the periodic table if the electron could only have spin $+\frac{1}{2}$. (10)
- (c) If a great deal of energy is required to form gaseous ions, why do ionic compounds form at all? Sketch the Born-Haber cycle for formation of CaO(s) from its elements and find out the steps which will require an input of energy. (10)
- (d) Predict impact of a reduced effective nuclear charge on chemical reactivity. (5)

3. (a) Predict the shapes of (i) SO_3^{2-} (ii) O_3 (iii) PCl_4^+ , showing all the necessary steps. (10)
- (b) from the three possible ways to connect carbon, nitrogen, and oxygen to form a monoanion: CNO^- , CON^- , and OCN^- , one is the cyanate ion, a common and stable species: one is the fulminate ion, salts of which are used as explosive detonators; and one is so unstable that it has never been isolated. Use the concept of formal charge to determine which isomer is cyanate, which is the fulminate, and which is the least stable one. (10)

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Contd ... Q. No. 3

- (c) Draw a diagram that illustrate how atomic p orbitals can form both σ and π molecular orbitals. What effect of 2s-2p mixing is observed in relative energy level of molecular orbitals (MOs) in homonuclear diatomic molecules of period 2 elements? (10)
- (d) Apply hard and soft acid-base theory to explain the solubility of silver halides. (5)
4. (a) Using 'Linear Combination of Atomic Orbitals' explain why hydrogen is found as H_2 molecule in nature. Compare the bond strength and bond length among C_2^+ , C_2 and C_2^- . (10)
- (b) What are the factors that influence the acidity of a compound, and how do they affect the strength of the acid? (10)
- (c) Calculate the pH of the 0.30 M NH_3 /0.36 M NH_4Cl buffer system. What is the pH after the addition of 20.0 mL of 0.050 M NaOH to 80.0 mL of the buffer solution? ($pK_a = 9.25$). (10)
- (d) Water can act as a Lewis base – explain using frontier molecular orbital theory. (5)

SECTION – B

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

5. (a) Describe the kinds of intermolecular interactions involved in solution formation. Why the solubility of glucose ($C_6H_{12}O_6$) is higher than cyclohexane (C_6H_{12}) in water. (10)
- (b) Define colligative properties. Derive Rault's law of relative lowering of vapor pressure. (10)
- (c) Draw and explain the phase diagram of water. Determine the degree of freedom of different curves, areas and points of the phase diagram of water. (15)
6. (a) What is equilibrium constant? Deduce the relationship between K_p and K_c . (10)
- (b) State Le Chatelier's principle. Explain the effect of increasing temperature and pressure on the reactions given below: (15)
- (i) $CH_4(g) + 2O_2(g) \rightleftharpoons CO_2(g) + 2H_2O(l) + 212.8 \text{ kcal}$
- (ii) $H_2(g) + I_2(g) + 12.4 \text{ kcal} \rightleftharpoons 2HI(g)$
- (iii) $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) + 22.2 \text{ kcal}$
- (c) Define standard enthalpy of formation and standard enthalpy of reaction. If the standard enthalpy of formation of $C_2H_5OH(l)$, $CO_2(g)$ and $H_2O(l)$ are -277.0 , -393.5 and $-285.5 \text{ kJ/mol}^{-1}$, respectively, calculate the standard enthalpy change for the reaction: $C_2H_5OH(l) + 3O_2(l) \rightarrow 2CO_2(g) + 3H_2O(l)$. (10)

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7. (a) Define enthalpy of combustion and enthalpy of neutralization with proper examples. Why the enthalpy of neutralization of strong acid and strong base is always constant? (10)

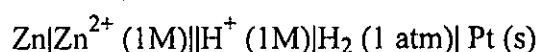
(b) State and explain Hess's law. Illustrate a proper example of Hess's law. (10)

(c) Draw and explain the construction of a primary standard hydrogen electrode. Calculate the emf, ΔG and K of the following cell and comment on the feasibility of the cell reaction – (15)



The standard potential of $\text{Ag}|\text{Ag}^+$ half-cell is +0.80 V and $\text{Zn}|\text{Zn}^{2+}$ is -0.76 V.

8. (a) Draw the schematic diagram of the cell given below: (10)



If E_{cell}^0 is 0.76 V, how can you calculate the $E^0 \text{Zn}^{2+}/\text{Zn}$.

(b) What is rate law? Explain the graphical method to determine the order of a reaction. (10)

(c) Derive the rate equation for second order reaction. Hydrolysis of ethyl acetate by NaOH using equal concentration of the reactants was studied by titrating 25 mL of the reaction mixture at different time intervals against standard acid. From the data given below, establish that it is a second order reaction. (15)

t (m)	0	5	15	25
mL acid used	16.00	10.24	6.13	4.32

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE** questions including **Q. No. 1** as compulsory.

1. (a) Explain with reference to the context any two of the following: (15)
- (i) "His specs - use them as burning glasses!"
- (ii) They were watching me as they watch a conjurer about to perform a trick."
- (iii) "It's what causes you to have money. If you're lucky you have money."
- (b) Answer any one of the following: (15)
- (i) What does D. H. Lawrence intend to delineate in the story "The Rocking Horse Winner"?
- (ii) What did the author try to showcase in the story 'An Astrologer's Day'?
- (c) Answer any three of the following: (15)
- (i) How did Paul prove himself lucky?
- (ii) Why was the police officer in a dilemma to shoot the elephant?
- (iii) How was the island where the children landed on after the plane crash?
- (iv) Give a pen picture of the death of the elephant?
- (v) Who was Guru Nayak? How was he entrapped by the astrologer?
2. (a) Recast and correct any ten of the following sentences: (15)
- (i) The Chinese have strange habits.
- (ii) Edison discovered the gramophone.
- (iii) A boy has a cat who is in our class.
- (iv) He complained that his wage is low.
- (v) The ordered goods have not arrived.
- (vi) I saw a strange dream last night.
- (vii) My sister is taller than me.
- (viii) He speaks the English very well.
- (ix) I was absent one time or two times.
- (x) All his money are kept in the bank.
- (xi) I do not wish any reward.
- (xii) He is now persuaded of his honesty.
- (b) Give the meaning of an make a sentence with any ten of the following words: (15)
- Accumulate, Bellow, Bewilder, Castigate, Conversion, Drowsy, Disseminate, Exultant, Imminent, Germinate, Profound, Reiterate.

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3. Expand any one of the following ideas: (30)
- (i) Work is worship
 - (ii) Happiness improves health and lengthens life.

4. Write a précis of the following: (30)

In Bangladesh, nature has been at a crisis point for quite some time, and one only needs to look at the present state of our rivers, forests and hills to understand that. This destructive trend has extended to biodiversity as well. Over the last several decades, there has been a persistent drop in the country's wildlife population. Populations of mammals, birds, amphibians, reptiles and fish are all also shrinking. This is a deeply troubling situation which we must address. The threat to wildlife has come under renewed scrutiny on this year's World Wildlife Day. According to a recent report wildlife trade has been going on unabated in many parts of the country which mentions 13 districts where illegal trade in live animals and animal parts is thriving.

According to sources, there has been an uptick in wildlife trafficking in recent months, suggesting the involvement of a powerful gang. As well as live animals, animal body parts including meat, bones, teeth, nails, skin and even blood are also reportedly sold at a higher price or smuggled. Although police occasionally seize consignments of animals and animal parts, clearly those haven't been enough to put a brake on this lucrative trade. Sadly, trafficking is only a part of the problem facing wildlife in Bangladesh. Often the threat also comes from irresponsible conduct by state officials. More alarmingly, wild animals are also suffering from increasing habitat loss. These developments only symptomize the ongoing neglect of wildlife in Bangladesh. Officially, the government retains the policy of supporting biodiversity conservation, but the reality is totally different. Given the grave, multidimensional risks that wildlife and our natural world face, we need to critically rethink our approach to this issue. We urge the authorities to ensure that all threats to wildlife are eradicated. They must take firmer action in this regard.

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE** questions including **Q. No. 1** as compulsory.

5. Read the following passage carefully and answer the questions that follow: (45)

In recent years biology has undergone a revolution that has attracted wide attention. The controversy centered initially on whether genetic cloning techniques could create new, possibly dangerous forms of life. Attention next focused on the power Biomedical Engineering to produce valuable new medical products. Biomedical Engineering is an interdisciplinary field that combines the principles of engineering and biology to design and develop medical devices, diagnostic tools, and therapies.

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Contd ... Q. No. 5

Biomedical engineers use their expertise to develop innovative solutions to improve healthcare and enhance the quality of life of patients. Largely overlooked, however developments in biomedical sectors that will ultimately have a far greater social impact: the ability to analyze genetic information will allow the prediction of human traits. To design and develop medical devices, biomedical; engineers must have a thorough understanding of the principles of biology. They use their knowledge of biological systems to create devices that can interact with the human body in a safe and effective manner. For example, a biomedical engineer designing an artificial heart valve would need to understand how the natural heart valve works in order to create a device that mimies its function. Another important area of focus for biomedical engineers is the development of regenerative medicine. This involves using the body's own cells and tissues to repair or replace damaged or tissue and genes. Biomedical engineers work to develop techniques for growing and manipulating cells or genes in the lab, as well as devices and therapies that can be used to transplant these cells into the body through gene therapy. Regenerative medicine has the potential to revolutionize healthcare by allowing doctors to replace damaged or diseased tissue or genes with healthy tissue grown from a patient's own cells.

While some fear that by analyzing the entire library of human gene sequences we will discover the essence of humanity, this is unlikely. Our bodies are complex networks of interacting components are influenced by a variable environment. Nevertheless, genes do help determine aspects of human form and function. Herein lay the seeds of future problems. By about the year 2010, barring unforeseen technical obstacles, scientists will have fully mapped the complex human genetic landscape. Before this, however, new information will make possible techniques that will engender a host of ethical issues. Even if society can anticipate and control most misuse of genetic data. we face a more insidious problem: a rising ethic of genetic determinism. For the past century, ideological currents have closely affected the nature versus nature debate. Widespread rejection of social Darwinism and institutionalized racism has buoyed the strong naturist sentiments of the past half century, but a growing proportion of the public, impressed by the successes of genetics, is likely to come to view genes as determinants of the human condition. Such an uncritical embrace of genetics is likely to come to view genes as determinants of the human condition. Such an uncritical embrace of genetics will not be deterred by scientists reminders that the powers of genetic predictions are limited. Environmental variations can cause genetically similar individuals to develop in dramatically different ways, and genetics will at best suggest only a probability of development for complex traits, such as those involved in behavior and cognition. Those overlooking this will disastrously misjudge individual ability. What a tragedy this would be. We have viewed our roots as interesting historical relies, hardly as rigid molds dictating all that we are and will be.

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Contd ... Q. No. 5

Moreover, a belief that each of us is responsible for our own behavior has woven our social fabric. Yet in the coming years we will hear increasingly from those attributing "bad" behavior to inexorable biological forces. Hence, there are ethical considerations that biomedical engineers must take into account when designing medical technologies. They must consider issues such as patient privacy, informed consent, and the potential for harm to patients. Biomedical engineers must also be aware of the regulatory environment in which they operate, as medical devices and therapies are subject to strict government regulations. The biological revolution of the past decades will spawn enormous benefits, but we will pay a price unless we craft an ethic that cherishes our spontaneity, unpredictability, and individual uniqueness.

Answer the following questions:

- (i) How do biomedical engineers use principles of biology in their work?
- (ii) What is the role of biomedical engineers in the development of regenerative medicine?
- (iii) What is your stance regarding the nature versus nature debate?
- (iv) What can be an appropriate title of the passage? Justify.
- (v) Summarize the passage.
- (vi) Give the meanings of the following words as used in the passage:
revolution, prediction, cognition, inexorable, spawn

6. (a) Suppose as a Biomedical Engineer of techno Co. Ltd., you had ordered 35 Autoclave Machine after examining the samples sent by the supplier. When the consignment arrived, you found neither in quality nor the quantity of the devices haven matched the samples you had approved. Demanding their replacement, write a complaint letter to the Managing Director of that company. (Provide other details from your own.) (10)
- (b) Write phonetic transcription of the following words: (any five) (10)
Total, Ago, Father, Beard, Poor, Donor
- (c) Explain the process of communication with a diagram. (10)
7. (a) What are the purposes of writing a report? Discuss all matters of interpretative report elaborately. (10)
- (b) Write a short essay on any one of the following topics: (10)
(i) Ensuring Safety in Laboratory: Prospects and Challenges
(ii) Industrial Visit: A Way of Enriching Pragmatic Knowledge
(iii) The Future of Biomedical Engineering: Trends and predictions
- (c) Write a dialogue between two classmates about insomnia among the students of BUET. (10)

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8. (a) Transform the following sentences as directed: (Any five) **(10)**
- (i) Though he is not sick, he feels weak. (Compound)
 - (ii) She was too poor to educate her children. (Complex)
 - (iii) Sam saw a snake and killed it at once. (Simple)
 - (iv) As I took the money. I came back to my mother. (Simple)
 - (v) Health is wealth. (Complex)
 - (vi) The weather being cold, we returned from the playground. (Compound)
- (b) Draw a structure of a business letter in full block format mentioning its all parts. **(5)**
- (c) Write short notes on any three of the following: **(15)**
- (i) Context modulators
 - (ii) Semantic gap in business correspondence
 - (iii) Essential key components of a paragraph
 - (iv) Questionnaire: Its Role in the Report Writing
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