Khulna University of Engineering & Technology
B. Sc. Engineering 4th Year 2nd Term Regular Examination, 2022
Department of Biomedical Engineering

BME 4215
Bio-Nanotechnology

Time: 3 Hours **Full Marks: 210**

N.B. i) Answer **any THREE** questions from each section in separate scripts
ii) Figures in the right margin indicate full marks.

Section A

(Answer **ANY THREE** questions from this section in Script A)

1.	a)	Define nanotechnology. Mention the differences between bionanotechnology and nano-biotechnology with examples.	(08)
	b)	"At nanoscale, properties become size-dependent" Explain the statement with describing five properties.	(20)
	c)	Briefly explain the principle of quantum tunneling.	(07)
2.	a)	Define nanomaterial. What are the ways of getting nanomaterials? What are the types of engineered nanomaterials?	(08)
	b)	Why are nanomaterials used? Give some examples of nanomaterials in products.	(07)
	c)	Discuss about the major fields in bionanotechnology.	(12)
	d)	Mention some advantages and applications of bionanotechnology.	(08)
3.	a)	"Bionanotechnology is used in disease diagnosis" Explain the statement with examples.	(08)
	b)	Explain the differences between traditional and targeted drug delivery with appropriate figures.	(08)
	c)	What is CNT? Describe with figure how the CNTs are used for cancer therapy.	(12)
	d)	Briefly describe the role of bionanotechnology in drug development.	(07)
4.	a)	What is meant by nanotechnology safety? Briefly explain the hazards of nanomaterials.	(11)
	b)	Mention some potential environmental benefits of nanotechnology (with specific examples).	(15)
	c)	How does nanotechnology impact our social life?	(09)

Section B

(Answer **ANY THREE** questions from this section in Script B)

5.	a)	What is self-assembly? Write down the types, adaptive features, and driving forces for self-assembly.	(10)
	b)	Explain the role of VNPs in different imaging modalities.	(10)
	c)	What is the general strategy for designing fusion proteins that assemble into symmetric nanostructures? Design a building array and nanotube or sheet using the protein self-assembly approach.	(15)
6.	a)	Explain the arrangement of an icosahedral symmetric viral capsids.	(10)
	b)	What is DNA nanotechnology? How are DNA nanostructures built? Explain briefly using the necessary diagram.	(15)
	c)	How can we produce SLN and NLC using the membrane contactor technique? Explain.	(10)
7.	a)	What is peptide ink? Elaborate on the fabrication process of peptide nanofibers.	(10)
	b)	What are the basic steps in niosome preparation? Explain the Ether Ejection method for niosome production.	(10)
	c)	What are the types of QDs? Discus the applications of QDs in biological contexts.	(15)
8.	a)	How can we produce liposome using sonification and DRV method?	(12)
	b)	Enumerate the strategies for developing functionalized VNPs.	(13)
	c)	What are the applications of bacterial nanoparticles in food industry?	(10)

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BME 4217
Rehabilitation Engineering

Time: 3 Hours **Full Marks: 210**

N.B. i) Answer **any THREE** questions from each section in separate scripts
ii) Figures in the right margin indicate full marks.

Section A

(Answer **ANY THREE** questions from this section in Script A)

1. a) What is rehabilitation engineering? Enumerate different types of rehabilitation with example. (10)
b) What is meant by health promotion? Explain the importance of rehabilitation using appropriate graphical representation. (13)
c) What are the goals of a typical rehabilitation program? Illustrate the Meikirch model of health and explain in brief. (12)

2. a) How does prolonged bed rest lead to body deconditioning? Explain with appropriate diagram. (12)
b) What is BCI? John is a paralyzed patient. He is paralyzed from neck to toe. He moves by operating a wheelchair. The wheelchair is equipped with EEG recording system. How does he turn the wheelchair to left/right? Explain with proper diagram. (13)
c) How does the Lingraphica AAC device help individual with speech and language impairments? (10)

3. a) Discuss the working principle of refreshable braille display. (10)
b) What are the key features will you add if you are about to design a smart blind stick and why? (13)
c) Outline the components of a cochlear implant and illustrate its structure. (12)

4. a) Show the Q angle and tibiofemoral angle. What is the basic advantage of using Canadian hip prosthesis? (10)
b) Discuss hip disarticulation (through hip) amputation. (13)
c) Who are the members of rehabilitation team? Explain their roles. (12)

Section B

(Answer **ANY THREE** questions from this section in Script B)

5. a) Illustrate the permeation of person and society in assistive technology and rehabilitation engineering. (12)
b) What is PIIAATE model? Explain the participatory action design model. (13)
c) What is assistive technology? Classify orthosis. (10)

6. a) Define orthotics. List the types of orthotic device with example. (10)
b) Discuss the biomechanical principles for designing orthotic devices. Also compare the properties of orthotic materials with natural muscle. (13)
c) Explain the process of assessing abnormal gait in patients with cerebral palsy. (12)

7. a) What is myoelectric prosthesis? Show the degrees of freedom in the hand for myoelectric prosthesis. (10)
b) Discuss the working principle of a myoelectric prosthesis with appropriate schematics. (13)
c) Which individuals benefit from using mobility aids? Discuss some common mobility aids for the rehabilitation of impaired people. (12)

8. a) Enumerate some common 3D printing technologies for soft tissue prosthetics. Illustrate a schematic of a typical soft prosthetic, outlining both the skin-like layer and the substructure. (10)
b) Discuss the transition of soft tissue prosthetics from hand-crafting to advanced manufacturing. (13)
c) What is body-powered prosthesis? Write an essay on the commercially available smart automatic prosthetic hands. (12)

Khulna University of Engineering & Technology
B. Sc. Engineering 4th Year 2nd Term Regular Examination, 2022
Department of Biomedical Engineering

BME 4221
Bioinformatics

Time: 3 Hours **Full Marks: 210**

N.B. i) Answer **any THREE** questions from each section in separate scripts
ii) Figures in the right margin indicate full marks.

Section A

(Answer **ANY THREE** questions from this section in Script A)

1. a) What is bioinformatics? Discuss the evolutionary basis of sequence alignment. (08)
   b) What is sequence similarity? Find the global sequence alignment between two sequences 'ATGGCCTC' and 'ACGGCTC' using dynamic programming. (Gap= -4, Mismatch = -3, and Match = 1) (16)
   c) Differentiate between global and local alignments. Compare the sequences 'TCAAGACTTACCGAC' and 'TAAGACATTACCG' using the dot plot method. (11)

2. a) Explain the process of FASTA for database similarity searching. (15)
   b) What are the sequence motif and PROSITE? Write down the steps to find the motif on PROSITE. (10)
   c) What is protein? Write down the important functions of protein. (10)

3. a) Explain the Chou-Fasman algorithm for secondary structure prediction. Assume a dataset consists of 100000 residues. One-third of them are in helix conformation. Alanine is observed 8000 times. In the helix conformation, there are 5000 Alanine. Determine the propensity value of Alanine to form α-helix. (12)
   b) Discuss the Profile Network from Heidelberg program. (10)
   c) Define functional genomics. Explain the DNA microarray based global gene expression profiling method. (13)

4. a) What is transcriptome analysis? Explain serial analysis of gene expression with appropriate schematic. (15)
   b) Construct a hashing table for the sequences 'AMPSDGL' and 'GPSDNAT' and also determine the optimum alignment. (10)
   c) How can you contribute in the field of bioinformatics as a biomedical engineer? Discuss your rationale with practical example. (10)

Section B

(Answer **ANY THREE** questions from this section in Script B)

5. a) Fig. 5(a) is showing four sequences A, B, C, and D. Construct a distance matrix from the sequences utilizing the Jukes-Cantor model. (10)

A→AATTAGCTAACCTGGCACCT
B→AGTCCGCTACCCTAACACCT
C→AATCAGTTAATTCTGGCACC
D→AGTTAGCTAACTTGGCACTT

Fig. 5(a)

b) (i) A distance matrix is given in Table 5(b). Construct a phylogenetic tree from the matrix data using the UPGMA method and compare the newly formed distance matrix with the given one. (25)

Table 5(b)

	A	B	C
B	0.40		
C	0.35	0.45	
D	0.60	0.70	0.55

(ii) Using the same matrix in Table 5(b), construct a phylogenetic tree through the NJ method and compare the output with that of output from the problem in (i).

6. a) Explain the progressive method of multiple sequence alignment with appropriate schematic. (12)

b) Point out a precise comparison of unweighted and weighted parsimony with required schematic illustration. (08)

c) Briefly explain the different forms of tree representation with suitable examples. (10)

d) Write a short note on the pros and cons of distance-based methods for phylogenetic tree construction. (05)

7. a) What is database? Classify biological database and briefly explain each category with examples. (13)

b) What are the parameters used for evaluating the performance of gene prediction programs. Discuss them addressing their limitations. (11)

c) Construct an NCBI GenBank sequence format showing the three major components of a sequence file. Briefly discuss each sub-section of it. (11)

8. a) Briefly discuss the modification process of a nascent eukaryotic transcript into a mature mRNA for protein translation. (12)

b) What is Bootstrapping? Differentiate between ortholog and homolog. (11)

c) Write short notes on any two of the followings: (12)

(i) Ab. initio-based programs
(ii) homology-based programs, and
(iii) consensus-based programs.

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BME 4231
Telemedicine and Healthcare

Time: 3 Hours **Full Marks: 210**

N.B. i) Answer **any THREE** questions from each section in separate scripts
ii) Figures in the right margin indicate full marks.

Section A

(Answer **ANY THREE** questions from this section in Script A)

1. a) Define telehealth. Discuss the safety and security issues in establishing a good telemedicine program. (11)

b) Evaluate the readiness of Home telehealth in terms of health agency and patients. (07)

c) Briefly describe the considerations on telehealth equity and access for: (09)
(i) people with disabilities,
(ii) rural populations, and
(iii) behavioral health.

d) Briefly discuss the selection of equipment in telemedicine. (08)

2. a) Briefly demonstrate a practical case study of telemedicine system in context of Bangladesh and mention its methods of implementation, barriers, and achievements in improving healthcare services. (15)

b) What is telepresence in surgery? Enlist the future trends of surgical telemonitoring. (10)

c) Draw a four-layer architecture for smart home. How smart home can contribute to elderly healthcare. (10)

3. a) Define HIS. Mention the functions and benefits of PACS and HIS in a hospital. (08)

b) Briefly discuss the evaluation methodology for telemedicine system. (13)

c) What are the differences between PAL and NTSC? (05)

d) Why are standards necessary for telemedicine? Describe ten minimum standards for telemedicine. (09)

4. a) Perform compression of the following data using Huffman coding. Then, compare the size of total compressed data with the size of total uncompressed data. (13)
Data: {BECCABBDDAECCBBAEDDCCE}

b) Address the key ethical and legal issues associated with telemedicine. Give your recommendation to resolve these issues. (14)

c) Explain JPEG image compression process. (08)

Section B

(Answer **ANY THREE** questions from this section in Script B)

5. a) Draw the block diagram of a communication system and explain each of the blocks. Why do you think that communication is an important part of telemedicine? (11)

b) A patient is admitted at KUET medical center. A doctor from Australia is monitoring the patient. Draw the communication link between the patient and the doctor. Multiple options should be provided if possible in any part of the link. (10)

c) What are the features of 6G communication? How 6G can add new dimension of telehealthcare? (08)

d) What is meant by Bluetooth? What are the specifications of Bluetooth technology? (06)

6. Briefly explain (i) WiFi, (ii) optical fiber communication, (iii) OCC, and (iv) satellite communication technologies used in telemedicine and also mention their roles in telemedicine. Mention the prospects and limitations of each of the technologies in the deployment of telemedicine. (35)

7. a) What is OWC? OWC or RFID which one is better for telemedicine and why? (07)

b) Why do we need multiple access? Briefly explain OFDMA technique. (07)

c) How GPS is needed in telehealthcare? Explain the working principle of a GPS system. (10)

d) Briefly explain the frequency reuse concept. What are sources of interference in communication (06)

e) Briefly explain the terms (i) star topology, (ii) transmission mode, and (iii) PAN. (05)

8. a) What is meant by mHealth? Mention the benefits of mHealth. Briefly explain the key success factors for mHealth. (10)

b) Briefly explain robot assisted surgery in telehealthcare. (09)

c) Draw the block diagram of a simple medical information system. Briefly explain the blocks. (09)

d) Briefly explain home blood pressure telemonitoring system. (07)

Khulna University of Engineering & Technology
B. Sc. Engineering 4th Year 2nd Term Regular Examination, 2022
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BME 4251
Biomedical Ethics and Safety

Time: 3 Hours **Full Marks: 210**

N.B. i) Answer **any THREE** questions from each section in separate scripts
ii) Figures in the right margin indicate full marks.

Section A

(Answer **ANY THREE** questions from this section in Script A)

1. a) Define biomedical ethics. List the four principles of biomedical ethics. What do the four principles demand of us? (13)

b) How do ethics, morality, and law differ? Explain with examples. (07)

c) Suppose in a hospital, only one heart is available for transplantation. Should a person who has young children be given the heart over a single person? Over an elderly person? Should age and whether or not a person has children even matter? Give your answer based on distributive justice criteria. (10)

d) Discuss the potential risks for human subjects involved in research. (05)

2. a) "Embryonic stem cell research: an ethical dilemma". Explain the statement from deontological and consequentialist perspectives. (08)

b) Explain the challenges in informed consent process. How would you solve them? (10)

c) What is HIPAA? Why do we need HIPAA? Briefly describe the patients' rights guaranteed by HIPAAA. (12)

d) Write short notes on: (05)
(i) notice of privacy practices (NOPP) and
(ii) good clinical practice (GCP).

3. a) Differ between privacy and confidentiality. Why are they important in medical research? (08)

b) Briefly describe the following terms: (10)
(i) respect for patient autonomy and
(ii) beneficence.

c) Why are animals used in medical research? Discuss the ethical considerations when using animals in research. (10)

d) Write down the functions of IACUC. Mention the criteria for IACUC to approve animal use. (07)

4. a) What is Nuremberg code? Briefly describe 10 standards mentioned in Nuremberg code. (12)

b) Discuss the criteria for the approval of IRB in: (i) human subject research and (ii) animal research. (11)

c) What is Declaration of Helsinki? Describe the ethical principles for medical research involving human subjects. (12)

Section B

(Answer **ANY THREE** questions from this section in Script B)

5. a) What are the different bio-safety levels? Describe them with examples. In which bio-safety levels, COVID-19 test is performed? (12)

   b) Why does laboratory safety matter? Point out the lab safety rules. (08)

   c) What is the difference between safety and welfare? Illustrate different hazard symbols and briefly describe each of them with examples. (10)

   d) As a biomedical engineer, if you have to prepare a report on an incident in a clinic, then which information will you add in your incident report? (05)

6. a) What is near miss? Briefly explain different ways of radiation monitoring and safety precautions against radiation. (12)

   b) What is bloodborne pathogen? Give examples. Describe engineering controls of bloodborne pathogens. (08)

   c) Describe different types of respiratory hazards with example. (10)

   d) Define health. Write a short note on public health. (05)

7. a) Write the importance of biohazard warning labels. (05)

   b) Write a short note on chemical hazard. How would you ensure chemical safety in a wet lab? (10)

   c) Briefly explain the process in activity based qualitative risk assessment methods. (07)

   d) Explain the following terms with required tables: (13)
      (i) risk evaluation and
      (ii) hierarchy of control measures.

8. a) Define innovation matrix. Show the innovation matrix based on competence-dedication innovation. (08)

   b) Briefly explain the academia-industry collaborative model of technology transfer via block diagram. (07)

   c) Show the innovation process checklist and briefly explain each part of it. (10)

   d) Construct the layout of a RA document using your own information. (10)