Khulna University of Engineering & Technology
B. Sc. Engineering 4th Year 2nd Term Examination, 2019
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 the term nanotechnology. Mention in brief the scope of nanotechnology in our everyday life. (07)

   b) "At the nanometer scale, properties become size dependent"– Justify your answer. (14)

   c) Why does size influence the materials properties? (14)

2. a) Define bionanotechnology. Discuss about the major fields in bionanotechnology. (10)

   b) How can we use nanotechnology in dental care and cardiac therapy? (12)

   c) Explain how bionanotechnology is useful to determine the pathophysiological conditions and anatomical changes of diseased tissues. (13)

3. a) Write down the classification of low dimensional system. (05)

   b) What is biocompatibility? What types of design consideration should be taken into account for specific applications of biomaterials? (10)

   c) How carbon nanotubes can be used as the delivery vehicles of drug and cancer therapy? Draw the schematic diagram if needed. (11)

   d) Explain the applications of nanotechnology in molecular imaging. (09)

4. a) Briefly elucidate the major challenges of bionanotechnology. (10)

   b) How can nanotechnology help us to protect our environment? (15)

   c) What environmental and ethical concerns should be followed by us to apply bionanotechnology in our day to day life? (10)

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 of self-assembly. (10)

   b) What is DNA nanotechnology? Why DNA is used as nanotechnological tools. (06)

   c) Write some applications of DNA nanotechnology. (09)

   d) Explain the development process of viral nanoparticles. (10)

6. a) What is solid lipid nanoparticles (SLNs)? What are the characteristics of SLNs? Why SLNs is better than noisome and liposome? (12)

   b) How can we produce liposome using sonification and DRV method? (15)

   c) Why have we not been able to develop a vaccine for HIV? (08)

7. a) What is peptide lego? How can we make nanofiber scaffolds with 16AA? What is RADA 16-I? (09)

   b) "Protein passport helps nanoparticles to get pass immune system"–Justify the statement. (11)

   c) Show the differences between 2D and 3D cell culture. How nanofiber scaffold is useful for 3D cell culture? (09)

   d) Write short note on the applications of bacterial nanoparticles in food industry. (06)

8. a) Explain the mechanism of paper based analytical process with necessary diagram. (09)

   b) Write down the applications of quantum dots in (09)
      (i) Medical imaging
      (ii) Cancer cell imaging
      (iii) Drug delivery.

   c) Is lipstick safe? Write the name of the heavy metals found in lipstick and their side effects. (08)

   d) What are the processes of fabrication of microfluidic paper based analytical device? Explain the wax printing process. (09)

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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.
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Section A

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

1. a) What is Rehabilitation Engineering? Briefly explain the role of rehabilitation engineers. (09)

   b) What is sociovocational rehabilitation? Mention the rehabilitation team with their function. (10)

   c) Define Impairment, Disability and Handicap. Design an assistive device for a cerebral palsy child as a rehabilitation engineer. (10)

   d) What is Smart T- shirt system? Explain in brief. (06)

2. a) What is life? What are the complications of prolonged bed rest? (10)

   b) Enumerate the cycle of deconditioning. What do rehab engineers do for an upper limb paralyzed patient? (10)

   c) What are the language and cognitive disorders? Draw and label the classical Wernicke-Geschwind model of language. (10)

   d) Write short note on smart glass for visually impaired person. (05)

3. a) How can you develop your communication skill? What are the various form of communications? (12)

   b) List the differences between Verbal and Nonverbal communication. What is Visual Communication? (08)

   c) A child has developmental disorder; he/she has also writing difficulty; what type of assistive device he/she needed and why? (06)

   d) Write short notes on: (09)
   (i) Weber test, (ii) Rinne test, (iii) BEAR.

4. a) What are the types of lower limb prosthesis? Mention the angle and axis that are needed to consider during hip joint prosthesis. (08)

   b) Write down the concept of the Helix 3D Hip joint. (10)

   c) What is an Auditory Evoked Potential? Draw and label the normal and abnormal ABR. (07)

   d) Discuss about the working principle of hearing aid. (10)

Section B

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

5. a) Define assistive technology. Explain the common aids to assist individuals with disabilities using proper examples. (12)

   b) Draw and explain the generalized integrated model of a rehabilitation organization. (12)

   c) What is orthoses? Write down the benefits and limitations of orthoses services. (11)

6. a) Write down the mechanical characteristics that are needed to consider during orthoses fabrication. (06)

   b) Discuss on different mechanical stresses considering orthoses design concept. (08)

   c) Classify orthoses in terms of their locations and functions. Also give examples of each class. (10)

   d) How does natural muscle work? Describe the working principle of Mckibben artificial muscle. (11)

7. a) What are the differences between Orthotics and Prosthetics? (05)

   b) What are the components of traditional body power controlled prosthetic arm. (08)

   c) Discuss on the hand anatomy and find the joints degree of freedoms (DOF) needed to develop artificial hand. (10)

   d) Explain the working principle of a dialysis machine as a replacement of kidney. (12)

8. a) What is biomaterial? Write down the steps involved in the development of biomaterial devices. (10)

   b) Explain the working principle of myoelectric prosthetic arm using suitable block diagram. (13)

   c) Briefly discuss on different mobility aids. (12)

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BME 4221

Bioinformatics

Time: 3 hours **Full Marks: 210**

N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
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Section A

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

1. a) What is bioinformatics? Which types of issues or problem related to biological data are dealt with the bioinformatics? (08)

b) Consider the following two sequences: (11)

ATCG
TCG

i) Compute the scoring matrix.
ii) Align the two sequences using global sequence alignment technique.

c) What is protein? Write down the important functions of protein. (09)

d) What are the distinction between a global and local pairwise alignment? (07)

2. a) What is a dot plot and what is it useful for? (07)

b) What is BLAST and FASTA? Consider the following two sequences: (12)

CCATCGCCATCG
CGGCATACG

Apply FASTA to compute the alignments.

c) What is sequence Motif and PROSITE? Write down the steps to find the motif on PROSITE. (09)

d) What is multiple sequence alignment and phylogenetic tree? Make a relationship between MSA and phylogenetic tree? (07)

3. a) What is propensity? What are the steps does Chou Fasman method perform to predict the secondary structure of protein? (11)

b) What is homolog? What are the differences between ortholog and paralog? (07)

c) What is protein –protein interactions (PPI)? Why need PPI? Describe different type of PPI in human body. (09)

d) How many pairwise alignments would be performed to get a multiple sequence alignment of 4 sequences? Justify your answer with example(s). (08)

4. a) What is meant by molecular evolution? Define molecular phylogenetics. (07)

b) How would you convert an unrooted tree to a rooted tree? Briefly explain. (12)

c) What is molecular clock? Write short note on cladogram. (06)

d) What is Newick format of tree representation? Draw the corresponding tree topology for the Newick format (((B,C), A), (D,E)) and (((B:1.5,C:2), A:2.5),(D:1.5,E:3)); where you can define the branch lengths as your own way so that it understandable. (10)

Section B

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

5. a) What is database? Given flat file contains records of five students from four different districts, each taking a different course. (12)

Flat file

Name, States, Course number, Course name| M. Haque, Sherpur, BME 3213, Biomechanics| A. Ghosh, Mymensingh, BME 4221, Bioinformatics| A.K.Tushar, Madaripur, ECE 3215, Body sensor Networks| S.Galib, Khulna, EEE 1215, Analog Electronics| F. Zohora, Thakurgaon, CSE 1215, Computer programming.

Construct a relational database to store the same information.

b) What is a biological database? Write short notes on: (12)
i) Primary databases; ii) Secondary databases; iii) Specialized databases.

c) Given is a multiple aligned sequences. Compute the sequence profile for this set. (11)
ATAATAC
ATAATAG
ATAATTC
ATATTAC
ATAATAA

6. a) Explain data retrieval system: Entrez for biological databases. (12)

b) Write short notes on systems biology. (08)

c) What is gene prediction? Mention the challenges for gene prediction. (09)

d) What is meant by sensitivity and specificity for performance evaluation of a gene prediction program? (06)

7. a) .Briefly discuss about ab initio-based gene prediction method. (08)

b) Illustrate the structure of a typical eukaryotic genome. (11)

c) Why eukaryotic gene prediction is more challenging than prokaryotic one? (06)

d) Briefly explain a web based program for gene prediction based on Hidden Markov Model (HMM). (10)

8. a) What is homoplasy? Briefly explain anyone substitution model for correcting homoplasy. (12)

b) Why finding a true tree is difficult in molecular phylogenetics? Explain with example. (10)

c) What is meant by functional genomics? Write down the advantages of transcriptome analysis. (08)

d) What is Bootstrapping? (05)

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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 Telecare. Briefly describe the subdivisions of e-Health. (10)

b) Define telehealth. Discuss the factors need to consider to ensure safety and security in establishing a telemedicine program. (10)

c) Briefly describe the business plan required for launching a telehealth program. (15)

2. a) Briefly explain analog signaling of PSTN in telephony. (10)

b) What is microphone? Briefly explain construction and mechanism of different types of microphones. (14)

c) What are the key questions that need to be asked for evaluation of telemedicine project? Explain those. (11)

3. a) Outline telemedicine approach and benefits of a fitness monitoring shoe for a morning jog. (15)

b) What are the concepts of PACS? What are the relations between PACS and RIS/HIS? (12)

c) Write short notes on: (08)
(i) SD video
(ii) Containers.

4. a) Briefly describe the ethical and legal challenges of telemedicine program. Give your recommendation to resolve the issues when launching a telemedicine program. (20)

b) How does codec compress a video? Explain. (10)

c) How smart home can contribute on telemedicine program? (05)

Section B

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

5. a) What are the different communication systems invariably used in telemedicine and m-healthcare? Write down their key features including operating frequency, data rate and coverage. (15)

   b) What are the possible types of channels used in communication system? Why wireless communication protocols are suitable choice for many telemedicine applications? (10)

   c) Sketch the layout of a telemedicine system processing medical information. Briefly describe each functional block. (10)

6. a) Show the framework of a typical body area network (BAN) for monitoring a patient with cardiac arrhythmia. What are the available mobile based units? (12)

   b) How BAN can provide solution in ambient assisted living? Briefly explain with examples. (06)

   c) Sketch a telemedicine framework for emergency rescue. Identify the necessary supports at the scene and at hospital for recovering patients from emergency. What could possibly go wrong at the hospital when treating such patients? (10)

   d) Describe the concept of an electronic drug store. (07)

7. a) What are the limitations of traditional K-type or Hg-thermometer for temperature monitoring in telemedicine applications? What could be a possible solution? Explain with suitable example. (10)

   b) What is photoplethysmography (PPG) signal? Describe a telemedicine device operation obtaining PPG signal. Mention the possible sources of artifacts. (10)

   c) Briefly describe a Home Blood Pressure Telemonitoring (HBPT) system. Is HBPT is better than self Home Blood Pressure Monitoring? Give reasons to justify your answer. (08)

   d) What are the challenges to record respiration rate of patients? How can you measure respiration rate using thoracic impedance? (07)

8. a) What is smart sensing? Why smart sensing devices are of ultimate choice for telemedicine and m-healthcare systems? (08)

   b) How a smart phone can be turned up to a mobile microscope? Explain its operation with proper optical layout and mention some applications. (10)

   c) Mention the key features of commercial telemonitoring devices serving blood pressure, blood glucose level and ECG monitoring. (09)

   d) Identify and briefly explain the possible scopes for the next generation telemedicine and healthcare system. (08)

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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) Explain what do you mean if a student says "I am a standard ethical student". (14)

b) "Practicing ethics in the workplace"–can improve the economy of the workplace– Justify the statement. (12)

c) Write the principles of business ethics. (09)

2. a) Mention IEEE code of ethics. (12)

b) Briefly describes the principle of medical ethics originated from united nations for the protection of prisoners and detainees against torture and other cruel in human or degrading treatment or punishment. (16)

c) What are dilemmas in ethics? How can you avoid dilemmas? (07)

3. a) Describe ethics from the western perspective. How is ethics related to economics? Mention the factor influencing ethical behavior. Give some examples of ethical issues. What are the attributes of an ethical culture? (15)

b) Describe the statements of professional ethics? Why self-plagiarism is prohibited? (08)

c) What are the attributes of an ethical culture? Describe the six principles of business ethics and conduct. (12)

4. a) "Never change your core values"– Discuss on this statement. (10)

b) What is machine ethics? Describe why it is to be maintained. (08)

c) "Performance and moral character are defined in terms of eight strengths of character"– Discuss on those strengths. (17)

Section B

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

5. a) Define bio-safety. Briefly explain the terms with examples: Pathogens, Microbes. Why do we need bio-safety? (08)

b) What is radiation? How much radiation is exposed to normal and how much it is safe? (07)

c) What are the different bio-safety levels? Describe them with examples. Describe the laboratory practices, safety equipment, and facility construction of different bio-safety levels. (20)

6. a) Explain the following terms with suitable examples: (12)
Accidents, Incidents, Ill health, Hazards, Risk, Threat, and Safety.

b) What is technology transfer? Mention the differences between innovation and invention with examples. How technology is transferred? Why it is necessary to collaborate between university and industry? (13)

c) Explain the steps followed in a building development for fire safety. (10)

7. a) "Safety should be first" in any workplace– Justify the statement with five reasons. (12)

b) Explain the measure of safety standards that followed by international community, especially in a laboratory. (14)

c) Explain the causes and effect of accident happened in a human subject experiment. (09)

8. a) What is the risk assessment? Describe five steps of risk assessment. Mention the key points to consider assessing infection risk. (12)

b) Describe the standard operating procedures and safe working practices in a laboratory. Mention different types of PPE. (15)

c) What are the duties of nominated laboratory safety officers? What are the key elements of successful health and safety management? (08)