

**Bangabandhu Sheikh Mujibur Rahman Science and Technology University**  
**Department of Computer Science & Engineering**  
**4th Year 2nd Semester B.Sc. Engineering Examination-2021**

Course Title: Robotics

Course No.: CSE465

Time: 03 hours

Full Marks: 60

N.B. i) Answer SIX questions, selecting any THREE from each section; each set should be answered in order.

**Section A**

- |  |             |
|--|-------------|
| Q.1 (a) What is a robot and robotics?<br>(b) Draw a simple robotic system using the basic components.<br>(c) What do you mean by DOF? Write the names of the lower pair connectors of 1, 2, and 3 DOF.   | 2<br>4<br>4 |
| Q.2 (a) Why is the coordinate system used in a robotic system? Explain the cylindrical, spherical, and revolute coordinate systems with respect to joint pairs.<br>(b) What do you mean by the work envelope of a robotic system?<br>(c) What do you mean by forward and backward robot kinematics | 6<br>2<br>2 |
| Q.3 (a) Explain pitch, yaw, and roll with figures.<br>(b) What are the applications of robot end-effectors?<br>(c) Suppose you have a plane surface on an object and you have to move that object using an end effector. Design that end effector with your thinking.                              | 2<br>2<br>4 |
| Q.4 (a) Define actuators? Explain the working principles of different kinds of actuators.<br>(b) Draw a simple positional servo system.  | 5<br>5      |

**Section B**

- |   |             |
|---|-------------|
| Q.5 (a) Draw and explain how a stepper motor can change its angular movement.<br>(b) In a stepper motor, what factors are responsible for measuring each step size?<br>(c) Draw a cross section of a stepper motor whose step size is 18 degrees.                         | 6<br>2<br>2 |
| Q.6 (a) What is a sensor? Write five key characteristics of a sensor.<br>(b) How does artificial skin work?<br>(c) How can a proximity sensor make sense of an object?  | 3<br>3<br>4 |
| Q.7 (a) What is robot programming? Distinguish between teach pendant robot programming and lead through robot programming.<br>(b) What kinds of programmable tools are used to program a robotic system?<br>(c) Differentiate between a contact and a non-contact sensor. | 4<br>2<br>4 |
| Q.8 (a) What do you mean by Robot Operating System (ROS)? List the features of ROS.<br>(b) How can two ROS nodes communicate using the ROS topic?<br>(c) Which contents exist within a ROS package?   | 4<br>4<br>2 |

# Bangabandhu Sheikh Mujibur Rahman Science and Technology University

Department of Computer Science and Engineering

4<sup>th</sup> Year 2<sup>nd</sup> Semester B.Sc. Engineering Examination-2021

Course Code: CSE457

Course Title: Cryptography and Network Security  
Time: 3 (Three) Hours

Total Marks: 60

i) Answer any SIX questions taking THREE from each section.

ii) All parts of a question must be answered sequentially.

## SECTION-A

1. a) What do you mean by cryptanalysis? Explain its common types briefly 4  
b) Explain SHA-512 with diagram. 3  
c) Explain a stream cipher and a block cipher. 3
2. a) Encrypt the message "the house is being sold tonight" using Affine cipher with key = (15, 20). Ignore the space between words. Decrypt the ciphertext to get plaintext. 4  
b) The encryption key in a transposition cipher is (3, 2, 6, 1, 5, 4). Find the decryption key. 2  
c) Using Chinese Remainder Theorem, find an integer that has a remainder of 3 when divided by 7 and 13, but is divisible by 12. 3
3. a) Explain DES structure with diagram. 4  
b) Briefly explain the steps of AES Round. 3  
c) Find the input of the initial permutation box when the output is given in hexadecimal as: 0x0003 0000 0000 0008 3

Initial Permutation	
58	50
42	34
26	18
10	02
60	52
44	36
28	20
12	04
62	54
46	38
30	22
14	06
64	56
48	40
32	24
16	08
57	49
41	33
25	17
09	01
59	51
43	35
27	19
11	03
61	53
45	37
29	21
13	05
63	55
47	39
31	23
15	07

4. a) Distinguish between conventional signature and digital signature. 3  
b) Explain the RSA digital signature scheme with example. 4  
c) Explain the cryptanalysis of Affine Cipher. 3

## SECTION-B

5. a) What will be the transmitted frame if the given frame is 101100111 using the generator:  $G(x) = x^3 + x^2 + 1$  when CRC code is used? 4  
b) Explain the different types of firewall and its configurations in details. 6
6. a) In RSA, given  $e = 13$  and  $n = 100$ , encrypt the message "CSE" using 00 to 25 for letters A to Z. 5  
b) Discuss the differences between SSL and TLS. 3  
c) In PGP, explain how Bob and Alice exchange the secret key for encrypting messages 2
7. a) Describe the ElGamal Cryptosystem with suitable example. 6  
b) In ElGamal, given the prime  $p = 31$ , choose an appropriate  $e_1$  and  $d$ , then calculate  $e_2$ . 2  
c) In ElGamal, what happens if  $C_1$  and  $C_2$  are swapped during the transition? 2
8. a) Write down the difference between congestion control and flow control. 2  
b) How congestion is controlled by Datagram Subnet? 4  
c) Describe two application layer protocols. 2

**Bangabandhu Sheikh Mujibur Rahman Science and Technology University**

Department of Computer Science & Engineering  
4th Year 2nd Semester B.Sc. Engineering Examination-2021

**Course Title: Digital Image Processing**  
Full Marks: 60

**Course No: CSE453**  
**Time: 3 hours**

**N.B.** i) Answer any **THREE (3)** questions from each Section.

**Section – A (30 Marks)**

Q.1 (a) What is digital image processing? Briefly describe the key stages of digital image processing with a diagram. 4

(b) Write a short note on: i) Image formation in the eye; ii) Brightness adaption in an eye. 4

(c) Discuss the applications of digital image processing. 2

Q.2 (a) Discuss the image digitization process with a figure. 4

(b) Consider the image segment shown below:

4	2	3	2(q)
3	3	1	3
2	3	2	2
(p) 2	1	2	3

Complete the length of shortest-4, shortest-8 and shortest-m paths between pixels p & q where, v = {1, 2}. If a particular path does not exist between these two points, explain why?

(c) What do you mean by contrast stretching? 2

Q.3 (a) What is histogram equalization? Derive the mathematical term for histogram equalization in image processing. 4

(b) An 8 level image is given below. Perform histogram equalization and draw histogram of original and equalized images. 4

4	6	0	3	7
2	1	5	0	3
4	2	7	0	7
1	5	7	0	7
4	7	5	4	1

(c) What is image enhancement? 2

- Q.4 (a) Let a 4-bit,  $4 \times 4$  image pass through an intensity transformation function given by  $s = T(r) = \alpha \log_2(1 + r) + \beta$ , where  $\alpha, \beta$  are constants. Few pixels are available in the input and output images, as shown below.

4

	3		3
9		15	B
	A		
1			3

 $\rightarrow T(r) \rightarrow$ 

	5		5
C		11	9
3	8		
D	9		5

What are the values of the pixels A, B, and C, D in the input and output images, respectively?

- (b) Briefly describe Power-law transformation for digital image processing and also show the image appearance of different values of gamma. 4
- (c) Image is a function, explain it. 2

#### Section - B (30 Marks)

- Q.5 (a) Consider the following  $5 \times 5$  8-bit image with grayscale range of  $[0, 9]$ . 4

0	5	7	7	5
7	2	6	2	6
6	9	7	7	0
6	6	1	7	6
9	3	2	4	8

Compress the image using Huffman encoding techniques and also discuss the efficiency of this compression.

- (b) Explain any of the four important noise probability density functions. 4
- (c) What are the differences between fixed length and variable length coding? Explain with examples. 2
- Q.6 (a) Sketch and explain a model for the image restoration process. How can you estimate the image degradation functions? 4
- (b) Explain the inverse filtering process to restore a noisy image. What is the shortcoming of the inverse filter? How does the Wiener filter overcome such a shortcoming? 4
- (d) What is the difference between Shannon-Fano and Huffman coding? 2
- Q.7 (a) Define Pseudo color image processing. Discuss about intensity slicing with appropriate diagram. 4
- (b) Prove that in a continuous domain, the probability distribution function of an equalized image is always uniform. Discuss it with an appropriate example. 4
- (c) Why do we require image compression? 2
- Q.8 (a) Explain the pseudo color image processing with a neat functional block diagram. 4
- (b) Define Hue and Saturation.  $(RGB) = (0.683, 0.1608, 0.1922)$  convert this into HIS model. 4
- (c) Write a short note on the CMY model. 2

N.B.

- i) Answer SIX questions, taking any THREE from each section.
- ii) All parts (a, b, c, ...) of a question must be answered sequentially.

#### SECTION – A (30 Marks)

1. a) What is machine learning? Write about some applications of machine learning. 3  
b) Distinguish between rule-based programming and machine learning approach. 4  
c) What type of machine learning algorithm would you use to allow a robot to walk into a maze searching for an exit? Justify your answer. 3
2. a) What is the significance of data preprocessing in machine learning? 2  
b) What are outliers in data? How to handle outliers data? 1+2  
c) State curse of dimensionality. Compare between dimensionality reduction and feature selection. 1+2  
d) How you would do one-hot encoding for three color labels red, green and blue of an object. 2
3. a) Differentiate between classification and regression. List different types of classification. 3  
b) Let us consider the following frequency tables of weather data (14 instances), which comprises outlook, humidity, and wind conditions. The target column is 'Play' i.e., can we play outside, which we have to predict. Now your task is it make a decision where to split data and find the root node while building a decision tree using information gain method. Information gain method

Frequency		Play		Frequency		Play		Frequency		Play	
		Yes	No			Yes	No			Yes	No
Outlook	Sunny	3	2	Humidity	High	3	4	Wind	Strong	6	2
	Overcast	4	0		Normal	6	1		Weak	3	3
	Rainy	3	2								

- c) What is zero frequency problem in Naïve Bayes Classifier? 2
4. a) What is the core idea of k Nearest Neighbors (kNN) learning? How to choose the value of k in kNN learning? 2+2  
b) Consider the following confusion matrix for a binary classification model. Find accuracy, precision, recall and F1 score of it. Confusion matrix

		Actual Values	
		Positive (1)	Negative (0)
Predicted Values	Positive (1)	55	2
	Negative (0)	5	38

- c) If your model performs great on the training data but generalizes poorly to new instances, what is happening? What can you do to overcome this situation? 2

#### SECTION-B (30 Marks)

5. a) Briefly explain the bias-variance tradeoff. 3  
b) What is an ensemble method? Distinguish between bagging and boosting? 3  
c) Write the working principle of the support vector machine (SVM) algorithm. How kernel function related to support vector machine? 4
6. a) What is regression analysis? Distinguish between classification and regression in machine learning. 1+2

- b) Briefly discuss simple linear regression and multiple linear regression.  
 c) Suppose you are given two list of values for a regression model (as follow):

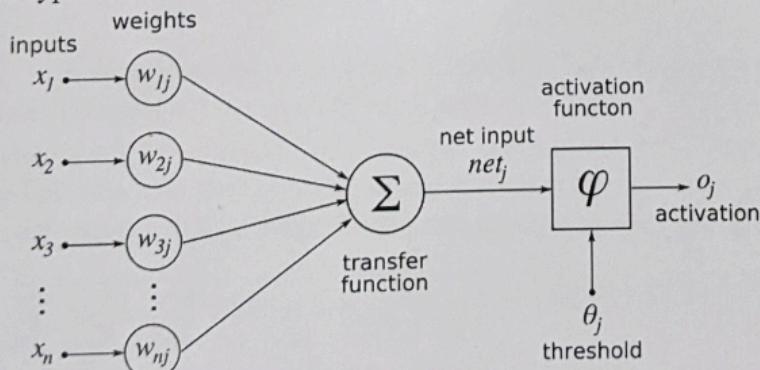
Original values:	-2	1	-3	2	3	5	4	6	5	6	7
Predicted values:	-1	1	-2	2	3	4	4	5	5	7	7

Find MAE, MSE, and RMSE to evaluate the model.

7. a) What is clustering? List some applications of clustering.  
 b) Write the k-Means clustering algorithm.  
 c) Consider the following proximity matrix. Find the clusters by applying single link and complete link hierarchical clustering. Also show your results by drawing a dendrogram.

	1	2	3	4	5
1	0	9	3	6	11
2	9	0	7	5	10
3	3	7	0	9	2
4	6	5	9	0	8
5	11	10	2	8	0

8. a) Mention some advantages of deep learning over traditional machine learning?  
 b) A typical neural network is given below. Explain how it works.



- c) Sketch of a feed-forward neural network and a recurrent neural network.