Course No.: CSE401

Time: 3 Hours

Full Marks: 60

N.B. 1) Answer SIX questions, taking any THREE from each section.
   2) Sequences must be maintained for each question.
   3) The figures in the right margin indicate full marks.
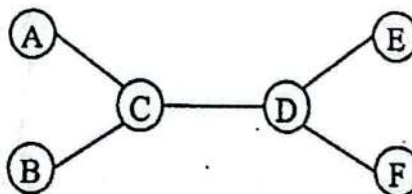
SECTION-A (30 Marks)

1.
a) What is an intelligent agent? Explain the learning agent model elaborately. — 4

b) What is PEAS? For each of the following activities, give a PEAS description of the task environment: (i) Automated Car Driving (ii) Medical diagnosis system. — 4

c) What is a rational agent? Why should a rational agent be autonomous? — 2

2.
a) Describe the terms complete and optimal with regards to evaluating search strategies. Is either depth-first-search or breadth-first-search complete? Is either of them optimal? — 4

b) For the following map, using A* algorithm, find a route from town A to town M. Show the search for your solution, showing the order in which the nodes are expanded and cost at each node. Assume previously visited states will not be revisited. The straight-line distances between any town and town M are shown in the table below. Use it as a measure of the straight-line distance heuristic. — 4

| Straight Line Distance to M	
A	51
B	50
C	32
D	28
E	42
F.	14
G	33
H	43
I	50
J	32
K	41
L	56
M	0
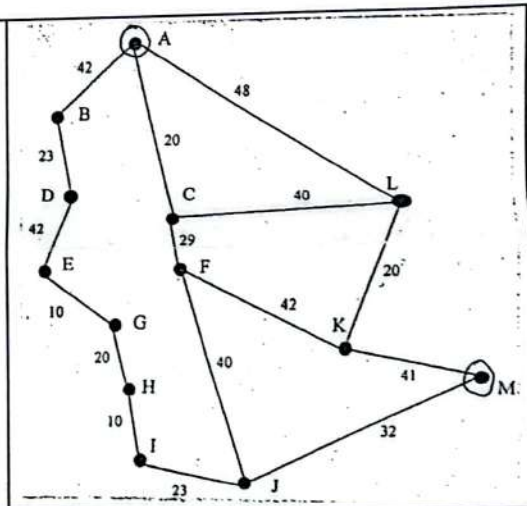
c) Derive the worst-case time and space complexity of depth-first-search and breadth-first-search algorithms? — 2

3.
a) Discuss A* algorithm. Give one example whether it is suitable to apply. — 4

b) Consider the water jug problem as stated here: "You are given two jugs, a 4-gallon one and a 3-gallon one. Neither has any measuring markers on it. There is a pump that can be used to fill the jugs with water. How can you get exactly 2 gallons of water into the 4-gallon jug?" Represent this as a problem in State Space Search and state its Production Rules. Show at least one solution to this problem. — 4

c) What are the properties of an artificial agent? — 2

4.
a) What is CSP? Solve the following tree structured CSP where there are only three colors (Red, Green and Blue) available. — 4
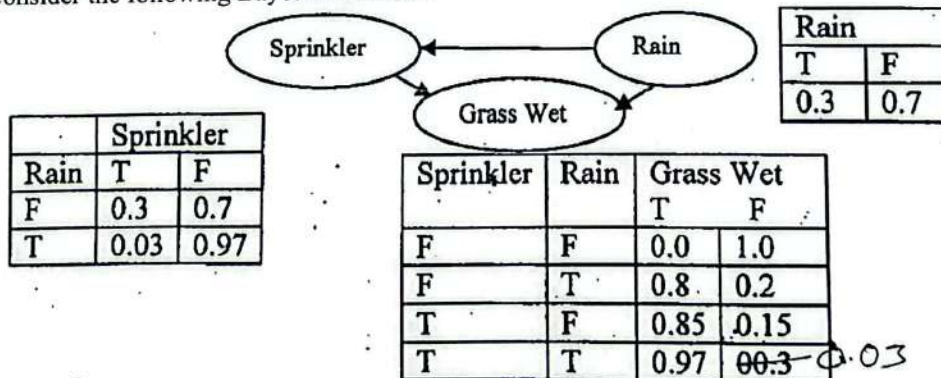

b) Develop a local search algorithm for solving N-Queen problems using min-conflict heuristic. — 3

c) What is uncertainty? What are the types of uncertainty? Explain with suitable examples. — 3

SECTION-B (30 Marks)

5. **a)** Why does a hill-climbing search often fail to find the global optimal solution? What is the random-restart hill-climbing search? Briefly explain how you can perform hill-climbing search for the map coloring problem? **4**

b) Translate the following sentences into first order logic (FOL) sentences: **4**
i) Every member of the Roofers club is either a skier or a mountain climber or both.
ii) Some women are more knowledgeable than others except for herself.
iii) Every fruit other than apricots and pineapples is bad and spoiled.
iv) Apricots and pineapples are bad fruits and spoiled.

c) Write down the differences between first order logic (FOL) and propositional logic. **2**

6. **a)** Express the following sentences in propositional logic. **4**
"The person is a toddler; if the person is a toddler, then the person is a child; if the person is a child and male then the person is a boy; if the person is an infant then the person is a child; if the person is a child and female then the person is a girl; the person is female." Also prove that the person is a girl using the rule of inferences.

b) How can you build a knowledge-based agent using a declarative approach? Convert the logic $A \Rightarrow (B \lor C)$ into CNF. **4**

c) Find predicate, function and term from the following sentences: **2**
(i) Brother (John, Richard)
(ii) >(Length(LeftlegOf(Richrad)), (Length(LeftlegOf(John)))

7. **a)** Derive the product formula for Bayesian networks. Show the steps to calculate the product formula of the following Bayesian network. **4**
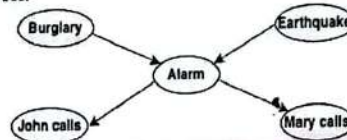
b) Consider a scenario, where 5% of the populations have some sort of cancer (cr) disease. Among the cancerous population, 40% of them have chronic cough (cc) as one of their symptoms. There are many other reasons for chronic cough, and among all chronic cough patients, 9 out 10 people are non-cancerous. If you have a symptom of chronic cough, what will be the probability that you will be diagnosed with cancer? **4**

c) How does backward chain work? Explain. **2**

8. **a)** Consider the following Bayesian network. **4**

Rain	
T	F
0.3	0.7

Sprinkler		
Rain	T	F
F	0.3	0.7
T	0.03	0.97

Sprinkler	Rain	Grass Wet	
		T	F
F	F	0.0	1.0
F	T	0.8	0.2
T	F	0.85	0.15
T	T	0.97	0.03

What is the probability that it is raining given that the grass is wet?

b) What are the key components in first order logic? Consider the following knowledge base: **4**

AB $A \Leftrightarrow B$
C∧D A $C \land D \Rightarrow A$
Q∧C D $Q \land C \Rightarrow D$
P∧A C $P \land A \Rightarrow C$
P∧Q C $P \land Q \Rightarrow C$
P   P
Q   Q

Using backward chaining, find out whether the query B is true.

c) What are the main differences between a probabilistic agent and logical agent? **2**

Bangabandhu Sheikh Mujibur Rahman Science and Technology University
Department of Computer Science and Engineering
4th Year 1st Semester B.Sc. Engg. Examination 2022

Course No.: CSE403
Course Title: Computer Simulation and Modeling
Full Marks: 60
Time: 3 (Three) Hours

N.B.:
1) Answer SIX questions taking any THREE from each section.
2) Sequence must be maintained for each question.
3) The figures in the right margin indicate full marks.

SECTION-A (30 Marks)

1. Assume that the setup cost and increment cost in an inventory system with policy (S, s) = (12, 3) are $50 and $7 respectively. Holding cost per day is $2 and backlog cost per day is $4. The demand occurs after each 5 days: **10**

$$D = \begin{cases} 1 & \text{w.p. } \frac{1}{5} \\ 2 & \text{w.p. } \frac{1}{5} \\ 3 & \text{w.p. } \frac{2}{5} \\ 4 & \text{w.p. } \frac{1}{5} \end{cases}$$

Let this occurrence follows $D_i = 5D_{i-1} + 3 \mod 16$. Here, D_0 is 7. If the inventory level is less than s, a normal order is placed and it comes after 15 days. If the inventory level is less than 0, an express order is placed and it comes after 5 days. Initial inventory level is 5. Determine the following for 2 months:
   i. Average ordering cost
   ii. Average holding cost
   iii. Average backlog cost

2. For a single server queuing system with interarrival time for 5 customers are $A_0 = 0.5$, $A_1 = 2.5$, $A_2 = 4.0$, $A_3 = 7.5$ and $A_4 = 9.5$ and their service time are $S_0 = 3$, $S_1 = 5$, $S_2 = 2$, $S_3 = 6$ and $S_4 = 4$. Now determine: **10**
   i. Average number of customers in queue
   ii. Average delay
   iii. Average utilization of server

3. a) Define system and model. Explain the types of a system. **4**
   b) Describe Bernoulli and Poisson distributions with examples. **3**
   c) Write down short note on divide and conquer approach of verification. **3**

4. a) Define simulation. Briefly explain the application areas of simulation. **4**
   b) For the time-shared computer model with service quantum of length $q = 2$ seconds and swap time $\tau = 1$ second, simulate the computer system for 4 jobs from 4 terminals. Each job arrives after the 'think' time of the operator. Calculate the average response time and average number of job in queue from the following information: **6**

Job	Think Time	Service Time
1	1	4
2	4	3
3	5	3
4	6	2

$n_{c_n} \, p^7 (1-p)^2$

SECTION-B (30 Marks)

5. a) Assume that the probability of winning a toss is p. If the probability that you win exactly three dollars in five tosses is 0.05, what is the value of p? **3**
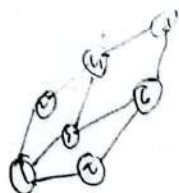   b) Find Z_{1030} from the recursive formula $Z_i = 3Z_{i-1} + 5 \mod 16$, where $Z_0 = 11$. **3**

c) Write down recursive algorithm for S_n for the following fractal.   4

S_0 ——————— S_1 ——|—

6. a) Find the critical path from the following data of a PERT Network: 5

Activity	Normal Time (days)	Crash Time (days)	Cost Slope
1-2	6	6	-
1-3	5	5	-
1-4	6	5	-
2-5	3	3	-
3-5	4	4	-
3-6	5	4	40
4-6	5	4	50
5-7	4	3	60
6-7	4	3	60

b) Crash the above project and find the total cost where direct cost is $250 and   5
indirect cost for each day is $15.

7. a) What are the advantages and disadvantages of simulation?   4

b) Consider the following information about a university database. Each project is   6
managed by one professor (known as the project's principal investigator). Each
project is worked on by one or more professors (known as the project's co-
investigators). Professors can manage and/or work on multiple projects. Each
project is worked on by one or more graduate students (known as the project's
research assistants). When graduate students work on a project, a professor must
supervise their work on the project. Graduate students can work on multiple
projects, in which case they will have a (potentially different) supervisor for each
one. Departments have a professor (known as the chairman) who runs the
department. Each graduate student has another, more senior graduate student
(known as a student advisor) who advises him or her on what courses to take.
Now design the Logical data model of the system.

8. a) Derive the formula of finding the dimension of fractal. Then using the formula   6
find the dimension of the following curves.

After first generation

Initial line   Initial line   After first generation
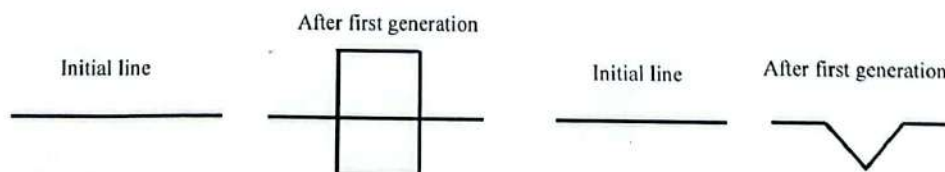
b) Write down the string production rule for Pythagoras tree. Draw the second   4
generation of this tree.

Course No.: CSE405
Course Title: Digital Signal Processing
Full Marks: 60
Time: 3 (Three) Hours

N.B.:
1) Answer **SIX** questions taking any **THREE** from each section.
2) Sequence must be maintained for each question.
3) The figures in the right margin indicate full marks.

SECTION-A (30 Marks)

1. a) A discrete-time signal $x(n)$ is defined as: 5

$$x(n)= \begin{cases} 1+\dfrac{n}{3}, & -3 \leq n \leq -1 \\ 1, & 0 \leq n \leq 3 \\ 0, & \text{elsewhere} \end{cases}$$

    i) Determine its values and sketch the signal $x(n)$.
    ii) Sketch the signal resulted if you first fold $x(n)$ and then delay the resulting signal by four samples.
    iii) Sketch the signal resulted if you delay $x(n)$ by four samples and then fold the resulting signal.

   b) Write short note on the following discrete time signals: 3
    i) Unit sample
    ii) Unit step
    iii) Unit ramp

   c) Explain energy signal and power signal.   2

2. a) Determine the z-transform and ROC of the following signal –   5

$$x(n)=\left(\frac{1}{2}\right)^{n} u(n)$$

   b) What is the significance of linear convolution and the Z-transform?   2
   c) Find the z-transform and ROC for the following finite-duration signal   3
    i) $x_1(n) = \{\underset{\uparrow}{1}, 2, 5, 7, 0, 1\}$

    ii) $x_2(n) = \{1, 2, \underset{\uparrow}{5}, 7, 0, 1\}$

    iii) $x_3(n) = \delta(n-k), k>0$

3. a) Draw the equation of Fourier series for continuous periodic signal and draw the power density spectrum.   6

   b) Determine the spectra of the following signals   4
    i) $x(n) = \cos \sqrt{2}\,\pi n$
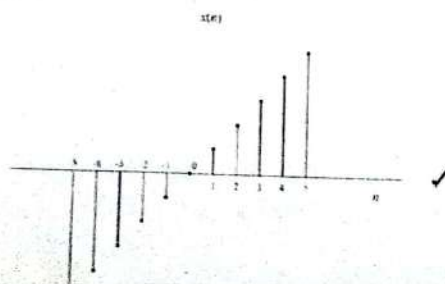   ii) $x(n) = \cos \pi \dfrac{n}{3}$

4. a) What are the advantages of digital over analog signal processing?   3
   b) Write short note on the followings: 3
    Continuous time signal vs discrete time signal
    Continuous valued signal vs discrete valued signal

   c) Explain differences between even and odd signal. Examine whether following is even or odd signal.   4

SECTION-B (30 Marks)

5. a) Define the unit step function, unit impulse, Gaussian and sinusoidal functions.   4

   b) Define the digital signal. How does an analog signal transform into a digital signal?   3

   c) Determine whether the unit ramp signal is a power or energy signal.   3

6. a) Briefly explain and draw the block diagram of the following system-   3

   $y(n) = \frac{1}{4}y(n-1) + \frac{1}{2}[x(n+1) + x(n-1)]$

   b) Write short note on (i) Linear and nonlinear signals (ii) Periodic and aperiodic signals.   2

   c) Let discrete-time system can be   5
   1. Static or dynamic
   2. Time invariant or time variant

   Examine the following system with respect to the properties above where $x(n)$ is input to the system.
   i) $y(n) = \cos[x(n)]$
   ii) $y(n) = x(n)\cos wn$
   iii) $y(n) = x(-n + 2)$

7. a) Define N-point DFT. Draw the equation of N-point DFT.   5

   b) A finite duration sequence of length L is given as   5

   $x(n) = \begin{cases} 1, & 0 \leq n \leq L-1 \\ 0, & \text{otherwise} \end{cases}$

   Determine the N-point DFT of the sequence for N>=L.
   Draw the N-point DFT for –
   i) N=50, L=10
   ii) N=100, L=10

8. a) Define FFT. Why is FFT preferred over DFT?   2

   b) Find the 8 point DFT and IDFT for the given data sequence $x(n) = \{1, 2, 3, 4\}$.   4

   c) Write down the advantages of using a digital filter. Differentiate between recursive and non-recursive filters.   4

Bangabandhu Sheikh Mujibur Rahman Science and Technology University
Department of Computer Science and Engineering
4th Year 1st Semester B.Sc. Engg. Examination 2022

Course No.: CSE407

Course Title: Digital System Design

Time: 3 Hours

Full Marks: 60

N.B. 1) Answer SIX questions, taking any THREE from each section.
2) Sequence must be maintained for each question.
3) The figures in the right margin indicate full marks.

SECTION A (30 Marks)

1. (a) Design an arithmetic unit using two selection variables; S_1 and S_0, that generates the following arithmetic operations (use an adder and basic gates).   **8**

S_1	S_0	$C_{in} = 0$	$C_{in} = 1$
0	0	$F = A + B$	$F = A - B$
0	1	$F = A - 1$	$F = A$
1	0	$F = A \wedge B$	$F = A \vee B$
1	1	$F = \overline{A \wedge B}$	$F = \overline{A \vee B}$

(b) What are the differences between macro-operations and mico-operations?   **2**

2. (a) Explain the following addressing modes of microprocessor: **4**
  i. Relative addressing mode
  ii. Indirect addressing mode
  iii. Indexed-indirect addressing mode
  iv. Indirect-indexed addressing mode.

(b) Design the circuit diagram for the following flag bits: **6**
  i. Carry, C
  ii. Overflow, V
  iii. Zero, Z
  iv. Parity, P
N.B.: Parity, P is set to 1 if count of 1 in a number is odd and otherwise 0.

3. (a) What are PLA and PAL? Give the differences between them.   **4**

(b) Make a 16x1 mux using 4x1 muxes.   **5**

(c) What are the differences between a flip-flop and a latch?   **1**

4. (a) Design a digital system that multiply two numbers, A and B.   **8**
  i. Draw the flowchart of the system
  ii. Draw the state diagram of the system and show the control outputs of each control states.
  iii. State the Boolean functions for the output controls
  iv. Design the control unit using one flip-flop (D flip-flop) per state.

(b) Illustrate the differences between microprocessor and microcomputer.   **2**

SECTION B (30 Marks)

5. (a) Explain hard-wired control and microprogram control with examples.   **4**

(b) For a 16-bit computer, define different data and instruction formats.   **3**

(c) Design a 4-bit combinational circuit for the following operations on a 4-bit number.   3

S	Operation
0	Multiply by 2
1	Divide by 2

6. (a) For a 16-bit computer some instructions with descriptions and hexadecimal codes   7
provided below:

Instruction	Hexadecimal Code	Description
CMA	6020	Complement A
INC	~~6020~~ 6200	Increment A
SUB	0m	Add to A
ADD	1m	Subtract from A
BSB	2m	Branch to subroutine
BUN	3m	Branch unconditionally

m is the address of memory word M.
initially register A contains 6203. A segment of memory is as follows:

44	2067
45	0046
46	6200
47	6020
	...
	...
67	
68	1045
69	3067

Write down the value of A at each stage and the word contained by memory address 67.

(b) Explain bidirectional bus buffer.   3

7. (a) Explain the register-transfer operations during fetch cycle and execute cycle.   4

(b) Explain the occurrence of overflow with necessary figure while performing addition two   3
numbers.

c) What is control word in processor unit? Explain with a suitable example.   3

8. (a) Compare and Contrast Synchronous and Asynchronous reset.   3

(b) With a neat logic diagram, explain the working of positive edge triggered D-flip-flop.   6

c) Define a combinational logic circuit.   1

Bangabandhu Sheikh Mujibur Rahman Science and Technology University
Department of Computer Science and Engineering
4th Year 1st Semester B.Sc. Engg. Examination 2022

Course No.: CSE411

Course Title: Communication Engineering

Full Marks: 60

Time: 3 Hours

N.B. 1) Answer SIX questions, taking any THREE from each section.
2) Sequence must be maintained for each question.
3) The figures in the right margin indicate full marks.

SECTION A (30 Marks)

1. a) Define data and data communication. Write down the data flow techniques of data communication.   3

   b) Mention the advantages and disadvantages of wireless communication over wire communication.   3

   c) Describe bandwidth. How can a composite signal be decomposed into its individual frequencies?   4

2. a) Assume we need to download text documents at the rate of 100 pages per second. What is the required bit rate of the channel?   2

   b) We send a voice signal from a microphone to a recorder. Is this baseband or broadband transmission?   2

   c) Describe transmission impairment.   3

   d) The power of a signal is 10 mW and the power of the noise is $1\mu W$; What are the values of SNR and SNR_{db}?   3

3. a) For the bit stream 01011001, sketch the waveforms for Manchester and differential Manchester schemes encoding format.   4

   b) Describe the benefits of block coding over line coding schemes.   3

   c) What are the advantages of QAM over ASK or PSK?   3

4. a) Define Channel capacity. What key factors affect channel capacity?   4

   b) For the bit stream 01011001, sketch the waveforms for NRZ-I and NRZ-L encoding format   2

   c) Briefly describe the pulse code modulation (PCM) technique.   4

SECTION B (30 Marks)

5. a) Four channels, two with a bit rate of 600 kbps and two with a bit rate of 500 kbps, are to be multiplexed using multiple slot TDM with no synchronization bits, Answer the following questions: 6
   i. What is the size of a frame in bits?
   ii. What is the frame rate?
   iii. What is the duration of a frame?
   What is the data rate?

   b) What do you understand by propagation and transmission delay and latency?   4

6. a) Describe frequency modulation (FM) technique. Sketch binary phase shift keying for the bit stream 1100110.   2

   b) Write down the advantages and disadvantages of optical fiber.   3

   c) What is the function of the twisting in twisted-pair cable?   2

   d) Draw the string 010010 in AMI and pseudo ternary schemes.   3

7. a) Differentiate between Nyquist theorem and Shannon's theorem for a communication channel in two points?   4

   b) Consider a noiseless channel with a bandwidth 4000 Hz, transmitting a signal with three bits per signal level. Calculate the maximum but rate for the channel.   4

   c) What is piggybacking?   2

8. a) What is parity bit? Generate codewords for data word 10101 using even parity and odd parity.   2

   b) Find the Hamming distance between two pairs of words 10101 and 11110.   2

   c) For P= 110011 and M= 1110011, find CRC using modulo 2 arithmetic.   3

   d) Discuss the concept of redundancy in error detection.   3