BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1   B. Sc. Engineering Examinations 2014-2015

Sub : **CSE 401** (Artificial Intelligence)

Full Marks : 210   Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) Define AI agent, rationality of an agent and the autonomy of an agent.   **(6)**

    (b) Develop a PEAS description of a chess player agent. Comment on the environment of such an agent.   **(10)**

    (c) Compare goal-based agents with learning agents.   **(10)**

    (d) Give suitable examples of the following environment types (i) stochastic (ii) strategic (iii) discrete (iv) semi-dynamic (v) partially observable (vi) sequential.   **(9)**

2. (a) Give the initial state, goal test, successor function and cost function for each of the following (choose a formulation that is precise enough to be implemented):

    (i) You have to color a planar map using only four colors, in such a way that no two adjacent regions have the same color.   **(7)**

    (ii) A 3-foot-tall monkey is in a room where some bananas are suspended from the 8-foot ceiling. He would like to get the bananas. The room contains two stackable, movable, climbable 3-foot-high crates.   **(8)**

    (b) Why is abstraction needed in problem solving? Give an example.   **(5)**

    (c) Compare BFS, DFS, uniform cost search, IDS with respect to completeness, time complexity, space complexity and optimality. Show necessary calculations.   **(15)**

3. (a) Prove the following assertion: for every game tree, the utility obtained by MAX using minimax decisions against a suboptimal MIN will never be lower than the utility obtained playing against an optimal MIN. Can you come up with a game tree in which MAX can do still better using a suboptimal strategy against a suboptimal MIN?   **(15)**

    (b) Prove the completeness and optimality of uniform cost search.   **(6)**

    (c) Give an example of a contingency problem. Does it require less steps than original problem? Justify your answer.   **(8)**

    (d) How can you use a relaxed problem in finding heuristics? Give examples to explain your answer.   **(6)**

CSE 401

4. (a) Prove that A* search is optimal if h(n) is consistent and admissible. **(7)**

    (b) "A* search runs out of memory before it runs out of time" – Justify the statement. **(6)**

    (c) Give the name of the algorithm that results from each of the following special cases: **(12)**

    (i) Local beam search with k = 1.

    (ii) Local beam search with k = ∞ (infinity).

    (iii) Simulated annealing with T = 0 at all times.

    (iv) Genetic algorithm with population size N = 1.

    Explain your choice with suitable example.

    (d) Compare three variations of hill climbing search. Which one is the best and why? **(10)**

SECTION – B

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

5. (a) Prune the game tree shown in Figure for Q. 5(a) with alpha-beta pruning. The up-directed-triangle and down-directed-triangle denote MAX and MIN, respectively. Clearly show which branches are pruned by striking through the edges of the tree. Also show the values of alpha and beta at each node clearly. **(18+2=20)**
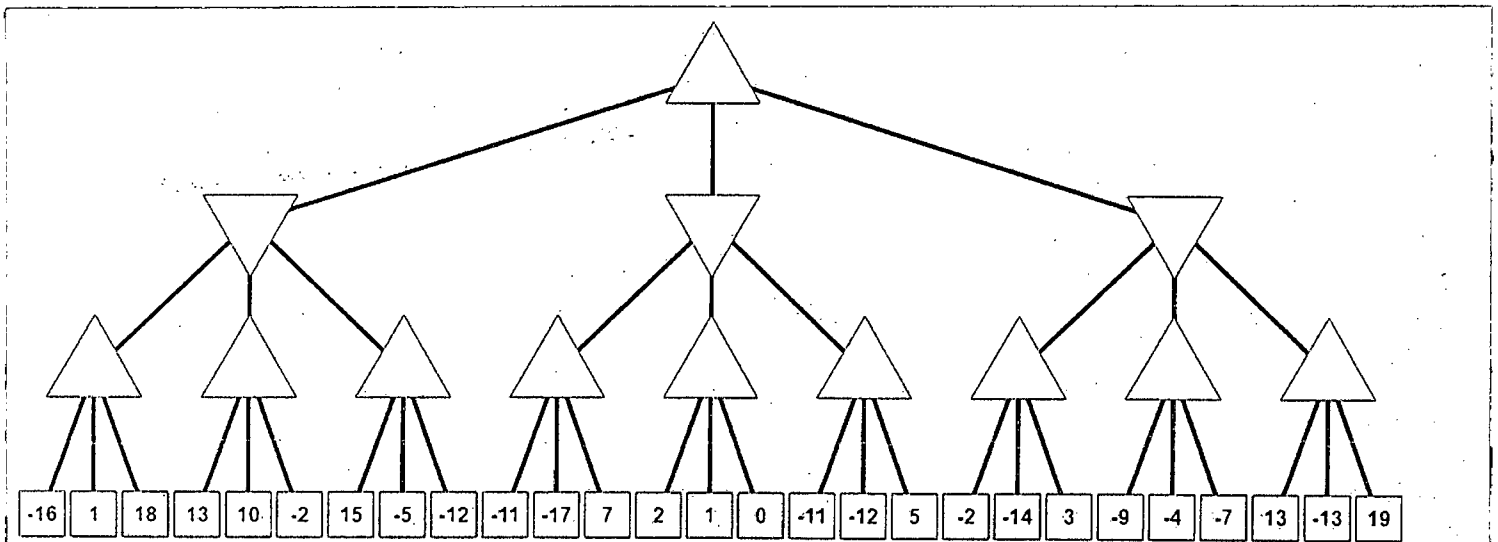
    Which move will be taken by MAX at root?

Figure for Question 5(a)

Note: The rectangular nodes represent terminal states and their labels indicate the utility values with respect to MAX.

(b) Briefly explain the gradient descent algorithm in the context of univariate linear regression. You do not need to calculate the derivatives. How does the step size impact its performance? **(15)**

CSE 401

6. (a) Suppose, the current Knowledge Base (KB) of a logical agent contains the following sentences: **(20)**

    (i) $P \vee R$

    (ii) $R \Rightarrow Q$

    (iii) $P \Rightarrow T$

    (iv) $\neg S$

    (v) $T \Rightarrow S$

Use PL-Resolution algorithm to determine whether the KB entails "Q" or not. Clearly show the set of clauses derived after each iteration of the algorithm.

(b) Briefly explain the Forward Checking algorithm with an example. How can it help the backtracking search? **(10+5=15)**

7. (a) Consider the following points in a 1-dimensional space: 1, 2, 3, 4, 7, 8, 10 and 12. Use K-means clustering algorithm with K = 2 to separate the points into two separate clusters. Clearly show, after each iteration of the algorithm, which points fall into the same clusters and the new **centroids (mean of the points in a cluster). Use 7 and 8 as initial centroids.** **(15)**

Use the absolute difference of two points as the distance measure, i.e., distance between 3 and 7 is $|3 - 7| = 4$.

(b) How does the ID3 algorithm for decision tree learning select attributes for partitioning the training set? **(10)**

(c) Briefly explain Minimum Remaining Values and Least Constraining Value heuristics in the context of Constraint Satisfaction Problem (CSP) with examples. **(5+5=10)**

8. (a) Suppose, the current Knowledge Base (KB) of a logical agent contains the following sentences: **(15)**

$A \wedge B \Rightarrow C$, $A \wedge D \Rightarrow C$, $B \wedge C \Rightarrow E$, $C \wedge E \Rightarrow D$, $A \wedge C \Rightarrow P$, $D \Rightarrow E$, $D \wedge P \Rightarrow Q$, $P \wedge Q \Rightarrow R$, $A \wedge D \wedge R \Rightarrow S$, A, and B

Use Forward Chaining algorithm (PL-FC-Entails?) to determine whether the KB entails "S" or not. Clearly show the states of the associated data structures at each iteration of the algorithm.

(b) What is a strongly k-consistent CSP? Suppose you are given a strongly n-consistent CSP with n variables. How can you devise an algorithm that can solve it in polynomial time, without involving any backtracking? **(3+7=10)**

(c) What is a naive Baysian model? Briefly explain with an appropriate example. **(10)**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA
L-4/T-1   B. Sc. Engineering Examinations 2014-2015

Sub : HUM 411 (Business Law)

Full Marks : 140   Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) Define 'contract'. Classify contract, and briefly explain each of their types.   **(10)**

    (b) Differentiate between void and voidable contract.   **(5)**

    (c) Mention the essentials of a valid contract. What are the conditions of valid offer and Acceptance?   **(8⅓)**

2. (a) Differentiate between contract of indemnity and contract of guarantee.   **(6⅓)**

    (b) Who is a surety? In what situations a surety may be discharged from his liability?   **(7)**

    (c) In what situations a person may be disqualified to enter into a contract? Explain briefly.   **(10)**

3. (a) What is fraud? Identify the essential elements of fraud.   **(6⅓)**

    (b) What is misrepresentation? Identify the essential elements of misrepresentation.   **(7)**

    (c) What do you mean by discharge of a contract? Identify different modes of discharging a contract.   **(10)**

4. (a) Define 'worker'. Classify different types of worker as per Bangladesh Labor Act 2006.   **(6⅓)**

    (b) Explain the provisions relating to punishment for conviction and misconduct.   **(7)**

    (c) Explain the provisions relating to termination of employment by employers and employees.   **(10)**

SECTION – B

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

5. (a) Differentiate between public and private limited company.   **(6)**

    (b) Write a note on the registration procedure of companies in Bangladesh.   **(7)**

    (c) What are the different sources of capital for a company? Differentiate between share capital and debt. Which is the most costly source of capital?   **(10⅓)**

HUM 411/CSE

6. (a) Differentiate between Memorandum of Association (MOA) and Articles of Association (AOA). (5⅓)

 (b) What are the usual contents of memorandum of company limited by shares and company limited by guarantee? (8)

 (c) What are the different modes of winding up of a company? In what situations a company can go for voluntary winding up? (10)

7. (a) What are the different types of fund a company is required to establish for workers participation in companies profit? How is such a fund established and managed? (8)

 (b) What do you mean by Collective Bargaining Agent (CBA)? What are the powers of CBA? (5⅓)

 (c) Mention some unfair labor practices on part of workers and employers. (10)

8. Write short notes on the following: (23⅓)

  (a) Name Clearance
  (b) Preferred Stock
  (c) Partnership
  (d) Adolescent, Child and Adult
  (e) Go Slow

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA
L-4/T-1   B. Sc. Engineering Examinations 2014-2015

Sub : **HUM 213** (Government)

Full Marks : 140   Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) Make a comparative analysis between democracy and dictatorship.   ($11\frac{1}{3}$)

    (b) Discuss the merits and demerits of presidential form of government.   (12)

2. (a) What is constitution? Discuss the good qualities of a constitution.   ($11\frac{1}{3}$)

    (b) Describe the modern classification of government with a diagram.   (12)

3. (a) Define bureaucracy. Explain the functions of bureaucracy in a state.   ($11\frac{1}{3}$)

    (b) Describe the functions of the legislature and the executive in a democratic state.   (12)

4. (a) Define sovereignty. Discuss different forms of sovereignty.   ($11\frac{1}{3}$)

    (b) What is citizenship? Briefly discuss the rights and duties of a citizen.   (12)

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.
Symbols indicate their usual meaning.

5. (a) Why is the six-point program called as the charter of freedom to the Bengali Nation?   (12)

    (b) Discuss the reasons and consequences of mass upsurge of 1969.   ($11\frac{1}{3}$)

6. (a) Define constitution. Describe the basic principles of Bangladesh constitution of 1972 and the changes in the constitution after the 5th amendment.   (12)

    (b) Critically discuss the impact of geographical position of Bangladesh on its foreign policy formulation.   ($11\frac{1}{3}$)

7. (a) Define local government? Critically discuss the constitutional provisions of Bangladesh regarding local government.   (12)

    (b) Define decentralization. How far is the local government system in Bangladesh decentralized?   ($11\frac{1}{3}$)

8. (a) What is meant by electoral college? How does the American political system work?   (12)

    (b) What do you know about the United Nations Organization? Discuss the successes and failure of United Nations Organization.   ($11\frac{1}{3}$)

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1   B. Sc. Engineering Examinations 2014-2015

Sub : **HUM 211** (Sociology)

Full Marks : 140   Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) What do you understand by socialization? Explain the conditions of successful learning. **(10)**

   (b) Evaluate the roles of different agents of socialization. **(13⅓)**

2. (a) What is social mobility? Discuss different types of social mobility with suitable examples. **(10)**

   (b) What is social stratification? Explain different systems of social stratification in the context of Bangladesh. **(13⅓)**

3. (a) Write the characteristics of white collar crime. **(10)**

   (b) What do you understand by deviant behaviour? How do situation theories explain deviant behaviour of a society? **(13⅓)**

4. Write short notes on any three of the following: **(23⅓)**

   (a) Culture and civilization.

   (b) Ethnocentrism.

   (c) Social values and norms.

   (d) Karl Mark theory of social stratification.

SECTION – B

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

5. (a) What were the social, economic, and political effects of the industrial revolution? **(13⅓)**

   (b) Does economic globalization improve the condition of poor people or is it a modern form of empire? **(10)**

HUM 211/CSE

6. (a) Enumerate the crucial elements of demography. How do these elements help to understand population dynamics? $(13\frac{1}{3})$

   (b) What do you think are the main factors contributing to overpopulation? (10)

7. (a) Explain the socio-economic features of pre-industrial and post-industrial cities. $(13\frac{1}{3})$

   (b) Demonstrate Burgess's 'Concentric Zone Model'. (10)

8. Write short notes on any THREE of the followings $(23\frac{1}{3})$

   (a) Pull factor of migration.

   (b) Neonatal Mortality

   (c) Chernobyl disaster

   (d) Horizontal mobility

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1   B. Sc. Engineering Examinations 2014-2015

Sub : **CSE 411** (Simulation and Modeling)

Full Marks : 210   Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) What are the different components of a discrete-event simulation model? Draw a schematic of flow of control for the next-event time-advance simulation approach. **(15)**

   (b) Consider a service facility that has two servers in a series (tandem) where first server has its own queue but the second one <u>does not</u> have its queue. So, when a customer finishes its service at server 1 and sees the server 2 busy cannot leave the server, rather waits there. This *blocks* server 1 taking customers from its queue (if any) even though it is serving none. If the customer waiting in server 1 cannot join to server 2 after a certain wait time, she *reneges* (i.e., leaves the system). In that case, server 1 can accept new customers if anyone waiting in the queue. Construct an event graph for the above description. Also, write down the "arrival" and "departure" event. **(15)**

   (c) Simulation is always better than its analytical counterpart. Does it always hold or not? Mention a case when this does not hold. **(5)**

2. (a) **(Three color chameleons)** Chameleon is an animal that can change its body color. In a jungle, there are chameleons of three colors: blue, green and red. When a blue color chameleon meets a green chameleon, both of them turn into red. The same happens for other colors too; that is, when two chameleons of different color meet, they both changed to the third one. Same colored chameleons, however, stay the same. A Biologist hypothesized that if the number of chameleons of a certain color is higher than the rest of the two colors in the initial population will eventually turn into that particular color by this process. **(15)**

   Give an outline to do a simulation to validate this claim. Make arbitrary assumptions if you need and mention them. Provide a pseudo code of your simulation program.

   (b) Describe Job-Shop model with all of its components. While simulating this, how many random streams do we need? **(10)**

   (c) Let an exam system have an MCQ part and a written part of equal weights (100). A student's score is the sum of the two scores. Mean and variance of two parts are as follows: **(10)**

	Mean	Variance
MCQ	45	144
Written	35	400

Correlation between the MCQ and written part is 0.8 indicating that students who perform good (or bad) in the MCQ also do the same in the written part. Given this information, find the mean and variance of the total score.

CSE 411

3. (a) Let X_1, X_2, ... and X_n be IID random variables with an unknown finite population mean μ. We want to estimate mean, μ. Let us define two *estimators* of mean as follows: **(15)**

$$A(n) = (X_1 + X_n)/2$$

$$B(n) = \frac{1}{n}\sum_{i=1}^{n} X_i$$

Show that both are indeed unbiased estimators of mean, μ. Still, we know $B(n)$ happens to be a better estimator than $A(n)$. Why? [Hint: Check their variances]

(b) Write down the expression for computing t confidence interval for population mean. How is the t value chosen for this interval? **(10)**

(c) The average wait time of an office space is 20 minutes. In order to reduce this wait time, the management team made some changes in the operation and collected samples from the new steup. The wait time (in minutes) became the following in 10 independent observations: **(10)**

15, 17, 25, 12, 28, 21, 20, 16, 15, 11

Based on these samples, can you suggest whether the new system has any change in its average time? Write down the appropriate null and alternative hypothesis. Use critical $t = 1.83$ at degree of freedom 9 and at level $\alpha = 0.1$.

4. (a) What are the different types of parameters of probability distributions? Name what type of parameters the following distributions have: **(8)**

(i) Weibull, (ii) Beta, (iii) Chi-square and (iv) Uniform

(b) Show the relationship between the following distributions: **(9)**

(i) Lognormal and normal

(ii) Chi-square and student's t

(iii) Poisson and exponential

(c) What is meant by empirical probability distributions? When are they used? Describe the technique how an empirical distribution is constructed from data points. **(10)**

(d) What do Q-Q plot and P-P plot mean? Briefly describe how they help determining the goodness of the fitted distribution compared to data points. **(8)**

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

5. (a) What are maximum likelihood estimators? Derive the maximum likelihood estimators for exponential distribution. **(4+6)**

(b) Perform chi-square test to determine whether following 35 numbers can be considered to be distributed geometrically. Take intervals as follows: 0-2, 2-4, 4-6, 6-9 and 9-13. Consider only the first value of each interval to be inclusive. **(17)**

CSE 411

Contd ... Q. No. 5(b)

2, 2, 4, 2, 1, 3, 8, 8, 0, 0, 2, 7, 0, 8, 6, 6, 0, 6, 10, 2, 1, 2, 1, 1, 1, 1,

12, 2, 5, 6, 9, 1, 1, 5, 3

Level of test should be **0.1**; Given $\chi^2_{4,0.9} = 7.779$.

(c) What are the advantages and disadvantages of Kolmogorov-Smirnov test with respect to chi-square test? **(4+4)**

6. (a) Explain the necessity of random number generators in simulation of a system or a process with the help of an illustrative example. **(6)**

(b) What are the difficulties in choosing $m = 2^b$ in multiplicative LCGs? How choosing m as a large prime number solve these difficulties? **(10)**

(c) What is the full period of a linear congruential generator (LCG)? What are the necessary and sufficient conditions for full-period LCGs. Which of the following LCGs have full period: **(2+5+4)**

(i) $Z_i = (13Z_{i-1} + 12) \bmod 24$

(ii) $Z_i = (Z_{i-1} + 11) \bmod 13$

(d) Explain the common idea behind spherical test and lattice test. **(8)**

7. (a) What is the inverse-transform method for generating random variates? Prove that the method is indeed correct. What are the drawbacks of this method? **(8)**

(b) Using the composition method, derive a generator for a random variable having the following density. **(12)**

Figure for Question 7(b)
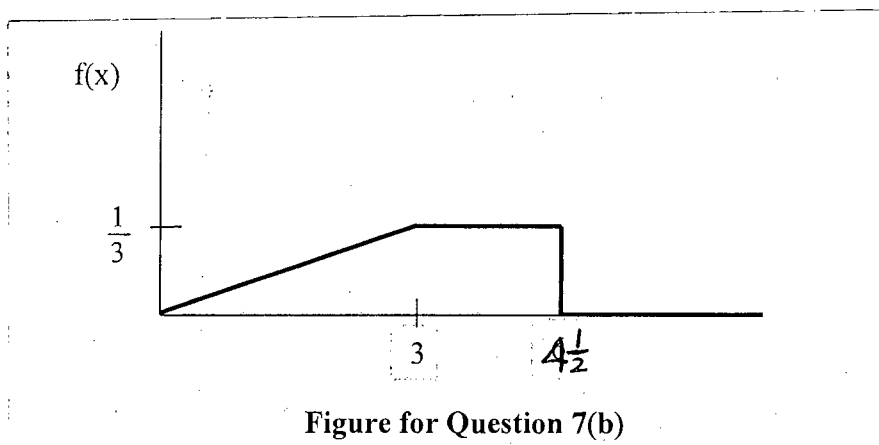
CSE 411

Contd ... Q. No. 7

(c) Plot the following density f. (2+5+8)

$$f(s) = \begin{cases} \dfrac{3x^2}{2} & \text{if } -1 \le x \le 1 \\ 0 & \text{otherwise} \end{cases}$$

Give inverse transform and acceptance-rejection algorithms for generating random variables of density f.

8. (a) How does a run test justify the independence of random numbers? What are various types of run test? For the following sequence of random numbers, find the runs-up of length from 1 to 6. Also, give the expression of test statistic, **R** for the number of runs up to length 1, 2, 3, 4, 5 and ≥6. For the expression, you do not have to assume any value a_{ij}, b_i and b_j. (3+2+3+4)

0.41	0.83	0.90	0.98	0.23
0.23	0.75	0.72	0.46	0.30
0.19	0.37	0.60	0.58	0.12
0.61	0.51	0.50	0.43	0.18
0.72	0.29	0.62	0.02	0.11

(b) Describe how MLE (Maximum Likelihood Estimation) is used top determine parameters of a hypothesized distribution from a set of given data values. (9)

(c) Describe Box and Muller method to generate standard normal variate. What is the limitation of this method? How can the method be extended to generate normal variate with arbitrary mean and variance? (14)

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1   B. Sc. Engineering Examinations 2014-2015

Sub : **CSE 421** (Basic Graph Theory)

Full Marks : 210   Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) Define the chromatic number and the chromatic index of a graph. Obtain a vertex coloring of each of the graphs in Figure 1 with the minimum number of colors.   **(4+6)**

Figure 1: Graphs for Question Number 1(a).
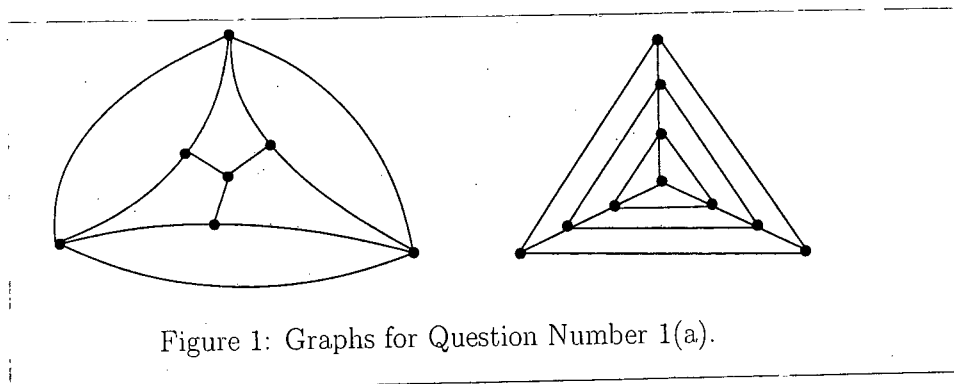
(b) Let G be a bipartite graph with the maximum degree Δ. Then show that $x'(G) = \Delta$.   **(12)**

(c) Construct three different orientations of K_5.   **(6)**

(d) Prove that a connected acyclic digraph always has a source and a sink.   **(7)**

2. (a) Let G be a maximal outerplane graph with n vertices. Then prove that (i) G has $2n - 3$ edges and (ii) G has at least three vertices of degree three of less.   **(6+4)**

(b) What is a separating triangle in a plane graph? Show that the number of separating triangles in triangulated plane graph of n vertices is at most $n - 4$.   **(3+12)**

(c) Construct the tree corresponding to Prüffer's code 1,2,2,7,6,6,5 showing every step.   **(10)**

3. (a) When do we call a matching a perfect matching? Find a maximum matching in each of the graphs in Figure 2 and identify whether the graph has a perfect matching or not.   **(4+6)**

Figure 2: Graphs for Question Number 3(a).
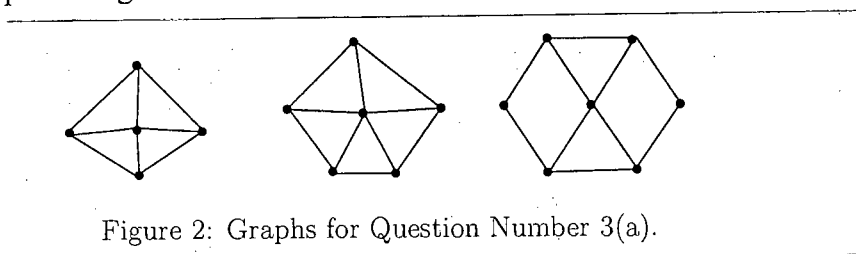
CSE 421

Contd ... Q. No. 3

(b) Let G be a bipartite graph with bipartition $V(G) = X \cup Y$. Then show that G contains a matching that saturates every vertex in X if and only if $|N(S)| \geq |S|$ for every subset S of X. **(15)**

(c) Describe applications of (i) a minimum dominating set and (ii) a connected minimum dominating set. **(10)**

4. (a) Show that K_5 is nonplanar. **(5)**

(b) Why is the dual graph of a maximal plane graph always a cubic graph? **(5)**

(c) Show that every simple planar graph has a straight-line drawing. **(15)**

(d) Define a clique and a minimal separator in a graph. Prove that a graph G is chordal only if every minimal separator of G is a clique. **(4+6)**

SECTION – B

There are **NINE** questions in this section. Answer any **SEVEN**.

5. An industry has 600 square meter rectangular area on a floor of a building where it needs to establish four processing units A, B, C and D. Processing units A and D requires 100 square meter area each whereas B and C requires 200 square meter each. Furthermore the following adjacency requirements must be satisfied: B, C and D should be adjacent to A; A and D should be adjacent to B; A and D should be adjacent to C; and A, B and C should be adjacent to D. Can you construct a floor layout where the space for each processing unit will be a rectangle? Propose a suitable layout in your justification. Draw the corresponding graph and triangulate the graph. **(15)**

6. Let $G = (V, E)$ be a graph with m edges and $deg(v)$ denote degree of vertex v. Prove that **(15)**

   (a) $\sum_{v \in V} deg(v) = 2m$

   (b) There is an even number of vertices of odd degree in an undirected graph.

7. What is graph isomorphism? Give an example of a self-complementary graph. Prove the following of disprove by giving a counter-example **(15)**

   "If two graphs have the same degree sequence, then the graphs are isomorphic".

8. Describe three approaches to represent graphs with examples and discuss their advantages and disadvantages. **(15)**

CSE 421

9. Define complement of a graph. Show that for any graph of six vertices, either the graph or its complement contains a triangle. Can any graph with at least six vertices and its complement both be bipartite? Justify your answer. **(15)**

10. Write an algorithm to find an Eulerian circuit in an Eulerian graph based on the fact that a connected graph G is Eulerian if an only if every vertex of G has even degree. **(15)**

11. Let G be a graph with n vertices. Then, any two of the following three statements imply the third (and characterize a tree of n vertices). **(15)**

    (a) G is connected.

    (b) G contains no cycle.

    (c) G has $n - 1$ edges.

12. (a) Let $\tau(G)$ be the number of number of spanning trees of a connected graph. Let G be a connected graph and let e be an edge in G. Show that $\tau(G) = \tau(G - e) + \tau(G \backslash e)$. **(10)**

    (b) What is a cut edge? If e is a cut edge what is the value of $\tau(G - e)$? **(5)**

13. Let G be a simple graph of n vertices. Let u and v be two vertices in G such that $(u, v) \in E(G)$ and $d_G(u) + d_G(v) \geq n$. Then prove that G is Hamiltonian if and only if $G + (u, v)$ is Hamiltonian. **(10)**

    (b) Explain ear decomposition of a graph with an example. **(5)**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA
L-4/T-1   B. Sc. Engineering Examinations 2014-2015

Sub : **CSE 433** (Digital Image Processing)

Full Marks : 210   Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) Why do we need lossless image compression? State the advantages of Lempel-Ziv-Welch (LZW) coding. **(8)**

    (b) Explain the imaging procedure that is used in ultrasonography (USG) and CT/PET. **(15)**

    (c) Draw block diagrams of (i) an encoder and (ii) a decoder of a lossy predictive coding model. Explain what makes the encoding procedure lossy. **(12)**

2. (a) The following are the gray scale values of a scan line of an image. EOB is a special symbol representiatg the end of the image block. Compress the segment using (i) Huffman coding and (ii) arithmetic coding. You should ignore EOB symbol while using Huffman coding. Is arithmetic coding lossless? Justify. **(25)**

    217   17   223   223   223   18   EOB

    (b) Do you really need to implement algorithms for 2D Fourier transform and its inverse to manage the spectrum of an image? Justify. **(10)**

3. (a) Explain the *illumination-reflectance based* image formation model. Can you relate this to an image filtering operation in frequency domain? Briefly describe that filtering operation. **(18)**

    (b) Explain how JPEG implements location dependent thresholding. What are its advantages over other thresholding techniques? **(10)**

    (c) Evaluate the importance of phase angle and spectrum of the Fourier transform of an image. **(7)**

4. (a) The Fourier theorem is used to represent a periodic complex signal in terms of a number of simpler signals. Justify how this theorem is applied in an image whereas an image is hardly periodic. **(10)**

    (b) Explain how sampling and quantization are related to spatial and gray level resolutions of an image. Describe the nearest neighbor based technique to increase the spatial level resolution of an image. **(15)**

    (c) With necessary examples, describe the chain code based technique for shape representation. **(10)**

CSE 433

SECTION – B

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

5. (a) Laplacian 2nd order derivative is given by the formula: **(15)**

$$\nabla^2 f = \frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2}$$

Derive an implementation of this derivative for image sharpening. Draw two masks that are rotation invariant for 45° and 90° increments (one for each).

(b) What are the advantages of gradient? Write down the Roberts cross gradient and Sobel operators. **(8)**

(c) What is unsharp masking? How can it be used for image sharpening? **(6)**

(d) Will you prefer first order derivative or second order derivative to detect ramp-like transitions? Justify your answer. **(6)**

6. (a) During image enhancement using image subtraction method, we can end up having negative value for a pixel. Propose two solutions to overcome it. **(10)**

(b) Derive the expression for first-order and second-order derivative at x in the horizontal intensity profile of a 2-d image. Calculate the first-order and second-order derivatives at each point of the following 2-d image strip. By analyzing these values, identify ramp, line and isolated noise with explanation. **(20)**

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

(c) Which type of filter is most suitable to remove salt-and-pepper noise? What are the advantages of this filter? **(5)**

7. (a) What is gamma correction? Explain why gamma correction is used in CRT devices? **(10)**

(b) Derive an intensity transformation function that can make the intensity histogram uniform. Prove mathematically that the intensity histogram of the transformed image is uniform and independent of the original image. First, assume continuous intensity values. Then, propose a transformation function for discrete intensity values. **(15)**

(c) How can we distinguish dark, bright, low contrast and high contrast images from histograms? **(6)**

(d) What is box filter? What is the purpose of this type of filter? **(4)**

8. (a) Write down an algorithm for finding polygonal fitting of open and closed curves. **(10)**

(b) Describe region splitting and merging techniques for image segmentation. Which type of data structure is used for this purpose? **(11)**

(c) What is accumulative difference image (ADI)? How can this be used to detect motion from an image? **(9)**

(d) Write down the generalized global thresholding equation. What are the limitations of basic global thresholding? **(5)**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1   B. Sc. Engineering Examinations 2014-2015

Sub : **IPE 493** (Industrial Management)

Full Marks : 210   Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) Discuss different managerial levels. How are these levels associated with different basic managerial skills? **(15)**

   (b) Explain different types of authority. **(10)**

   (c) Briefly describe the contingency factors for organizational design. **(10)**

2. (a) Write short note on Hawthorne studies. **(10)**

   (b) Differentiate between rationality and bounded rationality. **(10)**

   (c) Write short note on Maslow's need theory of hierarchy. Give a practical example that violates Maslow's need theory of hierarchy. **(15)**

3. (a) Discuss the four aspects of the reinforcement theory. **(10)**

   (b) What are the critical factors of management of technology? How does the knowledge gap after the price of the technology? **(10)**

   (c) Mention the relative advantages and disadvantages of different performance appraisal methods. **(15)**

4. (a) Mention the steps to improve marketing intelligence. **(5)**

   (b) Explain the role of economic and natural environment in market analysis. **(15)**

   (c) What is innovation cycle? Describe different stages of S-curve for technological progress. **(15)**

SECTION – B

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

5. (a) How can a company influence the market demand of its products? **(6)**

   (b) Define different components of demand. Explain the general principles to determine the values of exponential smoothing constants α and δ. **(8+6=14)**

IPE 493/CSE

Contd ... Q. No. 5

(c) In a small machine shop, each job needs to be processed in two workstations. At the beginning of a month, there are seven jobs that need to be scheduled. The processing times for all jobs on each workstations are given below: **(15)**

Job	Processing Time on WS 1 (days)	Processing Time on WS 2 (Days)
A	5	7
B	4	2
C	6	5
D	9	8
E	12	10
F	1	2
G	2	4

(i) Determine the sequence of the jobs

(ii) Determine the time when all the jobs will be completed

(iii) Determine the delivery time of each job

(iv) Determine the idle time for Workstation 2

6. (a) In a manufacturing organization, which type of inventory model should be used for a critical item and why? **(8)**

(b) Mention the assumptions of the basic fixed order quantity model of inventory. **(5)**

(c) A company uses quarterly demand forecast to develop its production plan. The company uses past demand data to predict the future demand. The actual sales of a product for the last 12 quarters are as follows: **(22)**

Year 2013	Sales	Year 2014	Sales	Year 2014	Sales
1st Quarter	750	1st Quarter	950	1st Quarter	1190
2nd Quarter	720	2nd Quarter	930	2nd Quarter	1160
3rd Quarter	940	3rd Quarter	1180	3rd Quarter	1440
4th Quarter	1120	4th Quarter	1420	4th Quarter	1820

Forecast the demand of the product in each quarter of the year 2016 using linear regression technique.

IPE 493/CSE

7. (a) A retailer sells a grocery item "G". He/she orders the product after every two weeks. The order arrives after 4 days. There is Tk. 30 profit for selling one unit of the product. But, if the product remains unsold after 18 days, the retailer incurs Tk. 20 loss for each remaining unit. The retailer uses last 8 weeks actual sales data to decide the order size for the coming time period. The sales for the last eight weeks are 650, 620, 605, 590, 575, 600, 650, and 610. How many units the retailer should order for the coming time period? **(17)**

(b) Determine the project completion time, critical path, and slack time for each activity for the following information: **(18)**

Activity	Immediate Predecessor	Time (Weeks)
A	None	6
B	None	9
C	A	5
D	B	3
E	C, D	5
F	C, D	10
G	E	4
H	F	6
I	A, B	20
J	G, I	8
K	G, J	4
L	J, K	5
M	L	5
N	L	7

8. (a) Discuss the significance of the expectancy theory in motivating employees. **(10)**

(b) Define career. Write down the factors that influence the compensation and benefits of an employee. **(10)**

(c) Explain the differentiation strategy in the competitive environment. Mention the factors that determine the width of span for an organizational structure. **(15)**

STANDARD NORMAL DISTRIBUTION: Table Values Represent AREA to the LEFT of the Z score.

Z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.50000	.50399	.50798	.51197	.51595	.51994	.52392	.52790	.53188	.53586
0.1	.53983	.54380	.54776	.55172	.55567	.55962	.56356	.56749	.57142	.57535
0.2	.57926	.58317	.58706	.59095	.59483	.59871	.60257	.60642	.61026	.61409
0.3	.61791	.62172	.62552	.62930	.63307	.63683	.64058	.64431	.64803	.65173
0.4	.65542	.65910	.66276	.66640	.67003	.67364	.67724	.68082	.68439	.68793
0.5	.69146	.69497	.69847	.70194	.70540	.70884	.71226	.71566	.71904	.72240
0.6	.72575	.72907	.73237	.73565	.73891	.74215	.74537	.74857	.75175	.75490
0.7	.75804	.76115	.76424	.76730	.77035	.77337	.77637	.77935	.78230	.78524
0.8	.78814	.79103	.79389	.79673	.79955	.80234	.80511	.80785	.81057	.81327
0.9	.81594	.81859	.82121	.82381	.82639	.82894	.83147	.83398	.83646	.83891
1.0	.84134	.84375	.84614	.84849	.85083	.85314	.85543	.85769	.85993	.86214
1.1	.86433	.86650	.86864	.87076	.87286	.87493	.87698	.87900	.88100	.88298
1.2	.88493	.88686	.88877	.89065	.89251	.89435	.89617	.89796	.89973	.90147
1.3	.90320	.90490	.90658	.90824	.90988	.91149	.91309	.91466	.91621	.91774
1.4	.91924	.92073	.92220	.92364	.92507	.92647	.92785	.92922	.93056	.93189
1.5	.93319	.93448	.93574	.93699	.93822	.93943	.94062	.94179	.94295	.94408
1.6	.94520	.94630	.94738	.94845	.94950	.95053	.95154	.95254	.95352	.95449
1.7	.95543	.95637	.95728	.95818	.95907	.95994	.96080	.96164	.96246	.96327
1.8	.96407	.96485	.96562	.96638	.96712	.96784	.96856	.96926	.96995	.97062
1.9	.97128	.97193	.97257	.97320	.97381	.97441	.97500	.97558	.97615	.97670
2.0	.97725	.97778	.97831	.97882	.97932	.97982	.98030	.98077	.98124	.98169
2.1	.98214	.98257	.98300	.98341	.98382	.98422	.98461	.98500	.98537	.98574
2.2	.98610	.98645	.98679	.98713	.98745	.98778	.98809	.98840	.98870	.98899
2.3	.98928	.98956	.98983	.99010	.99036	.99061	.99086	.99111	.99134	.99158
2.4	.99180	.99202	.99224	.99245	.99266	.99286	.99305	.99324	.99343	.99361
2.5	.99379	.99396	.99413	.99430	.99446	.99461	.99477	.99492	.99506	.99520
2.6	.99534	.99547	.99560	.99573	.99585	.99598	.99609	.99621	.99632	.99643
2.7	.99653	.99664	.99674	.99683	.99693	.99702	.99711	.99720	.99728	.99736
2.8	.99744	.99752	.99760	.99767	.99774	.99781	.99788	.99795	.99801	.99807
2.9	.99813	.99819	.99825	.99831	.99836	.99841	.99846	.99851	.99856	.99861
3.0	.99865	.99869	.99874	.99878	.99882	.99886	.99889	.99893	.99896	.99900
3.1	.99903	.99906	.99910	.99913	.99916	.99918	.99921	.99924	.99926	.99929
3.2	.99931	.99934	.99936	.99938	.99940	.99942	.99944	.99946	.99948	.99950
3.3	.99952	.99953	.99955	.99957	.99958	.99960	.99961	.99962	.99964	.99965
3.4	.99966	.99968	.99969	.99970	.99971	.99972	.99973	.99974	.99975	.99976
3.5	.99977	.99978	.99978	.99979	.99980	.99981	.99981	.99982	.99983	.99983
3.6	.99984	.99985	.99985	.99986	.99986	.99987	.99987	.99988	.99988	.99989
3.7	.99989	.99990	.99990	.99990	.99991	.99991	.99992	.99992	.99992	.99992
3.8	.99993	.99993	.99993	.99994	.99994	.99994	.99994	.99995	.99995	.99995
3.9	.99995	.99995	.99996	.99996	.99996	.99996	.99996	.99996	.99997	.99997

STANDARD NORMAL DISTRIBUTION: Table Values Represent AREA to the LEFT of the Z score.

Z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
-3.9	.00005	.00005	.00004	.00004	.00004	.00004	.00004	.00004	.00003	.00003
-3.8	.00007	.00007	.00007	.00006	.00006	.00006	.00006	.00005	.00005	.00005
-3.7	.00011	.00010	.00010	.00010	.00009	.00009	.00008	.00008	.00008	.00008
-3.6	.00016	.00015	.00015	.00014	.00014	.00013	.00013	.00012	.00012	.00011
-3.5	.00023	.00022	.00022	.00021	.00020	.00019	.00019	.00018	.00017	.00017
-3.4	.00034	.00032	.00031	.00030	.00029	.00028	.00027	.00026	.00025	.00024
-3.3	.00048	.00047	.00045	.00043	.00042	.00040	.00039	.00038	.00036	.00035
-3.2	.00069	.00066	.00064	.00062	.00060	.00058	.00056	.00054	.00052	.00050
-3.1	.00097	.00094	.00090	.00087	.00084	.00082	.00079	.00076	.00074	.00071
-3.0	.00135	.00131	.00126	.00122	.00118	.00114	.00111	.00107	.00104	.00100
-2.9	.00187	.00181	.00175	.00169	.00164	.00159	.00154	.00149	.00144	.00139
-2.8	.00256	.00248	.00240	.00233	.00226	.00219	.00212	.00205	.00199	.00193
-2.7	.00347	.00336	.00326	.00317	.00307	.00298	.00289	.00280	.00272	.00264
-2.6	.00466	.00453	.00440	.00427	.00415	.00402	.00391	.00379	.00368	.00357
-2.5	.00621	.00604	.00587	.00570	.00554	.00539	.00523	.00508	.00494	.00480
-2.4	.00820	.00798	.00776	.00755	.00734	.00714	.00695	.00676	.00657	.00639
-2.3	.01072	.01044	.01017	.00990	.00964	.00939	.00914	.00889	.00866	.00842
-2.2	.01390	.01355	.01321	.01287	.01255	.01222	.01191	.01160	.01130	.01101
-2.1	.01786	.01743	.01700	.01659	.01618	.01578	.01539	.01500	.01463	.01426
-2.0	.02275	.02222	.02169	.02118	.02068	.02018	.01970	.01923	.01876	.01831
-1.9	.02872	.02807	.02743	.02680	.02619	.02559	.02500	.02442	.02385	.02330
-1.8	.03593	.03515	.03438	.03362	.03288	.03216	.03144	.03074	.03005	.02938
-1.7	.04457	.04363	.04272	.04182	.04093	.04006	.03920	.03836	.03754	.03673
-1.6	.05480	.05370	.05262	.05155	.05050	.04947	.04846	.04746	.04648	.04551
-1.5	.06681	.06552	.06426	.06301	.06178	.06057	.05938	.05821	.05705	.05592
-1.4	.08076	.07927	.07780	.07636	.07493	.07353	.07215	.07078	.06944	.06811
-1.3	.09680	.09510	.09342	.09176	.09012	.08851	.08691	.08534	.08379	.08226
-1.2	.11507	.11314	.11123	.10935	.10749	.10565	.10383	.10204	.10027	.09853
-1.1	.13567	.13350	.13136	.12924	.12714	.12507	.12302	.12100	.11900	.11702
-1.0	.15866	.15625	.15386	.15151	.14917	.14686	.14457	.14231	.14007	.13786
-0.9	.18406	.18141	.17879	.17619	.17361	.17106	.16853	.16602	.16354	.16109
-0.8	.21186	.20897	.20611	.20327	.20045	.19766	.19489	.19215	.18943	.18673
-0.7	.24196	.23885	.23576	.23270	.22965	.22663	.22363	.22065	.21770	.21476
-0.6	.27425	.27093	.26763	.26435	.26109	.25785	.25463	.25143	.24825	.24510
-0.5	.30854	.30503	.30153	.29806	.29460	.29116	.28774	.28434	.28096	.27760
-0.4	.34458	.34090	.33724	.33360	.32997	.32636	.32276	.31918	.31561	.31207
-0.3	.38209	.37828	.37448	.37070	.36693	.36317	.35942	.35569	.35197	.34827
-0.2	.42074	.41683	.41294	.40905	.40517	.40129	.39743	.39358	.38974	.38591
-0.1	.46017	.45620	.45224	.44828	.44433	.44038	.43644	.43251	.42858	.42465
-0.0	.50000	.49601	.49202	.48803	.48405	.48006	.47608	.47210	.46812	.46414

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1   B. Sc. Engineering Examinations 2015-2016

Sub : **CSE 403** (Digital System Design)

Full Marks : 210   Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) Design the circuit diagram to connect a programmable counter 8254 and a priority interrupt controller 8259A to an SDK-86 board using 74LS138. Show the connections of system address bus $A_0 - A_{15}$ and data bus $D_0 - D_{15}$.   **(20)**

    (b) Show the truth table for the address decoder 74LS138 as per design of Q. 1(a) and find the system addresses of 8254 and 8259A.   **(10)**

    (c) From the truth table of Q. 1(b), find the system addresses of the counters and control word registers of 8254.   **(5)**

2. (a) Show the design of a hexadecimal matrix keypad connecting with a 4-bit output port and an 8 bit input port. Explain the operation of the keypad with a flow chart. Find the codes that are produced when Keys 0, 5, A and F are pressed.   **(10)**

    (b) Draw the connection diagram of a programmable port device 8255A with the system address bus, data bus and control bus and explain mode 1 operation.   **(10)**

    (c) Show that circuit for driving a single 7-segment LED display with 7447 and find out the resistance of the current limiting resistor for 20 mA current.   **(15)**

3. (a) How can you convert an analog voltage input to binary code output by using parallel comparators? What are the advantages and disadvantages of this type of conversion?   **(10)**

    (b) How can you measure weight by using strain gages and a balance-bridge circuit to produce equivalent voltages? How is the effect of temperature compensated?   **(10)**

    (c) Explain the analog to digital conversion process using the circuit diagram of successive approximation A/D converter.   **(15)**

4. (a) Show the internal block diagram of priority interrupt controller 8259A. How is priority resolved if IR_4 is under process with INTR enabled in IR_4 procedure and IR_2 arrives. Show the execution of IR_4 and IR_2.   **(15)**

    (b) Design an interrupt system to handle 22 interrupts using one master programmable interrupt controller and a minimum of slave controllers. Explain the execution of an interrupt from a slave controller input.   **(10)**

    (c) Show the connection of drive or peripheral devices with main computer buses in SCSI hard disk interface system. What is the purpose of adding one extra layer of hardware between the main bus and drive controllers?   **(10)**

CSE 403

SECTION – B

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

5. (a) Design an arithmetic circuit with two selection variables, s_1 and s_0 that generates the following arithmetic operations. Draw the logic diagram of one typical stage. **(20)**

$s_1\ s_0$	$C_{in} = 0$	$C_{in} = 1$
0 0	F = A	F = A + 1
0 1	F = A – B – 1	F = A – B
1 0	F = B – A – 1	F = B – A
1 1	F = A + B	F = A + B + 1

(b) Using JK flip-flops design one typical stage of a register that performs the following logic micro-operation is (draw necessary figures): **(10)**

   P1: A ← A – 1 (Decrement)

   P2: A ← A V B (OR)

Here, P1 and P2 are control variables.

(c) What is the difference between hard-wired control and microprogram control? What are the advantages of microprogram control method? **(5)**

6. (a) Suppose, we wish to design an arithmetic circuit that multiplies two fixed-point binary numbers in sign-magnitude representation. The product obtained from the multiplication of two binary numbers whose magnitudes consist of k-bits each can be up to 2k-bits long. The sign of the number occupies one additional bit. The Multiplication of two fixed-point binary numbers in sign-magnitude representation is done with paper and pencil method by successive additions and shifting. The process consists of looking at successive bits of the multiplier, least significant bit first. If the multiplier bit is a 1, the multiplicand is copied down; otherwise zeros are copied down. The numbers are copied down in successive lines are shifted one position to the left from the previous number. Finally, the numbers are added; their sum forms the product.

The sign of the product is determined form the sings of the multiplicand and the multiplier. If they are alike, the sign of product is plus. If they are unlike, the sign of the product is minus.

A modification of the above stated algorithm can be done by shifting the partial product to the right instead of shifting the multiplicand to the left.

Now, design a multiplier using above stated modified algorithm. Your design must contain followings: **(25)**

   (i) Equipment Configuration (ii) Derivation of the Algorithm with flow-chart

   (iii) Control State Design   (iv) Data-Processor Specification.

CSE 403

Contd ... Q. No. 6

(b) Suppose, A and B are both sign-2's complement numbers. How can you detect six relational logic between A and B using only subtraction operation? Show the effects of status bits (Zero Flag, Sign Flag, Overflow Flag, and Carry Flag) in terms of Boolean functions. **(10)**

7. (a) Design a 2048-bit ROM having word size 4-bits each? **(3)**

(b) A combinational circuit is defined by the functions: **(8)**

$$F_1(A, B, C) = \Sigma(3, 5, 6, 7)$$

$$F_2(A, B, C) = \Sigma(0, 2, 4, 7)$$

Implement the circuit with a PLA having three inputs, four product terms and two outputs.

(c) Describe four different methods of control organization with block diagram. **(12)**

(d) Describe Fetch cycle and Execution cycle of SAP-1 architecture. **(8)**

(e) Define Machine cycle and Instruction cycle with examples. **(4)**

8. (a) The positive clock edge occurs halfway through each state in SAP architecture. Why this is important? **(5)**

(b) Write machine cycle description for CALL instruction in SAP-2 architecture. **(10)**

(c) Differentiate between SUB and SBB operation with example for SAP-3 architecture. **(5)**

(d) Differentiate between RLC and RRC operation with example for SAP-3 architecture. **(5)**

(e) SAP-2 has a clock frequency of 1MHz. This means that each T state has a duration of 1 μs. How long does it take to execute the following SAP-2 subroutine? **(7)**

```
        MVI B, 0AH
LOOP1:  MVI C, 47H
LOOP2:  DCR C
        JNZ LOOP2
        DCR B
        JNZ LOOP1
        RET
```

(f) The 8080/8085 programming manual says that it takes thirteen T states to fetch and execute the LDA instruction. If the system clock has a frequency of 2.5 MHz, how long is this instruction cycle? **(3)**