NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Even Semester End-term Examination, 2021-22

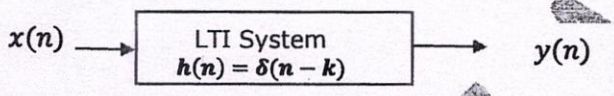
Course Code: CSE 405 Full Marks: 30

Course Name: Signals and Systems Time: 90 Minutes

Question Paper No.: NITDGP/CSE405/1 Date of Exam: 30/04/2022

Instructions: Answer all the questions.

Materials to be supplied: Graph paper shall be supplied if required.

Question No.	Body of the Question	Marks	Mapped CO
1	Find the z-transform ($X(z)$) of the signal ($x(n)$) given below. $$x(n) = \left(\frac{1}{4}\right)^n u(n) + \left(\frac{1}{2}\right)^n u(-n-1)$$ Find the ROC of $X(z)$ on z-plane.	3	CO2
2	Prove that the output of the Linear Time-Invariant (LTI) system shown in Figure is $x(n-k)$ 	2	CO3, CO1
3	The transfer function ($H(z)$) of an LTI system is given by $H(z) = \frac{1}{1-0.25z^{-1}}$ ROC: $\lvert z\rvert > 1$ Comment on the causality of the system.	2	CO5, CO1
4	An initially relaxed LTI system is described by a difference equation as follows: $$y(n) = ay(n-1) + x(n)$$ Find the range of a for which the system will be stable.	3	CO5, CO1
5	Explain Linearity and Time-Invariance Property of an LTI system.	2	CO6, CO1
6	Choose the correct option: If $X(s) = s$; and Inverse Laplace Transform of $X(s)$ is $x(t)$, then $x(t)$ will be equal to: (a) $u(t)$ (b) $\partial(t)$ (c) $\frac{d}{dt}[\partial(t)]$ (d) 1	2	CO2
7	Calculate Laplace Transform of the function: $e^{-3t}\sin(2t)\,u(t)$	2	CO2
8	Determine Inverse Laplace Transform of the s-domain function: $X(s) = \frac{1}{(s+3)^2}$	2	CO4
9	Comment on the Stability of the system given by Transfer Function: H(s) = $\frac{s+1}{(s+2)^2+9}$	2	CO5, CO1
10	Define Fourier transform.	1	CO2
11	Compute Fourier transform of $e^{j\omega_0 t}$	3	CO4
12	Compute Fourier transform of $e^{-at}\cos(\omega_0 t)\,u(t)$	3	CO4
13	Compute Fourier transform of $\text{rect}\left(\frac{t}{\delta}\right)$, rect stands for rectangular pulse.	3	CO4

Course Outcomes
CO1:
CO2:
CO3:

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Even Semester End-term Examination, 2021-22

Course Code: CSE614

Course Name: ADVANCED COMPUTER ARCHITECTURE

Full Marks: 30

Time: 90 Minutes

Question Paper No.: NITDGP/CSE614/1

Date of Exam: 21/04/2022

Instructions: Answer all the questions.

Materials to be supplied: Graph paper shall be supplied, if required.

Question No.	Body of the Question	Marks	Mapped CO
1	Compare static and dynamic instruction scheduling used to reduce the total number stalls in a pipelined processor.	3	CO4
2	"Miss rate keeps on decreasing with increasing size of cache block" – State whether the statement is true or false and write justification in support of your answer.	3	CO4
3	Consider an instruction pipeline with five stages without any branch prediction: Fetch Instruction (FI), Decode Instruction (DI), Fetch Operand (FO), Execute Instruction (EI) and Write Operand (WO). The stage delays for FI, DI, FO, EI and WO are 5 ns, 17 ns, 10 ns, 8 ns and 6 ns, respectively. There are intermediate storage buffers after each stage and the delay of each buffer is 1 ns. A program consisting of 100 instructions I1, I2, I3, …, I100 is executed in this pipelined processor. Instruction I17 is the only branch instruction and its branch target is I91. If the branch is taken during the execution of this program, calculate the time (in ns) needed to complete the program.	3	CO2, CO3
4	Explain cache coherence problem. Name the different directory based cache coherence protocols and briefly describe any one of them.	3	CO4
5	What is a `victim cache'? Define cache `conflict miss'. How introduction of a victim cache can reduce the conflict misses in a system?	3	CO4
6	Define `control hazard' in a pipeline system. Describe the `predict taken' and `predict not-taken' schemes.	3	CO2
7	Take the following example program segment *for i = 1 to 500 do* *P[i] = P[i] * Q[i];* *for i = 1 to 500 do* *Q[i] = P[i] * P[i];* Each P[i]/Q[i] forms a block. If the segment is executed in a system with only two cache frames (blocks), one for P[i]s and the other for Q[i]s, then compute the total number of cache misses during execution. Perform loop fusion and then compute the number of such misses.	3	CO2

Course Outcomes

CO1:To know about the classes of computers, and new trends and developments in computer architecture

CO2: To acquire knowledge about the various architectural concepts that may be applied to optimize and enhance the classical Von Neumann architecture into high performance computing systems.

CO3: To learn the basic design procedure for different levels of parallelism.

CO4: To learn the design issues relating to the architectural options.

8	What is false sharing cache miss? 'False sharing miss normally occurs in a system realizing the large block size and write-invalidate scheme for cache coherence' – Explain.	3	CO4
9	In the MIPS 32 pipeline, which data dependency will always result in a pipeline stall due to data hazard without any instruction rescheduling? Write justification in support of your claim.	2	CO1
10	In a two-level cache system, the access times of L1 and L2 caches are 1 and 8 clock cycles, respectively. The miss penalty from the L2 cache to main memory is 18 clock cycles. The miss rate of L1 cache is twice that of L2. The average memory access time (AMAT) of this cache system is 2 cycles. The miss rate of L1 and L2 respectively are: (a) 0.056 and 0.111, (b) 0.0892 and 0.1784 (c) 0.1784 and 0.0892 (d) 0.111 and 0.056 Choose the correct answer from the list of options and clearly depict the calculation steps.	2	CO2
11	If a memory system consists of a single external cache with an access time of 20 ns and a hit rate of 0.92, and a main memory with an access time of 60 ns, what is the effective memory access time of this system? (a) 75.2 ns (b) 24.8 ns (c) 80 ns (d) 4.8 ns Choose the correct answer from the list of options and clearly depict the calculation steps.	2	CO2

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Even Semester End-term Examination, 2021-22

Course Code: CSE615
Course Name: Optimization Techniques
Question Paper No.: NITDGP/CSE615/1

Full Marks: 30
Time: 90 Minutes
Date of Exam: 21/04/2022

Instructions: Answer Question No. 1 and any two from the rest.

<table>
<tr><th>Question No.</th><th>Body of the Question</th><th>Marks</th><th>Mapped CO</th></tr>
<tr><td>1 i)

ii)
iii)
iv)

v)</td><td>What type of LPP problems can be solve by using two-phase simplex method and why?
Define degenerate and non-degenerate solution for a LPP.
Formulate transportation problem as a liner programming problem.
How a non-linear programming problem is related to concave and convex optimization problem?
What will be the sufficient conditions while concavity and convexity is not known?</td><td>5x2= 10</td><td>CO1</td></tr>
<tr><td>2</td><td>A firm manufactures four different machine parts M_1, M_2, M_3 and M_4 made of copper and zinc. The amounts of copper and zinc required for each machine part, their exact availability and the profit earned from one unit of each machine part are as follows
<table>
<tr><th></th><th>M_1 (kg)</th><th>M_2 (kg)</th><th>M_3 (kg)</th><th>M_4 (kg)</th><th>Exact availability (kg)</th></tr>
<tr><td>Copper</td><td>5</td><td>4</td><td>2</td><td>1</td><td>100</td></tr>
<tr><td>Zinc</td><td>2</td><td>3</td><td>8</td><td>1</td><td>75</td></tr>
<tr><td>Profit (Rs.)</td><td>12</td><td>8</td><td>14</td><td>10</td><td></td></tr>
</table>
Formulate the given problem and find the following solutions
(i) Basic solutions
(ii) Basic feasible solutions
(iii) Non-degenerate basic feasible solutions, and
(iv) Optimal basic feasible solution.</td><td>10</td><td>CO2, CO3, CO4</td></tr>
<tr><td>3 a)

b)</td><td>Find the necessary and sufficient conditions for the optimal solution of the following problem. What is the optimal solution?
Optimize $z = 2e^{3x_1+1} + e^{2x_2+3}$
Subject to constraint $x_1 + x_2 = 5$ and $x_1, x_2 \geq 0$

Find the initial basic feasible solution by vogal's approximation method of the following Transportation problem.
<table>
<tr><th></th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>a_i</th></tr>
<tr><td>A</td><td>3</td><td>7</td><td>4</td><td>8</td><td>2</td><td>4</td></tr>
<tr><td>B</td><td>7</td><td>4</td><td>1</td><td>3</td><td>8</td><td>7</td></tr>
<tr><td>C</td><td>4</td><td>2</td><td>7</td><td>7</td><td>7</td><td>8</td></tr>
<tr><td>D</td><td>2</td><td>8</td><td>4</td><td>4</td><td>7</td><td>2</td></tr>
<tr><td>b_j</td><td>7</td><td>3</td><td>8</td><td>2</td><td>2</td><td></td></tr>
</table></td><td>6+4</td><td>CO1, CO3</td></tr>
<tr><td>4</td><td>Solve the following LPP by two-phase simplex method
$Max\ z = -4x_1 - 3x_2 - 9x_3$
$Subject\ to\ 2x_1 + 4x_2 + 6x_3 \geq 15$
$6x_1 + x_2 + 6x_3 \geq 12$ and $x_1, x_2, x_3 \geq 0$</td><td>10</td><td>CO3</td></tr>
</table>

Course Outcomes
CO1: To understand the Basic principles of optimization
CO2: To able to formulate optimization problem mathematically
CO3: To know various solution methods in optimization Problems
Co4: Able to explore a wide range of engineering optimization problems

B. Tech. Even Semester Examination 2022
Subject: Artificial Intelligence
CSE – 616

Time: One Hour and a Half **Full Marks: 30**

All questions carry equal marks. Figures in the margin indicate full marks
Answers should be brief and exactly to the point
All the different parts of the same questions should strictly be written together

1. 2*5=10

(a) Is there any disadvantage if the Game Playing Program is not using alpha and beta cut- offs?

(b) What should be the nature of problems for Goal Stack Planning?

(c) Name some ML Systems which performs learning at Programmer Level

(d) What is the speciality about EBL System? Why there are two goal concepts in EBL?

(e) Why a PROLOG Program can be visualized as an Expert System with Production Rule Architecture?

2. Find out the incorrect statements: 2*5 =10

A.

(a) Mini max search is strictly 'depth first depth oriented search'

(b) alpha beta cut-offs are used to reduce search

(c) Game Tree is a subset of Search Tree

(d) As the number of levels in Game Tree is increased we get better approximation

B.

(e) Goal Stack Planning is suited for Path Problem

(f) A Problem suitable for linear planning can be suited with non-linear planning

(g) Hierarchical cannot be applied to decomposable problems **[Turn Over]**

(h) Reactive Planning can also be termed as 'one step planning'

C.

(i) A Decision Tree is one type of Discovery based Learning

(j) Learning differs for Programming

(k) There are three different types of Analogy

(l) Discovery is one restricted type of ML

D.

(j) Expert Systems are also called as Knowledge Based Systems

(k) Automatic ES may or may not use ML Systems

(l) Knowledge Engineer has to conduct successful interview with the expert and then structure and formalize the knowledge for the Knowledge Base

(m) ES has to strictly use Production Rules in its Knowledge Base

E.

(n) ANN was inspired from Biological Neurons

(o) For natural intelligence it is always more easy to recognize an image than to perform calculations

(p) Hopfield Network is an early ML System

(q) A single perceptron can only perform two class classifications

3. Fill up the blanks with most appropriate word only 2*5=10

(a) Game Tree is _____ from Search Tree

(b) Planning is not at all needed for _____Problems

(c) We can only induce Knowledge from data with _____ Systems

(d) The processing speed of Artificial Neurons is much _____ than Biological Neurons

(e) _____ Classification only can be actuated by a single perceptron.

Advanced Algorithms (CSE 617)
End-Semester Examination
Full Marks - 30
Time - 90 Minutes
Answer all questions. Graph paper will be provided.

1. The Manhattan distance between two points $P_1 = (x_1, y_1)$ and $P_2 = (x_2, y_2)$ in the plane is defined as, $d_\infty(P_1, P_2) = max(|x_1 - x_2|, |y_1 - y_2|)$. Compute the Voronoi diagram of the three points $P_1 = (0, 0)$, $P_2 = (8, 6)$ and $P_3 = (12, -4)$ with respect to the Manhattan distance clearly. [10]

2. Let S be a finite set, and $S_1, S_2, \ldots, S_k$ a collection of subsets of S. A sub-collection $S_{i_1}, S_{i_2}, \ldots, S_{i_l}$ with $1 \leq i_1 < i_2 < \ldots < i_l \leq k$ is called a *cover* of S if $S = \cup_{j=1}^{l} S_{i_j}$. In this case, l (the number of subsets in the cover) is called the size of the cover. The decision problem $SET - COVER$ takes as input a set S, a collection $S_1, S_2, \ldots, S_k$ of subsets of S, and a positive integer l, and decides whether S has a cover (in the given subsets) of size exactly l. In this exercise, we prove that $SET - COVER$ is an NP-Complete problem. You may assume any standard representation of sets (such as sorted/unsorted arrays, linked lists, or trees).
(a)What is the output of SET-COVER for the following input? $S = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$ with five subsets $S_1 = \{2, 3, 5, 7\}$, $S_2 = \{1, 2, 3, 5, 8\}$, $S_3 = \{1, 2, 4, 8\}$, $S_4 = \{3, 6, 9\}$, and $S_5 = \{4, 6, 8, 9\}$, and $l = 2$. [1]
(b) Show that $SET - COVER \in NP$. [3]
(c) In order to prove the NP-hardness of $SET - COVER$, reduce $VERTEX - COVER$ to $SET - COVER$. Let $< G, t >$ be an input for $VERTEX - COVER$(vertex cover of size t), where $G = (V, E)$ is an undirected graph with $n = |V|$ vertices and $e = |E|$ edges. The reduction algorithm produces an instance $< S, (S_1, S_2, \ldots, S_k), l >$ for $SET - COVER$.
Remark: Your reduction must fulfil the following requirement: S has a set cover of size l if and only if G has a vertex cover of size t. [6]

3. Consider the optimization version of the set covering problem of Exercise 2. That is, given a finite set S and a collection of k subsets $S_1, S_2, \ldots, S_k$ of S, we intend to find out a cover of S (from the given collection) of size as small as possible. Let us denote this optimization problem by $MIN - SET - COVER$. Design a polynomial-time $f - approximation$ algorithm for $MIN - SET - COVER$.[10]

——End——

NITDGP/BTECH/Reg/Even/2021-22

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Even Semester End-term Examination, 2021-22

Course Code: CSE622
Course Name: Soft Computing
Question Paper No.: NITDGP/ CSE622/30

Full Marks: 30
Time: 90 Minutes
Date of Exam: 22/04/2022

Instructions: **Answer any three questions**

<table>
<tr><th>Question No.</th><th>Body of the Question</th><th>Marks</th><th>Mapped CO</th></tr>
<tr><td>1</td><td>a) Consider a fuzzy set A defined on the interval x = [0, 10] of integers by the membership function $\mu A(x) = x / (x+ 2)$. Find the α cut corresponding to $\alpha = 0.5$.
b) Consider 3 sets: P is a set of 3 persons = {P1, P2, P3}, S is a set of 4 symptoms of diseases = {S1, S2, S3, S4} and D is a set of 3 diseases = {D1, D2, D3}. R1 is a fuzzy relation between P and S, and R2 is a fuzzy relation between S and D. Given R and S as follows, find a fuzzy relation R to show which person is affected with which disease.
<table>
<tr><th>R1</th><th>S1</th><th>S2</th><th>S3</th><th>S4</th></tr>
<tr><td>P1</td><td>0.3</td><td>0.4</td><td>0.5</td><td>0.5</td></tr>
<tr><td>P2</td><td>0.7</td><td>0.3</td><td>0.9</td><td>0.9</td></tr>
<tr><td>P3</td><td>0.5</td><td>0.6</td><td>0.0</td><td>0.0</td></tr>
</table>
<table>
<tr><th>R2</th><th>D1</th><th>D2</th><th>D3</th></tr>
<tr><td>S1</td><td>0.7</td><td>0.9</td><td>0.1</td></tr>
<tr><td>S2</td><td>0.9</td><td>0.5</td><td>0.0</td></tr>
<tr><td>S3</td><td>0.5</td><td>0.2</td><td>0.0</td></tr>
<tr><td>S4</td><td>0.3</td><td>0.6</td><td>0.0</td></tr>
</table></td><td>3+7</td><td>CO3 & CO5</td></tr>
<tr><td>2</td><td>Explain the differences among M-A fuzzy rules, TSK fuzzy rules and fuzzy rules for classification with suitable examples. Considering two fuzzy input variables and single fuzzy output variable, and for each input variable there are three fuzzy sets.</td><td>10</td><td>CO3 & CO5</td></tr>
<tr><td>3</td><td>What are the significances of exploitation and exploration in genetic algorithm (GA)? How those are obtained by GA?</td><td>10</td><td>CO2</td></tr>
<tr><td>4</td><td>a) Can we get an optimal solution by GA using only selection and crossover?
b) Based on the principles of the GA operators explain the reason behind the evolutionary characteristic of GA.</td><td>2×5</td><td>CO2</td></tr>
</table>

Course Outcomes
CO1: To familiarize with neural networks and learning methods for neural networks
CO2: To introduce basics of genetic algorithms and their applications in optimization and planning
CO3: To introduce the ideas of fuzzy sets, fuzzy logic and fuzzy inference system
CO4: To introduce students' tools and techniques of Soft Computing
CO5: To develop skills thorough understanding of the theoretical and practical aspects of Soft Computing

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Even Semester End-term Examination, 2021-22

Course Code: CSE623 Full Marks: 30

Course Name: Advanced Database Systems Time: 90 Minutes

Question Paper No.: NITDGP/CSE623/1 Date of Exam: 22/04/2022

Instructions: Answer any 6 questions.

Materials to be supplied: N/A

Question No.	Body of the Question	Marks	Mapped CO
1	i)What kind of indexing is usually needed to evaluate the following query efficiently? SELECT E.Id FROM Employee E WHERE E.salary <= 100000 AND E.salary >= 30000 ii) What are the design issues of ER Data Model? iii) Consider a disk pack with 16 surfaces, 128 tracks per surface and 256 sectors per track 512 bytes of data are stored in a bit serial fashion in a sector. The capacity of the disk pack and the number of bits required to specify a particular sector in the disk respectively.	5	CO1,CO2
2	Suppose we have a relation R(a,b,c,d,e), and there are at least 1000 distinct values for each of the attributes. Consider each of the following query workloads independently of each other. If it is possible to speed it up significantly by adding up to two additional indexes to relation R, specify for each index (1) which attribute or set of attributes form the search key of the index, (2) if the index should be clustered or unclustered, (3) if the index should be a hash-based index or a B+-tree. You may add at most two new indexes. If adding a new index would not make a significant difference, you should say so. Give a brief justification for your answers. (a) 100,000 queries have the form: select * from R where b <? 10,000 queries have the form: select * from R where c =?	5	CO2
3	i) What is the difference between cardinality and selectivity? ii) Why are the selectivity and cardinality used in databases?	2.5*2 =5	CO2
4	i) Check whether the given schedule S is conflict serializable or not- S : R1(A) , R2(A) , R1(B) , R2(B) , R3(B) , W1(A) , W2(B) ii) Determine all the possible serialized schedules for the given schedule.	2.5*2 =5	CO1
5	i) Highlights the advantages of Distributed Database System. ii) Explain data Fragmentation with example.	5	CO3
6	i) List the requirements of Multimedia Database. ii) What is content-based retrieval?	2.5*2 =5	CO4
7.	i) Explain Strict Two-Phase Locking Protocol. ii) What is granularity of locking? iii) How does granularity affect the performance?	1.5+1+2.5 =5	CO1

Course Outcomes

CO1: Acquire knowledge about the design and application view of DBMS

CO2: Able to analyze query expression, specially importance of query optimization

CO3: To learn about design, features and operations in the field of DDBMS, OODBMS and DW

CO4: To learn the concept of using multimedia database as a real-life application