National Institute of Technology, Delhi

Name of the Examination: B. Tech

| Branch | : CSE | Semester | : VI |

| Title of the Course | : Operating System | Course Code | : CSB 302 |

Time: 3 Hours   **Maximum Marks: 50**

Note : Please attempt all questions

Marks	Q. (1)	Q. (2)	Q. (3)	Q. (4)	Q. (5)
CO	CO3	CO3	CO4	CO4	CO4
BL	L3	L3	L3	L4	L4

1. (each 5 Marks)

Consider the following program:
```
int a[128][128];
int main () {
for (int i = 0; i!=128; i++)
for (int j = 0; j!=128; j++)
a[i][j]=0;
return 0; }
```
A. How many distinct segment can be address with format 1 and with format 2?

B. Which of format (1or 2) requires least amount of memory of memory to be devoted to page and segment tables. Justify your answer by showing your calculation of how many bytes would be required for format 1 and would be required for format 2?

2. (each 04 Marks)

A. Two process A and B, each need records 1, 2, 3 in a database. If A asks for them in the order 1, 2, 3 and B asks for them in the order. Then deadlock is not possible, however. If B asks for them in the order 3, 2, 1 then deadlock is possible, with three resources there are 3 or 6 possible ordering for each process to request the resources. What fraction of all the combination is guaranteed deadlock-free.

B. Consider the following segment table.

Segment	Base	Length
0	219	600
1	2300	14
2	90	100
3	1327	580
4	1952	96

What are physical addresses for the following logical addresses:

i)   0430   ii)   110   iii)   2500   iv) 3400

3. (each 04 Marks)

A. A computer installation has 1000 KB of main memory. The job arrive and finish in the following sequence:

Job 1	requires 200KB	arrives
Job 2	requires 350KB	arrives
Job 3	requires 300KB	arrives
Job 1		finishes
Job 4	requires 120KB	arrives
Job 5	requires 150KB	arrives
Job 6	requires 80KB	arrives

Among best fit and first fit, which performs better for this sequence?

B. Assume that you have a page reference string for a process with m frames (initially all empty). The page reference string has length p, n distinct page numbers occur in it.

i)   What is lower on number of page faults?

ii)   What is upper bound on number of page faults?

4.

A. Consider a logical memory architecture with the following parameters:
- Byes-addressable memory (this is what we've always assumed in lectures)
- 24-bit logical addresses
- Maximum segment size of 2MB
- Page size of 512 bytes

1. Draw how the logical address is partitioned (i.e., the number of bits used to designate segments, pages and page offset). Don't worry about having page tables fit within a page.
2. Now worry about having each page table within a page. Assume that each page table entry contains a read and a write protection bit and that the maximum amount of physical memory supported by the architecture is 8 MB Redraw the logical address, showing the number of bits used to index into each level page tables. (Hint: You need to calculate the size of each page table entry)

B. Consider a system with a total of 15 units of memory. Allocated to their processes as shows :

Process	Max	Hold
1	70	45
2	60	40
3	60	15

Apply the banker's algorithm to determine whether it would be safe to grant each of the following requests. If **Yes**, indicate a sequence of termination that could be guaranteed possible. If **No**, show the reduction of the resulting allocation table.
1. A fourth process arrives, with a maximum memory need of 60 and an initial need of 25 unit.
2. A fourth process arrives, with a maximum memory need of 60 and an initial need of 35 unit.

5.

A. Consider a paged logical address space (composed of 32 pages, 2Kbytes each) mapped into a 1-Mbytes Physical memory space.
1. What is the format of the processor's logical address?
2. What is the length and width of the page table (disregarding the "access rights" bits)
3. What is the effect on the page table if the physical memory space is reduced by half?

B. Assume a task is divided into 4 equal segments, and that the system builds an eight entry page descriptor table for each segment. Thus the system has a combination of segmentation and paging. Assume also that page size is 2 Kbytes.
1. What is maximum size of each segment?
2. What is maximum logical address space for the task?
3. Assume that an element in Physical location 00021ABC is accessed by the task. What is the format of the logical address that the generates for it?
4. What is the maximum physical address space for the system?

6.

A. Consider the following page-reference string:
   1, 2, 3, 4, 2, 1, 5, 6, 2, 1, 2, 3, 7, 6, 3, 2, 1, 2, 3, 6
How many page faults would occur for the following replacement algorithms, assuming three frames? Remember that frames are initially empty.
1. LRU Replacement
2. FIFO Replacement
3. Optimal Replacement

B. Consider the following snapshot of a system with 4 resources A, B, C and D and five processes Po, P1, P2, P3, and P4:

Process	Allocation	Max	Available
	ABCD	ABCD	ABCD
P0	0012	0012	1520
P1	1000	1750	
P2	1354	2356	
P3	0632	0652	
P4	0014	0656	

Answer the following question using Banker's Algorithm:
1. What is the content of the matrix need?
2. Is the system in a safe state.

National Institute of Technology, Delhi

Branch :CSE   **Semester** : V

Title of the Course :Computer Organization

Course Code :CSBB   301

Time: 3 Hours   **Maximum Marks: 50**

Note: 1. Attempt **ANY TEN** questions. (5 Marks each)

Que No	Question	MARKS	CO	PO	BL
1	What do you mean by instruction architecture of a computer? What are the main parameters that characterize the instruction set architecture of a processor?	5	1	2	2
2	Simplify the following Boolean function in sum of product form by means of a four variable map. (a) Draw the logic diagram with AND gates. (b) NAND gates. (c) Draw the logic diagram from the simplified expression and compare the total number of gates of part (a) and part (b) with the diagram of part (C) $F(A, B, C, D)= \sum(0, 2, 8, 9, 10, 11, 14, 15)$	5	2	1	2
3	What is the difference between serial and parallel transfer? Using a shift register with parallel load, explain how to convert serial input data to parallel output and parallel input data to serial output.	5	3	1	2
4	List the 10 BCD digits with an even parity in the leftmost position (total of five bits per digit). Repeat with an odd parity bit.	5	2	2	2
5	Design a digital circuit that performs the four logic operations of Exclusive-OR, Exclusive-NOR, NOR and NAND. Use two selection variables. Show the logic diagram of one typical stage.	5	3	1	2
6	The content of AC in the basic computer is hexadecimal A937 and the initial value of E is 1. Determine the contents of AC, E, PC, AR, and IR in hexadecimal after the execution of the CLA instruction. Repeat 11 more times, starting from each one of the register-reference instructions. The initial value of PC is hexadecimal 021.	5	2	2	2

7	The following program is a list of instructions in hexadecimal code. The computer executes the instructions starting from address 100. What are the content of AC and the memory word at address 103 when the computer halts?	5	3	2	3
	--				
	Location Instruction				
	--				
	100 5103				
	101 7200				
	102 7001				
	103 **0000**				
	104 7800				
	105 7020				
	106 **C103**				
8	What is the difference between a microprocessor and microprogram? Is it possible to design a microprocessor without a microprogram? Are all microprogrammed computers also microprocessors?	5	1	1	1
9	Explain with example Implied, Immediate, Register, Autoincrement and Indirect addressing modes.	5	1	3	1
10	What is Parallel Processing? Explain following Flynn's classification with EXAMPLE : SISD, SIMD, MISD and MIMD	5	2	2	2
11	Show that adding B after the operation $A + \bar{B}$ +1 restores the original value of A. What should be done with the end carry?	5	2	1	2
12	Explain the following types of semiconductor memory: sRAM, dRAM, PROM & FLASH. (NOTE: If you feel that the question is out of syllabus, you can attempt this question as a general knowledge of Computer Science).	5	2	2	2
13	Briefly explain the working of "optical MOUSE" with the help of a schematic diagram.	5	3	3	3

National Institute of Technology, Delhi

Name of the Examination: B.Tech
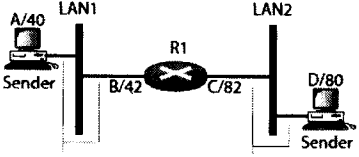### End Semester Examination (Autumn, 2023)

Branch	**: B.Tech (CSE)**	**Semester**	**: 5th**
Title of the Course	**: Computer Networks**	**Course Code**	**: CSB 304**
Time: 3 Hours		Maximum Marks: 50 Marks	

Note: All questions are compulsory.

COURSE OUTCOMES		COGNITIVE LEVELS
CO1	To Understand role of various layers of ISO/OSI model and various data communication techniques.	**Understanding** (Level II)
CO2	To Understand the basic MAC protocols and various design issues related to Data Link Layer	**Understanding** (Level II)
CO3	To Understand Local Area Network, Wireless Local area and personal area Network technologies	**Applying** (Level III)
CO4	To analyse suitable IP addressing scheme, subnetting and routing protocol implementation for a given scenario	**Analyzing** (Level IV)
CO5	To Explain the role and working of TCP and UDP protocols. To implement various Application Layer protocols and build an application using the same.	**Applying** (Level III)

Answer the following questions.

Q. No.	Question	Marks	CO	BL	PO
	Section I: Each question carries 2 mark				
1	An organization is granted the block 130.56.0.0/16. The administrator wants to create 1024 subnets. a. Find the subnet mask b. Find the number of addresses in each subnet	2	CO4	Level-4	3
2	Match the following to *one or more* layers of the OSI model: a. Reliable process-to-process message delivery b. Route selection c. Defines frames d. Provides user services such as e-mail and file transfer	2	CO1	Level-2	2
3	A digitized voice is made by digitizing a 4-kHz bandwidth analog voice signal. We need to sample the signal at twice the highest frequency (two samples per hertz). We assume that each sample requires 8 bits. What is the required bit rate? What is the minimum required bandwidth to send it using NRZ-I baseband transmission?	2	CO1	Level-2	2

4	In the Figure shown, assume that the communication is between a process running at computer A with port address i and a process running at computer D with port address j. Show the contents of packets and frames at the network, data link, and transport layer for each hop if the message is M and Trailer is T.	2	CO5	Level-3	3

Section II: Each question carries 3 marks					
5	Briefly define subnetting and supernetting. How do the subnet mask and supernet mask differ from a default mask in Classful Addressing?	3	CO4	Level-4	2
6.	Describe the important elements of Transport protocol in TCP/IP.	3	CO5	Level-3	2
7.	Differentiate between Circuit and Packet switching. a) Which of the switching will give better utilization of network resources. b) Which of the switching technique will provide better reliability of the connection between devices.	3	CO4	Level-2	4
8.	Elaborate the following lines on the command prompt pertaining to appropriate *Client- Server* Services: Name the related Application programs/processes. a) $ *telnet mail.adelphia.net 25* *Trying 68.168.88.100...* *Connected to mail.adelphia.net (68.168.88.100).* b) $ *telnet www.mhhe.com 80* *Trying 198.168.78.100...* *Connected to www.mhhe.com (198.168.78.100).*	3	CO5	Level-3	3

Section III: Each question carries 10 Marks					
9.	Illustrate the followings pertaining to TCP protocol a) Various Fields of 20 byte TCP Segment header b) Connection establishment using three-way handshaking c) Connection termination using three-way handshaking	10	CO5	Level-3	3
10	Describe the operation CSMA/CD and CSMA/CA using appropriate Flow diagrams. Why Collision Detection is not feasible in Wireless LAN? Why minimum size of the frame is necessary for LAN using CSMA/CD?	10	CO3	Level-3	2
11.	a) Describe the Link State Routing. How it is different from Distance Vector Routing? b) Describe the E-Mail Architecture, components and Protocols used, when both sender and receiver are connected to the mail server via a LAN/ WAN.	10	CO4	Level-4	3

****All the Best***

Branch: CSE (B.Tech)   Semester: V

Title of the Course: Artificial Intelligence   Course Code: CSB 310
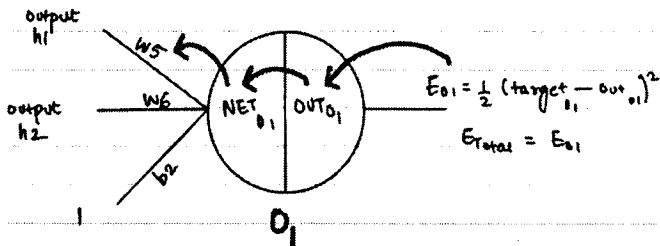
Time: 3 hours   Maximum Marks: 50

This Question paper consists of total X questions and X pages.
Attempt all the questions and be brief while writing the answers.

Q. No	Questions	Marks	CO	BL
1(a)	What is Artificial Intelligence (AI), and how does it differ from traditional computer programming	2.5	1	L1
1(b)	Do you think that Chat GPT is an example of Artificial intelligence. Justify your answer.	2.5	1	L2
2(a)	Explain the role of AI in autonomous systems, such as self-driving drones. Identify the PEAS task environment.	2.5	2	L3
2(b)	Describe the concept of explainable AI (XAI) and its importance in real-world applications.	2.5	1	L2
3(a)	How does deep learning differ from traditional machine learning algorithms	2.5	4	L2
3(b)	Discuss the ethical considerations in the development and deployment of AI technologies.	2.5	4	L2
4(a)	How Markov Decision Process is different from Reinforcement Learning. Show with an example.	5	3	L2
4(b)	Consider the following sentences: (a) If Ram carries an umbrella, it is raining. (b) Ram is not carrying an umbrella. (c) Therefore it is not raining. Translate these sentences into propositional logic by defining appropriate symbols, and derive (c) given (a) and (b). If it is not possible to derive (c) given (a) and (b), justify.	5	3	L4
5(a)	Consider a neuron from the backpropagation neural network as following. Consider $h_1 = 0.593$ $h_2 = 0.597$, $b_2 = 0.6$, $W_5 = 0.4$, $W_6 = 0.45$ and Target $O_1 = 0.01$. Derive and find the partial derivative of E_{Total} with respect to W_5 i.e ($\frac{\partial E_{Total}}{\partial w_5}$) for the above figure . [05=04+01 marks]	5	4	L5
5(b)	Suppose there are five states as shown below. `10 ‖ ‖ ‖ 1` a b c d e	5	3	L3

	Following action are possible : East, West, and Exit (only available in exit states a, e). Consider 0 rewards in non terminal states and transitions is deterministic. i) For $\gamma = 1$, what is the optimal policy? ii) For $\gamma = 0.1$, what is the optimal policy? iii) For which γ are West and East equally good when in state d?			
6 (a)	Name the search algorithms that we live our life closest to. State the reason for the choice. How one can solve 8 queen problem using genetic algorithm.	7= 2+5	1	L2
6 (b)	What are the key challenges in implementing natural language processing (NLP) systems?	3	5	L4
7.	Many patients arriving at an emergency room, suffer from chest pain. This may indicate acute coronary syndrome (ACS). Patients suffering from ACS that go untreated may die with probability 2% in the next few days. Successful diagnosis results lowers the short-term mortality rate to 0.2%. Consequently, a prompt diagnosis is essential. Approximately 50% of patients presenting with chest pain turn out to suffer from ACS (either acute myocardial infraction or unstable angina pectoris). Approximately 10% suffer from lung cancer. Of ACS sufferers in general, 2/3 are smokers and 1/3 non-smokers. Only 1/4 of non-ACS sufferers are smokers. In addition, 90% of lung cancer patients are smokers. Only 1/4 of non-cancer patients are smokers. Assumption 1 A patient may suffer from none, either or both conditions! Assumption 2 When the smoking history of the patient is known, the development of cancer or ACS are independent. One can perform an ECG to test for ACS. An ECG test has sensitivity of 66.67% (i.e., it correctly detects 2/3 of all patients that suffer from ACS), and a specificity of 75% (i.e., 1/4 of patients that do not have ACS, still test positive). An X-ray can diagnose lung cancer with a sensitivity of 90% and a specificity of 90%. Assumption 3 Repeated applications of a test produce the same result for the same patient, i.e. that randomness is only due to patient variability. Assumption 4 The existence of lung cancer does not affect the probability that the ECG will be positive. Conversely, the existence of ACS does not affect the probability that the X-ray will be positive. What does the above description imply about the dependencies between the patient condition, smoking and test results? Assume the following events (i.e., variables that can be either true or false): A: ACS; C: Lung cancer S: Smoking ; E: Positive ECG result ; X: Positive X-ray result a) Draw a belief network for the problem. b) What is the probability that the patient suffers from ACS if the patient is a smoker?	5 = [2+3]	4	L4

National Institute of Technology, Delhi

End Semester Examination (Autumn Semester 2023)

Branch : CSE, B.Tech (minor) **Maximum Marks : 50**
Semester : 3ʳᵈ year, V Sem **Time** : 3 Hours
Title of the Course : Machine Learning **Course Code** : CSBB 311

Q. No	Questions	Marks	CO	BL	PO
1 (a)	What is Apriori algorithm? Discuss the performance bottlenecks of Apriori algorithm?	3	CO2	L1	1
1 (b)	Using Apriori algorithm generate Association rules from frequent itemsets and find the best association rule among them. Min. support count required is 2.	4	CO2	L2	2
1 (c)	What do you mean by feature extraction and feature selection? Explain the different types of feature selection techniques.	3	CO2	L1	1
2 (a)	Cluster the following eight points (with (x, y) representing locations) into three clusters: A1(2, 10), A2(2, 5), A3(8, 4), A4(5, 8), A5(7, 5), A6(6, 4), A7(1, 2), A8(4, 9) Initial cluster centers are: A1(2, 10), A4(5, 8) and A7(1, 2). The distance function between two points a = (x1, y1) and b = (x2, y2) is defined as- $$P(a, b) = |x2 - x1| + |y2 - y1|$$ Use K-Means Algorithm to find the three cluster centers after the second iteration.	4	CO3	L2	3
2 (b)	The table below is an example of a distance matrix. Only the lower triangle is shown, because the upper triangle can be filled in by reflection. Draw the dendrogram for the given distance matrix.	4	CO3	L2	3

For Q. 1(b), the table of transactions:

TID	List of Items
T100	I1, I2, I5
T100	I2, I4
T100	I2, I3
T100	I1, I2, I4
T100	I1, I3
T100	I2, I3
T100	I1, I3
T100	I1, I2, I3, I5
T100	I1, I2, I3

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

2 (c)	Explain Ensemble techniques in Machine Learning.	2	CO2	L1	1
3 (a)	Illustrate Principal Component Analysis (PCA) method of dimensionality reduction technique with suitable examples.	3	CO2	L1	2

3 (b)	Let us assume the following features of dimensions as F1, F2, F3, and F4. Apply Principal Component Analysis (PCA) on the above dataset.	7	CO3	L2	3

Large size Orange (F1)	Rotten Orange (F2)	Damaged Orange (F3)	Small Orange (F4)
1	5	3	1
4	2	6	3
1	4	3	2
4	4	1	1
5	5	2	3

4 (a)	What is Support Vector Machine (SVM) and how does SVM works? Explain different SVM kernels.	4	CO2	L2	2

4 (b)	Given a transaction database DB and a minimum support threshold ξ, find all frequent patterns (item sets) with support no less than ξ. Minimum support: $\xi =3$.	6	CO2	L2	2

TID	Items bought
100	{f, a, c, d, g, i, m, p}
200	{a, b, c, f, l, m, o}
300	{b, f, h, j, o}
400	{b, c, k, s, p}
500	{a, f, c, e, l, p, m, n}

5 (a)	What is Reinforcement learning (RL)? Explain the elements of RL and its applications.	2	CO5	L2	3
5 (b)	Explain the Markov Decision Process (MDP) in RL.	2	CO5	L2	3
5 (c)	Using Bellman Equation find the values at each state of the given environment for 5 iteration. Consider $\lambda=0.90$.	6	CO5	L3	4

National Institute of Technology, Delhi

Name of the Examination: End-Semester (Autumn Semester 2023)

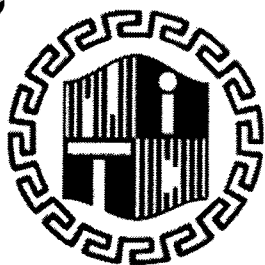|			
Branch	: B. Tech. (CSE, Minor Degree)	**Semester**	: V
Title of the Course	: Digital Image Processing	**Course Code**	: CSBB 313

Time: 3:00 Hours   **Maximum Marks: 50**

Note: Attempt *all* sections. Be precise in your answer.

Assume any missing data. Marks are mentioned on the right side.

S. No.	Questions	Marks	CO	BL	PO
1.	(a) Discuss the effect of non-uniform sampling and quantization. (b) If all the pixels of an image are shuffled, will there be any change in the histogram. Justify your answer. (c) Discuss the property of unitary transform.	9	CO1	1-2	1
2.	Compute the discrete convolution of two-dimensional array as shown below (circled element being origin) *n* ... 1 4 1 / ②(origin) 5 3 → *m* x (*m, n*) *n* ... 1 1 / ①(origin) 1 → *m* h (*m, n*)	4	CO2	3	2
3.	Explain how color images are represented using HSI color space model. Compare HSI and YCrCb color space models.	6	CO2	2-4	3

4.	(a) Compute median of following image using 3x3 mask having unit elements.	9	2	2-3	3

$$\begin{bmatrix} 18 & 22 & 33 & 25 & 32 & 24 \\ 34 & 128 & 24 & 172 & 26 & 23 \\ 22 & 19 & 32 & 31 & 28 & 26 \end{bmatrix}$$

(b) Consider the following image. Determine the new value of pixel (2,2) and (3,3) if smoothing is performed using 3×3 mask having unit elements.

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

    (a) Mean filter
    (b) Weight average filter
    (c) Min filter
    (d) Max filter

5.	Compare the Inverse filter with Wiener filter. Discuss the Wiener smoothing filter.	6	3	4	4

6.	(a) DCT is employed compared to other transformations in the JPEG Compression technique like DFT, Haar Transformation, WHT, KLT. Justify (Compare with each transformations') (b) Instructor has decided to establish Advanced **VISUAL** COMPUTING Lab in the Electronics and Communication Engg. Department, NIT Delhi. Deduce arithmetic encoding of the **highlighted** sentence and determine the compressed code.	10	4	4	4

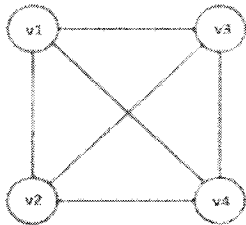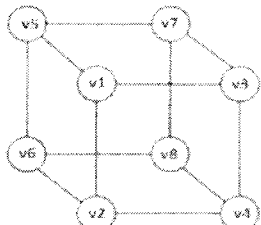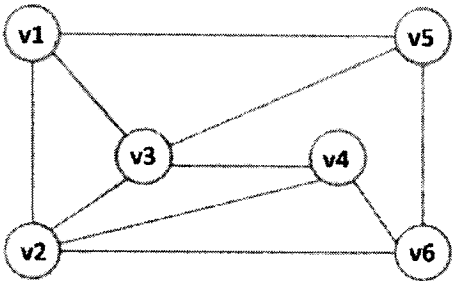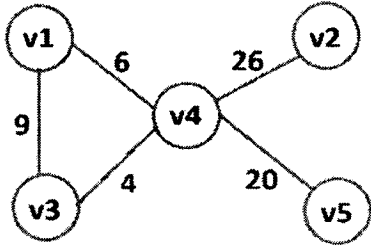| 7.	(a) Compare Robert, Prewitt, and Sobel operators in detection of edge discontinuity. (b) Deduce the process of Image segmentation using Canny edge detection algorithm step-wise.	6	3	4	3

Autumn Semester AY 2023-24

Department of Computer Science and Engineering

End Semester Examination

December 16, 2023 (10:00 AM – 01:00 PM)

Degree	B. Tech.	Branch	CSE
Semester	V		
Subject Code & Name	CSL 363 – Graph Theory and Combinatorics		
Time: 180 Minutes	Answer All Questions		Maximum: 50 Marks

Sl. No.	Question	Marks	KL	CO
1.a	What is the significance of the *Undirected Graphs* for real-world scenarios? Explain with an example.	2	L1	CO3
1.b	Apply your understanding of *Degrees of Graph* to illustrate the mechanism to identify significant nodes in a network. A proper explanation is required.	3	L3	CO3
1.c	Suppose, in a road network, there persists a traffic congestion on one of the roads connected to an intersection. Now, the navigation system of the vehicles needs to take decision for re-routing the vehicles to avoid that congested road. Analyze this scenario to resolve the issue by identifying one significant concept of graph theory. Discuss in detail.	5	L4	CO3
2.a	Explain the concept of *Graph Embedding*. Also, identify that out of graphs G_1 and G_2, as shown in Fig. 1, which is planner? Fig. 1: (a) Graph G_1 and (b) Graph G_2, for Q. No. 2.a	2 (1+1)	L2	CO4
2.b	Give your opinion for the traceability of *Cut Point* in a graph structures? How is the separability of graph identified?	3	L5	CO4
2.c	Identify and explain the property of graph theory that let the two graphs to have the same *Incidence Matrix*.	5	L3	CO4
3.a	What is the *Chromatic Number* of a graph? Determine the chromatic number of the graph, as shown in Fig. 2.	2 (1+1)	L1	CO5

Fig. 2: Graph for Q. No. 3.a

3.b	Identify the situation that best utilizes the *Adjacency Matrix* representation of a graph. Also, if the graph possesses *x* number of vertices and *y* number of edges, what is the order of its corresponding adjacency matrix.	3 (2+1)	L3	CO5
3.c	Give your opinion for the following points with proper explanation: i. Condition required for the *Proper Coloring* of a graph. ii. *Chromatic Number* of a null graph. iii. *Minimal Proper Coloring* of a complete graph K_n.	5 (1+2+2)	L5	CO5
4.a	Explain the significance of *Combinatorics* in Graph Theory.	2	L2	CO1
4.b	Determine the edges that contribute for *Minimum Spanning Tree* in the given graph, as shown in Fig. 3. Fig. 3: Graph for Q. No. 4.b	3	L2	CO1
4.c	The concept of *k-Clique* states that every pair of nodes of sub-graph under consideration, are at maximum distance of *k*-edges. Analyze this statement to conclude the structure of sub-graph under consideration, if value of *k* is 1. A proper explanation is required.	5	L4	CO1
5.a	Derive the relationship between the *In-degree*, *Out-degree* and number of edges in a graph.	2	L3	CO2
5.b	Design and develop a Graph Theory-based conceptual application for the development of a rural area. A detailed discussion along with framework is required.	3	L6	CO2
5.c	Analyze the following statement to given your rationale: "*A bridge cannot be a part of a cycle in a graph*"	5	L4	CO2

*****Good Luck*****