Duration: 3 Hrs. **Total Marks : 80**

N.B.: 1) Question No. 1 is Compulsory.
2) Attempt any three questions, from remaining five questions.
3) Figure to the right indicates full marks

Q.1.	a)	State and explain the design issues of OSI layers.	**5**
	b)	Compare the performance characteristics of coaxial, twisted pair and fiber optic transmission media.	**5**
	c)	List the types of Error Detection and Correction techniques with the help of example.	**5**
	d)	Compare the Network layer protocols IPv4 and IPv6.	**5**
Q.2.	a)	Explain ISO-OSI reference model with diagram.	**10**
	b)	Illustrate TCP protocol for establishing a connection using 3-way handshake technique in the transport layer.	**10**
Q.3.	a)	What is the throughput of the system both in Pure ALOHA and Slotted ALOHA, if the network transmits 200 bits frames on a shared channel of 200 Kbps and the system produces? a) 1000 frames per second b) 500 frames per second	**10**
	b)	Analyze the steps involved in Token and Leaky bucket algorithm by quoting the need and benefit in the network layer with suitable diagrams.	**10**
Q.4.	a)	Explain Linked State Routing with the help of example.	**10**
	b)	An ISP is granted a block of addresses starting with 190.100.0.0/16 (65,536 addresses). The ISP needs to distribute these addresses to three groups of customers as follows: a. The first group has 64 customers; each need 256 addresses. b.The second group has 128 customers; each need 128 addresses. c.The third group has 128 customers; each need 64 addresses. Design the subblocks and find out how many addresses are still available after these allocations.	**10**
Q.5.	a)	What is Congestion control? Explain Open loop and Close loop Congestion control.	**10**
	b)	Draw and summarize the structure of HTTP request and response.	**10**
Q.6.		Write Short Note on (**Any Two**) (a) Address Resolution Protocol (ARP) (b) Classful and Classless Addressing (c) Distance Vector Routing (DVR)	**20**

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Time: 3 hours **Max. Marks: 80**

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Note: 1. Question no.1 is compulsory.
2. Attempt any three out of remaining five.
3. Assumptions made should be clearly indicated.
4. Figures to the right indicates full marks.
5.Assume suitable data whenever necessary.

Question 1 **Write a short note on the following. Solve any four.**

(5 marks each)

A Write a note on web usage mining. Also state its any two applications.

B Describe any five issues in data mining.

C Explain how Naive Bayes classification makes predictions and discuss the "naive" assumption in Naive Bayes. Provide an example to illustrate the application of Naive Bayes in a real-world scenario.

D Suppose the data for clustering is {6,14,18,22,1,40,50,11,25} consider k=2, cluster the given data using k means algorithm.

E Explain the concept of market basket analysis with example.

F Differentiate between ER modeling vs Dimensional modeling.

Question 2 **10 marks each**

A Describe in detail about how to evaluate accuracy of the classifier.

B Illustrate major steps in ETL process.

Question 3 **10 marks each**

A Explain KDD process with neat diagram. Also state any five applications of data mining.

B For the table given perform Apriori algorithm and show frequent item set and strong association rules. Assume Minimum Support of 30% and Minimum confidence of 70%.

TID	Items
1	1,4,6,8
2	2,5,3
3	7,1,3,8
4	9,10
5	1,5

Question 4 **10 marks each**

A A social media platform wants to analyze user engagement data to improve content recommendations and user experience. The INTERACTIONS fact table contains information about user interactions, including interaction details, user information, content details, and time periods. The dimension tables provide additional context about users, content, categories, and time periods. Design a star schema and snowflake schema for the same.

B Explain Multilevel Association Rules Mining and Multidimensional Association Rules Mining with examples.

Question 5 **10 marks each**

A A company wants to predict whether a customer will subscribe to a premium membership based on their demographic and browsing behavior data. The dataset contains information about customers, including age, gender, income, browsing time, and subscription status.

Age	Gender	Income	Browsing Time	Subscription
20-30	Male	High	10am-12pm	Yes
20-30	Female	Medium	2pm-4pm	Yes
30-40	Male	Low	8am-10am	No
30-40	Female	High	4pm-6pm	Yes
>40	Male	Medium	6pm-8pm	Yes
>40	Female	Medium	8am-10am	No
>40	Male	High	12pm-2pm	Yes
20-30	Female	Low	10am-12pm	No
20-30	Male	Medium	2pm-4pm	Yes
30-40	Female	High	8am-10am	Yes

Use ID3 to build the decision tree and predict the following example:

Age	Gender	Income	Browsing Time
20-30	Male	Medium	10am-12pm

B Illustrate page rank algorithm with example.

Question 6 **10 marks each**

A Following table gives fat and proteins content of items. Apply single linkage clustering and construct dendrogram.

Food Item	*Protein*	*Fat*
1	*1.1*	*60*
2	*8.2*	*20*
3	*4.2*	*35*
4	*1.5*	*21*
5	*7.6*	*15*
6	*2.0*	*55*
7	*3.9*	*39*

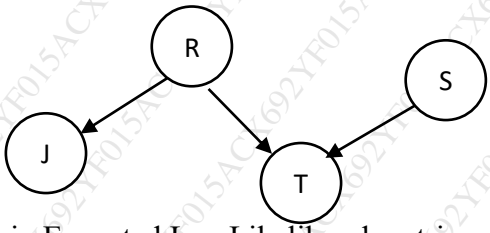
B Explain in brief what is data discretization and concept hierarchy generation.

Duration: 3 Hours **[Max Marks: 80]**

N.B. : (1) Question No 1 is Compulsory.
(2) Attempt any three questions out of the remaining five.
(3) All questions carry equal marks.
(4) Assume suitable data, if required and state it clearly.

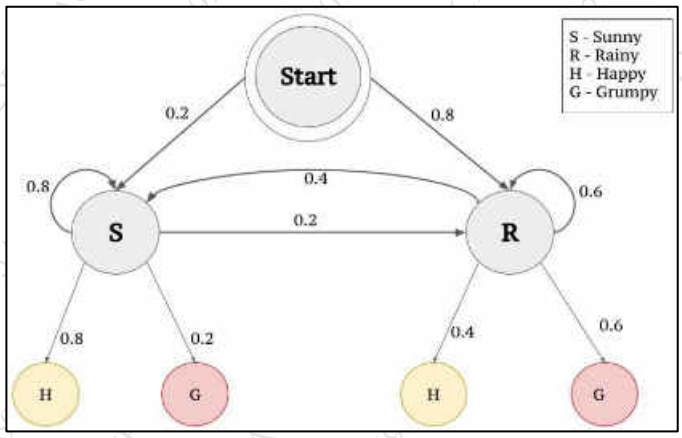
1 Attempt any FOUR (5 marks) **[20]**

a Explain Plate Models with the help of an example.
b Differentiate between Rule based CPD and Tree based CPD.
c Given the Bayesian network , Write down the appropriate factorization for the joint distribution P(T,J,R,S)



d Explain Expected Log Likelihood metric
e Explain Variable Elimination with the help of an example

2 a From the HMM given below, find the likelihood of the sequence {Happy, Grumpy} **[10]**

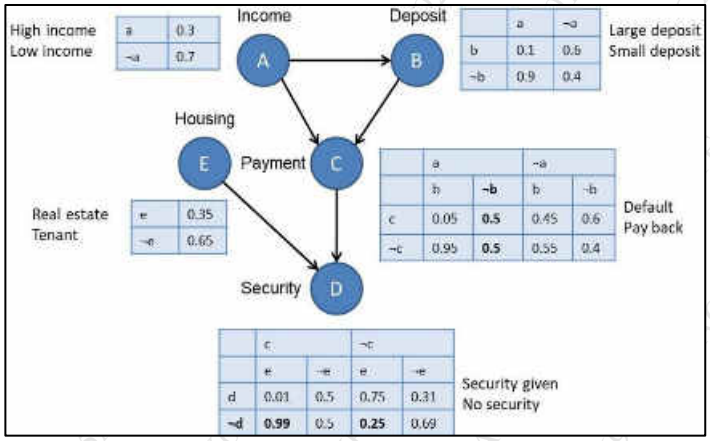


b Explain with example D-separation in a BN structure **[10]**

3 a Explain the application of HMM in POS tagging **[10]**
b Explain any one application of Markov Model with respect to PGM. **[10]**

4 a Discuss Temporal Models with the help of an example. **[10]**
b Explain the concept of Log Linear Parameterization with the help of an example **[10]**

5 a

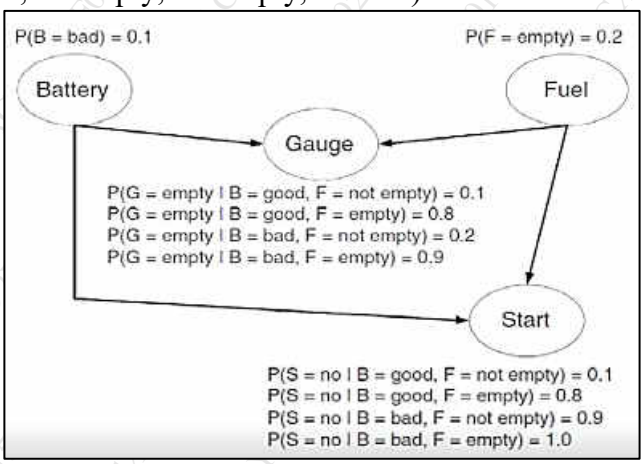


Find P(a, ¬b, c, ¬d, e) for the above Bayesian network **[10]**

b Assume that a man's profession can be classified as professional, skilled labourer, or unskilled labourer. Assume that, of the sons of professional men, 80 percent are professional, 10 percent are skilled labourers, and 10 percent are unskilled labourers. In the case of sons of skilled labourers, 60 percent are skilled labourers, 20 percent are professional, and 20 percent are unskilled. Finally, in the case of unskilled labourers, 50 percent of the sons are unskilled labourers, and 25 percent each are in the other two categories. Assume that every man has at least one son and form a Markov chain by following the profession of a randomly chosen son of a given family through several generations. **[10]**

Set up the matrix of transition probabilities.
Find the probability that a randomly chosen grandson of an unskilled labourer is a professional man.

6 a Consider following Bayesian network **[10]**
Find P(B=Good, F=Empty, G=Empty, S=YES)



b Explain Application of Bayesian Network in classification with the help of an example. **[10]**

[Duration: 3hrs] **[Marks: 80]**

N.B. : (1) Question No 1 is Compulsory.
(2) Attempt any three questions out of the remaining five.
(3) All questions carry equal marks.
(4) Assume suitable data, if required and state it clearly.

1.		**Attempt any FOUR**	[20]
	a	Explain <audio> and <video> controls of HTML5 with appropriate example.	[05]
	b	Explain the Document Object Model in detail with an example.	[05]
	c	Discuss the advantages of React Js.	[05]
	d	Explain the different datatypes of PHP.	[05]
	e	What are the characteristics of Rich Internet Application (RIA)	[05]
2.	a	Explain the working of rowspan and colspan of table when used in HTML with suitable example.	[10]
	b	Write a short note on JDBC	[10]
3.	a	What is mean by Event handling in JavaScript explain it with example.	[10]
	b	Write a short note on JSP.	[10]
4.	a	Explain how Shadow effect can be applied on Text using CSS with suitable example.	[10]
	b	Draw a diagram of Ajax application model and Traditional application web model and compare them.	[10]
5.	a	Write a JavaScript code to accept a name and password from user and validate the data as follows:- • Name should not be empty • Password should not be less than 6 characters	[10]
	b	What are the features of React JS and write a code for "Hello World" using React JS.	[10]
6.	a	Explain the structure of XML Document with an example.	[10]
	b	Explain the Servlet Life cycle with neat diagram.	[10]

Duration: 3 Hours **[Max Marks: 80]**

N.B : (1) **Question No 1 is Compulsory**.
(2) Attempt any **three** questions out of the remaining **five**.
(3) All questions carry equal marks.
(4) Assume suitable data, if required and state it clearly.

1 **[20]**

a Explain the ways of acceptance by a PDA. **[05]**

b Discuss difference in transition function of PDA, TM and FA **[05]**

c Design DFA that accepts Strings that contain "ba" or "ab" as suffix over $\sum$={a,b}. **[05]**

d Construct CFG to generate the language $L = \{a^i b^j c^k \mid k=i+j, i, j >=1 \}$ **[05]**

2 a Represent RE epsilon for L = {w : w has prefix bab and suffix abb and w is a string over {a,b}. Design NFA with epsilon moves for accepting L. Convert it to minimized DFA. **[10]**

b Explain Pumping Lemma for regular languages. Prove that given language is not a regular language. $L=\{ a^n b^{n+1} \mid n>=1\}$ **[10]**

3 a The grammar G is $S \rightarrow aB \mid bA$, $A \rightarrow a \mid aS \mid bAA$, $B \rightarrow b \mid bS \mid aBB$
Derive using Left Most Derivation(LMD) and Rightmost Derivation (RMD) for the following string "aaabbb". Draw Parse Tree. **[10]**

b Give formal definition of Push Down Automata. Design PDA that accepts odd palidromes over {a,b,c}, where c exists only at the center of every string. **[10]**

4 a i) Design DFA that accepts Strings that are multiples of 4 $\sum$={0,1}. **[10]**
ii) Design NFA that accepts strings starting with a and ending with a or starting with b and ending in b.

b Design a Mealy machine to change every occurrence of a with x, b with y and c is kept unchanged. Convert the same to equivalent Moore machine. **[10]**

5 a Consider following CFG. Is it already simplified ? Explain you answer. Convert it to CNF form. **[10]**

$S \rightarrow ASB \mid a \mid bb$
$A \rightarrow aSA \mid a$
$B \rightarrow SbS \mid bb$

b Design a TM for converting a input binary number to its one's complement of a binary **[10]**

number.

6 Write Short notes (**Any Four**) **[20]**

a Chomsky Hierarchy

b Post Correspondence Problem.

c Arden's Theorem

d TM-Halting Problem.

e Variants of Turning Machines

Time: 3 Hours **Max. Marks: 80**

N.B. (1) Question one is Compulsory.
(2) Attempt any 3 questions out of the remaining.
(3) Assume suitable data if required.

Q. 1 Solve any Four out of the following (5 marks each) **20M**

a. Explain Software Process Umbrella Activities
b. Explain software reengineering
c. What is Capability Maturity Model (CMM) Explain different CMM levels
d. Design User Interface for Online Shopping System
e. Discuss limitations of Waterfall model & Spiral Model
f. Draw Use Case Diagram for Hospital Management System

Q. 2

a. What is Agile Process? Explain SCRUM Process Model with all activities **10M**
b. What do you mean by Cohesion & Coupling? Explain different types of cohesion & Coupling **10M**

Q. 3

a. What is Software Testing? Explain different types of software testing **10M**
b. Define Risk? What are different categories of risks? Explain RMMM plan with suitable example. **10M**

Q. 4

a. Explain & compare FTR & Walkthrough. **10M**
b. Explain change control & Version Control **10M**

Q.5

a. Explain different types of software maintenance. **10M**
b. What is SRS? Prepare a SRS for Online Movie Booking System. **10M**

Q. 6

a. List different metrics used for software measurement? Explain function point-based estimation technique in detail. **10M**
b. Explain software design principles in detail illustrating with example **10M**

(3 Hours) **Total Marks: 80**

N.B. : **(1)** Question No. 1 is compulsory.

(2) Attempt any three questions out of remaining five questions

Q.1 (a) By using matrices, solve the following system of linear equation **(5)**

$4x - y + 2z + w = 0$, $2x + 3y - z - 2w = 0$, $7y - 4z - 5w = 0$,

$2x - 11y + 7z + 8w = 0$.

(b) State Central limit theorem. Let $\bar{X}$ be the mean of a random sample of size 50 drawn from a population with mean 116 and standard deviation 40. **(5)**

a. Find the mean and standard deviation of $\bar{X}$.

b. Find the probability that $\bar{X}$ assumes a value between 114 and 118.

(c) Obtain the graph of $y = e^{-4x}$ **(5)**

(d) Compare constrained and non-constrained optimization Techniques. **(5)**

Q.2. (a) Find Singular Value of Decomposition of matrix $A = \begin{bmatrix} 1 & 1 & 0 \\ 0 & 1 & 1 \end{bmatrix}$ **(10)**

(b) Ten students were given intensive coaching for a month in Mechanics. The scores obtained in tests are given below. **(10)**

Sr. No	1	2	3	4	5	6	7	8	9	10
Marks in 1st test	52	54	51	58	63	65	46	67	70	78
Marks in 2nd test	70	60	70	70	65	72	54	87	79	91

Does the score from test 1 to test 2 show an improvement? Test at 5% level of significance.

Q.3. (a) Calculate the expected frequencies for the following data presuming the two attributes viz. condition of home and condition of child independent **(10)**

		Condition of Home	
		Clean	Dirty
Condition of Child	Clean	70	50
	Fairly Clean	80	20
	Dirty	35	45

Use test at 5% level to find whether the two attributes are independent.

(b) Draw two Pie diagrams to represent the following data giving profits of different partners in a firm. **(10)**

Partner	**Profit (in ₹) 2021**	**Profit (in ₹) 2022**
A	14	9
B	16	10
C	29	27
D	17	25
E	16	18
F	8	11
Total	**100**	**100**

Q.4. (a) Find 3 yearly moving averages and represent these on a graph paper. Also represent the original time series on the graph. **(10)**

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007
Sales (in lakhs)	31	33	30	34	38	40	45	49	44

(b) Minimize the function $f(x_1, x_2) = 4x_1 + 8x_2 - x_1^2 - x_2^2$ **(10)**
subject to $x_1 + x_2 = 4, \quad x_1, x_2 \geq 0$

Q.5. (a) Explain the need for exploratory data analysis. Also list and explain exploratory data analysis techniques. **(10)**

(b) Find the root of the equation $x^3 - 4x - 9 = 0$ using bisection method correct three decimal places in the interval (2, 3). **(10)**

Q.6. (a) Describe with example and action to be taken for the following **(10)**

1. Data Cleaning
2. Irrelevant data
3. Incorrect dataS
4. Handle Missing Data
5. Outliers

(b) Write a short note on linear discriminant analysis techniques and principal component analysis algorithm **(10)**