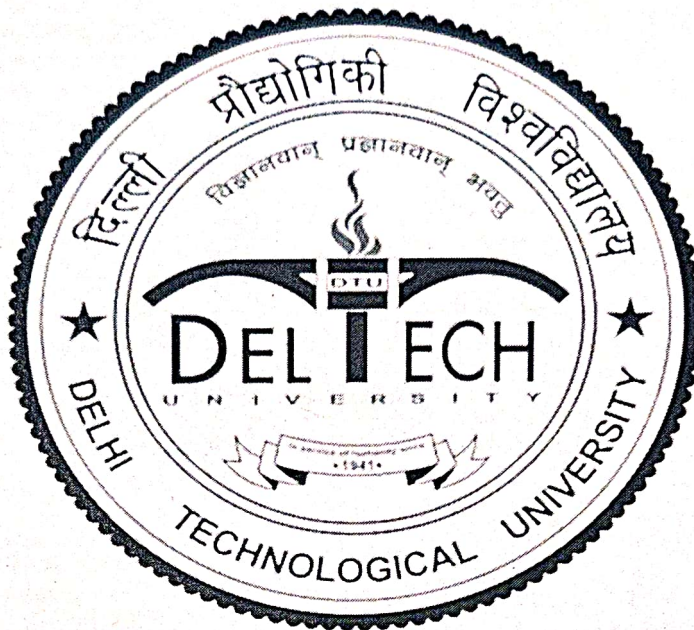


**QUESTION PAPERS FOR END TERM THEORY
EXAMINATIONS**

November/ December-2024



**M.Tech., MTPT, M.Sc., MBA, EMBA, M.Des.,
MBA (USME), B.Sc. /M.Sc. Integrated**

1st, 3rd & 5th SEMESTER

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M.TECH/MTPT/Ph.D.

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Roll No.

M.Tech.(AI) Ist SEMESTER

End SEMESTER EXAMINATION

(November – 2024)

AI501

Advance Data Structure & Algorithm

Paper Code

Title of the subject

Time: 3 Hours

Max. Marks: 40

Note: Answer any 8 questions. All Qs carry 5 marks each. Assume suitable missing data, if any.

Q1. (i) Illustrate the way to store sparse matrices with the help of an example of 9×9 matrix A having only 7 non zero elements namely : $A(1,5)$, $A(2,3)$, $A(3,8)$, $A(4,1)$, $A(6,4)$, $A(7,2)$, $A(9,7)$. You can assume any value for these elements.

(ii) Write down an algorithm to calculate transpose of this matrix and work out the improvement in storage.

[2,3]

Q2. (i) Explain the concept of open addressing, quadratic probing in hashing with suitable example.

(ii) Explain the concept perfect hashing with suitable example.

[2.5x2]

Q3. (i) Propose an algorithm that requires minimum number of comparison to find minimum and maximum element of an array a of n elements.

(ii) Consider an array storing minimum heap having $n.2^n$ elements. Work down the time complexity of extracting minimum element maintaining property of heap.

[2,3]

Q4. Create a red black tree by inserting following numbers:
8,18,5,15, 17, 25,40,80

[5]

Q5. Work out the steps to derive Breadth first search for a graph given in Figure 1. Consider starting vertex as A ; graph as undirected graph with weights ignored. Also draw BFS tree with discovery time. Also work out time complexity.

[5]

Q6. Work out two topological sorts of graph given in Figure 1, ignore weights. Also give steps to calculate strongly connected component. Also draw its strongly connected components.

Q7. Write down generic procedure for divide and conquer problem for problem in the interval [a..b]. Work out few steps of Bellman Ford Algorithm when run on the Graph shown in Figure 1.

[5]

Q8. Write down steps to solve optimization problem using Dynamic Programming. Apply it to find longest common subsequence of two strings:

X=ABCBDB and Y=BDCABA

[5]

Q9. Explain first NP-complete problem discovered. Write down the hierarchy of NP-Complete problems.

[5]

Q10. Prove that vertex cover problem. is NP-complete Write down procedure to solve it

[5]

Q11. What is the strategy back tracking used for solving NP-Complete problem? Illustrate your problem with suitable example.

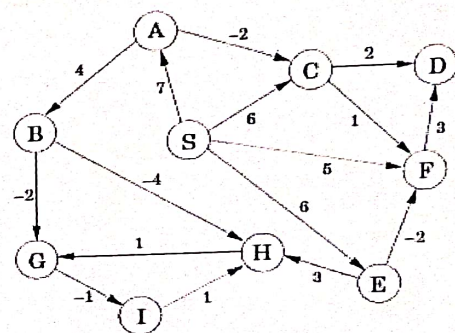
[5]

Q12. Write short notes on any two from following:

- (i) Fibonacci heaps
- (ii) Binomial Heaps
- (iii) B-Trees
- (iv) Travelling sales man problem

[5]

Figure 1



- [b] Conduct a depth-first search (DFS) and a breadth-first search (BFS) on the tree shown in Fig. 1. The start node is 'S' and the goal node is 'G'. Which nodes are explored first in DFS and BFS? [2+2] [CO3]

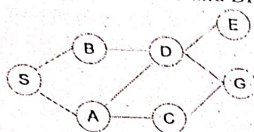


Fig. 1

- [c] Two streaming platforms, StreamIt (MAX) and ViewNow (MIN), are deciding on release strategies for a popular TV series. StreamIt can choose Small, Moderate, or Large releases, followed by ViewNow's similar choice. The goal for StreamIt is to maximize viewership (scores) while ViewNow aims to minimize market influence loss. The scores are as follows: matching strategies yield 0 (e.g., Small/Small), while mismatched strategies result in Small/Moderate: +1, Small/Large: +3, Moderate/Small: -1, Moderate/Large: +2, Large/Small: -3, and Large/Moderate: -1. Apply the minimax algorithm to determine the optimal strategy for StreamIt and explain the reasoning behind the steps taken. [4] [CO3]

- 5[a] Value Iteration is an important algorithm in Reinforcement Learning for finding optimal policies in environments modelled as Markov Decision Processes (MDPs). What is the role of the Bellman Optimality Equation in Value Iteration, and how does it help the algorithm converge to the optimal policy? [4] [CO4]

- [b] Consider a 5x5 grid world environment where an agent can move up, down, left, or right. The agent starts at position S (1,1) and needs to reach the goal G at position (5,5). The reward for each step is -1, and reaching the goal provides a reward of +10. The discount factor γ is 0.9. Given the current value estimates for the neighbouring states of (1,1), as shown below, use the Bellman update equation to determine the optimal action for the agent at state (1,1). [4] [CO4]

Table VI

State	(1,1)	(1,2)	(2,1)	(2,2)	(3,3)	(4,4)	(5,5)
Value	5.0	5.4	5.2	5.6	7.0	8.8	10.0

----Best of Luck----

Total No. of Pages 04

FIRST SEMESTER

Roll No.

M. Tech.

END SEMESTER EXAMINATION November-2024

AI505/RICV501/RIRA501/RNCS501/IEM5401

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

Time: 3:00 Hours

Max. Marks: 40

Note: Answer ALL questions.

Assume suitable missing data, if any.

CO# is course outcome(s) related to the question.

- 1[a] Determine whether the following tasks belong to supervised learning, unsupervised learning, or reinforcement learning. [0.5x8=4] [CO1]
- You are building a model to predict the probability that a new customer will purchase a product based on their demographic and online browsing data from past customer behaviours.
 - Given a large, unlabelled dataset of social media posts, identify key themes or topics present in the data and organize them into clusters of related content.
 - A company wants to improve customer retention by understanding if there are distinct segments of customers based on their purchasing patterns and engagement history.
 - Using historical data on house sales (including variables like location, size, and age of the house), you need to create a model that estimates the likely sale price of new properties.
 - Grouping pixels in an image to detect regions representing different materials (e.g., water, vegetation, urban areas) based on their colour, texture, and brightness properties.
 - Training an autonomous drone to navigate through an unknown environment and reach a destination point while avoiding obstacles.
 - Analysing a vast collection of customer feedback reviews to identify underlying patterns and uncover latent sentiment types, such as specific pain points or product preferences, without predefined categories.
 - Given recent weather and environmental sensor data, forecast whether air quality in a city will improve or worsen in the upcoming week based on prior patterns.
- [b] A company uses a decision tree to classify customers into "high-spender" and "low-spender" categories based on their monthly shopping habits. The table below provides information about a subset of the decision tree's nodes, including the classification accuracy before and after pruning each node. [4] [CO2]

Metric	Node A	Node B	Node C	Node D	Node E
Training Accuracy Before Pruning (%)	98	95	99	97	96
Training Accuracy After Pruning (%)	95	93	96	97	94
Validation Accuracy Before Pruning (%)	85	84	83	80	78
Validation Accuracy After Pruning (%)	85	86	82	82	81

Identify which nodes should be pruned based on the relative gain or loss in validation accuracy and justify your answer mathematically.

2. Answer *any TWO* of the followings

- [a] A social media platform is trying to classify posts as either "Promotional" or "Non-Promotional" using a Naive Bayes classifier. Based on past data, the following counts for certain keywords in posts have been recorded:

Keyword	Count in Promotional Posts	Total Promotional Posts	Count in Non-Promotional Posts	Total Non-Promotional Posts
"target"	50	250	150	400
"win"	175	250	100	400

The prior probabilities are given as: $P(\text{Promotional}) = 0.3$ and $P(\text{Non-Promotional}) = 0.7$. Classify a new post containing both "target" and "win" using above classifier. Now if prior probabilities are change to $P(\text{Promotional}) = 0.6$ and $P(\text{Non-Promotional}) = 0.4$. What will be new class of the post.

- [b] A real estate company is using a logistic regression model to predict whether a property will sell within 30 days ($y = 1$) or not ($y = 0$) based on three features: Property Size (x_1 , in square feet), Location Score (x_2 , a rating from 1 to 10), and Number of Listings in the Area (x_3). The trained logistic regression model has coefficients $w_0 = -1$ and $w = \{0.01, 0.3, -0.05\}^T$ with threshold of $P(y = 1) = 0.5$ to classify properties as likely to sell within 30 days. For a property with $x_1 = 2000$ sq. ft., $x_2 = 7$, and $x_3 = 5$, determine whether it will be classified as likely to sell. If the threshold is adjusted to $P(y = 1) = 0.4$, discuss how this change affects false positive and false negative rates, and explain the trade-off involved.
- [c] A company is testing a machine learning model to predict whether a transaction is fraudulent ("Fraud" = 1) or legitimate ("Not Fraud" = 0). During evaluation on a test set, the model achieved the following results: True Positive Rate (Recall): 0.85; False Positive Rate: 0.10; Precision: 0.75. Calculate the F1-score for the model, and briefly explain its significance in this fraud detection scenario. Explain, the impact of the

False Positive Rate in this context and discuss why lowering the False Positive Rate might be essential for the institution. [4] [CO2, CO3]

3. Answer *any TWO* of the followings

- [a] A manufacturing quality control system uses a perceptron with two input features to classify products as acceptable ($y = 1$) or defective ($y = 0$). The training data includes: (3, 4, 1), (-2, 2, 0), (1, -3, 1), and (4, 3, 0), where each triplet (x_1, x_2, y) represents product features and the label. The perceptron's weights are initialized to [0.05, -0.1], bias to 0, and learning rate to 0.2. Perform two iterations of training and update the weights and bias after each sample using the sign activation function for classification.
- [b] Consider a computational graph for a neural network where the output z is given by $z = w_0 + w_1x_1 + w_2x_2$, with $y = \sigma(x)$ (sigmoid activation), and the loss function is $L = \frac{1}{2}(y - \hat{y})^2$, where $\hat{y} = 0.5$. The initial values are $w_0 = 0.1$, $w_1 = 0.4$, $w_2 = -0.6$, $x_1 = 0.1$ and $x_2 = -0.1$ with a learning rate $\eta = 0.1$. Perform a forward pass through the computational graph to compute z , y , and L . Then, perform backpropagation to compute the gradients $\frac{\partial L}{\partial w_0}$, $\frac{\partial L}{\partial w_1}$, and $\frac{\partial L}{\partial w_2}$ and update the parameters w_0 , w_1 , and w_2 using gradient descent for one step. Show all intermediate calculations.
- [c] Consider a neuron in an Artificial Neural Network (ANN) with an input $x = [1.0, -0.5, 2.0, -1.0]$, which passes through a ReLU activation followed by a Sigmoid activation. Given the upstream gradient from the loss with respect to the Sigmoid output $\frac{\partial L}{\partial y} = [0.1, -0.2, 0.3, -0.4]$, compute the output of the ReLU and Sigmoid layers. Then, calculate the downstream gradient $\frac{\partial L}{\partial x}$ using the chain rule, showing all steps and intermediate calculations for the derivatives of both ReLU and Sigmoid functions.

4. Answer *any TWO* of the followings

- [a] Let, now it is decided to use iterative deepening depth-first search (IDDFS) instead of DFS or BFS. Assume that the maximum depth of the tree is 3. In what order are the nodes visited? Compare the number of nodes visited by DFS, BFS, and IDDFS. Which algorithm visits the fewest nodes in this case?

Total No. of Pages 02

Roll No.

FIRST SEMESTER

M.Tech. (AI)**END SEMESTER EXAMINATION November, 2024****AI507/RIRA505 NATURAL LANGUAGE PROCESSING**

Time: 3:00 Hours

Max. Marks: 50

Note: Answer *Any FIVE* questions.
Assume suitable missing data, if any.
CO# is course outcome(s) related to the question.

1. A library wants to implement a system that allows users to search for books based on similar keywords in book titles. Explain how word embeddings (e.g., Word2Vec) can be used to represent book titles. Propose a method to compute similarity between book titles using these embeddings and evaluate how well CBOW and Skip-Gram models would perform for this task. [10] [CO1]
2. A subscription-based service wants to predict whether customers will cancel their subscriptions based on feedback. Using the following customer comments, preprocess the data and construct features for logistic regression to classify feedback as churn-related (yes) or not (no):
"The service was too expensive." – Yes
"I enjoy the features provided." – No
"It's not worth the money." – Yes
"The customer support is excellent." – No
Explain how Naïve Bayes differs from logistic regression for this type of classification task. [10] [CO1, CO3]
3. Calculate the tri-gram probability for the sentence "My bat ball" using the following corpus:
"I played with bat ball"
"My bat is powerful"
Include start (<s>) and end (</s>) tags in your calculations to account for sentence boundaries. Use smoothing, if required. [10] [CO3]
4. Explain why standard RNNs struggle with real-time speech recognition tasks involving long conversations. Discuss how gradient-related issues affect the ability of RNNs to capture context. Suggest architectural

improvements to mitigate these challenges and enable real-time processing. [10] [CO3]

5. Given the sentences "Cats chase mice." and "Dogs chase cats.," construct a vocabulary of unique words and represent each sentence as a Bag-of-Words (BoW) vector. Calculate the term frequencies (TF) for words in the sentence "Cats chase mice." Finally, compute the cosine similarity between the two BoW vectors. Show all steps, including vocabulary construction, vector creation, and similarity calculation. [10] [CO2]
6. A research team is using an LSTM network to predict daily energy consumption from historical data, given a sequence of normalized values: 0.1, 0.15, 0.2, 0.18, 0.22. Assume the input size is one (single scalar per time step), the hidden and cell states have two components, all weight matrices are initialized to ones, biases to zeros, and initial states are zeros. For the first input value (0.1), calculate the updated cell and hidden states using the LSTM process: compute forget gate activation, input gate activation, candidate cell state, and output gate activation; then update the cell and hidden states accordingly. Explain the roles of the gates in this step, and round all results to four decimal places. [10] [CO4]
7. Evaluate the suitability of different models (e.g., Word2Vec, Transformer, BERT, or GPT) for analyzing customer reviews and generating personalized recommendations. Discuss factors like dataset size, context awareness, computational efficiency, and interpretability. Recommend the most suitable model with a justification based on the task requirements. [10] [CO1, CO4]

—Best of Luck—

... of the following:

[2.5*4=10 M][CO#1,CO#4][BTL#2]

- i) Perceptron-Convergence Theorem
- ii) Max-Pooling v/s Average Pooling
- iii) Credit Assignment Problem
- iv) Hessian Matrix
- v) Network Pruning Techniques
- vi) Deconvolution

Total no. of Pages: 04

Roll no.....

FIRST SEMESTER

M.Tech./M.Tech.(Research)

END TERM EXAMINATION

Nov-2024

AI509/RICV505: ARTIFICIAL NEURAL NETWORKS

Time: 03:00 Hours

Max. Marks: 50

Note: All questions carry equal marks.
Assume suitable missing data, if any.

- Q.1 a) Consider a model that detects driver fatigue in cars. It is crucial that the model detects fatigue, to prevent any accidents. Which of the following is the most appropriate evaluation metric for such model: Accuracy, Precision, Recall, Loss value. Justify your choice.
[2 M][CO#5][BTL#5]
- b) Consider a classification model which you have initially trained on 20 samples. Training converges, but the training loss is very high. You then decide to train this network on 10,000 examples. Is your approach to fixing the problem correct? If yes, explain the most likely results of training with 10,000 examples. If not, give a solution to this problem.
[2 M][CO#5][BTL#5]
- c) Consider a Majority Classifier on the training set containing 10 examples shown in Figure 1 where each example has one real-valued feature, x , and a binary class label, y , with value 0 or 1. This Majority Classifier predicts the class label that is in the majority in the training set, regardless of the input value. In case of ties, it predicts class 1.

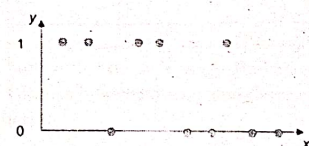


Figure 1

i) Compute the training set accuracy of the above classifier when all the 10 samples are used in the training set?

[2 M][CO#5][BTL#5]

ii) Compute the Leave-One-Out Cross-Validation accuracy?

[2 M][CO#5][BTL#5]

iii) Compute the Two-Fold-Cross-Validation accuracy?

[2 M][CO#5][BTL#5]

Q.2 a) Consider the binary classification task of classifying images as Cat v/s Non-Cat. You design a Convolutional Neural Network (CNN) with a single output neuron. Let the output of this neuron be z . The final output of your network, \hat{y} is given by: $\hat{y} = \sigma(\text{ReLU}(z))$, where σ denotes Sigmoid activation. You classify all inputs with a final value $\hat{y} \geq 0.5$ as cat images. What problem are you going to encounter?

[2 M][CO#2][BTL#4]

b) Consider a CNN classifier as shown in Figure 2. For each layer, calculate the number of weights, number of biases and the size of the associated feature maps. The notation follows the convention: • CONV-K-N denotes a convolutional layer with N filters, each filter of size $K \times K$, padding and stride are always 0 and 1 respectively. • POOL-K indicates a $K \times K$ max pooling layer with stride K and padding 0. • FC-N stands for a fully-connected layer with N neurons.

[8 M][CO2][BTL#4]

Layer	Activation map dimensions	Number of weights	Number of biases
INPUT	$128 \times 128 \times 3$	0	0
CONV-9-32			
POOL-2			
CONV-5-64			
POOL-2			
CONV-5-64			
POOL-2			
FC-3			

Figure 2

Q.3 Given a neural network in Figure 3. ReLU activation σ is applied at hidden layer and output layer neurons. The loss function is $L = 1/2(\hat{y} - y)^2$, where \hat{y} is the predicted output. The hidden layer and output layer weights are given by matrices W and V respectively which are initialized as follows:

[10 M][CO#2][BTL#3]

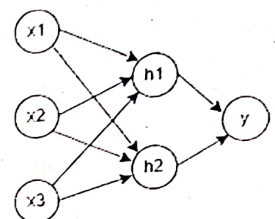


Figure 3

$$W = \begin{bmatrix} 1 & 0 & 1 \\ 1 & -1 & 0 \end{bmatrix} \quad V = \begin{bmatrix} 0 & 1 \end{bmatrix}$$

- Write the expression of mapping x to \hat{y} in terms of σ , W and V .
- Assume the current input is $x = [1 \ 2 \ 1]$, output $y=1$. Compute \hat{y} for the given x . Show all intermediate steps.
- Compute the gradient of loss function L with respect to weights V and W . Also, compute the updated values of W and V . Pick learning rate $\alpha = 1$.

Q.4 a) Assume for a single time step, input data x has dimension p and the hidden state h has dimension q . Write the expression of RNN forward pass for single timestep when operated on mini-batch of size r . Also, provide dimensions of each term in the expression.

[5 M][CO#2][BTL#3]

b) What are the possible ways of reducing overfitting in a neural network?

[2.5 M][CO#4][BTL#4]

c) Why is it important to place non-linearities between the layers of neural networks?

[2.5 M][CO#4][BTL#4]

Total no. of Pages:03

Roll no.....

First Semester M.Tech (AI)

END TERM EXAMINATION

Nov-2024

AI531B : Advance Database Management Systems

Time: 03:00 Hours

Max. Marks: 40

Note : All questions carry equal marks.
Assume suitable missing data, if any.
Attempt any Four

Q.1 (a) What is an Extended ER Diagram, and how does it differ from a traditional ER Diagram?

[5][CO#1][BTL#]

(b) What are the key limitations of the Relational Data Model?

[5][CO#1][BTL#]

Q.2 (a) Describe ECA (Event-Condition-Action) rules with an example.

[5][CO#2][BTL#]

(b) Explain Distributed Deadlock. Discuss the methods used for its detection and resolution.

[5][CO#3][BTL#]

Q.3 (a) Discuss the challenges in Query Processing and Concurrency Control in Real-Time Databases.

[5][CO#3][BTL#]

(b) Explain the role of a Query Processor in a database management system. Discuss its components and describe how it translates and optimizes SQL queries.

[5][CO#4][BTL#]

Q.4 A production company maintains a database to store information about movies, including the actors who starred in each movie and the awards won by each movie. Each movie can have multiple actors, and each movie may have won multiple awards. However, there is no direct relationship between specific actors and awards for a given movie — any actor associated with a movie is unrelated to the awards that the movie may have won.

The company stores all this information in a single table called Movies:

MovieID	Title	Actor	Award
1	Inception	Leonardo DiCaprio	Best Cinematography
1	Inception	Leonardo DiCaprio	Best Sound Editing
1	Inception	Tom Hardy	Best Cinematography
1	Inception	Tom Hardy	Best Sound Editing
2	The Matrix	Keanu Reeves	Best Visual Effects
2	The Matrix	Keanu Reeves	Best Sound
2	The Matrix	Laurence Fishburne	Best Visual Effects
3	Titanic	Leonardo DiCaprio	Best Original Score
3	Titanic	Leonardo DiCaprio	Best Art Direction
3	Titanic	Kate Winslet	Best Original Score

- Identify the multivalued dependencies present in the Movies table.
- Decompose the Movies table into 4NF by separating out the multivalued dependencies.
- Identify the join dependency and ensure the decomposition satisfies 5NF.
- After decomposing the table, reconstruct the Movies table using a join and verify that it produces all possible combinations of Actor and Award for each movie.

[10][CO#4][BTL#]

Q.5 A bank's database must handle transactions where customers transfer funds between accounts. Each transfer is a multi-step transaction involving checking the balance, deducting funds from one account, and adding funds to another account.

- Explain the concept of "nested transactions" and discuss how it might be beneficial in handling fund transfers.
- Describe a possible implementation using compensating transactions if one part of the transaction fails.
- Suggest methods to ensure serializability in these transactions and explain why it is important.

[10][CO#4][BTL#]

*****End*****

- [c] In a two-player zero-sum game tree (Fig. 2), the root node represents the current state, with leaf nodes containing some known scores. Player Max's objective is to maximize the score, while Player Min's goal is to minimize it. Apply the minimax algorithm enhanced with alpha-beta pruning to evaluate the optimal value of the root node. Highlight the branches pruned during the process and explain the reasoning behind each pruning decision.

[4] [CO3]

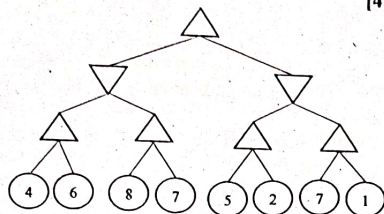


Fig. 2

- 5[a] In a Markov Decision Process (MDP), what is the role of the discount factor (γ)? Explain how the value of γ (e.g., close to 0 or close to 1) affects the robot's decision-making in terms of prioritizing immediate versus long-term rewards.
- [b] A robot operates in an MDP with two states (S1 and S2) and a goal state (G). From S1, the robot can either stay in S1 (reward = -1, probability = 0.8) or move to S2 (reward = -1, probability = 0.2). From S2, it can move to G (reward = 10, probability = 1). With a discount factor ($\gamma = 0.9$), write the Bellman equations for S1 and S2, calculate their values assuming initial values of 0, and determine the robot's optimal policy based on these values.

[4] [CO4]

---Best of Luck---

Total No. of Pages 04

Roll No.

FIRST SEMESTER

M. Toch.

END SEMESTER EXAMINATION

November-2024

IEM5313

AI/ML IN INDUSTRIAL ENGINEERING AND MANAGEMENT

Time: 3:00 Hours

Max. Marks: 40

Note: Answer ALL questions.

Assume suitable missing data, if any.

CO# is course outcome(s) related to the question.

- 1[a] For the following tasks, identify the type of machine learning (supervised, unsupervised, or reinforcement), the type of data involved (labeled, unlabeled, or interactive feedback), and explain the specific challenge for each task in achieving its goal. Provide concise answers with justification.
- [1x4=4] [CO1]
- A model is developed to forecast the likelihood of a customer purchasing a product based on demographic and browsing data. How can this model ensure it adapts well to new customer behavior trends?
 - Social media posts without labels are analyzed to discover prevalent themes and form cohesive clusters. What measures could help determine if the clustering is meaningful?
 - An autonomous drone learns to navigate an unknown indoor environment, avoiding obstacles to reach its goal. What strategy could improve its learning efficiency in balancing exploration and exploitation?
 - Historical housing data, including features like neighborhood and house size, is used to predict future house prices. What considerations are necessary to make the model robust to varying economic conditions?
- [b] A manufacturing plant uses a decision tree model to classify products as "defective" or "non-defective" based on quality inspection metrics such as dimensions, surface finish, and material properties. Pruning is performed on specific nodes in the decision tree to enhance model generalization. Analyze the effects of pruning on the model's performance by using the table below. Identify which nodes should be

pruned to optimize the model's validation accuracy while minimizing overfitting, and justify your conclusions mathematically.

Table I

Metric	Node A	Node B	Node C	Node D	Node E
Training Accuracy (%) Before Pruning	98	97	96	95	94
Training Accuracy (%) After Pruning	96	95	94	93	92
Validation Accuracy (%) Before Pruning	82	83	84	85	86
Validation Accuracy (%) After Pruning	84	85	86	87	88

Determine which nodes should be pruned to achieve better generalization for product classification. [4] [CO2]

2. Answer any TWO of the followings

- [a] A marine research institute is using a Naive Bayes classifier to classify a newly discovered aquatic species as either "Fish" or "Mammal." The classification is based on three binary features: "Has Fins," "Breathes Air," and "Warm-Blooded" (1 for true, 0 for false). The following table summarizes the relevant counts from the training dataset:

Table II

Class	Has Fins = 1	Breathes Air = 1	Warm-Blooded = 1	Total Objects in Class
Fish	50	10	5	80
Mammal	20	50	40	70

A newly discovered species has the following features: Has Fins = 1, Breathes Air = 1, Warm-Blooded = 1. Using the Naive Bayes classifier, classify the species as "Fish" or "Mammal," and provide the mathematical justification for your decision. [4] [CO1, CO2]

- [b] A health analytics company is using a logistic regression model to predict whether a patient is at high risk of developing diabetes ($y = 1$) or not ($y = 0$). The prediction is based on three features: BMI (x_1 , in kg/m^2), Age (x_2 , in years), and Daily Exercise Time (x_3 , in minutes). The logistic regression model has coefficients $w_0 = -2$ and $w = [0.05, 0.02, -0.01]^T$, with a classification threshold of $P(y = 1) = 0.5$. For a patient with BMI = 28, Age = 45, and Daily Exercise Time = 30, determine whether they are classified as high risk. [2+2] [CO2]

- [c] A manufacturing plant uses a machine learning model to predict whether a machine part is defective (Defective = 1) or non-defective (Non-defective = 0) based on three features: Material Hardness (x_1 , in Brinell scale), Tolerance Deviation (x_2 , in mm), and Surface Roughness (x_3 , in μm). The model achieved the following performance metrics during testing: True Positive Rate (Recall): 0.88, False Positive Rate: 0.12, and Precision: 0.81. Discuss the trade-offs between Precision and Recall for detecting defective parts in the manufacturing process. [Maximum 3 sentences] [4] [CO2, CO3]

3. Answer any TWO of the followings

- [a] A robotic arm's performance is predicted (Efficient = 1, Inefficient = 0) using a Multilayer Perceptron (MLP) based on two features: Motor Speed (x_1 , in RPM) and Torque (x_2 , in Nm). The MLP consists of 2 input neurons (layer 0), 2 hidden neurons with ReLU activation (layer 1), and 1 output neuron with sigmoid activation (layer 2). The network parameters are:

$$W^{(1)} = \begin{bmatrix} 0.6 & -0.4 \\ 0.9 & 0.2 \end{bmatrix}, W^{(2)} = \begin{bmatrix} 0.7 \\ -0.5 \end{bmatrix}, b^{(1)} = \begin{bmatrix} 0.2 \\ -0.1 \end{bmatrix}, b^{(2)} = -0.3$$

Given the input $X = [150, 5]$, compute the hidden layer and output layer values using ReLU and sigmoid activations, respectively. Determine whether the robotic arm is classified as "Efficient" or "Inefficient" based on a threshold of 0.5. [4] [CO3]

- [b] For the MLP described in the above question, let the true label for the customer $X = [150, 5]$ be $Y = 1$. Compute the error using binary cross-entropy loss. Then, derive the gradient of the loss with respect to the activation from the output layer. [2+2] [CO3]
- [c] For the MLP described in the above question, Construct the computational graph showing the flow of calculations. Then, derive the gradient of the loss with respect to $W^{(2)}$. [2+2] [CO3]

4. Answer any TWO of the followings

- [b] In the following graph, a delivery robot must navigate from the starting node 'X' to the destination node 'Z'. The graph is arranged as in Fig. 1. Conduct a Depth-First Search (DFS) starting at 'X' and find the order in which nodes are explored until reaching 'Z'. [2+2] [CO3]

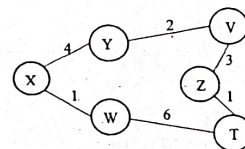


Fig. 1

- [a] Consider the graph in Fig. 1 again. The delivery robot now uses Uniform Cost Search (UCS) to find the shortest path. Determine the order in which nodes are explored until the robot reaches the target node 'Z'. [4] [CO3]

Total No. of Pages: 03

M. Tech. (AI)

End-Semester Examination

AI-6209 Predictive Modelling

Roll No.....

Third Semester

(November 2024)

Time: 1.5hrs

Max. Marks: 50

Note: Attempt any five questions.

Assume suitable missing data if any.

Usage of Statistical Table is allowed

- Q1. Consider a scenario where 40 students had developed the same program. The size of the program is measured in terms of LOC and is provided in Table below. Evaluate whether the size values of the program developed by 40 students individually follows normal distribution. Test the result at 0.05 significance value. [10]

LOC Values

641	672	811	770	741	854	891	792	753	876
801	851	744	948	777	808	758	773	734	810
833	704	846	800	799	724	821	757	865	813
721	710	749	932	815	784	812	837	843	755

- Q2. Consider Table below that shows the performance values (accuracy) of three techniques (A1, A2, and A3), which are applied on four data sets (D1, D2, D3, and D4) each. We want to investigate whether the performance of all the techniques calculated in terms of accuracy are equivalent. Test the result at 0.05 significance value. [10]

Accuracy Values of Techniques

Data Sets	Techniques		
	A1	A2	A3
D1	60 (x_{11})	50 (x_{12})	40 (x_{13})
D2	40 (x_{21})	50 (x_{22})	40 (x_{23})
D3	70 (x_{31})	40 (x_{32})	50 (x_{33})
D4	80 (x_{41})	70 (x_{42})	30 (x_{43})

- Q3. Consider an example for comparing the coupling values of two different software (one open source and other academic software), to ascertain whether the two samples are identical with respect to coupling values (coupling of a module corresponds to the number of other modules to which a module is coupled).

Academic: 89, 93, 35, 43

Open source: 52, 38, 5, 23, 32

Test the result at 0.05 significance value.

- Q4. Consider the table below where three research tools were evaluated by 17 different researchers and were given a performance score out of 100. Investigate whether there is a significant difference in the performance rating of the tool. Test the result at 0.05 significance value. [10]

Performance Score of Tools			
Tools			
Tool 1	Tool 2	Tool 3	
30	65	55	
75	25	75	
65	35	65	
90	20	85	
100	45	95	
95		75	

- Q5. Consider an example for comparing the properties of industrial and open source software in terms of the average amount of coupling between modules (the other modules to which a module is coupled). The purpose of both the software is to serve as text editors developed

in Java language. In this example, we believe that the type of software affects the amount of coupling between modules.

Industrial: 150, 140, 172, 192, 186, 180, 144, 160, 188, 145, 150, 141
Open source: 138, 111, 155, 169, 100, 151, 158, 130, 160, 156, 167, 132

Test the result at 0.05 significance value. [10]

- Q6. For example, consider an example where a researcher wants to compare the performance of two techniques (T1 and T2) on multiple data sets using a performance measure as given in Table below. Investigate whether the performance of two techniques measured in terms of AUC differs significantly. Test the result at 0.05 significance value. [10]

Performance Values of Techniques		
Data Sets	Techniques	
	T1	T2
D1	0.75	0.65
D2	0.87	0.73
D3	0.58	0.64
D4	0.72	0.72
D5	0.60	0.70

- Q7. Explain the following:

- Parametric and Non-Parametric Tests with example
- One-Tailed and Two-Tailed tests
- Mode, Standard Deviation, and Z-Score
- Outlier Analysis

[10]

Total no. of Pages: 01

Roll no.....

THIRD SEMESTER

M.Tech (AI)

END TERM EXAMINATION

Nov-2024

AI6307 : Blockchain and Application

Time: 03:00 Hours

Max. Marks: 50

Note : All questions are compulsory.
Assume suitable missing data, if any.

- Q.1 What is blockchain? How does it differ from traditional centralised databases? [5Marks][CO#1][BTL#2]
- Q.2 Discuss the different types of accounts in Ethereum. Differentiate between those accounts. [5 Marks][CO#2][BTL#2]
- Q.3 Describe the Merkle Tree using a clear diagram. [5 Marks][CO#3][BTL#2]
- Q.4 What are Decentralised Apps (Dapps)? Explain the difference between centralized apps and decentralised apps. [5 Marks][CO#3][BTL#2]
- Q.5 Elaborate the "Double Spending Problem". Explain how blockchain solves it. [10 Marks][CO#3][BTL#3]
- Q.6 Explain the concept of Proof of Work(PoW) using suitable diagrams. How Proof of Stake (PoS) is different from Proof of Work? [10Mark][CO#4][BTL#3]
- Q.7 Discuss the concept of Sharding in blockchain and its impact on scalability. [10 Marks][CO#5][BTL#2]

-----All the Best-----

Q.3 Answer the following:

(a) Explain the concept of image segmentation in computer vision. Compare and contrast different methods of image segmentation, providing examples of their applications.

[4][CO2][BTL2]

(b) Discuss the role of Kalman filters and particle filters in motion tracking. How do they differ in implementation and application?

[4][CO3][BTL3]

Q.4 Answer the following:

(a) Describe the procedure by which SVM determines the optimal hyperplane for classifying data.

(b) Given the data points (1,1),(2,2),(2,0) labeled as +1, and (0,0),(1,0),(0,1) labeled as -1 find the equation of the maximum-margin hyperplane using a linear SVM.

(c) A linear SVM produces a hyperplane with the equation $2x_1 + 3x_2 - 6 = 0$.

Calculate the margin if one support vector is at (1,1).

(d) Consider the dataset $\{(2,2,+1), (1,1,+1), (2,0,-1), (0,0,-1)\}$. Identify the support vectors after fitting a linear SVM.

[2x4][CO2][BTL2,3]

Q5. Answer the following:

(a) Explain the concept of transfer learning in deep neural networks.

[2][CO1][BTL1]

(b) Consider a single-layer neural network with:

Input $x = [1, 2]$, Weight vector $w = [0.5, -0.4]$, Bias $b = 0.1$,

Target output $y_{\text{true}} = 1$, Activation function $\sigma(z) = 1/(1 + e^{-z})$ and Loss function:

$$\text{MSE} = 1/2(y_{\text{true}} - y_{\text{pred}})^2$$

(i) Compute the forward pass to find y_{pred}

(ii) Compute $\partial L / \partial w_1$, $\partial L / \partial w_2$, and $\partial L / \partial b$ using backpropagation.

(iii) Update the weights and bias using a learning rate $\eta = 0.01$.

[6][CO3][BTL4]

Total no. of Pages: 2

Roll no.

Ph.D. Course Work

END TERM EXAMINATION

Nov-2024

COURSE CODE: AM-502

COURSE TITLE: Mathematical Modeling and Simulation

Time: 03:00 Hours

Max. Marks: 70

Note : All questions carry equal marks.
Assume suitable missing data, if any.

Q.1 Consider the population of a country. Assume constant per-capita birth and death rates, and that the population follows an exponential growth (or decay) process. Assume there to be significant immigration and emigration of people into and out of the country.

- a) Assuming the overall immigration and emigration rates are constant, formulate a single differential equation to describe the population size over time. Give a suitable compartment diagram for this model.
- b) Suppose instead that all immigration and emigration occurs with a neighbouring country, such that the net movement from one country to the other is proportional to the population difference between the two countries and such that people move to the country with the larger population. Formulate a coupled system of equations as a model for this situation.

In both (a) and (b) start with appropriate word equations and ensure all variables are defined. Give clear explanations of how the differential equations are obtained from the word equations.

[10][CO1,2][BTL 2,3]

Q.2 Consider the system of differential equations

$$\dot{x} = x + \epsilon y$$

$$\dot{y} = x - y$$

Determine the conditions on ϵ for which the critical point of the system may be saddle point and a center in the phase plane and identify the points where this change occurs.

[10][CO3][BTL3,5]

Q.3 Explain and analyse the Predator-Prey system (Lotka-volterra model by identifying and discussing all isolated critical points.

[10][CO2,3][BTL 3]

Q.4 Use Routh Hurwitz criterion the discuss the stability of

$$s^5 + s^4 + 2s^3 + 2s^2 + s + 1. \quad [10][CO2,4,5][BTL2,3,5]$$

Q.5 Use Lyapunov function to prove the stability of the following model:

$$\ddot{x} + \cos x = 0 \quad [10][CO 3,4,5,][BTL 4]$$

Q.6 Calculate the critical points of the constant Harvesting model

$$\frac{dN}{dt} = rN \left(1 - \frac{N}{K}\right) - H.$$

Discuss the behaviour of the model at these points. Examine if bifurcation exists at any of these points. If yes, discuss the type of bifurcation which exist. Finally sketch the bifurcation diagram of fixed point.

[10][CO 3,4,5,][BTL 4]

Q.7 Consider the following system of differential equations:

$$\frac{dx}{dt} = 60x - 3x^2 - 4xy$$

$$\frac{dy}{dt} = 42y - 3y^2 - 2xy$$

Show that the linearization model of this system at (20,0) is

$$\frac{du}{dt} = -60u - 80v$$

$$\frac{dv}{dt} = 2v$$

Find the eigenvalues and corresponding eigenvectors of the coefficient matrix of the linear system. Hence, confirm the nature of the critical point (20,0).

[10][CO 2,4,5,][BTL 4,5]

Total no. of Pages:

Roll no.

First SEMESTER

END TERM EXAMINATION

Nov-2024

COURSE CODE AM-503A COURSETITLE Geometric Function Theory

Time: 03:00 Hours

Max. Marks: 50/50

Note : All questions carry equal marks.
Assume suitable missing data, if any.

Q.1 Describe the importance of normalization and choice of domain in geometric function theory. [5][CO1][BTL2]

Q.2 Define starlikeness of an arc. Also, show that the image of $\Gamma_z: z = z(\gamma)$ under $f(z)$ is starlike with respect to w_0 if

$$\operatorname{Im} \left[\frac{f'(z)}{f(z) - w_0} \cdot z'(\gamma) \right] \geq 0; t \in [a, b].$$

[5][CO1][BTL4]

Q.3 If $f \in ST$, then show that $|a_n| \leq n$. Also, prove the sharpness of this result. [5][CO2][BTL1]

Q.4 If $f \in P$, then prove that $|p_n| \leq 2$. Also, prove the sharpness of this result. [5][CO3][BTL5]

Q.5 State and prove the Noshiro-Warschawski theorem. [5][CO2][BTL1]

Q.6 State Littlewood's Conjecture and show that how it is weaker than Bieberbach's conjecture. [5][CO1][BTL4]

Q.7 State and prove Alexander's theorem. [5][CO2][BTL6]

Q.8 Define Close-to-Convex functions. Also, prove that $|a_n| \leq n$ for $n=2,3,4$ where $f \in CC$ along with its sharpness. [5][CO2][BTL3]

Q.9 State the generalized CARAKALOV-DISTLER theorem and prove it. [5][CO3][BTL2]

Q.10 Define convolution. Show that $(k*f)(z)=zf'(z)$. Here $k(z)$ is the Koebe function and $f \in S$. Also, show that if $f, g \in H$, then
 $z(f*g)'(z)=(zf'(z))*g(z)=f(z)*(zg'(z)).$ [5][CO4][BTL5]

Total No. of Pages : 02

Ist Semester END SEMESTER EXAMINATION Ph.D. (AM)
PAPER CODE - AM-504B Nov./Dec-2024

TITLE OF PAPER - Advanced Mathematical Methods

TIME: 3 HRS

MAX. MARKS:50

Note: Attempt any FIVE questions. Each question carry equal marks.

Assume suitable missing data, if any.

1. Solve the following Euler difference equations:

[10]

CO-1

$$(n+1)(n+2)a_{n+2} - 2(n+1)a_{n+1} - 3a_n = 0$$

subject to the initial conditions $a_0 = 2, a_1 = 2$.

2. Find the possible leading behaviors as $n \rightarrow \infty$ of solution to the difference equation $a_{n+1} = a_n + \frac{a_n}{n^3}$.

[10]

CO-2

3. Find the integral representation of a solution to a boundary-value problem: $xy''' + 2y = 0, y(0) = 1, y(+\infty) = 0$.

[10]

CO-3

4. Discuss the asymptotic behaviour of $\int_0^x t^{-1/2} e^{-t} dt$ as $x \rightarrow 0+$.

[10]

CO-4

5. (a) Show that Laplace's equation is invariant under rotations.

[5] CO-5

- (b) Compute the first three terms of the continued-fraction representation of the series $\sum_{n=0}^{\infty} (n!)^2 (-z)^n$.

[5] CO-5

6. (a) Find the controlling factor of the leading behaviour to $a_{n+1} = na_n$.

[5] CO-2

(b) Find the solution of the second-order difference equation

[5] CO-4

$$(n+4)a_{n+2} + a_{n+1} - (n+1)a_n = 0.$$

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Total No. of Pages : 02

Ist Semester END SEMESTER EXAMINATION Ph.D. (AM)
PAPER CODE - AM-504C Nov./Dec.-2024

TITLE OF PAPER - Numerical Method for PDEs

TIME: 03 HRS

MAX. MARKS: 50

Note: Attempt any FIVE questions. Each question carry equal marks.

Assume suitable missing data, if any.

1. Show that for $0 \leq r \leq 1/2$, the solution of the difference scheme [10]
CO-1

$$u_k^{n+1} = (1 - 2r)u_k^n + r(u_{k-1}^n + u_{k+1}^n), \quad n \geq 0, \quad k = 1, \dots, M-1$$

$$u_0^{n+1} = u_M^{n+1} = 0, \quad n \geq 0 \text{ and } u_k^0 = f(k\Delta x), \quad k = 0, \dots, M$$

converges in the sup-norm to the solution of the initial-boundary-value problem

$$\begin{cases} v_t = \nu v_{xx}, & x \in (0, 1), \quad t > 0 \\ v(x, 0) = f(x), & x \in [0, 1] \\ v(0, t) = v(1, t) = 0, & t \geq 0. \end{cases}$$

2. Show that the difference scheme $u^{n+1} = Qu^n$ is stable with respect [10]
to the operator norm if and only if there exists positive constants CO-2
 Δt_0 and Δx_0 and non-negative constants K and β so that $\|Q^{n+1}\| \leq$
 $K \exp(\beta t)$ for $0 \leq t = (n+1)\Delta t$, $0 < \Delta x \leq \Delta x_0$ and $0 < \Delta t \leq \Delta t_0$.
3. Prove that if a two-level difference scheme $u^{n+1} = Qu^n + \Delta t G^n$ is [10]
accurate of order (p, q) in the operator norm to a well-posed linear CO-3

initial-value problem and is stable with respect to the operator norm, then it is convergent of order (p, q) with respect to the same norm.

4. Analyze the dissipative and dispersive qualities of the FTFS difference scheme $u_k^{n+1} = u_k^n - R(u_{k+1}^n - u_k^n)$ where $R = a\Delta t/\Delta x$. [10]
CO-4
5. Consider the system of equations $V_t = AV_x$, $x \in (0, 1)$ where the matrix $A = \begin{pmatrix} 0 & 4/3 & -2/3 \\ 1 & -2/3 & -5/3 \\ -1 & -4/3 & -1/3 \end{pmatrix}$. Discuss some of the possible boundary conditions. [10]
CO-5
6. Discuss the consistency, stability and convergence of the Leapfrog difference scheme for the one dimensional heat equation. [10]
CO-3,5

Total No. of Pages: 2

Roll No.....

Ph. D

END SEMESTER EXAM

(November-2024)

PAPER CODE: AM-505D

TITLE OF PAPER: Quantum Information Theory

Time: 3hrs

Max. Marks: 50

Note: Assume suitable missing data, if any.

- Q1. (i) Define a pure and a mixed state. Derive the condition by which we can discriminate a pure and a mixed state. [1+4][CO1][L1,L5]
 (ii) Show that an arbitrary density matrix for a mixed state qubit may be written as

$$\rho = \frac{I + \vec{r} \cdot \vec{\sigma}}{2}$$

where \vec{r} is a real three-dimensional vector such that $\|\vec{r}\| \leq 1$.

[6][CO1][L1,L5]

- Q2. (i) Suppose we have two qubits in the state $\frac{|00\rangle + |11\rangle}{\sqrt{2}}$, and we

measure the observable $\sigma_z \otimes \sigma_y$. What is the average value of

$\sigma_z \otimes \sigma_y$.

[3][CO2][L3,L5]

- (ii) Derive CHSH Bell's inequality. Show that the singlet state violate the Bell inequality maximally. [3+4][CO2][L3,L5]

- Q3. (i) Define a product state and separable state. Name any two measure of entanglement. [1+2][CO3][L1,L5]

- (ii) Define negativity. Calculate the negativity of the quantum state described by the density operator

$$\rho_{AB} = \begin{pmatrix} 0.1 & 0 & 0 & 0 \\ 0 & 0.2 & x & 0 \\ 0 & x & 0.4 & 0 \\ 0 & 0 & 0 & 0.3 \end{pmatrix}, 0 \leq x \leq 0.283 [1+6] [CO3][L1,L5]$$

Q4. (i) State and Prove Schmidt decomposition.

Find the Schmidt decompositions of the state $\frac{|00\rangle + |01\rangle + |10\rangle}{3}$.

[3+4] [CO3][L1,L2,L5]

(ii) What do we mean by the term purification of a quantum state.

Explain.

[3] [CO3][L2,L4]

Q5. (i) Explain in detail the conventional protocol of quantum teleportation.

[6] [CO5][L2,L4]

(ii) Determine whether the state described by the density operator

$$\rho = \frac{1}{2}|00\rangle\langle 00| + \frac{3}{4}|00\rangle\langle 11| + \frac{1}{3}|11\rangle\langle 00| + \frac{1}{2}|11\rangle\langle 11|$$

is an entangled state by partial transposition method.

[4] [CO5][L3,L5]

Total no. of pages: 2

Roll No.

IIIrd SEMESTER

M.Tech. Biotechnology

End Term Examination

Nov 2024

BIO6201: Design and Analysis of Algorithms

Time: 3:00 Hours

Max. Marks: 50

Note: Answer all questions. Assume suitable missing data, if any.

1. Write Short note on following (any 6) [2.5x6= 15 marks]
(CO#1, 2, 3,4,5) (BTL 1, 2)

- a. Hamiltonian Circuit problems
- b. Binary Search Tree (BST)
- c. Greedy Algorithm
- d. Finding minimum and maximum using the Divide and Conquer strategy
- e. Backtracking
- f. Psudocodes
- g. Graphs
- h. Pruning

2. Answer any two of the following [2x5= 10 marks] (CO#2, 4) (BTL 6)

- a. Sort the array [34, 7, 23, 32, 5, 62] using Quick Sort. Show all the steps involved, including the choice of pivot, partitioning of subarrays, and the recursive sorting of these subarrays.

Or

You are given an array of integers; arr=[38, 27, 43, 3, 9, 82,10]. Apply the merge sort algorithm to sort the array. Show all intermediate steps and write the total number of comparisons required during the merge process.

- b. Solve the following 0/1 Knapsack problem using dynamic programming. Given items with weights [2, 3, 4, 5] and corresponding values [3, 4, 5, 7],

and maximum capacity of 7, determine the maximum value that can be obtained.

Or

You have planned a trip and the maximum weight you can carry is 10 kg, thus using knapsack algorithm you have to optimize the value of items in your bag. The weights [4, 5, 6, 3] and their corresponding values are mentioned as [20, 30, 50, 10]. Explain using sequential steps.

3. Differentiate between the following using suitable examples (any 2)

[2x5=10] (CO#2, 3,4) (BTL 2, 3)

- DFS and BFS using suitable examples.
- Prims's and Kruskal's algorithm.
- Bubble sort and Insertion sort

4. Write the details explanation of the following question [1x5=5]

(CO#1, 4) (BTL 4, 6)

Compare their time and space complexities in the best, average, and worst cases. Which one is more efficient in practice and why?

Or

Explain how AVL Trees maintain balance and why they provide better performance for search, insert, and delete operations compared to unbalanced Binary Search Trees.

5. Discuss in brief, how the following algorithms can be used as application in biotechnology using examples (any 5)

[2x5=10] (CO#3, 4, 5) (BTL 4, 5)

- N-Queens problem
- Travelling salesman problem
- Knapsack problem
- Huffman trees
- Walsall's and Floyd algorithm
- Sub-set problem

Total No. of Pages 01

Roll No. _____

III SEMESTER
M. Tech Bioinformatics
END TERM EXAMINATION
BIO6401 Drug Design and Discovery
Time : 3:00 Hours

NOV/DEC 2024

Max Marks : 40

Note: All questions are compulsory.
 All questions carry equal marks
 Assume suitable missing data, if any

- Q1. a) Write short notes on different receptor theories. [4+4] [CO2]
 b) Describe allosteric modulators.
- Q2. Write short notes on [4+4] [CO3]
 a) Molecular Docking
 b) Pharmacophore Modeling
- Q3. a) What do you understand by clinical trials in drug development. Describe in detail.
 b) What are the different approaches for synthetic vaccine design. [4+4] [CO4]
- Q4. a) Discuss in detail the main physicochemical parameters studied in QSAR.
 b) What is Taft's steric factor. [4+4] [CO5]
- Q5. a) Differentiate between Agonist and Antagonist
 b) This superfamily is the largest evolutionary conserved and structurally characterized by possessing seven transmembrane domains with an extracellular N-terminus and cytoplasmic C-terminus. Nearly 50% of drugs work on these receptors which are being targeted for drug designing. Coupling this protein receptor is responsible for intracellular signaling pathway, activating adenylyl cyclase and relaying signaling to second messenger cAMP. What type of protein receptor is discussed here and write elaborately. [4+4] [CO1]

Note : All questions carry equal marks. Attempt any Five.
Assume suitable missing data, if any.

Q.1 Answer all the following questions:

- a) Define the Dempster –shafer theory. [2] [CO#1][BTL#2]
- b) Give the Baye's theorem equation. [2] [CO#2][BTL#1]
- c) Define the knowledge acquisition process. [2] [CO#1][BTL#2]
- d) Describe the application of expert system. [2] [CO#1][BTL#2]
- e) Explain syntactic methods of Pattern recognition. [2] [CO#1][BTL#2]

Q.2 a) Define Expert system. Explain the architecture of an expert system in detail with a neat diagram and an example. [5][CO#2][BTL#3]

- b) Justify the statement "Artificial neuron can learn the environment" through different learning strategies. [5][CO#3][BTL#3]

Q.3a) Analyse the performance of Fuzzy system based medical image processing for predicting the brain disease. [5][CO#4][BTL#4]

- b) Explain the working of back propagation neural network with neat architecture and flowchart. [5][CO#3][BTL#3]

Q.4a) Explain the working of back propagation neural network with neat architecture and flowchart. [5][CO#3][BTL#3]

- b) what is hybrid artificial intelligence system approaches. Explain the components and design methodologies of hybrid artificial intelligence system. [5][CO#4][BTL#4]

Q.5a) Define fuzzy set theory. Discuss fuzzy number with respect to membership function. Explain the methods of membership value assignments. [5][CO#2][BTL#3]

b) Discuss in detail about the Genetic operators and evolution strategies of Genetic Algorithm. [5][CO#4][BTL#4]

Q.6a) Distinguish between supervised learning and unsupervised learning methods of artificial neural network? [5][CO#4][BTL#3]

b) Explain the limitations of backpropagation learning. Also explain the scope to overcome these limitations. [5][CO#3][BTL#3]

I SEMESTER
M.Tech. (Bioinformatics)

END TERM EXAMINATION**November- 2024****COURSE CODE -BIO-501 COURSE TITLE: - Introduction to Bioinformatics****Time: 3:00 Hours****Max. Marks: 40**

Note: Attempt any 5 questions.
All questions carry equal marks.
Assume suitable missing data, if any

- 1) (a) Explain how integrated platforms like the UniProt and Ensembl databases facilitate the study of protein function, gene annotation, and variant analysis. In what ways do these resources enhance the efficiency of multi-omics research in understanding complex diseases?

(b) Using the Protein Data Bank (PDB), design a study to explore structural variations in a protein implicated in cancer. Outline the steps you would take to retrieve, analyze, and interpret the structural data to identify potential drug targets.

[4+4] [CO# BIO-501.1] [BTL#2]
- 2) (a) Assess the impact of DNA sequence polymorphisms on genomic research. How do these genetic variations enhance our understanding of hereditary diseases and their progression?

(b) Design an experiment using the GenBank database to analyze the genomic sequences of a specific gene associated with a hereditary disease. Outline the steps you would take to identify conserved regions, annotate functional elements, and explore potential genetic mutations.

[4+4] [CO# BIO-501.2] [BTL#6]
- 3) (a) Explain the role of loops in programming for bioinformatics. How can they be used to analyze biological datasets efficiently?

(b) What is the purpose of using data structures like arrays in bioinformatics programming? Provide an example of how arrays can store and manipulate DNA sequences.

[4+4] [CO# BIO-501.4] [BTL#4]

- 4) (a) Compare the key differences between PAM and BLOSUM scoring matrices in sequence alignment. Discuss how their design principles influence alignment strategies and when each matrix is most appropriately applied in bioinformatics analyses.

(b) Given the following protein sequences:

MKAFLGLQTLVLMMAASR

MKTFLGLQTLVLMVSSR

Explain how you would decide between using a PAM or BLOSUM matrix for their alignment. What factors, such as sequence divergence or evolutionary relationship, would guide your choice? Provide a rationale for selecting the most suitable matrix in this case.

[4+4] [CO# BIO-501.4] [BTL#3]

- 5) (a) Describe the detailed procedure for conducting multiple sequence alignment (MSA). Outline the key steps involved, including sequence preparation, parameter selection, and result interpretation. Also, mention popular tools used for MSA and challenges commonly faced in this process.

(b) Choose commonly used MSA software and explain its core functionality. Discuss the algorithms it uses, its scoring methods, and how it ensures alignment accuracy.

[4+4] [CO# BIO-501.5] [BTL#1]

- 6) (a) Explain the differences between GenBank, DDBJ, and EMBL nucleotide sequence databases. In which scenarios would you choose one over the others for retrieving genomic data? Justify your selection based on data accessibility, update frequency, and format compatibility.

(b) Explain the importance of sequence alignment tools like BLAST in analyzing genomic data. How would you decide which database to use for identifying conserved gene regions across multiple species?

[4+4] [CO# BIO-501.1] [BTL#5]

Total no. of Pages:02

Roll no:

1ST SEMESTER**M.Tech. Bioinformatics****END TERM EXAMINATION****Nov- 2024****BIO505 : Functional Genomics and Proteomics**

Time: 03:00 Hours

Max. Marks: 40

Note: All questions are compulsory.
Assume suitable missing data, if any.

- Q.1 Discuss the steps involved in PCR. Describe the different types of PCR and their applications in genomics research.
- Or
- Briefly describe Sanger sequencing, Next generation sequencing, and Third generation sequencing and its key applications in genome analysis. [5][CO4][BTL1]
- Q.2 A pharmaceutical company is looking to develop a personalized drug treatment for a specific cancer type. Outline how genomics, transcriptomics, and proteomics play role in the stages of drug discovery. [5][CO5][BTL3]
- Q.3 (a) Define transcriptomics and explain its significance in studying gene expression. Outline the process of RNA interference (RNAi) and its applications in gene silencing.
- (b) What are siRNA and miRNA, and how do they differ in their mechanisms of gene regulation? [10][CO3][BTL2]
- Q.4 (a) What are the different methods of protein quantification. Give applications of protein quantification in proteomics studies.
- (b) Discuss the role of post-translational modifications (PTMs) in regulating protein activity, stability, and cellular localization.

Provide examples of common PTMs and their effects on protein function. [10][CO2][BTL1]

- Q.5 (a) Discuss the concept of the central dogma of molecular biology in the context of "omics" studies. List the major techniques used in functional genomics for studying gene expression and gene function.
- (b) A researcher is studying a newly discovered protein using proteomics. Outline the steps they would follow from identifying the protein to understanding its function within the proteome. [10][CO1][BTL3]

Ist SEMESTER

M.Tech. (BIOINFORMATICS)

END TERM EXAMINATION

Nov-2024

BIO507 Database Management

Time: 03:00 Hours

Max. Marks: 40

Note: Question No. 1 is compulsory. Attempt FIVE questions in all.
Assume suitable missing data, if any.

Q.1 Explain briefly whether the following statements are true or false giving suitable reasons: [12][CO#1,2,3,4,5][BTL#L2]

- [a] NoSQL DB has a pre-defined schema.
- [b] Dot plots can also find repeat elements in a single sequence.
- [c] An attribute consisting of more than one value for a given entity is called composite attribute.
- [d] Data in DW is non-volatile and time-variant.
- [e] Hadoop can process both structured and unstructured data types.
- [f] HIPAA regulates the legal issues regarding genomic databases.

Q.2 Answer the following questions:

- [a] Who is the father of DBMS? Differentiate between Hierarchical and Network model of DB. [3][CO#1][BTL#L1, L2]

- [b] Illustrate the schema of RDBMS showing its various features.

[4][CO#1][BTL#L3]

Q.3 Answer the following questions:

- [a] Examine the different methods of generating pairwise alignment. [3][CO#2][BTL# L3]

- [b] Compare BLAST and FASTA.

[4][CO#2][BTL#L5]

Q.4 Answer the following questions:

[a] Show diagrammatically the 3-tier architect of Dataware house: [3][CO#4][BTL#L4]

[b] Create an ER diagram given the following relations and the attributes:

- Student (Student_ID, Name, Age, Address)
- Course (Course_ID, Course_Name, Credits)
- Enrollment (Student_ID, Course_ID, Date_Enrolled)
- Create relationships and represent the cardinality.

[4][CO#3][BTL#L6]

Q.5 Answer the following questions:

[a] Enlist 3 OLAP operations.

[3][CO#4][BTL#L1]

[b] Derive the highest normal form of the given relation

R(A,B,C,D) with the following functional dependencies:

- $A \rightarrow B$
- $B \rightarrow C$
- $A \rightarrow D$

[4][CO#3][BTL#L6]

Q.6 Answer the following questions:

[a] Explain cloud computing, its advantages and applications biotechnology.

[3][CO#5][BTL#L1]

[b] Summarize the steps in big data analytics.

[4][CO#5][BTL#L1]

20

Total No. of Pages: 02

Roll No.

I SEMESTER
M.TECH. (BIOINFORMATICS)
END SEMESTER EXAMINATION (Nov 2024)
BIO509 **IMMUNOINFORMATICS**
Time: 3 Hours Max.Marks: 40

Note: Answer any 5 Questions, all carry equal marks.
Assume suitable missing data, if any.

1. Explain in detail the rationale for the following. Give Suitable supporting diagrams: [CO1]
 - a. IgM is a pentameric immunoglobulin that is present in both secretory and membrane bound form on B cells.
 - b. T cell receptor diversity is pre-formed in Naïve mature T cells and T cell activation is regulated by CTLA4 and CD28 activity.
2. Write short notes on the following: [CO2]
 - a. Autoimmunity
 - b. Hypersensitivity
 - c. Multi epitope Vaccines
 - d. Tumor immunology
3. Explain in detail, how bioinformatics is useful in solving the following problems (Give suitable case studies in support of your answer): [CO3, 4]
 - a. Prediction of a suitable B cell and T cell epitope.
 - b. HLA classification into supertypes
4. a. Antibody diversity relies on the randomness of VDJ rearrangement as well as introduction of random nucleotides during recombination. Explain in detail.
b. How does MHC II prevent endogenous antigen loading in the ER lumen? Why is it essential to use bioinformatic tools to efficiently predict MHC epitopes for better prediction of vaccine candidates capable of activating T cell response? Enumerate some of the databases that are useful for epitope prediction. [CO 1, 3, 4]

Q.4 What are microRNAs (miRNAs), and how do they function in gene regulation and the role of key enzymes, involved in miRNA biogenesis and processing. Describe the key histone modification sites and their effects on transcriptional regulation?
[10][CO4][BTL2]

Q.5 Why is a small cohort used in Phase I studies, and how does this impact the generalizability of the results? What are the ethical and privacy considerations associated with handling large genomic datasets in clinical trials? What are potential challenges in implementing pharmacogenomic testing in a clinical trial setting?
[10][CO5] [BTL3]

Q.6 What is multiplex PCR, and how does it differ from standard PCR? In what scenarios is multiplex PCR especially useful, and what are some challenges associated with its use? Discuss the limitations of PCR, particularly in terms of amplification bias, primer design, and limitations in amplifying long or GC-rich sequences?
[10] [CO1] [BTL1]

Total No. of Pages -2.

Roll No.

I SEMESTER (Mechanical)

M.Tech./Ph.D (Mech)

END SEMESTER EXAMINATION

Nov-2024

CAD-501 Numerical Methods for Engineering Applications

Time: 3 Hours

Max.Marks: 40

Note: Attempt any four questions. Assume suitable missing data, if an

- 1 (a) Solve $x^4 - x - 7 = 0$ correct to two significant figures by Newton-Raphson method correct up to 6 significant digits. 5 CO1, CO2
- (b) Compute one root of $e^x - 3x = 0$ correct to two decimal places. 5 CO2, CO3
- 2 (a) Using following data to find the Newton's interpolating polynomial and also find the value of y at $x=24$ 10 CO3

x	20	35	50	65	80	
y	3	11	24	50	98	

- 3 Solve following linear equation using Gauss-Seidel iteration Method starting from 1,1,1 10 CO2, CO3
- $$x_1 + x_2 + 2x_3 = 8$$
- $$2x_1 + 3x_2 + x_3 = 12$$
- $$5x_1 + x_2 + x_3 = 15$$
- 4 Using Trapezoidal and Simpsons rule to evaluate the following integral with number of subsets $n = 8$ and compare the results 10 CO4, CO5

$$\int_0^{0.8} \frac{dx}{4 + x^2}$$

- 5 (a) Find Laplace transform of 5 CO3, CO4
- $$L\left(\int_0^t e^{-t} \sinh 2t dt\right)$$
- Find Fourier transform of

Q.3[a] Determine the drawing force required to produce a 20% reduction in a 10mm diameter steel wire if the flow stress is given by $\sigma = 1300 C^{0.3}$ MPa. The die angle is 12° and $\mu = 0.9$.

- If the wire is moving through the die at 3 m/sec, determine the power required. [3]
- What is the maximum possible reduction under these conditions? [2]

[b] Neglecting the friction, derive an expression for draw stress in a wire drawing operation to achieve reduction in area, r . Also show that the maximum possible reduction in this case is 63%. [3] CO-7

Q.4 The stress state at a point is given by following components of stress tensor:

$$\sigma_{ij} = \begin{pmatrix} 70 & 30 & 25 \\ 30 & 80 & 40 \\ 25 & 40 & 90 \end{pmatrix} \text{MPa}$$

- Determine the normal stress on octahedral plane whose normal has the direction cosines: $1/\sqrt{3}$, $1/\sqrt{3}$, & $1/\sqrt{3}$ with the principal axes. [3]
- Determine the total shear stress on the above plane. [2]
- If the yield strength of the material is 120MPa, determine whether the material yields as per von-Mises and Tresca. Find the factor of safety on yield. CO-2[3]

Q.5 A cylindrical cup with an inside radius 30 mm and height of 80 mm is to be drawn from a blank of thickness 3 mm. A blank holder force of 53 kN is applied. If the uniform axial yield stress of the material is 360 MPa, determine (a) The drawing force required (ignoring strain hardening) assuming coefficient of friction to be 0.1 (b) Limiting draw ratio (c) Determine the draw force required for data given in problem if the material strain hardens according to the power law of hardening $\sigma_0 = (360 + 50 C^{0.5})$, also calculate the limiting draw ratio. CO-3[8]

Q.6 A steel sheet of 1mm thickness and 50mm width is bent under plane strain conditions over a tool having radius of curvature of 125mm. The material follows stress strain curve given by:

$[\sigma = 510 C^{0.18}]$ MPa. (Where σ and C are effective stress and strain respectively), $E = 200 \text{ GPa}$, Poisson's ratio = 0.3 and coefficient of friction (μ) = 0.125. Then solve the followings:

- If the above bending operation is done on V bending Die with a die opening width of 100mm, what is the max force required?
- If the elastic portion is considered in the above problem, what fraction of thickness will remain elastic?
- What %age error does neglecting the elastic core cause in the calculation of the bending moment? CO-4 [8]

Q.7 What is forming limit diagram? Draw a typical Forming limit diagram. Explain the formability of a sheet metal with reference to:

- Strain hardening coefficient
- Normal and planar anisotropy
- Yield strength
- Grain size

CO-5 [8]

Total No. of Pages 2
FIRST SEMESTER
END SEM EXAMINATION

Roll No.
M.Tech. (CAAD)
Nov, 2024

CAD507/FINITE ELEMENT METHOD

Time: 3 hr

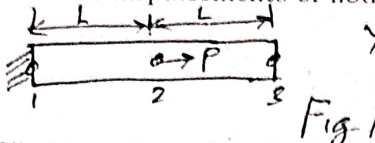
Max Marks : 40

Note: Answer any five questions.

Assume suitable missing data, if any.

All questions carry equal marks.

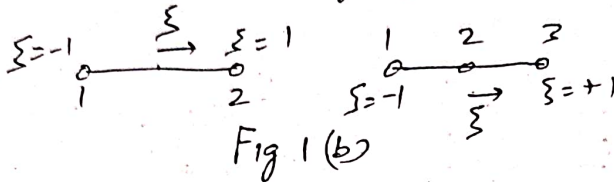
- 1(a) Find global stiffness matrix and force vector for the 1-d modelling of rod shown in Fig. 1. Find displacements of nodes and reaction at fixed end.



Young's modulus = E
Cross-sectional area = A

4 [1#] [1#]

- (b) What is a shape function? What is consistency property of a shape function? Write shape functions for linear and quadratic interpolation for 1-d element. Show that these shape functions are consistent. Fig 1(b)

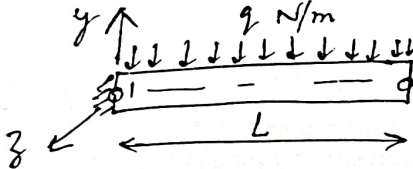


4 [1#] [1#]

- 2(a) For the cantilever in Fig. 2, calculate the end displacement and rotation. Use a single element. Use the given beam element stiffness matrix. Interpolation for deflection v is given as:

$$v = N_1 v_1 + N_2 \theta_1 + N_3 v_2 + N_4 \theta_2, \text{ where}$$

$$N_1 = 1 - 3\frac{x^2}{L^2} + 2\frac{x^3}{L^3}, \quad N_2 = x - 2\frac{x^2}{L} + \frac{x^3}{L^2}, \quad N_3 = 3\frac{x^2}{L^2} - 2\frac{x^3}{L^3}, \quad N_4 = -\frac{x^2}{L} + \frac{x^3}{L^2}.$$



$$K = EI \begin{bmatrix} \frac{4}{L^3} & \frac{6}{L^2} & -\frac{12}{L^3} & \frac{6}{L^2} \\ \frac{6}{L^2} & \frac{4}{L} & -\frac{6}{L^2} & \frac{2}{L} \\ -\frac{12}{L^3} & -\frac{6}{L^2} & \frac{12}{L^3} & -\frac{6}{L^2} \\ \frac{6}{L^2} & \frac{2}{L} & -\frac{6}{L^2} & \frac{4}{L} \end{bmatrix}$$

4 [2#] [1#]

- (b) Derive one term of stiffness matrix for a 2-noded beam element.

- 3(a) Consider the rod in Fig. 3 rotating at constant angular velocity ω rad/s. Determine the nodal displacements and axial stress at Gauss points in the rod using a single linear element. Consider only centrifugal force. Ignore bending of the rod. Use parameters E, ρ, A, L to describe the geometric and material properties of the bar.

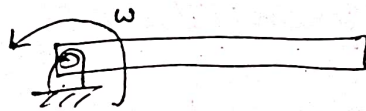


Fig. 3

4 [3#] [3#]

- (b) What is a weak formulation? Explain by an example.

4 [1#] [1#]

- Q 4(a) Fig. 4 shows a 4-node element. The values of nodal temperatures are $q = \{50, 20, 30, 40\}$. Find coordinates and temperature of the point corresponding to local coordinates $\xi = 0, \eta = 0$.

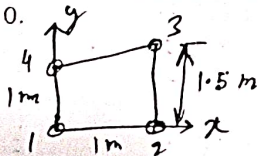


Fig. 4

4 [4#] [2#]

(b) Find area of the quadrilateral in Fig. 4 using Gauss quadrature.

4 [4#] [1#]

5(a) Describe different ways you can model and analyse the cantilever problem using FEM.

4 [5#] [4#]

(b) Heat conduction equation for 2-d is given as

$$\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} = 0$$

Boundary conditions on the sides are (Fig. 5)

$$\begin{aligned} T &= 0 \text{ at } x = 0 \\ \frac{\partial T}{\partial y} &= 0 \text{ at } y = 0 \\ -k \frac{\partial T}{\partial x} &= q \text{ at } x = L \\ -k \frac{\partial T}{\partial y} &= h(T - T_\infty) \text{ at } y = H \end{aligned}$$

4 [4#] [2#]

Develop expressions for element stiffness matrix and force vector.

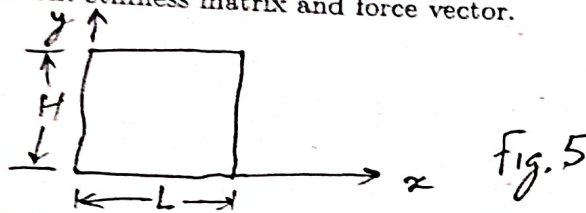


Fig. 5

6(a) For the plane stress situation, derive expressions for stiffness matrix and force vector. Assume constant body force.

4 [4#] [1#]

(b) For a unit square element, find one term of stiffness matrix using bilinear interpolation. Find force vector for the element.

4 [4#] [1#]

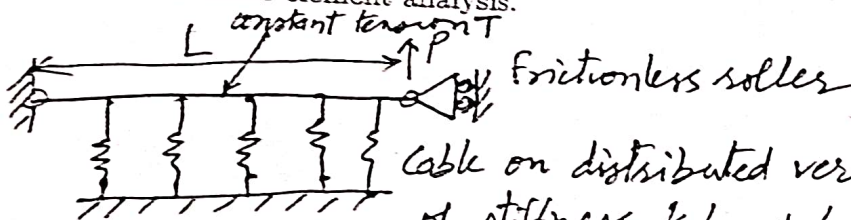
7(a) Consider the prestressed cable shown in Fig. 6. The variational functional is

$$\Pi = \frac{1}{2} \int_0^L T \left(\frac{dw}{dx} \right)^2 dx + \int_0^L \frac{1}{2} k w^2 dx - P w_L$$

(1) 4 [1#] [1#]

where w is the transverse displacement and w_L is the transverse displacement at $x = L$. Establish the differential equation of equilibrium and state all boundary conditions.

(b) Describe the process of finite element analysis.



4 [5#] [5#]

Fig. 6

Q-6 (a) Determine the equation for natural frequency of a uniform rod in torsional oscillation with one end fixed and other end free.

[4] [CO5]

(b) Discuss the different types of isolators and mounts. [2] [CO2]

(c) Add the following motion analytically.

$$X_1 = 2 \cos(\omega t + 0.5) \text{ and } X_2 = 5 \sin(\omega t + 1.0)$$

[2] [CO1]

Total no. of pages: 4

FIRST SEMESTER

END Semester Exam

CAD-507

Advanced Vibration and Control

Time: 3:00 Hr.

Roll No. _____

M. Tech (CAAD)

NOV 2024

Max. Marks: 40

Note: 1. Attempt any five questions.
2. Assume missing data, if any

Q-1 (a) Derive the expression of work done by a harmonic force on a harmonic motion. [2] [CO1]

(b) A periodic motion observed on the oscilloscope as shown in Fig.-1. Represent the motion by harmonic series. [4] [CO1]

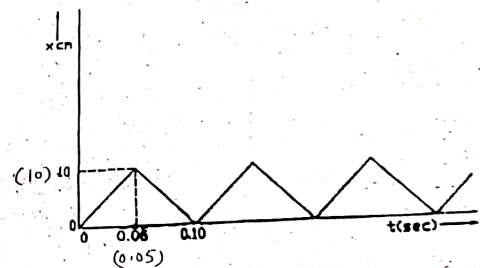


Fig.-1.

(c) Explain the different types of damping. [2] [CO2]

Q-2 (a) Between a solid mass of 10 kg and the floor are kept two slabs of isolators, natural rubber and felts in series as shown in Fig.-2. The natural rubber has a stiffness of 3000 N/m and equivalent damping coefficient of 100 N-sec/m. The felt slab has a stiffness of 12000 N/m and equivalent damping coefficient of 330 N-sec/m. Determine the un-damped and damped natural frequency of the system in vertical direction. [4] [CO2]

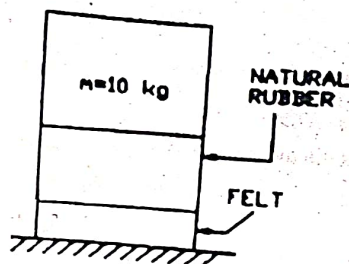


Fig.-2.

(b) Discuss the basic functioning of Vibration and frequency measuring instruments with diagram. [4] [CO4]

Q-3 (a) Derive the frequency equation of two degree of spring-mass system. Draw and explain their mode shapes when the mass and stiffness are equal. [4] [CO2]

(b) Explain the working principle of vibration absorber. Also, explain the effect of mass ratio on natural frequency and frequency response curves. [4] [CO4]

Q-4 (a) Define the orthogonal principle and derive the equations, which define the orthogonal principle. [4] [CO3]

(b) Find the natural frequency of Vibration fir the system as shown in Fig.-3 by Dunkerley's Method. [4] [CO3]

Take $E = 1.96 \times 10^{11} \text{ N/m}^2$ and $I = 4 \times 10^{-7} \text{ m}^4$.

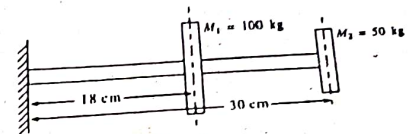


Fig.-3

Q-5 What is non-linear vibration? Give two examples of non-linear vibration. [4] [CO5]

(b) Discuss the procedure to find natural frequency of multi-degree of freedom system by Stodola Method. [4] [CO3]

1st Semester
M.Tech CAAD

END TERM EXAMINATION

SUB CODE: CAD-5313

RAPID PROTOTYPING AND TOOLING

Time: 3 Hours

MM-50

Note: Attempt any five questions..
All Questions carry equal marks.
Assume suitable missing data, if any.

Q1: Discuss in detail the following with suitable examples:

- a) Rapid Prototyping and its applications
- b) Limitations of RPT.
- c) Need for Rapid Prototyping.
- d) Computer integrated Process Planning and its types wrt RPT Manufacturing ..
- e) Digital Manufacturing and Digital twins [10] [CO1]

Q2(a) Elaborate the working principle and details of process parameters of an FDM machine..Also discuss with an example path generation in FDM process..

(b) Discuss the applications of FDM Models.

(c) Enlist advantages and limitations of FDM..[10] [CO2]

Q3: Describe the role of Rapid Prototyping in Product development..

Discuss various steps followed in RPT [10][CO3]

Q4: Explain various manufacturing techniques of RPT with schematic sketches. How do these techniques differ from conventional manufacturing? [10][CO2]

Q5: Discuss in detail AI (Artificial Intelligence), Machine Learning, Deep Learning, ANN, IOT, IIOT, Big Data with applications and Suitable examples. Also elaborate these techniques with Schematic diagrams and examples in relation to RPT and Industry 4.0 [10][CO4]

Q6 Explain the principle of working of Stereo lithography system..? Discuss in detail its applications? What are the advantages and limitations of SLA? [10][CO5]

Total No. of Pages : 03

Roll No.

III SEMESTER

MLTech (200)

END SEMESTER EXAMINATION

Nov-2024

CAD6201 COMPOSITE MATERIALS TECHNOLOGY

Time: 3:00 Hours

Max. Marks : 50

Note : Answer all questions by selecting any two parts from each questions.

All questions carry equal marks.

Assume suitable missing data, if any.

Q.1 [a] What is a composite material? Also, draw the stress strain diagram for different fibres and show the variation of tensile strength and young's modulus of different fibres. [2+3] [CO1][BTL1,2]

[b] Explain the graphite fiber structure. Explain pyrolysis process for graphite fibers and types of precursor used for graphite fibers. [5] [CO1] [BTL2]

[c] Write the compliance and stiffness matrices for a lamina for plane stress condition along material axis in terms of elastic constants. Take material axis are 1-2 and elastic constants are $E_1, E_2, G_{12}, \nu_{12}$ and ν_{21} . [5][CO2] [BTL3,4]

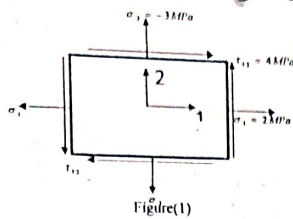
Q.2[a] Determine the stiffness and compliance matrices along material axis for a unidirectional AS4/3501-6 graphite epoxy lamina that has following engineering constants: $E_1=145\text{GPa}$, $E_2=12.5\text{GPa}$, $G_{12}=5.25\text{GPa}$, $\nu_{12}=0.27$ [5][CO2] [BTL4,5]

[b] Calculate the longitudinal modulus and tensile strength of a unidirectional composite containing 60 percent by volume of carbon fibres ($E_f=3.6\text{GPa}$ and $\sigma_{1f}=5.6\text{GPa}$) in a toughened epoxy matrix ($E_m=3.6\text{GPa}$ and $\sigma_{mt}=2.94\text{MPa}$). What fraction of load carried by fibres in the composite? [2+2+1] [CO3] [BTL4,5]

[c] Derive the expression for in-plane shear Modulus for composite materials, when applied loads are perpendicular to the fibre direction in terms of (G_f , G_m , V_f & V_m) [5] [CO3] [BTL2,3]

Q.3 [a] Explain Tsi-Hill failure theory & modified Tsi-Hill failure theory for composite material with mathematical expression. [5] [CO4] [BTL2,3]

[b] Determine the compliance matrices for a unidirectional graphite epoxy lamina that has following engineering constants: $E_1=181\text{GPa}$, $E_2=10.3\text{GPa}$, $G_{12}=7.17\text{GPa}$, $\nu_{12}=0.28$. Also find strains in 1-2 coordinates if the applied stresses are shown in the figure (1). [5] [CO2] [BTL4,5]

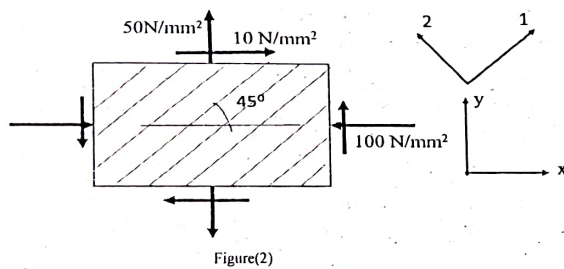


$$V_{min} = \frac{\sigma_{m2} - (\sigma_m)_{f_i}}{\sigma_{f2} + \sigma_{m2} - (\sigma_m)_{f_i}}$$

- where σ_m and σ_b indicate the tensile strength of matrix and fibres. $(\sigma_m)_{f_i}$ indicates matrix stress at the fibers fracture strain ϵ_f^* [5] [CO4] [BTL6]
- [c] Write short notes on (including advantages & disadvantages)
- (i) Thermoplastic polymer (ii) Thermoset polymer [5] [CO6] [BTL2]

- [c] Explain the vacuum bag moulding for manufacturing of composite materials. Write its advantages and limitations. [3+2] [CO5] [BTL2]

- Q.4 [a] With neat sketch explain the hand lay up process in composite manufacturing. Write its advantages and limitations. [3+2] [CO5] [BTL2]
- [b] The carbon/epoxy unidirectional ply in which fibers are oriented at 45° to the reference xy-axis as shown in figure 2. Determine if the ply failure has occurred using Tsai-Hill failure criteria.



[5] [CO4] [BTL5]

- [c] With neat sketch explain the filament winding in composite manufacturing. [5] [CO5] [BTL2]

- Q.5 [a] Explain the function of matrix materials in composite. Classify the matrix materials and explain its briefly. [5] [CO6] [BTL2]
- [b] Explain the failure mechanism of fibres matrix and composite with help of stress strain diagram. Also derive expression V_{min} (minimum fibre volume fraction),

Total No of Pages...Two.....

Roll No.....

Third Semester

M Tech [CAD]

End Semester Examination
 CAD 6303
 Paper Code

(November – 2024)
 Mechatronics System Design
 Title of the Subject

Time: 03 Hrs.

Max Marks. 40

Note : Question No. 1 is Compulsory.

Attempt four Questions more from the rest of the Question Paper.

In total attempt Five Questions.

Assume missing data, if any.

- Q No 1 Differentiate between. (2x4=08)
 (a) – Hysteresis and Dead Band CO 01
 (b) – Analogue and Digital signal
 (c) – Finite and Infinite position valves
 (d) – SPST and DPDT switches
- Q No 2(a) What do you understand by Systematic errors? Discuss its various types in brief. (4)
 CO 02
- Q No 2(b) Differentiate between Open and Closed loop control systems, with examples in brief. (4)
 CO 04
- Q No 3(a) What are various dynamic characteristics of Sensors? Discuss in brief. (4) CO 03
- Q No 3(b) What is Signal Conditioning? Also mention various types of Signal conditioning processes in brief. (4)
 CO 02
- Q No 4(a) What are different type of motors used in Electrical Actuation system? Mention their principle of operation and applications in brief. (4)
 CO 04
- Q No 4(b) Describe various components of Hydraulic and Pneumatic actuation systems in brief. (4)
 CO 03

- Q No 5(a) Discuss various Logic gates used in Mechatronic systems? (4) CO 02
- Q No 5(b) How Piezoelectric materials are used for Actuation purposes in Mechatronic systems? Explaining its Mechanism, mention some examples. (4) CO 04

- Q No 6(a) What do you understand by Drift? Also explain its types in brief. (4) CO 03
- Q No 6(b) A Platinum resistance thermometer is calibrated in an environment at a temperature of 15°C and has the following Resistance/Temperature characteristic. (4) CO 02

Measurement with Calibrated Platinum Resistance Thermometer

Resistance (Ω)	0	3	6	9	12	15	18	21	24
Temperature ($^{\circ}\text{C}$)	0	16	32	48	64	80	96	112	128

Two other similar Platinum resistance thermometer A and B have been used in an environment at a temperature of 50°C and the following Resistance/Temperature characteristic were measured.

Measurement with Platinum Resistance Thermometer A

Resistance (Ω)	2	5	8	11	14	17	20	23	26
Temperature ($^{\circ}\text{C}$)	0	16	32	48	64	80	96	112	128

Measurement with Platinum Resistance Thermometer B

Resistance (Ω)	2	6	10	14	18	22	26	30	34
Temperature ($^{\circ}\text{C}$)	0	16	32	48	64	80	96	112	128

Determine the Drifts present, if any, in Platinum Resistance Thermometers A and B with change in temperature (Calibrated), along with the respective values of Drift.

- Q No 7(a) Describe various types of Electrical switches used in Electrical actuation systems, in brief. (4) CO 01
- Q No 7(b) Explain Case study of any Mechatronic system in brief (4) CO 02
- Q No 8 Write short note on any two of the following. (2x4=08) CO 02
- (a) – Gauges used in mechanical measurement (b) – PLC
- (c) – Microprocessors and Microcontrollers (d) – ER and MR fluids

Total no. of Pages: 02
 THIRD SEMESTER
 END TERM EXAMINATION

Roll no.....
 M.Tech. [CAAD]
 Nov./Dec.-2024

CAD- 6401 COMPUTATIONAL FLUID DYNAMICS
 Time: 03:00 Hours Max. Marks: 40

Note: Answer all questions by selecting any two parts from each question. Assume suitable missing data, if any. All questions carry equal marks.

Q.1. [a] Discuss six advantages of CFD with respect to experimental methods. [4][CO1][BTL3]

[b] Derive the continuity equation in partial differential conservation form. [4][CO1][BTL4]

[c] Drive three dimensional Energy equation in partial differential conservation form with a neat diagram. [4][CO1][BTL4]

Q.2. [a] Write down the parabolic partial differential equations as applicable to computational fluid dynamics. Discuss its mathematical behavior and its impact on CFD. [4][CO2][BTL4]

[b]. Show that second order wave equation

$$\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$$

Is a hyperbolic equation:

Where symbols have their usual meaning. [4][CO2][BTL5]

[c] Explain errors and perform stability analysis on one dimensional heat conduction equation.

$$\frac{\partial T}{\partial t} = \alpha \frac{\partial^2 T}{\partial x^2}$$

Where symbols have their usual meaning.

[4][CO3][BTL5]

Q.3. [a] Using Taylor series drive an expression for second order central difference with respect to y. [4][CO3][BTL5]

[b] Using Taylor series drive an expression for second order central mixed difference with respect to x and y. [4][CO3][BTL5]

[c] Explain implicit equation solving approach with neat diagram. [4][CO3][BTL4]

Q.4. [a] Explain the differences between finite difference, finite element and finite volume methods. [4][CO3][BTL5]

[b] What is difference between initial value and boundary value problem? [4][CO3][BTL4]

[c] Explain solution of elliptic partial differential equation by explicit relaxation technique.

$$\frac{\partial^2 \phi}{\partial x^2} + \frac{\partial^2 \phi}{\partial y^2} = 0$$

Where symbols have their usual meaning.

[4][CO4][BTL5]

Q.5. [a] Explain alternating-direction implicit method to solve unsteady heat conduction equation

$$\frac{\partial T}{\partial t} = \alpha \left(\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} \right)$$

Where symbols have their usual meaning.

[4][CO4][BTL5]

[b] Explain Enthalpy method to model phase changes in fluid systems. [4][CO5][BTL4]

[c] Explain variable time step method to model phase change problems. [4][CO5][BTL4]

—————END—————

Total no. of Pages: 3

1st SEMESTER

Roll no.....

M.Tech. (CSE)/M.Tech. Research (CSE)

END TERM EXAMINATION

Nov-2024

CSE501/RNCS505: Advanced Algorithms and Data Structures

Time: 03:00 Hours

Max. Marks: 40

Note : Attempt any five questions.
All questions carry equal marks.
Assume suitable missing data, if any.

Q.1 (a) For a given problem with inputs of size n , algorithms A, B, C are executed. In terms of running time, one of the algorithms is $O(n)$, one $O(n \log n)$ and one $O(n^2)$. Some measured running times of these algorithms are given below:

	Input Size	512	1024	2048
Algo A	70	134	262	
Algo B	135	517	2053	
Algo C	42	86	182	

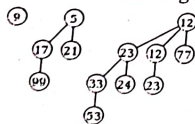
Identify the running time for each algorithm and explain how did you identify.

[4][CO1][L3,L4,L5]

(b) Write an algorithm to check if given binary tree is a Binary Search Tree.

[4][CO1][L2,L4,L6]

Q.2 Consider the following initial binomial heap:



Draw the heap after each of the following operations in sequence :

Insert 20, Delete-Min(), Insert 3, Delete-Min()

[8][CO2][L2,L3]

Q.3 An application need to maintain collection of values with following operations: insertion, deletion, searching and finding k th smallest number. Suggest a suitable data structure and write algorithm for finding k th smallest number. Give time complexity for all four operations on this data structure.

[8][CO3][L2,L4,L6]

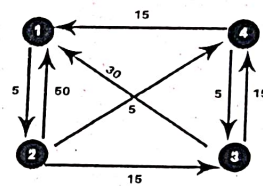
Q.4 Solve the following 0/1 Knapsack problem using branch and bound algorithm.

Knapsack Capacity $W=10$

Item	Value	weight
1	40	4
2	42	7
3	25	5
4	12	3

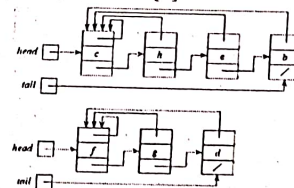
[8][CO4][L3,L4,L5]

Q.5 Solve the following All Pair Shortest Path problem using Dynamic Programming.



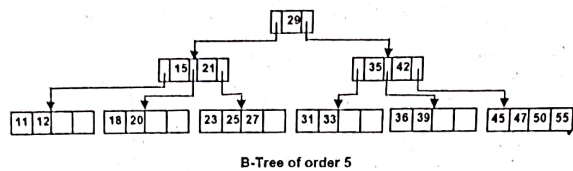
[8][CO4][L3,L5]

Q.6 Following diagram shows representation of disjoint sets $S_1 = \{c, h, e, b\}$ and $S_2 = \{f, g, d\}$ using linked lists. For every set S , we have $head[S]$, and $tail[S]$.



Design best possible algorithms for following operations:
 Make-set(), Find-Set(), Union()
 [8][CO2][L2,L4,L6]

- Q.7 (a) While implementing B-Trees for some application, how degree of B-tree is decided?
 (b) Perform delete 15 followed by delete 42 and draw B-tree after each deletion.



B-Tree of order 5

[4+4][CO5][L2,L3,L4]

Total no. of Pages: 02

Roll no:

End Term Examination

Nov-2024

1st Semester

M.Tech. CSE

Paper Code: CSE505 Title: Advanced Database Management System

Duration: 03 Hours

Max Marks: 40

Note: All questions are compulsory.
Marks for questions are indicated alongside
Assume suitable missing data, if any.

Q.1 Attempt any four parts:

a) Explain check integrity constraint in Relational Database.

[2][CO1][BTL1]

b) Explain unsafe query in Relational calculus.

[2][CO1][BTL1]

c) Explain all mapping cardinalities in ER – Diagram.

[2][CO2][BTL1]

d) Define Temporal Databases.

[2][CO6][BTL1]

e) Explain "redo and undo" phase of recovery after a system crash.

[2][CO3][BTL1]

Q.2 a) How recovery is made possible when number of transaction increased?

[4][CO3][BTL2]

b) You are designing a database for managing different types of employees in a company. There are two main types of employees: full-time employees and part-time employees. Both types of employees have common attributes such as name and hire date, but they also have specific attributes. Full-time employees have a specific attribute called "salary," while part-time employees have a specific attribute called "hourly rate."

(i) Design a schema for this database using table inheritance.

(ii) Write a query to retrieve the names of all employees.

[4][CO2][BTL2,3,5]

Q.3 a) List any five Equivalence rules used in query optimization with the help of an example.

[4][CO4][BTL2,3]

60

b) Describe wait-die and wound-wait scheme of deadlock prevention in transactions. [4][CO3][BTL1,4]

Q.4 a) What form of parallelism (interquery, interoperation or intraoperation) is likely to be the most important for each of the following tasks?

(i) Increasing the throughput of a system with many small queries
(ii) Increasing the throughput of a system with a few large queries, when the number of disks and processors is large. [4][CO4][BTL2,4,5]

b) Construct B-tree with given key values:

1, 12, 8, 2, 25, 5, 14, 28, 17, 7, 52, 16, 48, 68, 3, 26, 29, 53, 55, 45.

Order of the tree = 5

[4][CO3][BTL2,5,6]

Q.5 a) Let there is ordered file of 10,000 records stored on a disk with blocks of size 512 bytes and records are of fixed length and unspanned of length 20 bytes. Then find the number of index records in a single level primary index. [4][CO3][BTL4,5]

b) Explain Availability and any three approaches to attain availability in Distributed Databases. [4][CO5][BTL1,2]

END

Total no. of Pages:3

Ist SEMESTER

END TERM EXAMINATION

Roll no.....

M.Tech.

NOV-2024

CSE507: BIG DATA ANALYTICS

Time: 03:00 Hours

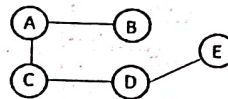
Max. Marks: 50

Note: Assume suitable missing data, if any.
Attempt all questions

1. A telecommunications company wants to analyze its customer call data to understand the underlying social network. The data consists of phone numbers and call records, indicating who called whom and how often.

CO4, CO5 [8 marks]

- Represent the phone call network as a graph. Identify and define the nodes and edges.
- Propose how the Girvan-Newman algorithm can be used to detect communities within this network. What would these communities represent?
- Calculate the betweenness centrality for node D for the given graph.



2. A Consider the following directed graph representing a small webpage network:

- Page A has links to pages B and C.
- Page B has links to pages C and D.
- Page C has links to pages A and D.
- Page D has no outgoing links (it is a sink).

- Calculate the transition matrix, T for this graph.
- Calculate the transition matrix T' when we add a spider trap (Page D links back to itself, creating a cycle with Page D).
- Calculate the PageRank of each page for 2 iterations using the transition matrix T (without spider traps) and T' (with spider traps) assuming the damping factor $d=0.85$ and initial page rank as $[0.25, 0.25, 0.25, 0.25]$

CO6 [10 marks]

3. a. Consider a collaborative network represented as a graph where nodes are researchers, and edges indicate co-authorship of papers. The adjacency matrix for a simplified graph with four nodes is given as:

CO4 [10 marks]

$$A = \begin{bmatrix} 0 & 1 & 1 & 0 \\ 1 & 0 & 1 & 1 \\ 1 & 1 & 0 & 1 \\ 0 & 1 & 1 & 0 \end{bmatrix}$$

- Compute the Jaccard similarity between Node 1 and Node 2.
- Calculate the Euclidean distance between the adjacency vectors of Node 2 and Node 3.

b. A movie recommendation system uses matrix factorization to predict user ratings for movies. The user-item (or ranking) matrix is given as follows:

User/Item	Movie 1	Movie 2	Movie 3	Movie 4
User 1	5	?	3	4
User 2	?	4	?	2
User 3	1	?	2	?

User matrix, P and item matrix Q is given as follows:

$$P = \begin{bmatrix} 1 & 0.5 \\ 0.5 & 1 \\ 0.3 & 0.7 \end{bmatrix} \quad Q = \begin{bmatrix} 1 & 0.4 \\ 0.6 & 1 \\ 0.5 & 0.8 \\ 0.3 & 0.5 \end{bmatrix}$$

Compute the missing entries in the user-item matrix.

4. a. Define NoSQL databases and how they differ from RDBMS. Explain the key features and advantages of various NoSQL database architectures.

b. Compare the master-slave and peer-to-peer distribution models in NoSQL systems. Discuss the pros and cons of each model, particularly in terms of data consistency, availability, and partition tolerance (CAP theorem).

CO5 [8 marks]

5. a. A content-based recommendation system uses feature vectors for three books (Book A, Book B, Book C) as follows:

Book A: [1, 2, 0, 1]; Book B: [2, 0, 1, 1] and Book C: [0, 1, 2, 1]

- Compute the cosine similarity between Book A and Book B.
- Which book should be recommended to a user who likes Book A?

b. In a small social network graph with nodes {X, Y, Z, W} and edges as {X ↔ Y, Y ↔ Z, Z ↔ W, W ↔ X}. Assume the SimRank similarity, $S(A, B)$ is computed as:

$$S(A, B) = \frac{C}{|I(A)||I(B)|} \sum_{i \in I(A)} \sum_{j \in I(B)} S(i, j) \text{ where } I(A) \text{ and } I(B) \text{ are the in-neighbours of A and B and } C = 0.8$$

Compute $S(X, Z)$ at iteration 1, assuming all initial similarities $S(i, j) = 1$ if $i = j$, and 0 otherwise.

CO3, CO4 [8 marks]

6. Write short note on (any two): CO1, CO2, CO3 [6 marks]

- Big Data Characteristics and how it differs from traditional data
- Hadoop Distributed File System (HDFS) vs HBase vs RDBMS
- MapReduce architecture with example

-----End-----

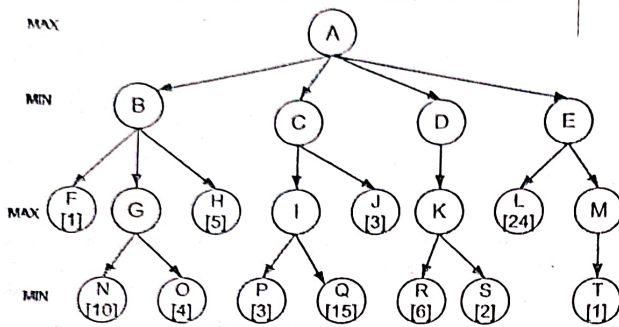


Figure 3

M.Tech.(CSE) 1st Semester
END SEMESTER EXAMINATION
CSE509
Paper Code
Time: 3 Hours

(November – 2024)
AI & Machine Learning
Title of the subject
Max. Marks: 40

Answer any five questions.
Assume suitable missing data, if any.

- Q1. (i). Define PEAC model for agent structure along with example.
(ii) What are the different properties of intelligent agent.
(iii) What are the properties of Rational agent?
(iv) Differentiate between deterministic and stochastic environment. [2x4]
- Q2. (i) Define major steps of data pre processing and its advantages.
(ii) Present any two techniques for feature selection and normalization.
(iii) Explain different steps of k-cross validation for evaluating a classification models. [2,3,3]
- Q3. (i) Consider the OR graph shown in Figure 1, where number written on edges represent the distance between the nodes. The number written on nodes represent the heuristic values. Find the most cost-effective path to reach from start A to final state J using A*.
(ii) Consider the given graph(Figure:2) that represents an AND-OR graph. The terminal nodes are labelled SOLVED and have zero cost. The arcs (all of them labeled) represent the cost of transforming the problem. Values associated with nodes are heuristic estimates of solving that node. Simulate the exploration of graph by AO* algorithm till it terminates. Show how the graph looks at the end of each cycle. Assume FUTILITY value of 45. Clearly mark the final solution (by double-lined arcs) in the final graph. [4,4]

- Q.3 Apply k-means clustering algorithm over the following data. Write all the steps of algorithm and mention appropriate assumptions wherever necessary. [8][CO3][BTL3]

(Given: No. of objects: 5, No. of clusters: 2 and data points x,y for each object in the below table).

x	3	33	17	20	9
y	21	29	9	6	17

- Q.4 The table given below shows parameters A1, A2 and A3 based on which classification may be done. Using this information, generate the decision tree. Comment on the status of overfitting in the tree and its resolution. [8][CO2][BTL3]

A1	Y	N	Y	N	Y	N	Y	N
A2	Y	Y	N	N	Y	Y	N	N
A3	Y	Y	Y	Y	N	N	N	N
Class	C1	C2	C2	C1	C1	C2	C2	C1

- Q.5 a) What is the significance of Precision and Recall measures? Explain in detail using an example. [3][CO4][BTL4]
 b) With the help of an example, explain how principal component analysis utilises eigen vector and eigen value. [5][CO1][BTL1]

7. A discrete time system is described by state equation (2×4)
- $$y(k+2) + 5y(k+1) + 6y(k) = u(k)$$
- $$y(0) = y(1) = 0; T = 1 \text{ sec.}$$

- Determine the state model in phase variable form
- Find state transition matrix
- Determine the state model in canonical variable form
- For input $u(k)=1$ for $k \geq 0$, find output $y(k)$. [CO4] [BTL6]

Total No. of Pages 04

Roll No.

FIRST SEMESTER

M.Tech.(C&I)

END SEMESTER EXAMINATION November 2024

C&I 501 System Theory

Time: 3:00 Hours

Max. Marks :40

Note: Attempt any five questions. All questions carry equal marks. Assume suitable missing data, if any.

- 1 [a] Obtain the state space (State Model) representation for the mechanical system shown in figure 1. [CO1] [BTL5]

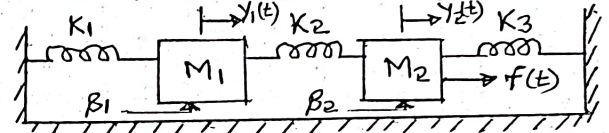


Fig. 1

- 1 [b] For the system shown in figure 2, choose $v_1(t)$ and $v_2(t)$ as state variables. Derive the state model of the system. [CO1] [BTL5]

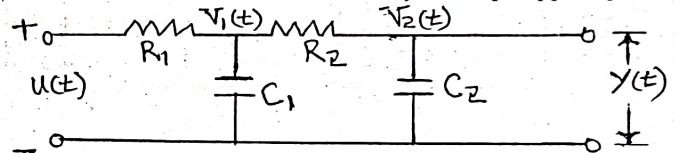


Fig. 2

- 2 [a] Find the inverse z-transform of the following function

[CO2] [BTL3]

$$F(z) = \frac{-10(11z^2 - 15z + 6)}{(z^3 - 4z^2 + 5z - 2)}$$

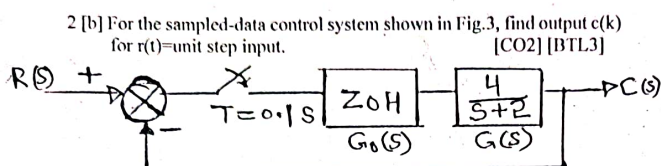


Fig.3

3 [a] For a system represented by the state equation $\dot{X}(t)=AX(t)$ [CO3] [BTL4]

the response of

$$X(t) = \begin{bmatrix} e^{-2t} \\ -2e^{-2t} \end{bmatrix} \text{ when } X(0) = \begin{bmatrix} 1 \\ -2 \end{bmatrix}$$

And

$$X(t) = \begin{bmatrix} e^{-t} \\ -e^{-t} \end{bmatrix} \text{ when } X(0) = \begin{bmatrix} 1 \\ -1 \end{bmatrix}$$

Determine the system matrix A and state transition matrix.

3[b] A system is described by the following differential equation. Represent the system in phase variable form:

$$\frac{d^3 y(t)}{dt^3} + 6 \frac{d^2 y(t)}{dt^2} + 11 \frac{dy(t)}{dt} + 6y(t) = u(t)$$

Give the block diagram representation of the state model. [CO3] [BTL4]

4 [a] Obtain the pulse transfer function $H(z)$ for the system. [CO2] [BTL6]

$$H(s) = \frac{s}{s(s+3)}$$

4 [b] Find the eigenvalues and eigenvectors. Find the model Matrix. Also find diagonalization matrix of canonical variable form. [CO1] [BTL6]

$$A = \begin{bmatrix} 0 & 1 & -1 \\ -6 & -11 & 6 \\ -6 & -11 & 5 \end{bmatrix}$$

5 [a] Determine the stability of the following characteristic equation using Bilinear Transformation.

$$5Z^2 - 2Z + 2 = 0$$

[CO2] [BTL2]

5[b] Check the stability of the following characteristic equation using Jury's stability test.

[CO2] [BTL2]

$$Z^3 - 0.22Z^2 - 0.25Z + 0.05 = 0$$

6 [a] Consider the dynamics of a non-homogeneous system as

$$\begin{bmatrix} \dot{x}_1(t) \\ \dot{x}_2(t) \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -6 & -5 \end{bmatrix} \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t)$$

where $u(t)$ is the unit step function occurring at $t=0$.

$$y(t) = \begin{bmatrix} 1 & 0 \end{bmatrix} X(t)$$

and the initial condition $X(0) = \begin{bmatrix} 1 & 0 \end{bmatrix}^T$
Determine the solution of state equation.

[CO3] [BTL5]

6 [b] Obtain the STM of the following system using Z transformation approach.

$$\begin{bmatrix} x_1(k+1) \\ x_2(k+1) \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1(k) \\ x_2(k) \end{bmatrix}$$

[CO4] [BTL1]

Total No. of Pages 02

Roll No.

M.Tech (C&I)

FIRST SEMESTER

End Term Examination

(Nov.-2024)

C&I 505 NON-LINEAR CONTROL THEORY

Time: 03 Hours,

Maximum Marks : 40

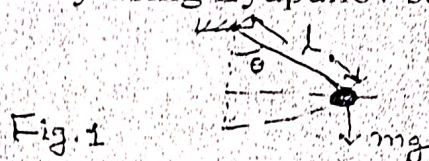
Note : **Question No. 1 is compulsory. Answer Any Four**
questions from remaining.
Write your name and roll number on question paper and
answer sheet.
Assume suitable missing data, if any.

- [1](i) Examine the stability of equilibrium point of the following system using Lyapunov stability theory

$$\dot{x} = -x^3 \quad 2$$

Assume a Lyapunov function $V(x) = \frac{1}{2}x^2$

- (ii) Derive the Energy function of the pendulum system shown in Fig.1 and examine its stability using Lyapunov stability theory. 2



- (iii) Examine the positive definiteness of P matrix for the following quadratic scalar function

$$V(x) = 10x_1^2 + 4x_2^2 + x_3^2 + 2x_1x_2 - 2x_2x_3 - 4x_1x_3$$

- (iv) Write six common behaviors of nonlinear systems. 2

- [2] Use Variable gradient method to construct a Lyapunov function for the system described as:

$$\dot{x}_1 = x_2$$

$$\dot{x}_2 = -x_2 - x_1^3$$

Show that the origin is a globally stable equilibrium state of this system

[3]

Consider the nonlinear second order system described as:

$$\ddot{y} - \left(0.1 - \frac{10}{3}\dot{y}^2\right)\dot{y} + y + y^2 = 0$$

- (i) - Write state space representation of this system and find all singular points.
- (ii) Compute the Jacobian matrix at each singular point and classify the singular point and examine their stabilities.
- (iii) Sketch the phase portrait about the singular point in phase plane.

8

[4] Consider the block diagram of a system shown in Fig. 2

[i] Derive state variable model with $x_1 = e$ and $x_2 = de/dt$.

[ii] Write equation of Isoclines on the x_1, x_2 plane.

[iii] Given $x_1(0) = 1, x_2(0) = 0$; obtain phase plane trajectory in different regions of operations of system and comment on the stability of the system.

8

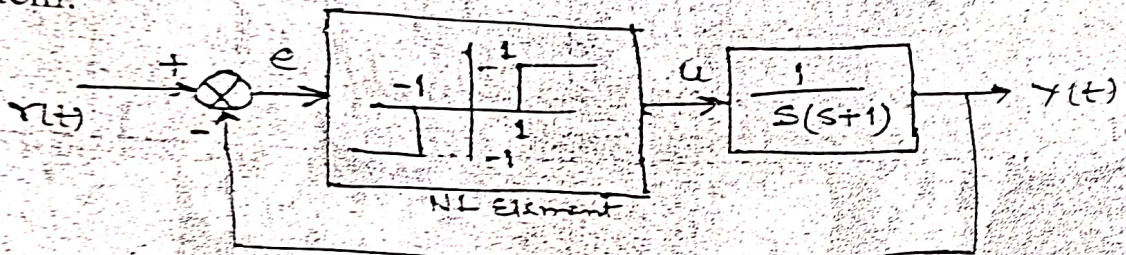


Fig. 2

[5] For the Nonlinear system shown in Fig. 3, check if a limit cycle is Predicted. If limit cycle exists assess its stability and determine its amplitude and frequency. Also, derive the describing function for the nonlinear element.

8

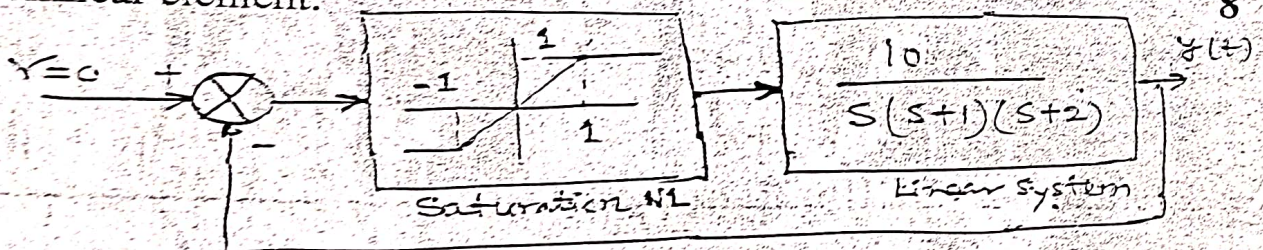


Fig. 3.

[6] Consider the following nonlinear system

$$\dot{x}_1 = -x_2$$

$$\dot{x}_2 = x_1 + (x_1^2 - 1)x_2$$

(i) Compute the Jacobian matrix of the system at equilibrium point i.e. origin and determine eigenvalues.

(ii) Write a quadratic Lyapunov function for the system and show that the origin is asymptotically stable.

8

Total no. of Pages: 2

Roll no.....

1st SEMESTER

M.Tech

END TERM EXAMINATION

Nov-2024

COURSE CODE C&I 507

COURSE TITLE Analog and Digital Electronics

Time: 03:00 Hours

Max. Marks: 40

Note : Attempt any Five questions.
All questions carry equal marks.
Assume suitable missing data, if any.

- Q.1 (a) For the circuit shown in Fig.1, determine:
 $R_m = \frac{V_m}{I_m}$, $A_v = \frac{V_o}{V_m}$ and $A_i = \frac{I_o}{I_i}$. Assume ideal Op-amp.

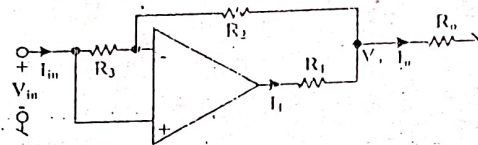


Fig. 1

[3][CO1][BTL4]

- (b) Sketch a neat circuit of all-pass phase lag circuit and hence describe the magnitude $\{M(\omega)\}$ and phase $\{\phi(\omega)\}$ responses.
[5][CO1][BTL1]
- Q.2 (a) Sketch a neat circuit of a single-resistance-controlled instrumentation amplifier using op-amps and hence derive an expression for the output voltage in terms of input voltages
[5][CO2][BTL1]
- (b) For the half wave precision rectifier shown in Fig. 2, explain the working principle of the circuit and hence sketch the waveforms at V_{o1} and V_{o2}

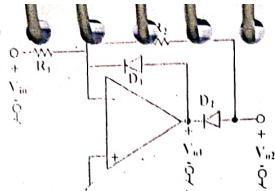


Fig. 2

[3][CO2][BTL5]

Q.3 (a) For the voltage-controlled current source shown in Fig.3:

- Determine an expression for the load current (I_L).
- Show that the requirement for linear operation is $|I_L| (R+2R_L) < V_{sat}$.

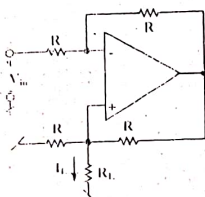


Fig. 3

[3][CO3][BTL3]

(b) For the circuit shown in Fig.4, if the comparator saturates initially at the voltage $V_o = +V_{sat}$, draw the waveforms of V_o and the voltage across the capacitor and hence derive an expression for the frequency of the generated waveforms. Assume ideal op-amp.

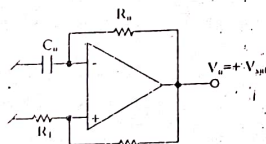
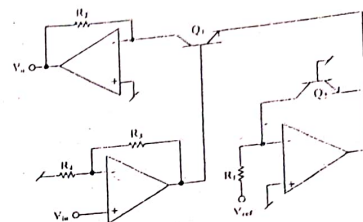


Fig. 4

[5][CO3][BTL3]

Q4. Give the application of log and anti-log amplifiers. function performed by the circuit of Fig.5. State the assumptions made.



[8][CO3][BTL2]

Fig. 5

Q5. (a) What is the problem with passive compensation? The Fig. 6 shows a compensated voltage follower, determine which error(s) has been compensated.

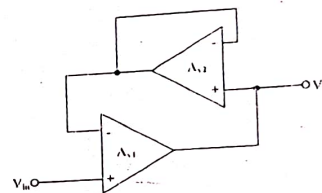


Fig. 6

[4][CO4][BTL2]

(b) Explain with neat circuit diagram how phase angle can be measured by using analog multiplier.

[4][CO4][BTL6]

Q.6 (a) Create a XOR gate using CMOS logic family.

[5][CO4][BTL6]

(b) Draw and explain the working of TTL NAND gate

[3][CO4][BTL1]

Q.7 (a) Design a full adder using a 3X8 decoder.

[4][CO4][BTL3]

(b) Convert a JK flip-flop to D flip-flop.

[4][CO4][BTL6]

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1st Semester

End-Term Examination

Roll No.

M.Tech. (C&I)

Nov. 2024

C&I-509 SCADA and EMS

Time: 3:00 Hours

Max. Marks: 40

Note: Attempt any five questions, all questions carry equal marks.
Assume suitable missing data, if any.

- Q1 (a) Identify the scan interval for a system that uses an UHF radio communication system with data rate of 2400bps, with 30 Remote Terminal Units being monitored by the MTU; given that: - (4) [CO1] {L3}
- i) The largest RTU has the following point count: -
 - Status Points - 100
 - Alarm Points - 60
 - Measurement Meters - 10
 - ii) MTU sends the following point counts to RTU: -
 - Discrete Control Points - 100
 - Valve Controller Set Points - 10
 - Motor Position Set Points - 05
- (b) A MTU instruct an RTU to open a valve up to 75%. Explain how the analogue control operation is performed by the RTU with the help of suitable diagrams (4) [CO1] {L2}
- Q2 (a) Each layer of the ISO-OSI model has specific functions and responsibilities. Analyse the use of the ISO-OSI model for data communication in a SCADA System. (4) [CO2] {L4}
- (b) With the help of suitable diagrams, explain the different transmission media used in a SCADA system. (4) [CO2] {L2}
- Q3 (a) Explain are the different types of data reporting employed in a SCADA System (4) [CO1] {L2}
- (b) The liquid level in a column gravity separator is observed to cycle with a five-minute period from one maximum level to the next. Evaluate the effectiveness of sampling the level of the liquid with (i) a five-minute scan rate and (ii) a one-minute scan rate. Also list the factors to be considered while selecting the scan interval for a SCADA system. (4) [CO3] {L5}

- Q4 (a) Identify the desired features that are incorporated at the operator consoles of an MTU to ensure its effectiveness. (4) [CO3] {L3}
- (b) Explain how RTU does discrete control (closing of a valve) through IEEE.C37 message format (4) [CO3] {L3}
- Q5 (a) Give a suitable interpretation for the terms availability, failure rate, MTBF and MTTR in a typical SCADA System. Illustrate the redundant dual processor configuration. (4) [CO4] {L2}
- (b) Elucidate the Modbus field protocol usually used in SCADA Systems. (4) [CO4] {L3}
- Q6 (a) Identify and explain the important energy management functions performed by a SCADA system. (4) [CO5] {L3}
- (b) "Energy conserved is energy Produced". Justify this statement and elaborate the various methods adopted for energy conservation (4) [CO5] {L5}
- Q7 (a) Describe the pre-dispatch, dispatch and post-dispatch activities in the Centralised Control Centre of SCADA based power system. (4) [CO5] {L3}
- (b) 40W tube-lights (280 Nos.) installed in various parts of an organization working 8 hours a day and 340 days in a year are to be replaced by energy efficient LED lights (28W). The cost of each 40W tube-light is ₹120 and each 28W LED light is ₹450. The cost per unit of electricity is ₹5. Ballast loss in 28W tube lights can be neglected and assuming a 20% power loss in the ballast of 40W tube lights, Estimate: -
- The annual savings in the electricity bill
 - The total cost of replacement
 - The payback period.

Total no. of Pages:03

Roll no.....

I SEMESTER

M.Tech. (CaI/PSY)/Ph.D

END TERM EXAMINATION

Nov-2024

C&I5313/PSY6315: Soft Computing Techniques

Time: 03:00 Hours

Max. Marks: 50

Note : Answer any five questions. All questions carry equal marks.
Assume suitable missing data, if any.

- Q.1 (a) Differentiate between the following: [5][CO1][BTL2]
(i) Supervised and Unsupervised Learning
(ii) Incremental and Batch Mode of Training
(b) Describe the role of a self-organizing map as a dimensionality reduction technique. [5][CO2][BTL2]

- Q.2 (a) Draw the architecture of a perceptron neuron. Also draw linear, log-sigmoid and tan-sigmoid transfer functions. [2+3][CO1][BTL4]

(b) Fig. 1 shows the schematic view of an NN consisting of three layers, such as input, hidden and output layers. The neurons lying on the input, hidden and output layers have the transfer functions represented by $y = x$, $y = \frac{1}{1+e^{-x}}$, $y = x$, respectively. There are two inputs, namely I_1 and I_2 and one output, that is, O . The connecting weights between the input and hidden layers are represented by $[V]$ and those between the hidden and output layers are denoted by $[W]$. The initial values of the weights are assumed to be as follows:

$$\begin{bmatrix} v_{11} & v_{12} & v_{13} \\ v_{21} & v_{22} & v_{23} \end{bmatrix} = \begin{bmatrix} 0.2 & 0.4 & 0.3 \\ 0.1 & 0.6 & 0.5 \end{bmatrix} \text{ and } \begin{bmatrix} w_{11} \\ w_{21} \\ w_{31} \end{bmatrix} = \begin{bmatrix} 0.1 \\ 0.2 \\ 0.1 \end{bmatrix}$$

Using an incremental mode of training for $I_1 = 0.5$, $I_2 = -0.4$ and $T_0 = 0.15$, calculate ΔV and ΔW values during back-propagation of error. The learning rate η is assumed to be equal to 0.2. Show only one iteration. [5][CO2][BTL3]

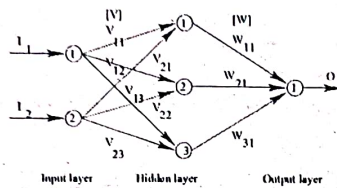


Fig. 1

Q.3 (a) Why do we prefer ranking selection to a Roulette-Wheel selection in Genetic Algorithm. [5][CO3][BTL5]

(b) Use a binary-coded GA to minimize the function

$$f(x_1, x_2) = x_1 + x_2 - 2x_1^2 - x_2^2 + x_1x_2$$

in the range of $0.0 \leq x_1, x_2 \leq 5.0$. Use a random population of size $N=6$, tournament selection, a single-point crossover with probability $p_c = 1.0$ and neglect mutation.

Assume 3 bits for each variable and thus, the GA-string will be 6-bits long. Show only one iteration by hand calculations. [5][CO3][BTL3]

Q.4 (a) How SVM can be used for linear and non-linear classification of data? [5][CO4][BTL5]

(b) Draw the architecture of LSTM cell. Explain the working of various gates in LSTM cell. [5][CO4][BTL4]

Q.5 (a) Define the following terms related to a Fuzzy Set:

(i) Normality, (ii) Height, (iii) Support, (iv) Core, and (v) Cardinality [5][CO5][BTL1]

(b) Let R : If 'job is risky' Then 'compensation is high' be a fuzzy rule. There are four jobs job_1, job_2, job_3 and job_4 , constituting the universe $job = \{job_1, job_2, job_3, job_4\}$. Also, there are four categories of compensation c_1, c_2, c_3 and c_4 in ascending order. Hence the universe for compensations is $compensation = \{c_1, c_2, c_3,$

$c_4\}$. The fuzzy sets risky-job and high-compensation over the universes job and compensation respectively as given below.

$$risky - job = \frac{0.3}{job_1} + \frac{0.8}{job_2} + \frac{0.7}{job_3} + \frac{0.9}{job_4}$$

$$high - compensation = \frac{0.2}{c_1} + \frac{0.4}{c_2} + \frac{0.6}{c_3} + \frac{0.8}{c_4}$$

Express the rule R : If 'job is risky' Then 'compensation is high' as a fuzzy relation using Zadeh's interpretation. [5][CO5][BTL3]

Q.6 Write short notes on ANY TWO of the following.

(a) Elman Network [5][CO2][BTL2]

(b) Crossover operator and its classification [5][CO3][BTL2]

(c) Fuzzy Controller [5][CO5][BTL2]

Total No. of Pages:3
THIRD SEMESTER

Roll No.....
M. Tech.

END SEMESTER EXAMINATION

November-2024

CSE-6205 ADVANCES IN INTERNET AND WEB TECHNOLOGY

Time: 3:00 Hours

Max. Marks: 50

Note: Attempt any five (5) questions. Assume suitable missing data, if any.

Q1. Answer the following questions:

- a. Why is protocol layering essential for Internet architecture? Provide an example. [2] [CO-1] [BLT 2]
- b. How does HTTPS ensure secure communication? Describe the encryption mechanism involved. [2] [CO-2] [BLT 2]
- c. Explain the concept of asynchronous JavaScript (AJAX) and its impact on web interactivity. [2] [CO-3] [BLT 2]
- d. Describe how social media analytics differs from traditional web analytics. [2] [CO-5] [BLT 4]
- e. What is collaborative filtering, and how is it applied in recommender systems? [2] [CO-4] [BLT 3]

Q2. a. Discuss the principles of server-side scripting and explain its purpose in web development, particularly for generating dynamic content. Using PHP as an example, describe how server-side scripts interact with databases, manage HTTP requests, and produce HTML output that is sent to the client browser. Include a sample PHP code snippet to illustrate a common use case, such as processing form data or retrieving database records. [5] [CO-3,5] [BLT 4]

b. Describe the MVC architecture and its benefits in web application design. Explain the roles in the MVC pattern, providing examples of how it facilitates maintainable and scalable web applications.

[5] [CO-2,5] [BLT 4]

Q3. a. Explain the significance of client-side technologies HTML, CSS, and JavaScript in contemporary web development. [5] [CO-3,5] [BLT 2]

b. Explain the purpose of the Document Object Model (DOM) in client-side development. Describe how the DOM enables dynamic content manipulation and interaction within a web page. [5] [CO-4,5] [BLT 2]

Q4. An e-commerce website wants to enhance its user experience by adopting a personalized recommendation system. The platform already uses basic client-side and server-side technologies to handle transactions and manage content but lacks advanced data analytics capabilities. The goal is to use contextual information retrieval, social media analytics, and sentiment analysis to understand user preferences better and deliver targeted product recommendations. [CO-3,5] [BLT 4,5]

i. Describe how contextual information retrieval can improve personalized recommendations for e-commerce users. [4]

ii. Explain how social media analytics and sentiment analysis could be integrated into the recommendation system to enhance its accuracy. [4]

iii. Identify the challenges the e-commerce website may face in implementing these technologies and suggest solutions. [2]

Q5. a. Define Web IR, discuss its role in organizing and retrieving web data, and provide examples of how search engines and other Web IR tools support information access. [3] [CO-4] [BLT 2]

b. What are cookies, and how do they help with state retention in HTTP? [3] [CO-3] [BLT 2]

c. Describe how HTTP caching works, including cache control and validation mechanisms, and explain how it improves loading speed and reduces server load. [4] [CO-4] [BLT 4]

Q6. A healthcare provider is developing a portal for patients to access medical records, consult doctors, and book appointments. Given the sensitivity of medical data, the provider plans to implement HTTPS, token-based authentication, and secure data storage solutions to protect against cyber threats. [CO-2,5] [BLT 4,5]

i. Explain why HTTPS alone may not be sufficient to protect sensitive patient information. [4]

ii. Describe the benefits of using token-based authentication in a healthcare portal. [4]

iii. Give two additional methods to enhance the security of the portal and protect patient privacy. [2]

Q7. Write a short note on (Any Five):

i. HTTP Cache and Cache Consistency [2] [CO-1] [BLT 1]

ii. Persistent HTTP [2] [CO-1] [BLT 1]

iii. the role of CSS in enhancing web design [2] [CO-2] [BLT 2]

iv. Remote Login [2] [CO-4] [BLT 1]

v. File Transfer Protocol (FTP) [2] [CO-1] [BLT 1]

vi. Usenet and its significance in real-time communication [2] [CO-1,5] [BLT 1,4]

Total No. of Pages 2

Roll No.

M.Tech III SEMESTER(C&I)**END SEMESTER EXAMINATION (NOV-2024)****C&I-6309 ADVANCED CONTROL SYSTEM DESIGN****Time: 3:00Hours****Maximum Marks :50**

Note : Answer any FIVE questions.
Assume suitable missing data, if any.

- 1(a) Discuss a more general approach to determine the observer feedback gain matrix K for full order state observer design. [CO1](5)
- (b) The Dynamics of the system is [CO1](5)

$\dot{X}=AX+BU$ and output is $Y=CX$

Where $A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix}$ $B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$

$C = [1 \ 0 \ 0]$

By using state feedback control $u = -KX$, it is desired to have the closed loop poles at $s = -2 \pm j2\sqrt{3}$ and $s = -10$. Determine the state feedback gain matrix K.

- 2 The approximate difference equation representation for a continuous operating system is $x(k+1)=x(k)+u(k)$; $k=0,1$ where $u(0)$ and $u(1)$ are to be selected to minimize the performance measure $J=x^2(2)+2u^2(0)+2u^2(1)$ subjected to constraints $0.0 \leq x(k) \leq 1.5$; $k=0,1,2$ and $-1.0 \leq u(k) \leq 1.0$; $k=0,1$ [CO3](10)

Quantize the state values in to the step of 0.5 and control input values in to the step of 0.25. Find the optimal control values and minimum cost for each point on the state grid.

- 3(a) Prove that in dead beat control, any non zero error vector will be driven to origin in at most n sampling period if magnitude of scalar control $u(k)$ is unbounded [CO1](5)

- (b) Consider the system defined by

[CO2](5)

$$x(k+1) = \begin{bmatrix} 0 & 2 \\ -0.2 & -3 \end{bmatrix} x(k) + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(k)$$

$$y(k) = [1 \ 0] x(k) \text{ and } u(k) = K_0 r(k) - Kx(k)$$

Design a state feedback control system with reference input such that desired characteristic equation are at $z=0.2 \pm j0.2$

- 4(a) Derive the expression for feedback gains of a sliding mode controller so that the closed loop system is stable to the sliding surface [CO4](5)

- (b) What is sliding surface? What are its characteristics? Explain the design of sliding surface in sliding mode control technique. [CO4](5)

- 5(a) By considering linear quadratic regulator problem derive expression for Algebraic Riccati Equation. [CO2](5)

- (b) For a linear regulator problem find optimal control input $u^*(t)$ to maintain the state vector close to the origin without an excessive expenditure of control effort. [CO2](5)

- 6(a) Consider the following model of dynamical system [CO3](5)

$$\dot{X} = \begin{bmatrix} 0 & 1 \\ -10 & 0 \end{bmatrix} X + \begin{bmatrix} 0 \\ 10 \end{bmatrix} U, \text{ which is to be controlled to minimize the performance index } J = \frac{1}{2} \int_0^2 u^2 dt, \text{ Given } x_1(0) = x_2(0) = 1 \text{ and } x_1(2) = x_2(2) = 0. \text{ Find optimal control input } u^* \text{ using Hamiltonian equation.}$$

- (b) Find the trajectories in the (t, x) plane which will extremize the functional [CO3](5)

$$J(x) = \int_0^1 (t \dot{x} + \dot{x}^2) dt, \text{ the boundary conditions are } x(0)=1 \text{ and } x(1)=\text{free}$$

- 7 Find the curve with minimum arc length between the point $X(0) = 0$ and the curve $\theta(t) = t^2 - 10t + 24$. Also derive the formula used [CO2](5+5)

Total No. of Page – 2

3rd Semester

End-Term Examination

Roll No.

M.Tech. (C&I)

Nov. 2024

C&I-6401 SCADA and EMS

Time: 3:00 Hours

Max. Marks: 40

Note: Attempt any five questions, all questions carry equal marks.
Assume suitable missing data, if any.

- Q1 (a) Consider a water metering system used in irrigated farms to keep track of the amount of water diverted from the water tank to the field. It takes 2 minutes to fill the tank and 4 minutes to drain the tank. Status switches on the drain valve are monitored by the SCADA system. When the drain valve is closed, the refill valve is open and vice-versa. If a scan interval of one minute is used, identify where (MTU / RTU) the computations should be performed, to ensure fail-safe operations. (4) [CO1]
{L3}
- (b) A MTU instruct an RTU to open a valve. Explain how this digital control operation is performed by the RTU with the help of suitable diagrams (4) [CO1]
{L2}
- Q2 (a) Compare the distinguishing features of twisted copper pair communication and optical fibre cable communication. (4) [CO2]
{L4}
- (b) If a transmission channel has a bandwidth of 1 MHz and signal to noise ratio (SNR) of 63, determine the optimum bitrate and signal level for this channel. (4) [CO2]
{L5}
- Q3 (a) Is SCADA a real time system? Justify your answer. Elaborate the important features of a real time system (4) [CO1]
{L6}
- (b) Analyse, whether the response time in the following cases is adequate to make it a real time system: - (4) [CO3]
{L4}
- i) Customer billing for gas through a meter is issued once per month
 - ii) Two meters measuring gas into and out of the pipe line are scanned every ten minutes. An alarm is generated if the sum of the last four inlet measurements exceeds the sum of the last four outlet measurement

- Q4 (a) Explain the concept of configuring a process picture at MTU using the example of an oil pipeline under the control of a SCADA system. (4) [CO3] {L2}
- (b) Making use of three RTUs along with associated field devices, for monitoring and control of the above oil pipeline system, build a model where the MTU can detect an oil leakage. (4) [CO3] {L3}
- Q5 (a) Elucidate the Profibus field protocol usually used in SCADA Systems. (4) [CO4] {L2}
- (b) Give a suitable interpretation of the terms availability, Failure Rate, MTBF and MTTR in a typical SCADA System. Illustrate the Redundant Dual processor configuration. (4) [CO4] {L2}
- Q6 (a) Energy audit of any organization provides an insight into the possibilities of optimal utilization of energy. Identify the objectives that should be laid down for such energy audits. (4) [CO5] {L3}
- (b) Model the various hierarchical levels of Production Control along with their objectives. (4) [CO5] {L3}
- Q7 (a) Identify the desired features of Alarms and Reports, in a typical operator interface, to make the presentation of information most effective. (4) [CO3] {L3}
- (b) Develop a checklist that can be used to verify the best technological practices adopted for Energy Conservation by any institution. (4) [CO5] {L3}

Total No. of Pages 03

Roll No.

FIRST SEMESTER
M.Tech. (DSC)

END TERM EXAMINATION

November-2024

DSC501 MATHEMATICAL FOUNDATIONS OF COMPUTER
SCIENCE

Time: 3:00 Hours

Max. Marks: 40

Note: Answer any 05 questions. All questions carry equal marks.
Assume suitable missing data, if any.

- Q1 [a] Alice searches for her term paper in her filing cabinet, which has several drawers. She knows that she left her term paper in a drawer j with probability $p_j > 0$. The drawers are so messy that even if she correctly guesses that the term paper is in the drawer i , the probability that she finds it is only d_i . Alice searches in a particular drawer, say drawer i , but the search is unsuccessful. Conditioned on this event, show that the probability that her paper is in the drawer j , is given by

$$\begin{cases} \frac{p_j}{1 - p_i d_i} & \text{if } j \neq i, \\ \frac{p_i(1 - d_i)}{1 - p_i d_i} & \text{if } j = i \end{cases}$$

[4][co1] [L3]

- [b] Distinguish between Covariance and Correlation (with formulas).
Explain the different methods for studying correlation.

[4] [co4] [L6]

- Q2 [a] What is isomorphism in Graph theory? Explain the different types of Graphs.

[4] [co5] [L5]

- [b] A die is thrown 132 times with following results:

Number Turned up	1	2	3	4	5	6
Frequency	16	20	25	14	29	28

Is the die unbiased? Use the Chi-square (χ^2) test for this purpose.

[4] [co1, co2] [L4]

- Q3 [a] An internet service provider uses 50 modems to serve the needs of 1000 customers. It is estimated that at a given time, each customer will need a connection with a probability 0.01, independent of the other customers.

- What is the probability mass function (PMF) of the number of modems in use at the given time?
- Repeat part (i) by approximating the PMF of the number of customers that need a connection with a Poisson PMF.

[4] [co2, co3] [L3]

- [b] What do you mean by Systematic and stratified sampling? Explain the method of selection of samples in Stratified random sampling.

[4] [co3] [L5]

- Q4 [a] Assume SAT scores are normally distributed with mean 1518 and standard deviation 325.

- If 16 SAT scores are randomly selected, find the probability that they have a mean between 1440 and 1480.
- Why can the central limit theorem be used in part (i) even though the sample size does not exceed 30?

[4] [co3] [L4, L3]

- [b] What is the difference between Bernoulli and Binomial distribution? Explain the formulas and limitations also.

[4] [co2, co3] [L6]

- Q5 [a] Calculate the Karl Pearson Coefficient of correlation for the following data.

X	4	7	11	14	19	15
Y	18	16	17	19	19	21

[4] [co4] [L2]

- [b] Define the following:

- Multivariate analysis techniques
- Overfitting and Underfitting

[4] [co5] [L5]

- Q6 [a] A six-sided die is loaded in a way that each even face is twice as likely as each odd face. All even faces are equally likely, as are all odd faces. Construct a probabilistic model for a single roll of this die and find the probability that the outcome is less than 4.

[4] [co1] [L2, L3]

- [b] Calculate the first four moments about the mean from the following frequency distribution. Also, calculate the Moment Ratios β_1 and β_2 .

x	0	1	2	3	4	5	6	7	8
f	1	8	28	56	70	56	28	8	1

[4] [co3] [L2]

Total No. Of Pages 2
FIRST SEMESTER
END SEMESTER EXAMINATION

Roll no.....
M.TECH (DSC)
Nov 2024

DSC505 DATA MANAGEMENT AND ETHICS

Time: 3 hours

Max. Marks: 40

Note: Attempt any four questions. Assume suitable missing data, if any.

Q.1 (a) Describe what do you mean by ER diagram. Identify steps to convert ER diagram to Database relational schema with help of example.

(b) Define three schema architecture and Data independence of database by taking suitable example.

[5*2=10][CO1][BTL1,BLT2]

Q.2 (a) Illustrate normalization? Determine 1NF,2NF,3NF, BCNF with examples. Apply and find the highest form for the relation R (A, B, C, D, E, F) for FD's { $AB \rightarrow C$, $C \rightarrow DE$, $E \rightarrow F$, $F \rightarrow B$ }.

(b) Examine Lossless join decomposition and Dependency preserving decomposition. Consider relational schema R (A, B, C, D, E) and FD's { $AB \rightarrow C$, $AC \rightarrow B$, $AD \rightarrow E$, $B \rightarrow D$, $BC \rightarrow A$, $E \rightarrow F$ }. Check R1(ABC), R2(ABDE), R3(EF) relation for Lossless and Dependency preservation.decomposition.

[5*2=10][CO3][BTL3]

Q.3 (a) Analyse the following schema for institute library: Student (RollNo, Name, Father_Name, Branch) Book (ISBN, Title, Author, Publisher) Issue (RollNo, ISBN, Date-of-Issue)

Write the following queries in SQL:

I. List roll number and name of all students of the branch 'CSE'.
II. Find the name of student who has issued a book published by 'ABC' publisher.

III. List title of all books and their authors issued to a student 'RAM'.

IV. List title of all books issued on or before December 1, 2020.

V. List all books published by publisher 'ABC'.

Q.4 (a) Consider schedules S1, S2, and S3 below. Decide whether each schedule is strict, cascade less, recoverable, or non-recoverable. (Evaluate the strictest recoverability condition that each schedule satisfies.)

S1: r1 (X); r2 (Z); r1 (Z); r3 (X); r3 (Y); w1 (X); c1; w3 (Y); c3; r2 (Y); w2 (Z); w2 (Y); c2;

S2: r1 (X); r2 (Z); r1 (Z); r3 (X); r3 (Y); w1 (X); w3 (Y); r2 (Y); w2 (Z); w2 (Y); c1; c2; c3;

S3: r1 (X); r2 (Z); r3 (X); r1 (Z); r2 (Y); r3 (Y); w1 (X); c1; w2 (Z); w3 (Y); w2 (Y); c3; c2;

(b) Summarise the timestamp ordering protocol for concurrency control. Conclude how does strict timestamp ordering differ from basic timestamp ordering?
 [5*2=10][CO4][BTL5]

Q.5 Read the following case study:

A university was found to have shared student data with third-party companies for marketing purposes without explicit consent. The data included academic records, email addresses, and demographic information. While the university claimed it was for "improving student services," many students felt their privacy was violated.

Based on the above case study, answer the following questions:

- (i) Derive whether the ethical standards in data handling were upheld or breached in this scenario. What are your reasons for this assessment?
- (ii) Formulate what were the potential outcomes for the university and the students involved? Consider legal, reputational, and ethical consequences.
- (iii) Generate how adhering to Academic Data Standards could have prevented this situation. What guidelines should have been followed?
- (iv) Design your recommendations for ethical data management practices to avoid such breaches in the future.

[2.5*4=10][CO5][BTL6]

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Total no. of Pages: 02

Roll no.

THIRD SEMESTER

M.Tech. (SWE + DSC)

END TERM EXAMINATION

Nov-2024

DSC6307, SWE6307: SOFTWARE QUALITY & METRICS

Time: 03:00 Hours

Max. Marks: 50

Note: All questions carry equal marks.
Assume suitable missing data, if any.

- Q.1 a) Describe the software metrics for analysis and design models. [5][CO6][BTL1]
b) What are empirical investigation techniques used in data collection and analysis. [5][CO1][BTL2]
- Q.2 a) Explain scope of software metrics and discuss them for maintenance goal. [5][CO5][BTL2]
b) Explain statistical methods for software metric estimation and evaluation. [5][CO2][BTL2]
- Q.3 a) How will you design your software metrics to verify the completeness and correctness of Software Requirement Specification (SRS) document? Illustrate with the help of an example. [5][CO1][BTL6]
b) What is the need for software metrics. [5][CO2][BTL3]
- Q.4 a) A software system consists of four independent components in series with reliabilities of 0.92, 0.97, 0.95, and 0.96. Calculate the overall system reliability. [4][CO5][BTL3, BTL5]
b) A program has 40 unique operators and 50 unique operands. The total occurrences of operators in the program are 250, and the total occurrences of operands are 300. Calculate the value of all the measures used in Halstead metrics. [6][CO4][BTL3, BTL5]

associated velocity and rate of discharge at this depth with the help of following data:

Proportionate area = 0.373

Proportionate wetted perimeter = 0.444

Proportionate HRD = 0.875

OR

- (b) Design the diameter and discharge of a circular sewer at a slope of 1 in 500 when it is running half full and with a velocity of 1.9 m/s. used Manning's formula and $n = 0.012$. [6][CO4][L6]

Q.4 (a) Design the screen for a sewage treatment plant treating a peak flow of 70 million litres per day of sewage. [4][CO3][L3]

- (b) Explain any one of the following terms: -

(i) Plug flow reactor.

(ii) Characteristics of industrial effluents.

[4][CO5][L2]

Q.5 (a) Evaluate the mechanism behind the functioning of a Batch reactor.

[4][CO5][L5]

- (b) What do you understand by waste water recycling and zero liquid discharge.

[4][CO4][L2]

Total No. of Page 2

Roll No.

FIRST SEMESTER**M.Tech.****END TERM EXAMINATION****Nov-2024****ENE – 505 AIR POLLUTION & CONTROL***Time: 3:00 Hours**Max. Marks: 40***Note: Attempt any four questions.****Assume suitable missing data, if any.**

1. Develop an air pollution-related health survey proforma for people living in close proximity to major transport corridors in Delhi. Also, analyse the effectiveness of the action taken by CAQMS to address the problem of air pollution along with the boundaries of action. [M 10] [CO#1,5] [BTL#4, 6]
2. (a) A certain jet flying overhead a residential area at a height of 100m has a SPL of 120 dB. Find the total SPL of eight such jets flying overhead at that height. [M 10] [CO#3] [BTL#3]
(b) The sound level specification is 80 dB for uniform traffic flow at 20 meters away. If the residential area is located 90 meters away from the road, then calculate SPL at the residence. [M 10] [CO#3] [BTL#3]
3. Minimum, how many pollutants are generally required to calculate overall AQI, and discuss the different methods to calculate AQI along

with the name of that country which follows banding based AQI rating scale, also mention different banding scales and associated health effects. [M 10] [CO#1] [BTL#2]

4. Describe the process for the constitution and function of the Air pollution control board along with the significance of sections 19.1, 24.5, and 26 under the Air Act. [M 10] [CO#1] [BTL#1]
5. Nitrogen dioxide (NO_2) is emitted at 110 g/s from a stack with a physical height of 80 m. The wind speed at 80 m is 5 m/sec on an overcast morning. Plume rise is 20 m, then (i) calculate the ground level centerline concentration 2 km downwind from the stack and (ii) calculate the concentration at 100 m off the centerline at the same distance. [M 10] [CO#4] [BTL#4]
6. Write short notes on the following:
(a) GRAP
(b) NCAP

[M 10] [CO#1] [BTL#2]

Page one

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RSK-783

M.Tech Environmental Engineering

ENE 307 Environmental Impact Assessment

END Semester Examination, 2024

Nov, 2024

Duration: 3 Hours

Max. Marks 50

Attempt any five questions; all carry equal marks

1. Write brief notes on:

(a.) LCA ; (b) ISO and EMP; (c) CSR ; (d) TOR (CO1K1)

2.(a) What are the major differences between EIA notification of 2006 and 3030 ? (CO3 K1)

(b) Why risk assessment is needed in all EIA- give one example (CO2K2)

3. Elaborate the Environmental Audit process using any coal based power plant as an example. (CO5K2)

4. (a) What are various steps in any EIA report preparation? (CO2K2)

(b) Comment on Mitigation and Monitoring for a typical mobile manufacturing plant (CO4K4)

5. What are various compliance required to obtain environmental clearance

Use paper manufacturing plant as an example. (CO3K2)

6. Are BIA, HIA and SIA part of any EIA? Explain with examples (CO1K1)

7. Compare and contrast Adhoc method, matrix method and check list methods in data collection and interpretation. Use a metro project for this purpose. (CO2K2)

8. Why SEA is needed for any development project? Use the Nicobar island project to illustrate the need for SEA preceding any EIA (CO5K3)

FIRST SEMESTER

M.TECH. (ENE)

END SEMETER EXAMINATION

NOV. - 2024

ENE-509 ENVIRONMENTAL CHEMISTRY & MICROBIOLOGY

Time: 03 Hours

Max. Marks: 40

Note: Attempt any five questions. All the questions carry equal marks.
Assume suitable missing data if any.

- 1 a) Describe the concept and components of aquatic chemistry CO2 K2
b) Discuss the chemistry of CFCs and their role in catalytic destruction of ozone. CO3 K3
- 2 a) Enlist the environmental effects of detergents in an aquatic environment CO2 K2
b) What is the equilibrium concentration of fluoride ions (mg/l) in pure water caused by dissolution of CaF_2 . The K_{sp} of CaF_2 is 3×10^{-11} . CO4 K4
- 3 a) Derive the solution for removal of nitrogen from wastewater based on the regulation of pH. CO5 K5
b) Describe the key phases of microbial growth and dynamics. CO1 K1
- 4 a) What is the equilibrium concentration of oxygen in water (in mg/l) at 10°C at an altitude of 2000 metres? It is given that the value of K_H at 10°C is 0.0016963. CO4 K5
b) Acclimatisation of waste can result in enhanced rate of biodegradation. Explain with suitable examples CO3 K3
- 5 a) Determine the pH of natural water considering no dissolution of impurities owing to air pollution if atmospheric concentration of CO_2 is 410 ppm and K_H for CO_2 at 25°C is 0.033363. CO5 K5
b) 4. Briefly discuss the profile of dissolved oxygen of River Yamuna downstream of the point of wastewater discharge by Najafgarh drain. CO3 K4
- 6 Write short notes on CO1 K1
a) Eutrophication
b) Ozone Hole
- 7 a) What is green house effect? Define green house gases. What are the environmental consequences of global warming? Discuss CO3 K3
b) What are biofilters? Explain the working and environmental benefits of biofilters CO1 K2

**FIRST SEMESTER
END-TERM EXAMINATION**

**M.Tech.(Env.Engg.)
NOV- 2024**

ENE- 523 OCCUPATIONAL HEALTH & SAFETY

Duration: 3:00 Hrs.

Maximum Marks: 40

Note: All Questions carry equal marks. Attempt ANY FOUR questions. Assume suitable missing data, if any.		Marks	CO#	BTL#
Q 1. a	Define Occupational Health and Environmental Safety Management. What is its scope and nature?	5	CO#1	BTL#1
Q 1. b	List common occupational diseases. How do they impact workers' health and productivity?	5	CO#1	BTL#1
Q 2. a	Describe the key characteristics of physical, chemical, and ergonomic hazards in the workplace. How do these hazards affect workers' health and safety?	5	CO#2	BTL#2
Q 2. b	Explain the key principles and practices of Occupational Safety and Health. How do they contribute to a safe work environment?	5	CO#2	BTL#2
Q 3. a	Describe how an Occupational Safety & Health organization can implement a safety policy. What roles and responsibilities should be assigned in such an organization?	5	CO#3	BTL#3
Q 3. b	Explain the role of Occupational Health Management Services in preventing workplace health issues. How can these services be	5	CO#3	BTL#3

implemented effectively at the workplace?

Q 4. a Analyse the process of monitoring and reviewing safety management systems in the workplace. How do audits contribute to continuous improvement in occupational health and safety? 5 CO#4 BTL#4

Q 4. b Assess the different control measures used to mitigate mechanical, electrical, and biological hazards in the workplace. Which of these hazards requires the most attention, and why? 5 CO#4 BTL#4

Q 5. a Evaluate the effectiveness of ILO and EPA standards in promoting workplace safety. How do these standards compare with national safety regulations? 5 CO#5 BTL#5

Q 5. b Design a comprehensive safety program based on the principles of Process Safety Management (PSM) as per OSHA and the requirements of OHSAS 18001. How would you evaluate the effectiveness of this program in preventing workplace accidents and ensuring compliance with safety standards? 5 CO#5 BTL#6

END TERM EXAMINATION

Nov-2024

ENE5311 GLOBAL WARMING AND CLIMATE CHANGE

Time: 3:00 Hours

Max. Marks: 50

Note : Q. 1. is compulsory

Answer any 4 questions out of the rest.

Be brief in your explanations

Assume suitable missing data, if any.

- Q.1. (a) What does the surface albedo depend on? Explain with examples.
- (b) Briefly describe two processes that cause negative climate forcing?
- (c) Explain why a small change in the average summer temperature is likely to cause a large change in the frequency of extremely hot days.
- (d) If fossil fuel emissions were to completely stop, predict what would happen to the extra CO₂ in the atmosphere?
- (e) Since water vapor is a stronger absorber of IR photons than CO₂, justify why we aren't more concerned about water vapor emissions?

[2x5] [CO1][CO2][CO3]

- Q.2. (a) Categorize five emissions reduction projects which can be taken up by the Government/other entities to combat Climate Change. Briefly explain with examples.

- (b) Briefly explain Short Lived Climate Forcers and discuss how do they effect the climate?

[5x2] [CO2][CO3]

Total No. of Page 2

Roll No.

FIFTH SEMESTER
M.Tech. (Part-Time)

END TERM EXAMINATION**Nov-2024****ENE – 6301 AIR QUALITY MODELING***Time: 3:00 Hours**Max. Marks: 40***Note: Attempt any four questions.****Assume suitable missing data, if any.**

1. Describe the detailed procedure for assessing air quality impacts of transportation interventions. **[M 10] [CO#2] [BTL#2]**
2. What is your opinion about Delhi's ambient air quality in the current scenario? In which year the amended air quality came into the picture? Write the ambient air quality standards of CO, NO₂, SO₂, O₃, PM₁₀ and PM_{2.5} in Indian conditions. **[M 10] [CO#2] [BTL#1,2]**
3. Compare, analyze, and evaluate the different action plans taken by central and national agencies to curb the air pollution problem in Delhi and also suggest the possible intervening actions that can be incorporated into the current action plan to increase its effectiveness. **[M 10] [CO# 3] [BTL#4, 5]**
4. Describe plume behaviour in various atmospheric conditions with appropriate figures. **[M 10] [CO# 1, 2] [BTL# 2]**

5. Based on different air quality models, suggest a suitable air pollution model that can be used in the capital city to predict the concentration along with the inputs, fundamental equations, expected outcomes and limitations. [M 10] [CO# 3, 4] [BTL# 5]
6. Write short notes on the following (Any Two): [M 10] [CO#1] [BTL# 1,2]
- (a) Indoor air quality
 - (b) Low Emission Zones
 - (c) Dust Pollution in Delhi

M.Tech. Environmental EngineeringENE 6401 Environmental Impact Assessment and Audit

END Semester Examination, 2024

Nov, 2024

Duration: 3 Hours

Max. Marks 50

Attempt any five questions; all carry equal marks

1. Write brief notes on:

(a) Compare and contrast LCA and Circular Economy (CO1K1)

(b) Elaborate ISO and EMP with examples (CO1K2)

2.(a) Critically compare the EIA notification of 2006 and the draft notification of 2020. (CO3 K1)

(b) What is risk matrix. Explain with example (CO2K2)

3. For the Panipat power plant, what are key audit issues at different stages from construction to commissioning (CO5K2)

4. (a) How does it get environmental clearance starting from TOR? (CO2K2)

(b) Comment on Mitigation and Monitoring for a typical mobile manufacturing plant (CO4K4)

5. What are various compliance of all components of any developmental project? Use a paper manufacturing plant as an example. (CO3K2)

6. Are BIA, HIA and SIA part of any EIA? Explain with examples (CO1K1)

7. Compare and contrast the Adhoc method, matrix method, and checklist methods in data collection and interpretation. Use a metro project for this purpose. Examine the role of statistics in environment data analysis. (CO2K2)

8. Why SEA is needed for any development project? Use the Nicobar Island project to illustrate the need for SEA preceding any EIA. (CO5K3)

Total no of Pages:03-

Roll No.....

1st SEMESTER

M Tech (GEOTECHNICAL ENGG)

End Term Examination

Nov - 2024

GTE-501 ADVANCED SOIL MECHANICS

Time: 3hr

Max Marks: 40

Note: Attempt the questions as per instruction. Assume the data suitably, if any. Use of semi log paper is permitted.

1. Attempt **all** of the following questions:

- (a) Mathematically prove that for two layered soils, the coefficient of permeability in the direction parallel to bedding plane is more than that in the direction perpendicular to bedding plane. (2) (CO-2)
- (b) Explain SEM technique for the identification of minerals. (2) (CO-1)
- (c) How the degree of consolidation is determined when the variation of pore pressure is linear. (2) (CO-4)
- (d) Why back saturation pressure is applied in triaxial test? (2) (CO-5)

2. Attempt any **two** questions out of the following:-

- (a) Explain optical microscope technique. How it is different from XRD? (4) (CO-1)
- (b) What are the empirical relations developed by various researchers for finding the coefficient of permeability of sandy soils.

For normally consolidated clay the following data is given:

Void ratio	Permeability (cm/sec)
1.18	3.06×10^{-8}
0.98	1.21×10^{-8}

Determine hydraulic conductivity of clay at a void ratio 0.68. (4) (CO-2)

- (c) Derive the relation used for finding the discharge through earth dam. Explain graphical solution proposed by Schaffernak. (4) (CO-3)

3. Attempt any **two** questions out of the following:

(a) Discuss numerical analysis of seepage in following conditions-

- On the boundary of permeable and impermeable layer
- Seepage in the layered soils

(4) (CO-3)

(b) Discuss safety of hydraulic structures against heaving. (4) (CO-3)

(c) Discuss how coefficient of consolidation is determined by following methods-

- Rectangular hyperbola method
- Square root of time fitting method

(4) (CO-4)

4. Attempt any **two** questions out of the following:

(a) Determine the degree of consolidation at a depth of $H/3$ measured from the top of the layer, when an initial excess hydrostatic pore pressure is constant with depth (i.e. $u_i = u_0$). Assume time factor as 0.5.

(4) (CO-4)

(b) Explain the concept of sand drain. What is the effect of smear?

(4) (CO-4)

(c) A sub soil consists of 3 m thick sand underlain by clay layer 2m thick. The void ratio of clay is 0.8 and liquid limit is 38%. Two footings each 2m x 2m and 5m apart centre to centre, are placed at a depth of 1m in sand and carries weight of 500kN each. The unit weight of sand and clay are 19.4 kN/m³ and 17.2 kN/m³ respectively. The water table is at the base of footing. Find the consolidation settlement of clay layer, both total and differential, if any.

(4) (CO-4)

5. Attempt any **two** questions out of the following:

(a) Explain Vane shear test. What is the effect of shape of vane.

(4) (CO-5)

(b) Derive an expression for unconfined compressive strength q_u in terms of C' and ϕ' . Take $B=1$ and initial capillary tension $=u$. Hence deduce the ratio of c_u/p for NC soil, where p is pre consolidation pressure.

(4) (CO-5)

(c) A compacted soil was tested in unconsolidated undrained condition in triaxial apparatus with a cell pressure of 400kN/m². Before the application of cell pressure, the pore pressure in the sample was zero. The results obtained are as follows-

Strain (%)	Deviator stress(kPa)	Pore pressure(kPa)
0	0	240
2.5	550	280
5.0	1020	160
7.5	1160	110
9.0	1230	95
11.5	1210	75
14.0	1180	55

(i) Plot the variation Pore pressure coefficient A_f with strain

(ii) Determine the value of pore pressure coefficient B and comment upon its degree of saturation.

(4) (CO-5)

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Total no. of Pages: 2

Roll no.

FIRST SEMESTER

M.Tech. (GEOTECHNICAL ENGINEERING)

END TERM EXAMINATION

Nov-2024

GTE 503/505/RCED505 ROCK MECHANICS

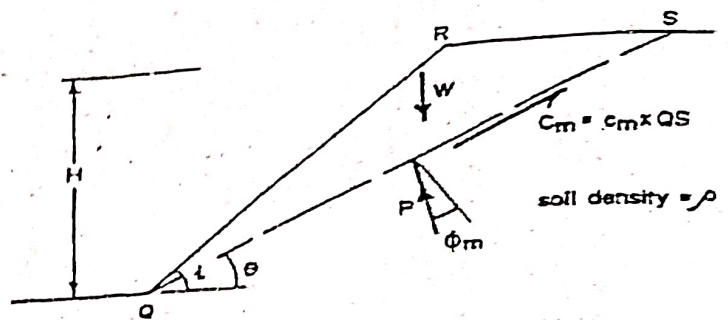
Time: 03:00 Hours

Max. Marks: 40

**Note : All questions carry equal marks.
Assume suitable missing data, if any.**

- Q.1 (a) Explain with suitable sketch the use of plate load test and their results for finding out the bearing capacity of rock on sound and poor rocks? [5][CO3][BTL 1,3]
(b) It is proposed to construct a ten story building in a hilly area having moderately jointed rock, the size of plot is 1000 sqm, plan the exploration for this site and explain the method of exploratory drilling will be used by you for the present case. [5][CO3][BTL 3, 4]
- Q.2 (a) It is proposed to construct a Tunnel on class D rock found at different length of 4 km long tunnel. The shape of Tunnel Modified Horse Shoe, Size of Tunnel 13.7 m x 9.9 m, Tunnelling Method Drill and Blast Method, Condition of Rock Mass Good to Fair, Slope of Tunnel 4.40% , Clear Width 11.5 m, Clear Height of Tunnel 5.5 m and Thickness of Lining 400 mm. Explain with suitable sketch the basic data requirement for design on this tunnel and tunnel support. [5][CO 4][BTL 5 , 6]
(b) Explain role of Instrumentation in Tunnelling. With the help of suitable sketches explain the role of 3 D- Bi-reflex optical target to find tunnel convergence. [5][CO 4][BTL 1 , 2]
- Q.3 (a) What are the different failure mechanisms of slope? What are the different factors of safety used for analysis of stability of slopes? [5][CO 4][BTL 1 , 2]

$H = 16\text{m}$, $\tan i = 2/3$, $\tan \phi = 1/3$, $c = 10\text{kPa}$, $\phi = 35^\circ$
 and the weight of the soil wedge QRS is 3.5MN/m . Calculate the factor
 safety (F) against, sliding along the potential failure surface QS.
 [5][CO5][BTL 3, 4]



- (b) What is rainfall induced landslides? Explain its triggering process. Explain the different sensors and their architecture which can be used for developing the early warning system. [M][CO5][BTL 1]

Q.4 Write short notes on

- (a) CNS boundary conditions are suitable for determination of shear behaviour of Rock Joints, support this statement. [2][CO2][BTL2, 4]
 (b) Q-system for Rock classification and design of Tunnel. [2][CO1][BTL1, 2]
 (c) Attention level and alarm level action plan for tunnel monitoring. [2][CO4][BTL2, 3]
 (d) Objective of rock exploration. [2][CO3][BTL1, 2]
 (e) Tunnel boring machine. [2][CO4][BTL1, 2]

Total No. of Pages: 3

I SEMESTER

END SEMESTER EXAMINATION

M. Tech. (Geotechnical Engineering)

November – 2024

GTE 507/505: Advanced Foundation Engineering

Time: 3 Hours

Max Marks: 50

NOTE: Answer any Five questions. Marks carried by a question are indicated against it. Assume suitable missing data, if any.

Q.1 (a) Explain “collapsible soils”. What are their important characteristics? What foundation problems they pose, and what are the possible solutions. (5)

(b) What do you mean by “expansive soils”; what are their important characteristics? What foundation problems they pose, and how will you resolve those problems. (5)

Q.2 (a) A square column foundation $1.5 \text{ m} \times 1.5 \text{ m}$ is located at a depth of 1.0 m below ground level in a soil deposit having properties: $\gamma = 18 \text{ kN/m}^3$, $\phi = 20^\circ$, $c = 30 \text{ kN/m}^2$. The allowable load is inclined at an angle of 15° with the vertical. Determine the allowable load using a factor of safety of 3. Use the general bearing capacity equation. (5)

(b) How will you determine the ultimate bearing capacity of soil taking into account the soil compressibility, describe giving necessary equations. (5)

Q.3 (a) A shallow foundation of length L and width B is subjected to a vertical load having two-way eccentricity. Describe, how will you determine the effective length, effective width, and effective area for different cases of eccentricity. (7)

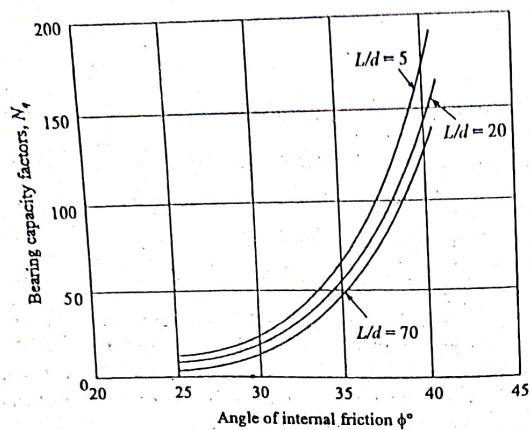
(b) Show the mechanism of negative skin friction in a pile foundation with the help of neat sketches. (3)

Q.4 A rectangular foundation $2 \text{ m} \times 4 \text{ m}$ in plan is located at a depth of 1.5 m in a sand deposit for which $\gamma = 18 \text{ kN/m}^3$, and $\phi = 35^\circ$. The foundation is subjected to a pressure of 150 kN/m^2 . Following data is given for variation of cone resistance (q_c) with depth (z).

$z \text{ (m)}$	$0.0 - 0.5$	$0.5 - 2.5$	$2.5 - 6.0$
$q_c \text{ (kN/m}^2\text{)}$	2300	3500	3000

Estimate the elastic settlement of the foundation using the strain influence factor method. Assume the time for creep is 10 years. (10)

Q.5 A concrete pile of 45 cm diameter is driven to a depth of 16 m through a layered system of sandy soil ($c = 0$). The data available are: **Top Layer:** thickness = 8 m ; $\gamma_d = 15.5 \text{ kN/m}^3$; $e = 0.60$; $\phi = 30^\circ$. **Middle Layer:** thickness = 6 m ; $\gamma_d = 16.5 \text{ kN/m}^3$; $e = 0.65$; $\phi = 35^\circ$. **Bottom Layer:** extends to a great depth; $\gamma_d = 17.0 \text{ kN/m}^3$; $e = 0.60$; $\phi = 38^\circ$. Assume $\delta = 0.75 \phi$ for all the layers. The value of K_s for each layer is equal to half of the passive earth pressure coefficient. The water table is at the ground level. Calculate the ultimate load carrying capacity of the pile. The graph given below can be used. (10)



Berezantsev's bearing capacity factor, N_q (after Tomlinson, 1986)

- Q.6** Elaborate in detail the Brom's procedure to determine lateral deflection at ground level at working load and the ultimate load carrying capacity of laterally loaded piles in saturated cohesive soils. Give all equations and representative charts.

(10)

transmission of force behave at different frequencies (low, resonance, and high)?

- (d) How the damping coefficient c and spring constant k can be adjusted to maximize vibration isolation at a specific frequency range? Provide a qualitative explanation of the exchange between damping and spring stiffness in the context of reducing transmitted force.

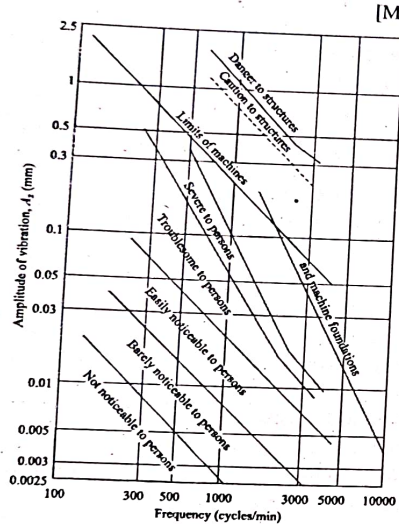


Fig. Plot of frequency dependent amplitude for design of machine foundation

Total no. of Pages:04

Roll no.....

FIRST SEMESTER

M.Tech.

END TERM EXAMINATION

Nov-2024

GTE509 SOIL DYNAMICS AND MACHINE FOUNDATION

Time: 03:00 Hours

Max. Marks: 40

Note : All questions carry equal marks.
Assume suitable missing data, if any.

- Q.1 (a) How a standard cyclic triaxial test is modified to determine the dynamic properties of an unsaturated soil sample? Compare the challenges in measuring dynamic properties for saturated and unsaturated soils. How the factors namely matric suction and air-entry pressure might influence the results?

[M4][CO1-2][BTL1-4]

- (b) During cyclic loading of a soil deposit in a tank there are varied amplification of displacement amplitude. How does varied amplification of displacement during cyclic loading take place and influence the dynamic shear modulus and damping ratio of the soil deposit? How does it simulate field conditions where build-up of amplification is a major concern?

[M4][CO1-3][BTL 5-6]

- Q.2 (a) If the resonant frequency of a soil sample changes with increasing confining pressure, explain how is it mathematically correlated with the change in resonant frequency to shear modulus and damping characteristics of the soil. How is it validated with respect to field conditions where dynamic soil properties are also critical for foundation design?

[M4][CO2-4][BTL2-6]

(b) In a resonant column test, the soil sample is subjected to varying confining pressures. How does it describe the change in the dynamic properties of the soil as confining pressure increases, and how does this relationship differ for granular and cohesive soils? Provide a theoretical explanation of why granular soils are more sensitive to changes in confining pressure than cohesive soils under dynamic loading.

[M4][CO2-4][BTL2-6]

Q.3 A reciprocating machine is symmetrically mounted on M-15 concrete block (unit weight = 24 kN/m^3) of size $4.0 \text{ m} \times 3.0 \text{ m} \times 3.5 \text{ m}$ high. The soil at the site is sandy having $\phi = 35^\circ$, saturated unit weight = 20 kN/m^3 . The water table is 3.0 m below the ground surface. The block is embedded in the ground at 2 m deep. The machine vibrating at a speed of 250 rpm generates:

Maximum vertical unbalanced force = 2.5 kN

Torque about z-axis = 4.0 kN-m

Maximum horizontal unbalanced force = 2.0 kN at a height of 0.2 m above the top of block

Machine weight is small in comparison to the weight of the foundation. Limiting amplitude of the machine is 150 microns . $C_u = 3.62 \times 10^4 \text{ kN/m}^3$ as determined from the block resonance test. Determine natural frequencies and amplitudes of vibration.

Plot natural frequencies and amplitudes of vibration using figure appended at the end.

[M4][CO2-4][BTL2-5]

Q.4 Design a suitable foundation for a double-acting steam hammer for the following data:

Weight of tup = 80 kN

Height of fall = 1.0 m

Area of piston = 0.2 m^2

Steam pressure on piston = 900 kN/m^2

Weight of anvil and frame = 1000 kN

Safe bearing capacity of soil under static loading conditions = 200 kN/m^2

Coefficient of elastic uniform compression of soil = $5 \times 10^4 \text{ kN/m}^3$

The base area of the elastic pad = 5.5 m^2

The thickness of the elastic pad = 0.60 m

Modulus of elasticity of the pad material = $5 \times 10^5 \text{ kN/m}^2$

Coefficient of elastic restitution = 0.5

Unit weight of soil = 16 kN/m^3

Efficiency of hammer = 0.65

Permissible stress for pad material = 3000 kN/m^2

Modification factor for the coefficient of elastic uniform compression of soil = 3

Unit weight of concrete = 24 kN/m^3

Use of figure appended at the end is permitted.

[M4][CO2-4][BTL1-6]

Q.5 Consider a mechanical system with a mass m , attached to a spring with spring constant k , and a damping element characterized by a damping coefficient c . The system is subjected to an external harmonic force $F(t) = F_0 \cos(\omega t)$, where F_0 is the amplitude of the applied force and ω is the driving frequency.

(a) Define the concept of vibration isolation in the context of this system. How does the resonance condition affect the displacement amplitude of the mass?

[M2][CO1-5][BTL6]

(b) Considering (a), explain what may happen to the displacement if the system is tuned such that the resonance frequency matches the driving frequency? Assume the system is underdamped.

[M2][CO1-5][BTL6]

(c) In a vibration isolation setup, the system is designed to reduce the force transmitted to the base of the foundation. Derive an expression for the force transmitted to the base, F_{trans} , in terms of the system parameters namely, m , c , k , and ω . How does the

Total no. of Pages:01

Roll no.....

FIRST SEMESTER

M.Tech (GEOTECHNICAL ENGINEERING)

END TERM EXAMINATION

November- 2024

GTE5403 : APPLICATIONS OF REMOTE SENSING AND GIS
IN GEOTECHNICAL ENGINEERING.

Time: 3:00 Hours

Max. Marks: 40

Note: Attempt any 5 questions.

Assume suitable missing data, if any.

- Q.1 (a) What is GIS? Describe it in detail. [04][CO1]
(b) Differentiate between Active Microwave remote sensing and Passive Microwave remote sensing. [04][CO1]
- Q.2 (a) What is RADAR? Write down its various applications. [04][CO2]
(b) Write down various other areas in which GIS applications can be used. Numerate these GIS applications in those areas. [04][CO1]
- Q.3(a) What are various components of Remote sensing? [04][CO2]
(b) Explain the various image resolution with details? [04][CO3]
- Q.4 (a) What is Orbit and how does Orbit selection vary? [04][CO2]
(b) Name Various type of orbits.
- Q.5 Write down short note on the following: -
i)- Optical radiation models
ii)- Synthetic Aperture Radar (SAR)
iii)- Geodetical Surveying
iv)- Image enhancement [08] [CO1]
- Q.6 What is image processing in GIS? Explain image processing methods. [08] [CO3]

END TERM EXAMINATION

November-2024

GTE 6201 Design of Underground Excavation

Time: 3:00 Hours

Max. Marks: 50

Note : Answer any FIVE.

All questions carry equal marks.

Assume suitable missing data, if any.

- Q.1 a) What are the key considerations and steps involved in planning and executing underground construction projects, such as tunnels, metro systems, and underground storage facilities? [5][CO1]
- b) What are the various instruments used in monitoring of underground excavations and explain their working? [5][CO2]
- Q.2 a) Explain the elasto-plastic analysis in tunnel engineering and describe its significance in understanding tunnel stability. Use appropriate diagrams to support your explanation. [5][CO3]
- b) Explain the working principles and applications of single-point and multi-point borehole extensometers in geotechnical engineering, including how these instruments are used to monitor ground movement? [5][CO3]
- Q.3 a) What is the analysis of underground openings in squeezing and swelling ground conditions, and how can these challenges be mitigated during the design and construction of underground structures? [5][CO4]
- b) Differentiate between rock bolting and rock anchoring. [5][CO4]
- Q.4 a) Describe Ladanyi's elasto-plastic analysis of stress distribution around a tunnel, focusing on the plastic and elastic zones. Use a diagram to illustrate the stress zones and label the key areas and stress components. [5][CO5]
- b) Explain rock mass tunnel support interaction in underground excavations. [5][CO5]

Q.5 Explain Daemen's Theory in the design of underground excavations. Discuss the key components of this theory, its applications in various underground projects, and its advantages and limitations in ensuring excavation stability. [10][CO6]

Q.6 Write note (Any two): [5x2] [CO1] [CO2]

- a) USMB (United States Material Bureau) type drill hole deformation gauge
- b) Elastic stress distribution around a circular tunnel
- c) Greenspan method

Total No. of Pages: 2

Roll No.

III_SEMESTER

M. Tech. (Geotechnical Engineering) / M. Tech. (Structural Engineering)

END SEMESTER EXAMINATION

November – 2024

PAPER CODE: GTE 6303/STE6305

TITLE OF PAPER: **Ground Improvement Techniques**

Time: 3 Hours

Max Marks: 50

NOTE: Answer ALL questions. Marks carried by a question are indicated against it. Assume suitable missing data, if any.

- Q.1** (a) Describe various types of rollers (including their construction, properties, suitability etc) used for field compaction. (5)
- (b) A soil profile is shown in **Fig 1.1**; as a result of construction, the average pressure on the clay layer is expected to increase by about 120 kN/m^2 . The clay is normally consolidated and drained at top and bottom. Determine the following:
- (i) The primary consolidation settlement of the clay layer caused by the pressure due to construction.
- (ii) The temporary surcharge that will be required to eliminate the entire primary consolidation settlement in 12 months by the precompression technique. (5)
- Q.2** At a particular site sand drains were used to accelerate the settlement of a normally consolidated clay layer that is drained at both top and bottom. Following data is given:
- For clay layer: thickness = 5.0 m; compression index, $C_c = 0.35$; Original voids ratio, $e_0 = 1.0$; coefficient of consolidation for vertical and radial drainage (C_v, C_{vr}) = $0.012 \text{ m}^2/\text{day}$; Original effective overburden pressure at the middle of the clay layer = 66 kN/m^2 .
- For sand drain: radius of sand drain = 0.1 m; diameter of effective zone of radial drainage = 2.2 m;
- A surcharge is applied as shown in **Fig 2.1**. Assume this to be a no smear case. Calculate the degree of consolidation and the consolidation settlement 45 days after the beginning of the full surcharge application. (10)
- Q.3** (a) What is a prefabricated vertical drain (PVD)? Write down the steps to be followed, including all the necessary equations, for the design of PVDs. (5)
- (b) Describe the construction and use of stone columns for ground improvement. How will you determine the load-bearing capacity of stone columns? (5)
- Q.4** (a) Describe the mechanism of ground improvement through electroosmosis and its applications. (5)
- (b) Describe “well-point” method of dewatering, give neat sketches. (5)

Q.5 (a) What is geotextile? Give some important specifications. Give neat sketches showing various uses of geotextiles. (6)

(b) Explain the following terms in connection with geotextiles:

- (i) Permittivity
- (ii) Porosity
- (iii) Percent open area
- (iv) Transmissivity

(4)

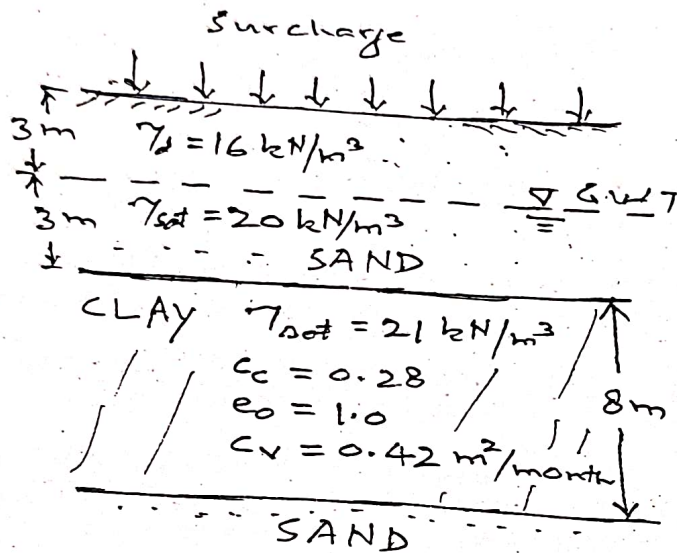


Fig. 1.1

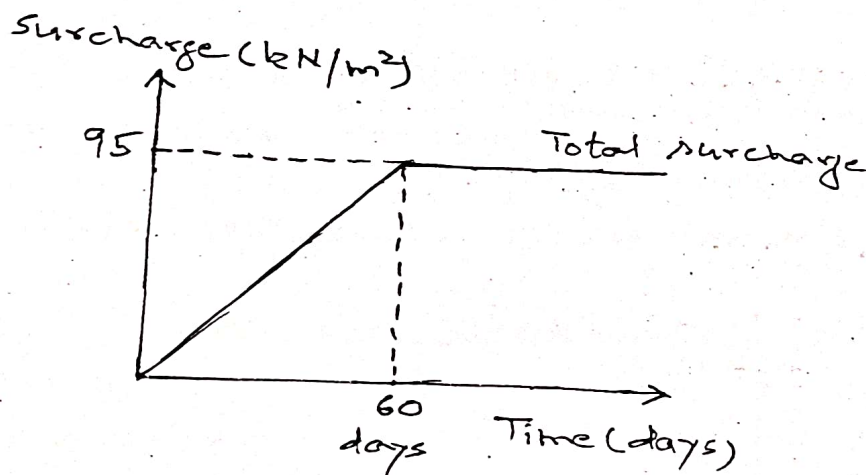


Fig 2.1

Total Number of Pages: 02

Roll No. _____

M.Tech./ PhD/Post Doctor (Research)

GTE/STE/EN/HRW/GIS- 6405 Design of underground sub- structures.

END SEM – NOVEMBER, 2024

Time: 3 Hours

MAX Mark -40

All Question are compulsory. Assume Suitable Missing Data if any

Q.1: What is Earthquake Resistant Design of shear wall as per IS 13920: 1993? –

Kindly refer page no. 02 the given high rise building 77 storeys which types of foundation is more suitable. Explain advantages and disadvantages. CO1 – 08 Marks

Q.2: Write Short notes on Retrofitting of Masonry Buildings by UNDP1983 design of underground Sub- Structures. CO2- 08 Marks

Explain merit and demerit of Advanced high speed Metro Railway in Asia for model Technology for design of underground Sub-Structures.

Reference: 23 Km India to Sri Lanka underground Tunnelling constitution

Q. 3: What is function of total station and DPS Remote sensing GIS and GPS? CO3- 08 Marks

Advantages and Disadvantages of BUST.

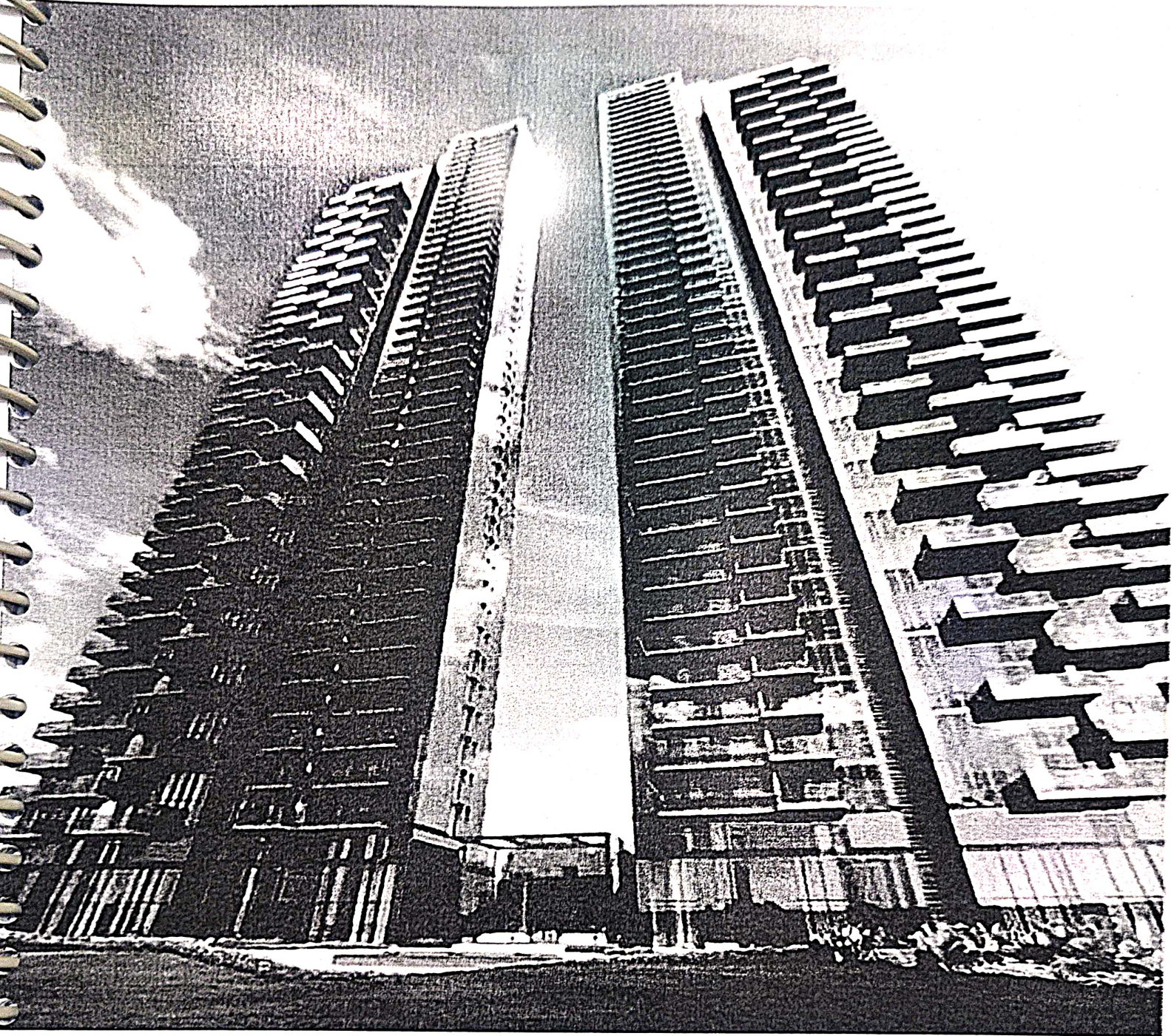
Q.4: What you understand by Pre tensioned – Post tensioned for high performance concrete and high quality Steel? CO4-08 Marks

Discuss during winter and during summer: using DUST.

Q.5 : What is quality control of DUST project by using? CO5-08 Marks

- a) Robotic technique in DUST
- b) Artificial intelligence technique in engineering surveying
- c) Field astronomy in DUST
- d) Construction Technology and project management in DUST

End



REF. 77 STORES 'Page No: 02.

- ii) Suppose we have a satellite image that has not been geo-referenced. Can we speak of geo-statistics on the pixel values? If yes, what are the coordinates and what are the attributes? [2][L3][CO5]

- 6) a) For the following joint distribution of random variables X and Y obtain the $H(X)$, $H(Y)$, $H(X,Y)$, $H(X|Y)$ and $H(Y|X)$. [6][L3][CO5]

Y \ X	1	2	3	4
1	$\frac{1}{8}$	$\frac{1}{16}$	$\frac{1}{32}$	$\frac{1}{32}$
2	$\frac{1}{16}$	$\frac{1}{8}$	$\frac{1}{32}$	$\frac{1}{32}$
3	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$
4	$\frac{1}{4}$	0	0	0

- b) Define the mutual information and obtain mutual information $I(X,Y)$ in above example. Verify the relation $I(X;Y) = H(X) - H(X|Y)$. [4][L3][CO5]

*****All The Best*****

Total No. of Pages: 04

Roll No.:.....

I SEMESTER
M.Tech.

END TERM EXAMINATION November-2024
GEO 501a Probability, Statistics, and Information theory in
Geoinformatics

Time: 3 Hours

Max. Marks: 50

Note: Answer any five questions. (Assume suitable missing data, if any.)

- 1)
 - a) Two Fair dice are tossed 600 times. Let X denote number of times a total of 7 occurs. Use Normal Approximation to find $P(90 < X < 110)$. [2][L3][CO1]
 - b) Suppose a test is run at level 0.025, and that the test has a power of 95%. For each of this problem give your answer and a short explanation. [2][L3][CO2]
 - i) Assuming the null hypothesis, what is the probability of type I error.
 - ii) Assuming the alternative hypothesis, What is the probability of type II error.
 - c) Define Entropy, Conditional Entropy and Joint Entropy. [3][L2][CO1]
 - d) What are key difference between Relative Entropy and Mutual Information? [3][L3][CO3]
- 2)
 - a) A random sample of 1000 persons from Chennai city have an average height of 67 inches and another random sample of 1200 persons from Mumbai city have an average height of 68 inches. Can the samples be regarded that the average height of persons from both cities is equal with a standard deviation of 5 inches? Test at 2% level of significance. [5][L5][CO3]

- b) A taxi company is to decide whether to purchase brand A or brand B tires for its fleet of taxis. To estimate the difference in the two brands an experiment is conducted using 30 tires of each brand. The tires are run until they wear out. The results are

Mean(A): 36,300km

SD(A): 5000km

Mean(B): 38,100km

SD(B): 6100km

Compute a 90% confidence interval for $\mu_B - \mu_A$ assuming the populations to be normal. What do you conclude from the confidence interval obtained?

[5][L4][CO4]

- 3) The grades of a class of 9 students on a midterm report (x) and on the final examination (y) are as follows:

X - 77 50 71 72 81 94 96 99 67

Y - 82 66 78 34 47 85 99 99 68

- Estimate the linear regression line. [4][L3][CO3]
- Estimate the final examination grade of a student who received a grade of 85 on the midterm report. [2][L3][CO3]
- Find Covariance between X and Y. [2][L2][CO2]
- Evaluate the Correlation coefficient between X and Y. [2][L2][CO2]

4)

- a) Homeland Security and missile defence technology make it paramount that we be able to detect incoming projectiles or missiles. To make the defence successful, multiple radar screens are required. Suppose it is determined that three independent screens are to be operated and the probability that, any one screen will detect an incoming missile is 0.8. Obviously, if no screens detect an incoming projectile, the system is unworthy and must be improved.

- What is the probability that an incoming missile will not be detected by any of the three screens?
- What is the probability that the missile will be detected by only one screen?
- What is the probability that it will be detected by at least two out of three screens?

[3][L4][CO3]

- b) The random variable X takes values -1, 0, 1 with probability 1/8, 2/8, 5/8.

i) Compute $E[X]$

ii) Give the pmf of random variable $Y = X^2$ and use it to compute $E[Y]$.

[3][L4][CO3]

iii) Compute $\text{Var}(X)$.

- c) Discuss the importance of geo-statistics. Give two applications of geo-statistics based analysis for solving real-world issues.

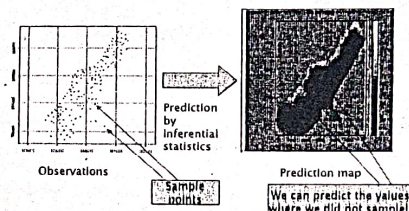
[4][L3][CO5]

5)

- a) The diameter of a ball bearing manufactured through a process is normally distributed with mean as 3cm and Std Dev as 0.005. The buyer sets the specifications as 3 ± 0.01 cm as acceptable limit. Find the percentage of scraped ball bearings? If the manufacturer wish to scrap only 5% of produce then what will be the range of diameter of admissible ball bearing?

[4][L3][CO4]

- b) In the following figure, Meuse river floodplain in the southern Netherlands is shown. The copper (Cu) content of soil samples has been measured at 155 points (left side); from this we can predict at all points in the area of interest (right). Give Answers to the following questions:



- i) Suggest some methodologies to produce prediction map for Copper content using the known points.

[4][L3][CO5]

Total no. of Pages:01

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Roll no.....

1st SEMESTER
M.TECH (GeoInformatics)

END TERM EXAMINATION

Dec.-2024

COURSE CODE: GEO507

COURSE TITLE: Introduction to GIS & WebGIS

Time: 03:00 Hours

Max. Marks: 40

Note: Assume suitable missing data, if any.

PART A: ATTEMPT ANY 5 QUESTIONS

Q1) Explain the following terms:

4Marks [CO 3,4,5] [BTL1,2]

- a) Accuracy
- b) Precision
- c) Radiometric Correction
- d) Universal Transverse Mercator

Q2) Distinguish between the following:

4Marks [CO 3,4,5] [BTL 1,2]

- a) Temporal and Attribute Accuracy
- b) Spaghetti and Topological Model
- c) Logical Raster overlay and Arithmetic Raster Overlay
- d) Euclidean and Manhattan Distance

Q3) What is the sources of error in GIS? Explain in context with source data, data encoding, data editing, conversion and analysis. Also briefly explain the role of Perkal Band in error analysis.

4Marks [CO 5] [BTL 3]

Q4) With respect to maps, briefly explain:

4Marks [CO 2,3] [BTL 1,3]

- a) Choropleth maps
- b) Dot-density maps
- c) Isopleth maps
- d) Cartograms

Q5) What is terrain mapping? Discuss the following techniques with respect to it:

4Marks [CO 3] [BTL 2,3]

- a) Contouring
- b) Vertical profiling
- c) Hill shading
- d) Hypsometric tinting
- e) Perspective view

Q6) What is spatial decision support system? Discuss with relevant example.

4Marks [CO 5] [BTL 3,4]

PART B: ATTEMPT ANY 4 QUESTIONS 125

Q7) You are required to analyse air quality of a particular city. From the perspective of GIS, what will be your approach to study it? 5Marks [CO 3] [BTL 6]

Q8) With respect to Fig.1, create the following topology: 5Marks [CO 4] [BTL 4,5]

- a) Arc Topology
- b) Node Topology
- c) Polygon Topology

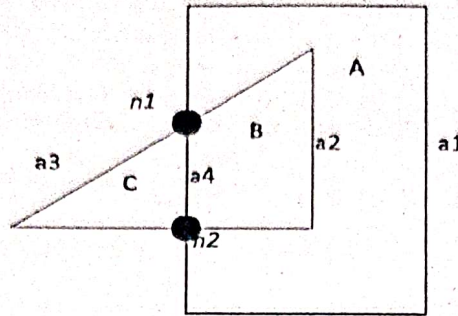


Fig 1

Q9) Discuss the 5 Levels of Detail in the Building module in City GML. 5Marks [CO 5] [BTL 1,2]

Q10) For the given entity model in Fig 2, perform Block Coding and create the file structure. 5Marks [CO 4] [BTL 5]

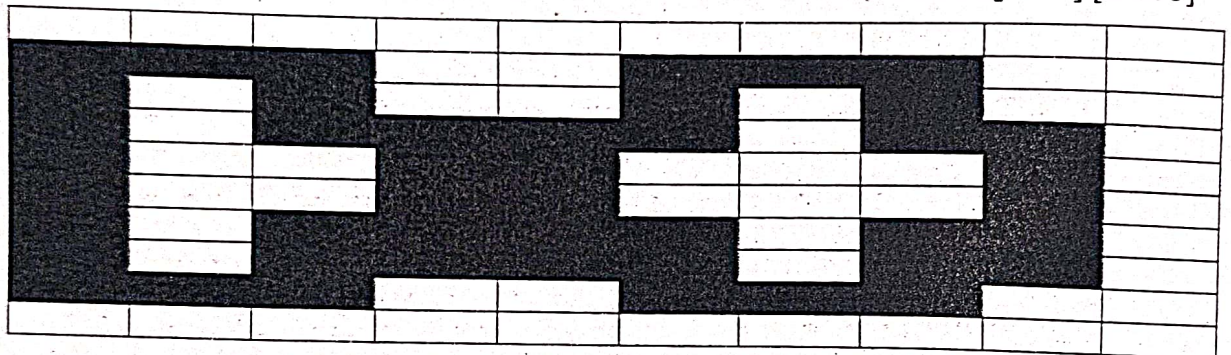


Fig2

Q11) For the following Raster data in Fig 3, create a quadtree and hence create the data structure showing the Node, Out and In. 5Marks [CO 5] [BTL 5]

Fig 3

Total no. of Pages:01

126

Roll no.....

1st SEMESTER
M.TECH (GeoInformatics)

END TERM EXAMINATION

Dec.-2024

COURSE CODE: GEO503

COURSE TITLE: Surveying, Satellite Geodesy, GPS/GNSS

Time: 03:00 Hours

Max. Marks: 40

**Note: All questions carry equal marks.
Assume suitable missing data, if any.**

- Q.1 (a). Describe how Plane surveying differs from geodetic surveying in terms of principles, scope, and applications? [4]
- (b). Explain the triangulation and trilateration of surveying, including their principles, methods, and typical applications? [4]
- Q.2 (a). A surveyor measured the distance between two points marked on the plan drawn to a scale of 1cm=1m(RF=1:100) and found it to be 50m. Later he detected that he used a wrong scale of 1cm=50cm (RF=1:50) for the measurement. Determine the correct length. (b) What would be the correct area if the measured area is 60m²? [4]
- (b). The length of a line measured on a slope of 15° was recorded as 550m. But it was found that the 20m chain was 0.05m too long. Calculate the true horizontal distance of the line. [4]
- Q.3. (a). The following fore and back bearings were observed in traversing with a compass in place where local attraction was suspected. Find the corrected fore bearing & back bearing of lines using included angles. [4]

Line	FB	BB
AB	158°30'	339°
BC	62°	242°
CD	342°	163°
DE	281°	101°30'
EA	210°30'	30°

- (b). Explain with sketches, the following methods of locating a point by plane table survey.
a) Radiation b) Intersection c) Resection [4]
- Q.4. (a). What is GNSS. Write a note on various GNSS Systems in the world. [4]
- (b). Write a note on LiDAR based Survey. [4]
- Q.5. (a). A vertical photograph was taken at an altitude of 1200 m above MSL. Determine the scale of the photograph for terrain lying at elevations of 80 m and 300m if the focal length of the camera is 15cm. [4]
- (b). What are the advantages and disadvantages of using UTM coordinates in GPS/GNSS positioning? [4]

END TERM EXAMINATION

November-2024

GEO 5312 Disaster Assessment and Management

Time: 3:00 Hours

Max. Marks: 50

Note : Answer any FIVE.
All questions carry equal marks.
Assume suitable missing data, if any.

- Q.1 a) Discuss the different aspects of disaster mitigation through advanced technology? [5][CO1]
b) How can a GIS-based decision support system (DSS) improve disaster management efforts? [5][CO2]
- Q.2 a) How can spatial data infrastructure (SDI) enhance real-time decision-making during a disaster event? [5][CO3]
b) How can remote sensing data (e.g., LiDAR, satellite imagery) be integrated with GIS to monitor mass wasting events over time? [5][CO3]
- Q.3 a) Explain different strategies of disaster mitigation & explain in detail the role of preparedness in disaster management. [5][CO4]
b) How does climate change influence flood risk and the frequency of Glacial Lake Outburst Floods (GLOFs)? [5][CO4]
- Q.4 Describe how remote sensing data, such as thermal imagery, can be used to identify hotspots and monitor fire intensity. What are the advantages of using GIS in tracking wildfire spread and assisting in evacuation planning? [10][CO5]
- Q.5 Define drought and explain its main types (meteorological, agricultural, and hydrological drought). Describe the socio-economic effects of drought on water resources and food security. [10][CO6]

Q.6 Differentiate between (Any two):

- a) Risk, Vulnerability & Resilience
- b) Sendai Framework for Disaster Risk Reduction
- c) Naming of cyclones and significance of naming in disaster management

Total no. of Pages:2

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Roll no.....

SEMESTER

**B.Tech./B.Des./BBA/BAE/M.Sc./M.Des./M.Tech./MBA/Ph.D./B.Tech.
(Eve)**

END TERM EXAMINATION

Nov/Dec-2024

**COURSE CODE: HU-703 COURSE TITLE:
ECONOMETRICS**

Time: 03:00 Hours

Max. Marks: 50

Note: All questions carry equal marks.
Assume suitable missing data, if any.
Answer any 4 out of 5 questions.

- Q.1 What is the meaning of measurement? What difference does it make whether we measure in terms of a nominal, ordinal, interval or ratio scale? Explain with example. [12.5 Marks]
- Q.2 Critically examine the various assumptions of the classical Linear Regression model. [12.5 Marks]
- Q.3 What is the difference between correlation and Regression? Calculate the Karl Pearson's coefficient of correlation for the data given below.
Independent Variable X: 3, 7, 5, 4, 6, 8, 2, 7,
Dependent Variable Y: 7, 12, 8, 8, 10, 13, 5, 10 [12.5 Marks]
- Q.4 What is the problem of heteroscedasticity and how does its presence affect the OLS estimators? Explain the method of GLS to correct the problem of heteroscedasticity. [12.5 Marks]

Q.5 (1) In order to assess the returns to English ability in the job market, the following regression model is estimated for males aged 15 to 65 years.

Dependent Variable: log of Annual Wages

English Ability is a categorical variable with 3 categories, "None", "Little", "Fluent".

	Model 1		Model 2			
	Coeff.	P-value	Coeff.	P-value		
None	-1.48	0.000	10.26	0.000		
Little	-0.87	0.000	10.87	0.000		
Fluent			11.74	0.000		
Intercept	11.74	0.000				

Define the dummy variables and give the difference between Models 1 and 2 using econometric equations. Why is there a blank row in model 1 and model 2?

[12.5 Marks]

Total No. of Pages: 01

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Roll No.....

PhD

END TERM EXAMINATION, November 2024

HUM705 Life, Literature and Cinema

Max. Marks. 50

Time: 03 Hours

Note: Answer any five questions.

Assume suitable missing data, if any.

1. Comment on literature and cinema as critique of life. (10) [CO 1]
OR
"Literature not only mirrors the society but also creates one."
Comment. (10) [CO 1]
2. Critically evaluate the struggle of the protagonist of the biopic, *The Man Who Knew Infinity*. (10) [CO2]
3. "Teesri Kasam is the extremely profound portrayal of human predicament" Comment. (10) [CO2]
4. "Omkara is an example of Indianization of Shakespeare."
Discuss. (10) [CO2]
5. Write a note on the political themes contained in *The Grapes of Wrath*. (10) [CO3]
6. Justify the title of the movie, *The Reluctant Fundamentalist*. (10) [CO4]

Total no. of Pages: 01

Roll no.....

SEMESTER-Ist

PhD

END-TERM EXAMINATION

November-2024

HU-706 RETELLINGS OF INDIAN MYTHS & HISTORY

Time: 3:00 Hours

Max. Marks: 50

Note: All questions carry equal marks.
Assume suitable missing data, if any.
Attempt all five questions.

Q. 1 Explain the reasons for the popularity of the Retellings of mythology in different genres.

10 (CO-1)

Q.2 Discuss the character of Karn as represented by Ramdhari Singh Dinkar. 10 (CO-3)

Q.3 Comment on the feministic take of Amish and Neena Paley in *Warrior of Mithila* and *Sita Sings the Blues*. 10- (CO-2)

Q.4 Elaborate on the contrast between mythological Ahalya and the short movie s by Gautam Ghosh. 10 (CO-4)

Q.5 Critically evaluate the *Mughal-E Azam* or the *Padmavati* movie. 10 (CO-5)

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END TERM EXAMINATION

Nov/Dec-2024

HU-708 Gender and Technology

Time: 03:00 Hours

Max. Marks: 50

Note : Attempt any five questions.
All questions carry equal marks.
Assume suitable missing data, if any.

- Q1: What do you know about Sustainable Development Goal- 5? Do you agree that the use of ICT helps in achieving it? Discuss. [CO# 1&3]
- Q2: Discuss how diversity and inclusion may be achieved through the use of Artificial Intelligence. [CO#3]
- Q3: Discuss the source of Biases and Stigmas at the workplace and the role of leadership in alleviating them. [CO#1&2]
- Q4: What do you mean by Women Empowerment? Discuss the role of various stakeholders in achieving it. [CO#2+3]
- Q5: What do you mean by Technology? Discuss various theories on Technology. [CO#1 & 3]
- Q6: Discuss various forms of Cybercrime against a diverse population. [CO#4]
- Q7: Discuss factors affecting and affected by the participation of Indian women in Science, Technology, Engineering & Mathematics (STEM) Research & Development. [CO#4]

---END---

Total No. of Pages 02

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Roll No.

FIRST SEMESTER

M.Tech. (HWRE)

END SEMESTER EXAMINATION

November-2024

HWE 501 Advanced Fluid Mechanics

Time: 3 hours

Max. Marks: 40

Note : Answer any five questions
All questions carry equal marks
Assume suitable missing data, if any.

1. (a) Explain briefly the term boundary layer. Give four examples in everyday life where formation of boundary layer is important.
[3 Marks] (CO 5) (BTL 3)
(b) A venturimeter is used for measuring the flow of petrol in a pipeline inclined at 35° to horizontal. The sp. gravity of the petrol is 0.81 and throat area ratio is 4. If the difference in mercury levels in the gauge is 50 mm, calculate the flow in m^3 / s if the pipe diameter is 300 mm. Take venturimeter constant = 0.975.
[5 Marks] (CO 1) (BTL 4)
2. (a) What is the 'slip condition' at the boundary? What boundary condition must be satisfied by the velocity distribution in laminar boundary layer over a plate?
[3 Marks] (CO 5) (BTL 2)
(b) Does the velocity potential exist for two-dimensional incompressible flow prescribed by $u = x - 4y$ $v = -(y + 4x)$ If so determine its form as well as that of stream function.
[5 Marks] (CO 2) (BTL 3)
3. A uniform flow of 12 m/s is flowing over a doublet of strength $18 \text{ m}^2 / \text{s}$. The doublet is in the line of the uniform flow. Determine:
(i) shape of the Rankine oval
(ii) radius of the Rankine circle
(iii) value of stream line function at Rankine circle
(iv) resultant velocity at a point on the Rankine circle at an angle of 30° from x-axis
(v) value of maximum velocity on the Rankine circle and location of the point where velocity is max.
[8 Marks] (CO 2) (BTL 4)
4. A plate $300\text{mm} \times 100\text{mm}$ is immersed in a liquid of density $998 \text{ kg} / \text{m}^3$ and kinematic viscosity $1 \times 10^{-6} \text{ m}^2 / \text{s}$ water is moving with a velocity of 15.0 m/s parallel to it. Calculate:
(i) Drag force on that portion of the plate over which the boundary layer is laminar,

- 135
- (ii) Total drag force on both sides of plate. [8 Marks] (CO 5) (BTL 4)
5. (a) Derive an expression for the velocity distribution for viscous flow through a circular pipe. Also sketch the distribution of velocity and shear stress across a section of the pipe. [3 Marks] (CO 4) (BTL 3)
- (b) The pressure difference Δp in a pipe of diameter D and length L due to viscous flow depends on the velocity V , viscosity μ and density ρ . Using Buckingham's theorem, obtain an expression for Δp . μ has been chosen as repeating variable (instead of ρ) since the flow is viscous. [Hint: Choose D , V and μ as repeating variables, μ has been chosen as repeating variable (instead of ρ) since the flow is viscous.] [5 Marks] (CO 3) (BTL 3)
6. (a) What is the physical significance of displacement thickness of boundary layer? Define momentum thickness and energy thickness. [3 Marks] (CO 3) (BTL 4)
- (b) A pipe 5 m long is inclined at an angle of 15° with the horizontal. The diameters of pipe at smaller section (at lower level) and larger section are 80 mm and 240 mm respectively. If the pipe is uniformly tapering and the velocity of water at the smaller section is 1 m/s, find the difference in pressures between the two sections. [5 Marks] (CO 3) (BTL 3)

Total No. of Pages 3

FIRST SEMESTER

END TERM EXAMINATION

Roll No.

M. Tech . CIVIL (HWRE)

NOV-2024

HWE- 505 ADVANCED HYDROLOGY

Time: 3 Hours

Max. Marks : 40

Note : Question 1 is compulsory. Attempt 4 more questions.
Assume suitable missing data, if any.

- 1 Answer Ten parts of the question
- [a] Explain the significance of Station- year method. (CO1, L2)
 - [b] Discuss the applicability of maximum Depth –Area -Duration curves in the design of hydraulic structures. How do you obtain these curves? (CO1, L4)
 - [c] Enlist the causes of inconsistency of rainfall data. How can it be corrected? (CO1, L1)
 - [d] What do you mean by PMP? How do you obtain it? (CO1, L1)
 - [e] Compare the applicability of different methods of curve fitting in hydrology. Enlist few examples where regression analysis is used successfully in Hydrology. (CO2, L5)
 - [f] Write a brief note on utility of stage-discharge curve. (CO1, L5)
 - [g] How do you select a suitable unit hydrograph to calculate peak flows for a given catchment area? (CO2, L5)
 - [h] Write a brief note on non-structural methods of flood management. (CO5, L4)
 - [i] State the method of flow routing used as short term method of forecasting for the Yamuna water level in Delhi. (CO1, L3)
 - [j] Write basic equations used in Lumped flow routing/Hydrologic flood routing and in Distributed flow routing/ Hydraulic flood routing techniques. (CO1, L1)
 - [k] Write a brief note on applicability of hydraulic methods of flood routing. (CO1, L2)
 - [l] Write a brief note on applications of time series analysis. (CO3, L2)
- (1x10)**

- 2 A rectangular parking lot is 140 m x 280 m long. The time of overland flow across the pavement to the longitudinal gutter along the centre is 18 minutes and the estimated total time of concentration to the downstream end of the gutter is 24 minutes. The runoff coefficient is 0.9. If rainfall of intensity 6 cm/hr falls on the lot for 1 minute and stops abruptly, determine the hydrograph up to its peak magnitude. (5) (CO1, L4)

- 3 Analysis of annual flood series of a river yielded a sample mean of 1100 m³/sec and standard deviation of 500 m³/sec. Estimate the design flood of a structure on this river to provide 90% assurance that the structure will not fail in next 60 years. Use Gumbel's method and assume the sample size to be very large. (5) (CO5, L4)

- 4 A basin has 400 km² of area L=35 km, LCA=11km. Assuming C_i=1.5 and C_p=0.7, develop a 3 hour synthetic unit hydrograph. (5) (CO5, L5)

- 5 Flood-frequency computations for a river by using Gumbel's method, yielded the following results:
- | Return period T (years) | Peak flood (m ³ /sec) |
|-------------------------|----------------------------------|
| 50 | 40,810 |
| 100 | 46,300 |
- Estimate the flood magnitude in this river with a return period of 500 years. (5) (CO2, L4)

- 6 A drainage basin has 160 km² area, 7 hours time of concentration and 9 hours as storage constant with the following information about inter-isochrone area distribution, determine 1 hour unit hydrograph. (5) (CO1, L3)

Time (h)	0-1	1-2	2-3	3-4	4-5	5-6	6-7
Inter isochrones	10	36	22	43	35	10	4
Area (km ²)							

- 7 The following are the data of the monthly ground water table fluctuations and ground water pumping in certain area. Obtain a regression relation and correlation coefficients (5) (CO2, L4)

Months	1	2	3	4	5	6	7	8	9	10	11	12
Ground W.T	3.60	4.05	4.12	4.57	4.8	4.95	5.02	4.80	4.42	4.44	18.9	1.80
GW pumping rate	14.0	23.4	32.4	51.2	62.3	79.5	61.4	47.4	34.4			

OR

- (a) From the following data of annual runoff depths in cm over a catchment, find if there is any trend in the data. (2.5) (CO3, L5)
36, 43, 44, 40, 35, 39, 41, 47, 45, 39, 52, 48.
- (b) Write a brief note on the advanced topic you searched as an assignment. (2.5) (CO4, L4)

END

END TERM EXAMINATION

November-2024

HWE 507 WATER POWER ENGINEERING

Time: 03:00 Hours

Max. Marks: 40

Note : Any five questions

All questions carry equal marks.

Assume suitable missing data, if any.

Q.1 (a) What are the functions of draft tube of hydroelectric powerplant?
Prove draft tube prevent loss of head of reaction turbine?

(b) A hydroelectric power station has to operate with a mean head 30m and supplied from reservoir whose catchment area is 250 km² and annual average rainfall 125cm/year. If 70% of Total rainfall can be used at expected load factor of 50%. Calculate power in kW for which station can be designed?

Assume head loss is 8%. Mechanical efficiency of turbine is 90% and generator efficiency 95%. [CO1]

Q.2 (a) What do you understand by water hammer in pipeline? Derive the expression for the water hammer in case of a rigid and elastic pipe.

(b) A hydraulic pipeline 3.5 km long and 50cm diameter is used to convey water with a velocity of 1.5 m/s. Determine the rise in pressure head in the pipeline if the valve provided at the outflow end is closed in (i) 20 seconds (ii) 3.5 seconds with rigid pipe. Given Bulk modulus of water $K = 20 \times 10^7$ kg/m. [CO4]

Q.3 (a) What are different sources of energy? Differentiate between renewable and non-renewable energy sources with their advantages and disadvantages?

(b) A turbine develops 10000KW when running at 10rpm. The head on the turbine is 45m, if the head of turbine is reduced to 26m. Determine the speed, power & specific speed developed by turbine. [CO3]

- 4 Calculate the balancing depth for a channel section having a bed width equal 17 m and side slopes of 1:1 in cutting and 2:1 in filling. The bank embankments are kept 2.9 m higher than the ground level (barm level) and crest width of banks is kept 2.0 m.
(4) (CO3, L3)

- 5 A stream of 140 litres per second was diverted from a canal and 105 litres per second were delivered to the field. An area of 1.7 hectare was irrigated in 8 hours. The effective depth of root zone was 1.6 m. The runoff loss in the field was 425 m³. The depth of water penetration varied linearly from 1.6 m at the head end of the field to 1.1 m at the tail end. Available moisture holding capacity of the soil is 22 cm. per metre depth of the soil. It is required to determine the water storage efficiency. Irrigation was started at a moisture extraction level of 50 % of the available moisture.
(4) (CO1, L4)

- 6 Determine the field capacity of a soil for the following data:
Root zone depth= 180 cm.
Existing moisture = 10%
Dry density of the soil = 1450 kg/m³
Quantity of the water applied to soil = 640 m³
Water lost due to deep percolation and evaporation = 13%
Area to be irrigated = 1000 m²
(4) (CO1, L5)

- 7 Design the crest and cistern a 1.2 m sarda fall for a channel carrying 25 cumecs of water at a depth of flow equal to 1.8 m. The bed width of the channel is 20 m. What modifications will you suggest if fall is 10 m.
(4) (CO2, L3)

- 8 The following table gives the mean monthly flows (m³/sec) in a river during certain year. Calculate the minimum storage required to maintain a flow rate of 58 m³/ sec.

Month	1	2	3	4	5	6	7	8	9	10	11	12
Mean flows	72	60	51	26	26	32	60	85	115	100	95	76

(4) (CO2, L5)

- 9 Design the expansion type of transition for a suitable cross drainage work, given the following data at the crossing of a canal and a drainage.

Canal	Drainage
Full supply discharge=32 cumecs	High flood discharge = 300 cumecs
Full supply level = 113.5 m	High flood level = 110 m
Canal bed level = 112m	High flood depth = 2.5 m
Canal bed width = 20 m	General ground level = 112.5m
Canal water depth = 1.5 m	
Trapezoidal canal section with 1.5 H:1 V slopes	(4) (CO3, L6)

- 10 Design a suitable section for the overflow section of a concrete gravity dam having the d/s face sloping at slope 0.7 H : 1.0 V. The design discharge for the spillway is 5500 cumecs. The height of spillway above the river bed is 60 m. Take effective length of the spillway as 50 m.
(4) (CO4, L6)

OR

From the stability analysis of a concrete gravity dam, the following data were found:

- (i) Algebraic sum of overturning moments about toe: 15000 T-m
(ii) Algebraic sum of resisting moments about toe: 40000 T-m
(iii) Algebraic sum of vertical forces: 2000 T
(iv) Algebraic sum of horizontal forces: 1000 T
(v) Base width of the dam: 36 m
(vi) Slope of d/s face of toe: 0.7 H:1 V
(vii) Coefficient of sliding friction between base and dam: 0.75
Determine: Vertical stresses at the toe & heel and Maximum principal stresses at the toe.
(4) (CO4, L4)

- 11 Find the values of Exit gradient and percentage uplift pressure at key points related with intermediate sheet pile for the details given in figure below. Apply necessary corrections required in values obtained from

Total no. of Pages: 02

Roll no.....

M Tech Industrial Engineering and Management

IEM 501: Data Analytics

END TERM EXAMINATION November 2024

Maximum Marks =40

Time 3 Hours

1. Attempt any FIVE Questions.
2. Use of Statistical Tables Permitted.

- 1a What is Data Analytics? Why its importance and applications are increasing in corporate world? CO1-CO5
- 1b Briefly discuss the properties of Binomial, Poisson and Normal distribution.
- 2a Explain the data imputation techniques to deal with missing data in data analytics. 4 CO2
- 2b A student is applying for a master course in 6 US Universities and believe that he has in each of the six universities a constant and independent 0.30 probability of getting selected. 8 CO2 CO3
- (i) What is the probability that he will get call from at least 2 universities?
- (ii) What is the probability that he will get a call from exactly 4 universities?
- Write Code also.
- 3a Discuss the different types of data based on level of measurement. 4 CO2
- 3b Briefly discuss reliability, completeness, usefulness, accuracy, missing data, and outliers to ensure the quality of the data. 4 CO2
- 4a What is the difference between Linear Regression and Logistic Regression? 4 CO2 CO3
- What is heatmap? How this is used in Linear Regression?
- 4b Why outlier analysis is important in a regression model. 4 CO3
- Explain Cook's Distance and Leverage Value methods of outlier analysis.

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5a.

What is confusion matrix? Explain sensitivity, specificity, precision and F-score. 4 CO2 CO3

5b

What do you mean by cut off probability in classification models. With the help of an illustration, explain Youden's Index to decide the cut off value. 4 CO1

6

A sample of 50 observations is selected from one population with population standard deviation (SD) is 6. The sample mean is 99. A sample of 40 observations is selected from second population, with population SD of 5. The sample mean is 102. Conduct the following test of hypothesis using 0.05 significance level. $H_0: \mu_1 = \mu_2$, $H_1: \mu_1 \neq \mu_2$. 8 CO4 CO5

- Is this a one tail test or two tail test?
- State the decision rule.
- Compute the value of test statistics?
- What is your decision regarding H_0 ?

What is p-value?

7

Write brief notes on

- Coefficient of Determination
- Multiple Regression Analysis
- Chi Square Test
- Conditional Probability

8 CO1

c	2.1	2.2	2.3	2.4	2.5
0	0.123 (0.123)	0.111 (0.111)	0.100 (0.100)	0.091 (0.091)	0.082 (0.082)
1	0.257 (0.380)	0.244 (0.355)	0.231 (0.331)	0.218 (0.309)	0.205 (0.287)
2	0.270 (0.650)	0.268 (0.623)	0.265 (0.596)	0.261 (0.870)	0.259 (0.543)
3	0.189 (0.839)	0.197 (0.820)	0.203 (0.799)	0.203 (0.779)	0.214 (0.757)
4	0.099 (0.938)	0.108 (0.928)	0.117 (0.918)	0.125 (0.904)	0.134 (0.891)
5	0.042 (0.980)	0.048 (0.970)	0.054 (0.970)	0.060 (0.964)	0.067 (0.953)
6	0.015 (0.995)	0.017 (0.993)	0.021 (0.991)	0.024 (0.985)	0.028 (0.980)
7	0.004 (0.999)	0.005 (0.998)	0.007 (0.998)	0.008 (0.995)	0.010 (0.990)
8	0.001 (1.000)	0.002 (1.000)	0.002 (1.000)	0.003 (0.995)	0.003 (0.990)
9				0.001 (1.000)	0.001 (1.000)

c	2.6	2.7	2.8	2.9	3.0
0	0.074 (0.074)	0.067 (0.067)	0.061 (0.061)	0.055 (0.055)	0.050 (0.050)
1	0.193 (0.267)	0.182 (0.249)	0.170 (0.231)	0.160 (0.215)	0.149 (0.190)
2	0.251 (0.518)	0.245 (0.494)	0.238 (0.490)	0.231 (0.446)	0.224 (0.423)
3	0.213 (0.736)	0.221 (0.715)	0.223 (0.692)	0.224 (0.670)	0.224 (0.647)
4	0.141 (0.877)	0.149 (0.854)	0.156 (0.848)	0.162 (0.832)	0.168 (0.815)
5	0.074 (0.951)	0.080 (0.944)	0.087 (0.935)	0.094 (0.926)	0.101 (0.916)
6	0.032 (0.963)	0.036 (0.959)	0.041 (0.976)	0.045 (0.972)	0.050 (0.966)
7	0.012 (0.995)	0.014 (0.994)	0.018 (0.992)	0.019 (0.990)	0.022 (0.988)
8	0.004 (0.999)	0.005 (0.998)	0.006 (0.998)	0.007 (0.997)	0.008 (0.996)
9	0.001 (1.000)	0.001 (1.000)	0.002 (1.000)	0.002 (0.999)	0.003 (0.999)
10				0.001 (1.000)	0.001 (1.000)

c	3.1	3.2	3.3	3.4	3.5
0	0.045 (0.045)	0.041 (0.041)	0.037 (0.037)	0.033 (0.033)	0.030 (0.030)
1	0.140 (0.185)	0.130 (0.171)	0.122 (0.159)	0.113 (0.146)	0.106 (0.136)
2	0.216 (0.401)	0.209 (0.390)	0.201 (0.390)	0.193 (0.339)	0.185 (0.321)
3	0.224 (0.625)	0.223 (0.603)	0.222 (0.582)	0.219 (0.558)	0.219 (0.537)
4	0.173 (0.798)	0.178 (0.781)	0.182 (0.764)	0.188 (0.744)	0.189 (0.720)
5	0.107 (0.905)	0.114 (0.895)	0.120 (0.884)	0.126 (0.870)	0.132 (0.858)
6	0.056 (0.961)	0.061 (0.956)	0.066 (0.950)	0.071 (0.941)	0.077 (0.935)
7	0.025 (0.980)	0.028 (0.984)	0.031 (0.981)	0.035 (0.976)	0.038 (0.973)
8	0.010 (0.996)	0.011 (0.995)	0.012 (0.993)	0.015 (0.991)	0.017 (0.990)
9	0.003 (0.999)	0.004 (0.999)	0.005 (0.998)	0.006 (0.997)	0.007 (0.997)
10	0.001 (1.000)	0.001 (1.000)	0.002 (1.000)	0.002 (0.999)	0.002 (0.999)
11				0.001 (1.000)	0.001 (1.000)

Total no. of Pages: 04

1 SEMESTER

END TERM EXAMINATION

IEM505 Quality Management

Time: 03:00 Hours

Max. Marks: 40

Answer ANY 5 questions

Assume suitable missing data, if any.

Roll no.

M.Tech.

Nov-2024

- Q.1 Explain the Deming's principles and his contribution in quality movement w.r.t Automobile manufacturing.
[Marks=8] [CO#1][BTL#1]
- Q.2 Describe Motorola's concept of six sigma quality and explain the level of non-conforming product that could be expected from such a process.
[Marks=8] [CO#2][BTL#2]
- Q.3 Consider the airline transportation industry. Develop a house of quality showing customer requirements and technical descriptors.
[Marks=8][CO#3][BTL#3]
- Q.4 The safe operation of an automobile is dependent on several subsystems. Construct a cause-and-effect diagram for automobile accidents. Conduct a failure mode and effects criticality analysis and comment on areas of emphasis for prevention of accidents.
[Marks=8] [CO# 4][BTL#6]
- Q.5 In a health care facility, it is known that nosocomial infections are rare, Following Table shows the number of admissions between occurrences of nosocomial infections. Construct an appropriate control chart and comment on the performance of the health care.
[Marks=8][CO#5][BTL#4]

Inspection sequence	Number of Admissions	Inspection sequence	Number of Admissions
1	120	11	120
2	100	12	100
3	150	13	90
4	140	14	140
5	95	15	160
6	100	16	170
7	110	17	185
8	95	18	190
9	115	19	200
10	135	20	185

Q6 Draw the OC curve for a single sampling plan; given $N = 1000$; $n = 50$; $c = 0$ & $c = 1$ and for $n=50$ & $n=100$; $c=0$, comment on producer's and consumer's risk. [Marks=8][CO# 5][BTL#5]

c	np ₁				
	0.1	0.2	0.3	0.4	0.5
0	0.005 (0.905)	0.019 (0.819)	0.041 (0.741)	0.070 (0.670)	0.097 (0.607)
1	0.001 (0.999)	0.004 (0.996)	0.011 (0.989)	0.022 (0.978)	0.035 (0.910)
2	0.004 (1.000)	0.016 (0.999)	0.033 (0.990)	0.054 (0.992)	0.076 (0.999)
3		0.010 (1.000)	0.004 (1.000)	0.007 (0.999)	0.013 (0.999)
4				0.001 (1.000)	0.001 (1.000)

c	np ₂				
	0.6	0.7	0.8	0.9	1.0
0	0.540 (0.540)	0.407 (0.407)	0.440 (0.440)	0.406 (0.406)	0.368 (0.368)
1	0.320 (0.878)	0.340 (0.845)	0.350 (0.808)	0.366 (0.772)	0.368 (0.736)
2	0.060 (0.977)	0.122 (0.967)	0.144 (0.952)	0.166 (0.938)	0.184 (0.920)
3	0.020 (0.997)	0.028 (0.995)	0.039 (0.991)	0.049 (0.987)	0.061 (0.981)
4	0.003 (1.000)	0.005 (1.000)	0.008 (0.999)	0.011 (0.998)	0.016 (0.997)
5			0.001 (1.000)	0.002 (1.000)	0.003 (1.000)

c	np ₃				
	1.1	1.2	1.3	1.4	1.5
0	0.333 (0.333)	0.301 (0.301)	0.273 (0.273)	0.247 (0.247)	0.223 (0.223)
1	0.366 (0.663)	0.381 (0.662)	0.354 (0.627)	0.345 (0.592)	0.335 (0.558)
2	0.201 (0.900)	0.217 (0.879)	0.230 (0.857)	0.242 (0.834)	0.251 (0.809)
3	0.074 (0.874)	0.087 (0.906)	0.100 (0.957)	0.113 (0.947)	0.126 (0.935)
4	0.021 (0.985)	0.028 (0.982)	0.032 (0.989)	0.030 (0.985)	0.047 (0.982)
5	0.004 (0.999)	0.007 (0.999)	0.009 (0.998)	0.011 (0.997)	0.014 (0.996)
6	0.001 (1.000)	0.001 (1.000)	0.002 (1.000)	0.003 (1.000)	0.004 (1.000)

c	np ₄				
	1.6	1.7	1.8	1.9	2.0
0	0.202 (0.202)	0.183 (0.183)	0.165 (0.165)	0.150 (0.150)	0.135 (0.135)
1	0.323 (0.525)	0.311 (0.494)	0.298 (0.463)	0.284 (0.434)	0.271 (0.406)
2	0.258 (1.000)	0.264 (0.758)	0.268 (0.731)	0.270 (0.704)	0.271 (0.677)
3	0.136 (0.990)	0.140 (0.907)	0.161 (0.892)	0.171 (0.875)	0.180 (0.857)
4	0.055 (0.994)	0.064 (0.971)	0.072 (0.964)	0.081 (0.956)	0.090 (0.947)
5	0.018 (0.976)	0.022 (0.993)	0.026 (0.990)	0.031 (0.987)	0.036 (0.983)
6	0.005 (0.921)	0.006 (0.990)	0.008 (0.998)	0.010 (0.997)	0.012 (0.995)
7	0.001 (0.783)	0.001 (1.000)	0.002 (1.000)	0.003 (1.000)	0.004 (0.999)
8					0.001 (1.000)

Total No. of Pages _03

Roll No.....

1st SEMESTER

OUTER: M.TECH(IEM)

END SEMESTER EXAMINATION NOV-2024

503 IEM-503, Production and Operations Management

Time: 3:00 Hours

Max. Marks : 50

Note: Answer any FIVE questions

Assume suitable missing data, if any.

1. (a) what is the operations strategy? Discuss the competitive dimensions of a manufacturing firm. [4][CO1][L2]
(b) A factory is producing two products X and Y by using either of two materials A or B. Product 1 is expected to be sold at Rs. 80 per unit and product 2 at Rs. 30 per unit. The operating data are as follows:

	Material A	Material B
Output X	200 units	400 units
Output Y	300 units	200 units
Quantity of raw material usage	1,000 Kg	1,000 Kg
Labour usage	300 man hrs.	250 man hrs.
Electric energy consumption	1000 KWhr	1500 KWhr
Cost of raw material/Kg	Rs. 30	Rs. 30
Labour per man hour	Rs. 5	Rs. 5
Electrical energy/KWhr	Rs. 1.5	Rs. 1.5

Compare the productivity of material, labour and electrical energy in using materials A and B. Also, Comment on the relative advantage of using either of the materials.

[6][CO1][L3]

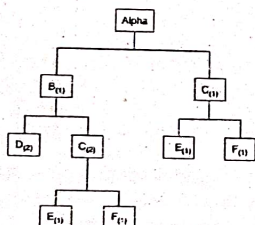
2. (a) Discuss the factors considered for selection of a production system. [4][CO2][L2]

- (b) An assembly consists of following elements. Determine the minimum number of workstations required to avoid the idle time and meet the production of one assembly for each 15 minutes. [6][CO2][L3]

Task	A	B	C	D	E	F	G	H	I	J	K	L
Immediate Predecessor	Nil	A	B	B	B	B	C,D	G	E	I,F	H,J	K
Task Time	12	6	6	2	2	12	7	5	1	4	6	7

3. (a) The daily demand for 52" flat-screen TVs at Sarah's Discount Emporium is normally distributed, with an average of 5 and a standard deviation of 2 units. The lead time for receiving a shipment of new TVs is 10 days and is fairly constant. Determine the reorder point and safety stock for a 95% service level. (z at 95%=1.65). [4][CO3][L3]

- (b) Using the product structure for Alpha as given below, and the lead times as indicated in the Table (below), quantity on hand, and master production schedule, prepare a net MRP table for Alphas.



ITEM	LEAD TIME	QUANTITY ON HAND
Alpha	1	10
B	2	20
C	3	0
D	1	100
E	1	10
F	1	50

Master Production Schedule for Alpha

PERIOD	6	7	8	9	10	11	12	13
Gross requirements			50			50		100

[6][CO4][L6]

4. A Juarez, Mexico, manufacturer of roofing supplies has developed monthly forecasts for a family of products. Data for the 6-month period January to June are presented in Table given below. The firm would like to begin development of an aggregate plan. Find the most suitable aggregate plan (among the constant level production, subcontracting, overtime production and hiring and firing of the workers) for lowest total production costs.

MONTH	EXPECTED DEMAND	PRODUCTION DAYS	DEMAND PER DAY (COMPUTED)
Jan.	900	22	41
Feb.	700	18	39
Mar.	800	21	38
Apr.	1,200	21	57
May	1,500	22	68
June	1,100	20	55
	6,200	124	

Inventory carrying cost	\$ 5 per unit per month
Subcontracting cost per unit	\$ 20 per unit
Average pay rate	\$ 10 per hour (\$80 per day)
Overtime pay rate	\$ 17 per hour (above 8 hours per day)
Labor-hours to produce a unit	1.6 hours per unit
Cost of increasing daily production rate (hiring and training)	\$300 per unit
Cost of decreasing daily production rate (layoffs)	\$600 per unit

[10][CO5][L5]

5. (a) Discuss the steps used to the work study and the objectives of conducting work study for a specific task.

[5][CO6][L2]

- (b) Differentiate quantitative and qualitative forecasting in terms of advantages and disadvantages.

[5][CO4][L2]

6. Write the short Notes on

- (a) Factors influencing the productivity

[2.5][CO1][L2]

- (b) Principles of Motion Economy

[2.5][CO1][L1]

- (c) Material Requirement Planning

[2.5][CO1][L1]

- (d) Chasing and Levelling Strategy of Aggregate Production Planning

[2.5][CO5][L2]

Total no. of Pages: 01

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Roll no.....

I SEMESTER

M.Tech (IEM)

END TERM EXAMINATION

Nov-2024

IEM 509: COURSE TITLE: Industry 4.0 & Smart Manufacturing

Time: 03:00 Hours

Max. Marks: 50

Note: Answer any FIVE questions

All questions carry equal marks. Assume suitable missing data, if any.

- Q.1 (a) Discuss the opportunities for sustainable manufacturing in Industry 4.0. [05][CO 01][BTL 02]
(b) What are the design challenges in smart factories and Industry 4.0 integration? [05][CO 01][BTL 05]
- Q.2 (a) Discuss the Integration of Sensors in Human-Machine Interaction, Industrial IoT. [05][CO 02][BTL 05]
(b) What is the sensor? Explain the types of sensors. [05][CO 02][BTL 01]
- Q.3 (a) Explain about the ethical dimension of cybercrimes. [05][CO 03][BTL 01]
(b) Describe the application of Cyber-Physical Systems (CPS) in agriculture. [05][CO 03][BTL 01]
- Q.4 (a) Elaborate on the necessity of big data and analytics in the implementation industry. [05][CO 04][BTL 02]
(b) Illustrate the applications of 3D printing in Industry 4.0 with suitable examples. [05][CO 04][BTL 02]
- Q.5 (a) Discuss Industry 4.0: Smart and Connected Business Perspective. [05][CO 05][BTL 03]
(b) Interpret the Integration of Sensors in Robots and Artificial Intelligence. [05][CO 05][BTL 04]
- Q.6 (a) How does integrating cloud manufacturing technologies and connected factory systems improve operational efficiency, and what challenges might organizations face during implementation? Provide examples to support your response. [05][CO 04][BTL 04]
(b) Distinguish Viruses and Worms? How it harms our machine. [05][CO 03][BTL 06]
- Q.7 (a) How is Industry 4.0 affecting job creation, displacement, and the emergence of hybrid roles? [05][CO 01][BTL 05]
(b) What steps can organizations and governments take to prepare workers for the Industry 4.0 Era? [05][CO 05][BTL 04]

Total no. of pages: 01

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Roll no.....

1st SEMESTER

M. Tech

END TERM EXAMINATION

NOV-2024

IEM-5205 PRINCIPLES OF MANAGEMENT

Time: 03:00 Hours

Max. Marks: 50

Note: Answer any FIVE questions.
All questions carry equal marks.
Assume suitable missing data, if any.

- Q.1 (a) Discuss the different functions of Management. [5]
(b) Differentiate various levels of Management. [5]
- Q.2 (a) What are the types of skills required for a manager? [5]
(b) Explain the roles of a manager. [5]
- Q.3 (a) Write short notes on Maslow need Hierarchy. [5]
(b) Differentiate Administration and Management. [5]
- Q.4 (a) In business management how the communication is classified? [5]
(b) How information serves in managerial control? [5]
- Q.5 (a) Explain briefly managerial ethics and social responsibility. [5]
(b) What are the tools and techniques of planning used in business? [5]
- Q.6 (a) Explain conflict and coordination in communication in organisation. [5]
(b) Define power, authority and responsibility and their relationship. [5]
- Q.7 (a) Explain the planning process and its various steps broadly. [5]
(b) What do you understand by the term "Effective Leadership"? [5]

Total no. of Pages:

I SEMESTER

END TERM EXAMINATION

Roll no.....

M.Tech.

Nov-2024

IEM5305 Total Quality Management

Time: 03:00 Hours

Max. Marks: 50

Answer ANY 5 questions

Assume suitable missing data, if any.

- Q.1 Explain Deming's system of profound knowledge with specifics in the following industries: (a) Car manufacturing (b) Banking sector.
[Marks=10] [CO#1][BTL#2]
- Q.2 Describe concept of six sigma quality and explain the level of non-conforming product that could be expected from such a process.
[Marks=10] [CO#2][BTL#2]
- Q.3 Explain the cause and effect diagram with an example of Rotor shaft manufacturing.
[Marks=10] [CO#3][BTL#3]
- Q.4 Consider the electrical ceiling fan manufacturing industry. Develop a house of quality showing customer requirements and technical descriptors.
[Marks=10] [CO# 4][BTL#6]
- Q.5 The ABC limited located at Coimbatore is supplying the castings to many electric motor's manufacturers in different parts of the country. The company has been receiving casting defects complaints from their customers. The company has decided to investigate this issue using Statistical process control tool. There are 20 units of a product and the count of defects in each unit has been given Table below.

P.T.O

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Unit no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Count defect	8	6	5	7	15	7	1	8	12	0	5	12	3	1	7	5	13	0	4	3

Establish a control limits using suitable chart. Is this process in control? If not, which samples were out of control? Establish revised control chart.
[Marks=10][CO#5][BTL#5]

- Q6 Write short notes on any TWO [Marks=10][CO# 2, 5][BTL#1]
- ISO 9000 standards
 - Consumer's and Producer's risk
 - Pareto Analysis
 - Process capability

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Total No. of Pages 02

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Roll No.

FIRST SEMESTER

M.Tech. (IEM)

END TERM EXAMINATION

November-2024

IEM-5407

Product Development and Design

Time: 3:00 Hours

Max. Marks: 40

Note: Answer any FIVE questions.
All questions carry equal marks.
Assume suitable missing data, if any.

- Q.1 (a) Define and discuss the importance of creativity in design. Also, (5) (CO 2)
- Q.1 (b) write various barriers to creativity. (3) (CO 1)
- What are the major stages of product design.
- Q.2 (a) What do you mean by Design communication. How does (4) (CO 4)
- drawing and visual aids help the design engineer to share his ideas?
- Q.2 (b) Discuss the guidelines for Design of Manufacturing and (4) (CO 3)
- Design for Assembly.
- Q.3 (a) What are various points that should be included in technical (4) (CO 4)
- report writing for easy and impactful communication.
- Q.3 (b) What is meant by Ergonomics. Define Anthropometrics data. (4) (CO 3)
- Plot and Discuss man-machine interface cycle.
- Q.4 (a) Write different ways to improve profit performance using (6) (CO 5)
- Break Even Chart.
- Q.4 (b) An industry producing 200 toy cars per day involving the (2) (CO 5)
- following cost:
- Direct material cost= Rs. 300/-
- Direct labour cost = Rs. 400/-
- Factory overheads = Rs. 300/-
- Assuming a profit of 10% of the selling price and selling on cost (overhead) 20% of the factory cost, calculate the selling price of one toy car.

- Q.5 (a) Draw and explain phases of a Bath tub curve. (4) (CO)
- Q.5 (b) Prove that $R(t) = e^{-\lambda t}$ (2) (CO)
- Q.5 (c) An electrical equipment has MTBF of 5000hrs and a uniform failure rate. Find the reliability associated with specified service period of 200 hours. (2) (CO)
- Q.6 (a) Discuss the role of computer in Product Design and its development. (4) (CO)
- Q.6 (b) Justify that "Brain storming is the unique approach to the team effort". (2) (CO)
- Q.6 (c) What do you understand by the term Synectics. (2) (CO)

Total no. of Pages: 01

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3rd Semester
M.Tech(IEM)

Roll no.....

Final Term Examination

(IEM-6201) -E-COMMERCE

Nov-2024

Time-3 Hrs

Total Marks-50

Total Five Questions(all are compulsory) Marks indicated in the questions

1. a. Explain the various types of Cloud Services along with their differences. Describe the key advantages of implementing cloud services in e-commerce. [5] -CO1
b. What are OLAP and OLTP systems? Compare their functions and explain how they support decision-making and transaction processing in e-commerce.. [5] -CO2
2. a. What do you understand by cross boarder E-commerce? Explain the benefits of cross boarder E-commerce & their challenges. [5] -CO1
b. Explain Nike's e-commerce strategy for increasing their customer base successfully. What challenges they face in E-commerce implementation?. [5] -CO5
3. a. Compare and contrast the different types of online auctions. How do these auction formats influence buyer behavior and pricing strategies in e-commerce? [5] -CO3
b. Explain the concept of Net Centrism in e-commerce management. How does an internet-centric approach influence business strategies, customer engagement, and global reach? [5] -CO2
4. a. Explain various important legal issues in global E-commerce. [5] -CO1
b. What are Channel conflicts in distribution? Discuss the types and causes of Channel conflict in E commerce. [5] -CO1
5. a. Explain various types of E-commerce fraud and list some best practices for fraud detection & prevention. [5] -CO2
b. Elaborate followings:- [2,5x2= 5] -CO1
i. Electronic Highway Robbery
ii. Software intellectual Property Law.

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END TERM EXAMINATION

Nov-2024

IEM-6405 Advance Operations Research

Time: 03:00 Hours

Max. Marks: 40

Note: All questions carry equal marks. Attempt any four questions.
Assume suitable missing data, if any.

Q.1 [a] Write applications of optimization in defence sector.

[5][CO#2][BTL#2]

[b] What is goal programming? Write the steps of GP model formulation.

[5][CO#1][BTL#1]

Q.2 [a] Find the extremum point(s) and their nature for the function:

$$U = x^2 + 2y^2 + 3z^2 - 4x - 4y - 8z + 10; \quad [5] [CO#3][BTL#3]$$

[b] Minimize the following function;

$$U = x^2 + y^2 + z^2$$

Subject to: $x + y + z - 6 = 0;$

[5][CO#3][BTL#3]

Q.3 [a] Find the minima of following function using quadratic interpolation method with an initial step size of 0.1:

$$F(x) = x^2 - 4x + 5.$$

[5][CO#3][BTL#4]

[b] Explain the Simplex method to solve an unconstrained multi-variable optimization problems.

[5][CO#1][BTL#3]

Q.4 [a] Explain the Gomory's cutting plane method for Integer programming problems.

[5][CO#2][BTL#4]

[b] Solve the following problem using implicit enumeration method:

Minimize, $Z = 2x_1 + 4x_2 + 3x_3$

Subject to constraint:

$$x_1 + x_2 \geq 1; \quad x_2 + x_3 \geq 1; \quad x_1 + x_3 \geq 1; \quad x_1, x_2, x_3 \text{ are binary};$$

[5][CO#3][BTL#6]

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Q.5 [a] Formulate the necessary conditions for the solution by following quadratic programming method:

Maximize $f = 4x_1 + 6x_2 - x_1^2 - x_2^2$

Subject to: $x_1 + x_2 \leq 2$; $x_1, x_2 \geq 0$;

[5][CO#3][BTL#5]

[b] What are multi-objective optimization applications? List some multiobjective optimization methods.

[5][CO#2][BTL#4]

Q.6 Write short notes on **any two** of the following topics:

[a] Geometric Programming; [b] Simulated Annealing;

[c] Stochastic Programming; [d] Karmakar Method.

[5x2][CO#2][BTL#4]

M.TECH

END TERM EXAMINATION

NOVEMBER-2024

COURSE CODE IBT 501

COURSE BIOENERGY

Time: 03:00 Hours

Max. Marks: 40

Note: All questions carry equal marks.
Assume suitable missing data, if any.

- Q.1 Write the differences between biogas, bioethanol and biodiesel. Why biofuels have not been yet established as an alternate to the traditional fuels? Write the efforts made by India to popularise these fuels. [10][CO1]
- Q.2 Explain in detail the unit operations involved in the production of biohydrogen by anaerobic bacteria and photosynthetic algae. Explain the enzymes involved and biochemical pathways in the production of biohydrogen. [10][CO4]
- Q.3 Explain the biodiesel production from Jatropha with the help of a flow diagram. Describe the reaction kinetics for the formation of biodiesel esters. [10][CO3]
- Q.4 Define the following: (Any five) [10][CO1, CO5]
- a) Syngas
 - b) Parali as a bioenergy source
 - c) Sustainable Development in bioenergy
 - d) Indian energy demand
 - e) Application of biotechnology with reference to bioenergy
 - f) Different generation of biofuels

Total no. of Pages: 02

1st SEMESTER

Roll no.....

M.Tech. Industrial Biotechnology

END TERM EXAMINATION

Nov 2024

CODE IBT-505 COURSE: INDUSTRIAL PLANT BIOTECHNOLOGY

Time: 03:00 Hours

Max. Marks: 40

Note: Attempt any 5 questions
Assume suitable missing data, if any.

Q.1a) What is protoplast culture? Explain the steps involved and the enzymes used in protoplast isolation.

b) Describe the process of protoplast fusion and its applications in creating hybrid plants.

[4 +4][CO1, 2]

Q.2a) What do you understand by batch culture? Differentiate between different types of batch culture.

b) What is somaclonal variation? How can it be utilised for development of commercial hybrids?

[4+4][CO2,3]

Q.3 a) What are reporter genes? Give examples. Describe the role of reporter genes like GFP (green fluorescent protein) in identifying transformed cells in tissue culture.

b) What are the ethical issues, such as environmental impact and food safety, related to genetically modified plants.

[4+4][CO4]

Q.4a) Define a bioreactor and explain its significance in large-scale plant cell or tissue cultivation. Discuss how bioreactors enhance scalability, control, and efficiency in tissue culture. [4][CO2]

b) Describe the various stages of cryopreservation and what is the role of cryoprotectants? Give the applications of cryopreservation

[4][CO1]

Q.5a) Describe how transgenic approaches have been used to develop crops resistant to biotic stresses, such as pests and diseases

[4] [CO4]

b) Explain the process of Agrobacterium-mediated gene transfer in plants. How does the T-DNA region in the Ti plasmid facilitate gene transfer?

[4] [CO3]

Q.6 What are biological databases? Explain the types of biological databases and state the importance of biological databases.

[8] [CO5]

OR

What do you understand by plant bioinformatics? Explain different types of plant specific genomic databases

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I - SEMESTER

Total no of pages...

Roll No.....

M.Tech. (IBT-507 Enzyme Technology and Industrial Application)

END SEMESTER EXAMINATION

NOV 2024

Time: 3 Hours

Max. Marks: 40

**Note: Answer any 8 questions. All questions carry equal marks.
Assume suitable missing data, if any.**

1. Give one example of the reaction catalysed by each of the following classes of enzymes. i) Oxido - reductases. ii) Transferases. iii) Hydrolases. iv) Isomerases. (CO# 1)
2. Explain the source and strategy of purification of enzymes? (CO# 4)
3. Define Immobilized enzymes? Explain the techniques of immobilization in details? (CO# 3)
4. Explain the significance of enzymes in diagnostics? (CO# 5)
5. Distinguish between active site, binding site and catalytic sites with reference to product synthesis. (CO# 1)
6. Explain the application of enzymes in different industry. (CO# 5)
7. Explain enzyme inhibition. How would you know whether an inhibitor is competitive or non competitive? (CO# 2)
8. Describe bioreactors for immobilized enzyme. Add a note on difference between free enzyme and immobilized enzyme reactor. (CO# 4)

9. Explain internal and external mass transfer limitations in case of immobilised enzymes. (CO# 3)

Total no. of Pages: 2

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Roll no.....

FIRST SEMESTER

M.Tech.(IBT)

END TERM EXAMINATION

Nov-2024

IBT509 Functional Genomics & Proteomics

Time: 03:00 Hours

Max. Marks: 40

Note : All questions carry equal marks.
Assume suitable missing data, if any.
Attempt any 5 questions.

- Q.1 a) What role does CRISPR-Cas9 play in genome editing?
b) How does TALEN differ from other genome-editing technologies like ZFNs and CRISPR?
[4+4 marks][CO# IBT109.1][BTL#2]
- Q.2 a) Describe how Arabidopsis knockout strategies contribute to understanding gene function in functional genomics.
b) Explain how PCR can be applied to confirm whether a CRISPR-Cas9 gene edit has been successfully implemented.
[4+4 marks][CO# IBT109.2][BTL#2]
- Q.3 a) Demonstrate how you would use mass spectrometry to identify specific post-translational modifications in proteins.
b) Analyze the differences between rational protein design and directed evolution, explaining when each approach might be more advantageous in protein engineering.
[4+4 marks][CO# IBT109.3][BTL#3]

Q.4 a) Illustrate the steps involved in using a microplate capture and detection assay for high-throughput analysis and discuss how it can be applied in a research setting.

b) Assess the advantages and limitations of DNA pull-down assays in comparison to ChIP, and describe situations where each method would be preferable.

[4+4 marks][CO# IBT109.4][BTL#3]

Q.5 a) Analyze the use of synthetic lethal screens in identifying potential drug targets, and discuss the criteria that make a target suitable for therapeutic development.

b) Compare and contrast TAP tagging and His-tagging for protein purification, examining factors such as efficiency, specificity, and suitability for various experimental conditions.

[4+4 marks][CO# IBT109.4][BTL#4]

Q.6 a) What is pharmacogenomics, and how does it use information from the Human Genome Project for personalized medicine?

b) What impact has the Human Genome Project had on the development of pharmacogenomics?

[4+4 marks][CO# IBT109.5][BTL#1]

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Total No. of Pages: 3

Roll No.

M.Tech. IBT
FIRST SEMESTER

END TERM EXAMINATION

November-2024

IBT 5313 Cell and Molecular Biology

Time: 03:00 Hours

Max. Marks: 40

Note: Answer all the questions.
Assume suitable missing data, if any.

- Q.1 [A] Evaluate any TWO of the following [4 marks] [CO1] [BTL4,5]
- (a) Structure of CTD tail of RNA Pol II for its significance in transcription and post-transcriptional processing
 - (b) Structure of *trpL* for its role in attenuation with respect to *trp* levels
 - (c) Structure of GU-AG intron for spliceosomal splicing
 - (d) Changing interactions between various types of RNAs on ribosome for translocation step of prokaryotic translation
- [B] Discuss the functions of any three proteins / RNAs that participate in the post-transcriptional processing of eukaryotic RNAs. Take one example each from post-transcriptional processing of mRNA, tRNA and rRNA. Clearly mention the processes in which each is involved [4 marks] [CO1] [BTL1,2]
- Q.2 [A] Analyze any TWO of the following [4 marks] [CO2,3] [BTL2,3,4]
- (a) p53 triggers cellular apoptosis or cell cycle arrest under stressful conditions. Comment with respect to both p53 stability and control of apoptosis and cell cycle arrest
 - (b) Phosphorylation status of pRb regulates cell cycle. Analyze giving mechanisms of phosphorylation / dephosphorylation and role in control of cell cycle
 - (c) Cytoskeletal elements and motor proteins drive various phases of mitosis. Analyze with respect to cytoskeletal dynamics and motor protein directionality

P.T.O.

- (d) Chemical nature of plasma membrane leads to lipid bilayer formation. Analyze giving its structure in detail
- [B] Attempt any ONE of the following [4 marks] [CO2] [BTL1,2,4]
- (a) Diagrammatically represent the apoptotic pathway(s) showing the involvement of five Bcl-2 family members. Write 5 points for each Bcl-2 family protein
- (b) What are protooncogenes? Assign reasons for their conversion into oncogenes? What effect is seen on cell growth, if one allele of protooncogene is hyperactivated? Also explain the cause of chronic myelogenous leukemia

Q.3 [A] Answer any TWO of the following [4 marks] [CO3] [BTL1,2,4]

- (a) With respect to cell signaling, analyze any two of the following statements with examples
- Same signal may have different effects in different cells
 - Response duration is dependent on signal
 - Molecular switches control cell signaling
- (b) Briefly describe protein components of any one of the following
- Adhesion belts
 - Extracellular matrix
- (c) Briefly describe the roles of various topogenic sequences for targeting of membrane proteins

[B] Draw self-explanatory signaling pathway to show how G-protein linked receptors relay signal for the secretion of saliva or generation of pain and inflammation. Also describe salient points in the pathway

[4 marks] [CO3] [BTL1,2]

Q.4 [A] Attempt any TWO of the following: [4 marks] [CO3,4] [BTL1,2,3]

- (a) Compare and contrast any two of the following
- Endocrine signaling and Synaptic signaling
 - Cell surface receptor and Intracellular receptor
 - Desmosome and Hemidesmosome

- (b) Explain the properties of central core and target mRNA for hammerheaded ribozyme action. How is an in-line nucleophilic attack facilitated?
- (c) MicroRNA (miRNA) directs target mRNA for cleavage. In a flowsheet/ diagrammatic representation, explain the mechanism of action of miRNA in post-transcriptional gene silencing. Clearly examine the roles of various proteins involved in the process
- [B] Vesicular trafficking is specific with respect to the selection of cargo, vesicle budding and fusion to target membrane. Analyze the statement and draw suitable well-labelled diagram(s)
- [4 marks] [CO3] [BTL2,4]

Q.5 [A] Answer any TWO of the following : [4 marks] [CO5] [BTL1,2]

- (a) Enumerate the differences between discontinuous PAGE and continuous PAGE with respect to gel employed and application
- (b) Discuss the role of DNA fingerprinting in paternity testing. Clearly explain with an example
- (c) Explain the principle of real-time PCR. How is it more advantageous than standard PCR? Also give an overview of probes / primers used
- [B] The blot is placed in hybridization buffer for Southern blot hybridization. Give an analysis of various components of hybridization buffer. Giving suitable example, describe non-radiolabeled probe detection
- [4 marks] [CO5] [BTL1,2,4]

* END *

P.T.O.

Total no. of Pages:03

Roll no.....

MTech. / Ph.D. _____ SEMESTER

END TERM EXAMINATION

Dec-2024

COURSE CODE ITY501 COURSE TITLE Linear Algebra & Probability

Time: 03:00 Hours

Max. Marks: 50

Note : All questions carry equal marks.
Assume suitable missing data, if any.

Q.1

- I) Consider the matrix $A = \begin{bmatrix} 5 & 4 & 2 \\ 0 & 1 & 0 \\ 0 & 0 & 3 \end{bmatrix}$. Find the eigenvalues and corresponding eigenvectors of A, and determine if A is diagonalizable? [5][CO#1][BLT#1]
- II) How does linear algebra play a vital role in artificial intelligence field?

$$\text{Let } A = \begin{bmatrix} 2 & 4 & 1 \\ -2 & -4 & 1 \\ 1 & 2 & 0 \end{bmatrix}$$

Find the rank of A, and Determine a basis for the null space of A.

[5] [CO#1][BLT#3]

Q.2

I) Let $\vec{u} = \begin{bmatrix} 3 \\ 1 \\ 4 \end{bmatrix}$ and $\vec{v} = \begin{bmatrix} -2 \\ 0 \\ 2 \end{bmatrix}$

Determine if \vec{u} and \vec{v} are orthogonal. If they are not orthogonal, find a vector \vec{w} that is orthogonal to both \vec{u} and \vec{v} . [5][CO#2][BLT#3]

- II) Let V be the vector space of all polynomials with real coefficients up to degree 3. Determine if the set $S = \{p(x) \in V : p(1) = 0\}$ is a subspace of V. [5][CO#4][BLT#4]

Q.3

- I) Suppose a girl throws a dice. If she gets a 5 or 6. She tosses a coin 3 times and note down the number of heads. If she gets 1,2,3 or 4, she

ossed a coin once and notes whether a head or tail is obtained. If she obtained exactly one head, what is the probability that she threw 1, 2, 3 or 4 with the dice? [5][CO#3][BLT#2]

OR

Let X be a continuous random variable with the following pdf:

$$f_X(x) = \begin{cases} ce^{-x}, & x \geq 0 \\ 0, & \text{otherwise} \end{cases}$$

Where C is a positive constant.

- I) Find C
- II) Find the CDF of $f_X(x)$
- III) Find $P(1 < x < 3)$ [5][CO#3][BLT#2]
- II) X and Y are independent identical distributed random variable with common pdf:

$$f_X(x) = e^{-x} U(x) \text{ and } f_Y(y) = e^{-y} U(y)$$

Find the pdf of the following random variables.

- I) $x + y$
- II) $x - y$
- III) x / y
- IV) $x * y$ [5][CO#3][BLT#4]

Q.4

- I) In an area, 10000 electric lamps are installed. The lamps have an average life of 1,000 burning hours with a standard deviation of 200 hours. Assuming normality, what number of lamps is expected to fail in between 800 and 1200 burning hours? It is given that $P(0 < Z < 1) = 0.3413$. [5][CO#4][BLT#5]
- II) A factory uses tools of a particular type, from time-to-time failure in these tools occur and needed to be replaced. The number of such failure in a day has Poisson distribution with mean 1.25. at the beginning of a particular day there are 5 replacement tools in stock. A new delivery of replacement will arrive after 4 days. If all 5 spares are used before, the new delivery arrives then further replacement can't be made until the delivery arrives. Find I) The prob. That 3 replacements are required over the next 4 days. II) The expected number of replacements actually made over the next four days.

OR

What do you mean by random processes and explain different types of random processes in detail with suitable examples?

[5][CO#4][BLT#5]

Q.5

- I) A simple random sample of size n is taken from the pdf $f_X(x) = 2\theta x e^{-\theta x^2}$ $x > 0$, where $\theta > 0$ is an unknown parameter of θ . Find the estimator of θ by the methods of moments.

OR

Explain the steps of hypothesis testing? Explain the concept of Acceptance Region, rejection Region and critical values in the context of Z statistics in the context of hypothesis two tail testing. Assume the sampling distribution as normal and level of significance as 5%. [5][CO#5][BLT#6]

- II) Suppose following table shows frequency counts of a company customer satisfaction levels related to the location of their store. They surveyed customers from three locations and asked them if they were satisfied (Yes) or not satisfied (No). Apply Chi-square test of independence to determine Using a significance level of $\alpha = 0.05$, if there is a significant association between location and customer satisfaction. Given tabulated Chi square with $(df = 2)$ is 5.991 and $(df = 6)$ is 12.592

[5][CO#5][BLT#6]

Total No. of Pages: 02

FIRST SEMESTER

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Roll No.

M.Tech. (IT)

MID SEMESTER EXAMINATION

Dec-2024

ITY-505 ADVANCED DATA STRUCTURES

Time: 3:00 Hours

Max. Marks : 40

Note : Attempt all Questions.

Assume suitable missing data, if any.

- 1) Given a sequence of operations on splay trees: [8] [CO 1][BTL 6, 4]
Insert(10), Insert(20), Insert(5), Insert(15), Find(10), Delete(5)
i) After each operation, draw the structure of the splay tree and show the tree after the splay operation.
ii) Show that the amortized time complexity of a sequence of n operations on a splay tree is $O(\log n)$ per operation.
- 2) Given the directed flow network below with source s and sink t , use the Ford-Fulkerson method to determine the maximum flow.

[8][CO 4] [BTL 3]

Edge	Capacity	
$s \rightarrow a$	10	
$s \rightarrow b$	8	
$a \rightarrow b$	2	
$a \rightarrow t$	6	
$b \rightarrow t$	10	

- Draw the initial flow network with capacities.
- Identify augmenting paths and compute the flow along each.
- Update the residual capacities after each iteration.
- Write the final maximum flow from s to t .

3)

[5][CO 3] [BTL 4]

- a) Prove that a Hamiltonian cycle exists in the following graph:
A graph $G = (V, E)$ where $V = \{A, B, C, D, E\}$ and the edges are:
 $E = \{(A, B), (A, C), (B, C), (B, D), (C, D), (C, E), (D, E), (E, A)\}$.

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b) What are some limitations of using graph isomorphism algorithms in real-world applications, and what are alternative approaches for approximate matching? [3][CO 3] [BTL 2]

4)

a) Define **open addressing** and **separate chaining** as collision resolution techniques in hash tables. [5][CO 6] [BTL 1,4]

Compare the performance of both techniques with respect to:

i) Time complexity of search, insert, and delete operations

ii) Space efficiency

iii) Handling of collisions

b) Explain why the amortized time complexity of the **delete operation** in Fibonacci heaps is $O(\log n)$, even though the worst-case time complexity can be higher. [3][CO 2] [BTL 5]

5) Consider a complete graph $G = (V, E)$ with vertices $V = \{A, B, C, D\}$ and the following distances: [8][CO 5] [BTL 3,5]

Edge	Distance
A \rightarrow B	4
A \rightarrow C	8
A \rightarrow D	6
B \rightarrow C	2
B \rightarrow D	3
C \rightarrow D	7

Apply the 2-approximation algorithm based on Minimum Spanning Tree (MST) to find an approximate TSP tour and its total cost.

Or

5) Compare and Contrast Approximation Algorithms and Geometric Algorithms. Analyse their primary applications and the types of problems they solve.

[8][CO 5] [BTL 4]

Total No. of Pages 3

FIRST SEMESTER

Roll No.

M.Tech. (IT)

END SEMESTER EXAMINATION

November-2024

ITY-507: ADVANCED OPERATING SYSTEM

Time: 3:00 Hours

Max. Marks : 50

Note : All questions are compulsory.
Assume suitable missing data, if any.

1[a] Write the meaning of the following path expressions:-

[5][CO1][BTL4]

- [i] path read + {write} end
- [ii] path {read} + {write} end
- [iii] path {read} + write end
- [iv] path read + write end
- [v] path read; write end

[b] Consider the data as given in the below matrix. Using the Banker's algorithm, answer the following questions:-

[i] How many resources of type A, B, C, D are there?

[ii] What are the contents of need matrix?

[iii] Find if the system is in safe state? If it is, find the safe sequence.

[5][CO1][BTL3]

Process	Max	Allocation	Available
	A B C D	A B C D	A B C D
P ₀	6 0 1 2	4 0 0 1	3 2 1 1
P ₁	2 7 5 0	1 1 0 0	
P ₂	2 3 5 6	1 2 5 4	
P ₃	1 6 5 3	0 6 3 3	
P ₄	1 6 5 6	0 2 1 2	

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2[a] Consider a group of distributed processors P1, P2, P3, and P4 that use the Ricart-Agrawala algorithm for ensuring mutual exclusion. Assume that P4 is currently in the critical section and there is no other node in the WAITING state.

- [i] Show the STATE and REQUEST_QUEUE entries at each processor.
[ii] Now consider P1 requests critical section at logical timestamp 2 and P2 requests critical section at logical timestamp 3. Now show the updated STATE and REQUEST_QUEUE entries at each processor.

[5][CO2][BTL3]

[b] Consider the space time diagram given in the figure 1. Assume that the logical clocks store only integer values and the initial logical clock values are all initialized to zero. Also assume that after each event, the corresponding logical clock is incremented by 1. List the vector timestamps for each event shown in figure 1:

[5][CO2][BTL3]

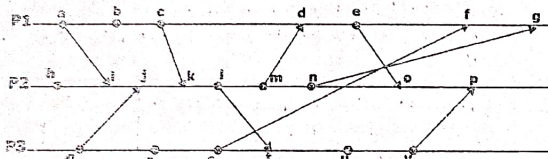


Figure 1

3[a] What are the various design issues in distributing file system?

[5][CO3][BTL2]

[b] Write the advantages and disadvantages of various Load distributing algorithms?

[5][CO3][BTL2]

Or

3[a] Explain the architecture of the DSM systems.

[5][CO3][BTL2]

[b] Write short note on mechanisms for building distributed file system.
[5][CO3][BTL2]

4[a] What do you mean by forward and backward error recovery? Define checkpointing.
[5][CO4][BTL1]

[b] What are the fault tolerant computer systems? What are the differences between commit and voting protocols?
[5][CO4][BTL2]

5[a] What are the different implementations of the access matrix model?
[5][CO5][BTL2]

[b] Consider two prime numbers 13 and 7 and encryption key $e = 5$, Encrypt the Plaintext 3, using RSA public key algorithm.
[5][CO5][BTL3]

Total No. of Pages: 03
FIRST SEMESTER

Roll No. _____
M.Tech./Ph.D.
November -2024

END SEMESTER EXAMINATION
ITY-509 FUNDAMENTAL OF MACHINE LEARNING
Time: 3:00 Hours Max. Marks: 40

Note: Attempt total FOUR questions.
Assume suitable missing data, if any.

- Q1.
- [a] What is the role of Bias, Variance and Bias-Variance tradeoffs in machine learning? [2][CO#1][BTL#1]
 - [b] Discuss the application of Machine Learning for handling text data. [2][CO#5][BTL#3]
 - [c] What are the key differences between the Regression KNN model & the classification KNN model? [2][CO#2][BTL#4]
 - [d] What is temporal differencing and Q-learning? [2][CO#4][BTL#2]
 - [e] What is bagging and boosting in machine learning? [2][CO#4][BTL#2]

- Q2.
- [a] A doctor wants to predict whether a patient has a certain illness based on symptoms. The dataset below shows information about previous patients:

Fever	Cough	Fatigue	Illness
High	Yes	Yes	Yes
High	No	Yes	Yes
Low	Yes	No	No
Low	No	No	No
High	Yes	No	Yes
Low	Yes	Yes	No

If a patient has symptoms (Fever: High, Cough: Yes, Fatigue: Yes), predict whether a patient has the illness. [5][CO#2][BTL#5]

- [b] Suppose you are given the following positively labelled data points: $\{(3, 1), (3, -1), (6, 1), (6, -1)\}$ and the following negatively labelled data points: $\{(1, 0), (0, 1), (0, -1), (-1, 0)\}$. Find the equation of the separating hyperplane that accurately discriminates the two classes using Support Vector Machine. [5][CO#2][BTL#6]

- Q3.
- [a] Define Agglomerative Hierarchical clustering. The table below is an example of a distance matrix. Obtain single linkage and complete linkage dendrogram for the given distance matrix using the concept of "Agglomerative Hierarchical Clustering". [5][CO#3][BTL#5]

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

- [b] Four points A (1, 1), B (2, 1), C (4, 3) and D (5, 4) are lying on a 2-dimensional X-Y plane. Group them into 2 clusters by calculating Euclidean distance using a K-means clustering algorithm. Show all the intermediate centroids and clusters in each iteration. [5][CO#3][BTL#5]

Q4.

- [a] Consider the medical diagnosis data given in below table. Construct a decision tree on the following dataset using the ID3 algorithm. [5][CO5][BTL#3]

Sore Throat	Fever	Swollen Glands	Congestion	Headache	Diagnosis
Yes	Yes	Yes	Yes	Yes	Strep Throat
No	No	No	Yes	Yes	Allergy
Yes	Yes	No	Yes	No	Cold
Yes	No	Yes	No	No	Strep Throat
No	Yes	No	Yes	No	Cold
No	No	No	Yes	No	Allergy
No	No	Yes	No	No	Strep Throat
Yes	No	No	Yes	Yes	Allergy
No	Yes	No	Yes	Yes	Cold
Yes	No	No	Yes	Yes	Cold

[b] Consider a dataset with the following features and labels:

Feature 1 (X1)	Feature 2 (X2)	Label (Y)
2	3	1
4	5	0
3	3	1
5	4	0
6	6	1
7	7	0
8	6	1

A Random Forest classifier is used to predict the label for a new sample where **Feature 1 = 5** and **Feature 2 = 5**. In this case, the forest consists of **3 decision trees**. The decision trees give the following predictions:

- **Tree 1:** Predicts 1
- **Tree 2:** Predicts 0
- **Tree 3:** Predicts 1

Perform the classification using the Random Forest algorithm and what will be the final prediction of the Random Forest model? [5] [CO#3] [BTL#5]

Q5.

Consider a neural network with the following settings:

- A single neuron with input $x_1 = 0.6$, and $x_2 = 0.8$
- The weights are $w_1 = 0.5$ and $w_2 = 0.4$, and the bias $b = 0.1$.
- The activation function is the **Sigmoid function**.
- The desired output $y_{true} = 1.0$.
- Learning rate $\eta = 0.1$.

Perform one iteration of the weight update and find the updated weights and Errors. [Hints: $E = \frac{1}{2} (y_{true} - y_{pred})^2$]. [10] [CO#2] [BTL#6]

[CO#]:- Course Outcome

[BTL#]:- Bloom's Taxonomy

____ SEMESTER

M.Tech.

Roll No. _____

END TERM EXAMINATION

NOV-2024

ITY531: MALWARE ANALYSIS

Time: 3 Hours

Max. Marks: 40

Note : All questions are compulsory.
All questions carry equal marks.
Assume suitable missing data, if any.

- Q.1 Explain the following in brief: [2x4][CO1,CO2,CO4,CO5][L1]
a) What is Metamorphic code?
b) What is Dalvik VM sandbox.
c) What are sensitive contents in Android System?
d) Explain microkernel based operating system.
- Q.2 [4x4][CO1,CO2][L2,L3]
a) Discuss "Good" viruses/worms.
b) How homogeneity of software affect the prevalence of malware?
- Q.3 [4x4][CO2,CO3][L6,L5]
a) Design a procedure to install Ubuntu OS in an Oracle virtual box.
b) Develop a procedure to analyse Cyber Attacks in the year 2024.
- Q.4 [4x4][CO3, CO4][L5,L4]
a) Design a procedure to patch copy.exe executable file.
b) Explain in detail Parcel's role in Android apps communicate with each other.
- Q.5 [4x4][CO4, CO5][L5,L3]
a) Develop a procedure for packing obfuscates strings.
b) Explain statically, runtime, and dynamically linking in binary executable files.

END TERM EXAMINATION

Nov-2024

ITY6331

QUANTUM COMPUTING

Time: 3:00 Hours

Max. Marks: 50

Note: All questions are compulsory. Kindly check the paper code before start your exam.

All questions carry equal marks. Assume suitable missing data, if any.

[M]: Marks allocated to the question. [CO#]: Course Outcome number.

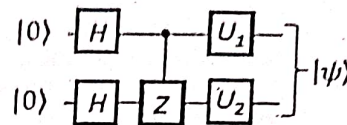
Q.
No.

Question Description

Q.1

(a) Consider the circuit:

[5][CO1,L2]



What should U_1 and U_2 be to prepare the entangled state $|\psi\rangle = 1/\sqrt{2}(|00\rangle + |11\rangle)$.

- (b) Consider the three-qubit state $1/\sqrt{2}(|000\rangle + |111\rangle)$. If Alice holds one of the three qubits, and Bob holds the other two, can Alice use this state to teleport one qubit to Bob? Explain your answer. [5][CO2,L2]

Q.2

(a) What are reversible gates? Explain its applications. [5][CO1,L1]

(b) Consider the following two-qubit quantum state, $|\phi\rangle$ [5][CO2,L3]

$$\frac{\sqrt{2}}{3\sqrt{3}}|00\rangle - \frac{1}{\sqrt{6}}|01\rangle + \frac{2i\sqrt{2}}{3\sqrt{3}}|10\rangle - \frac{5i}{3\sqrt{6}}|11\rangle$$

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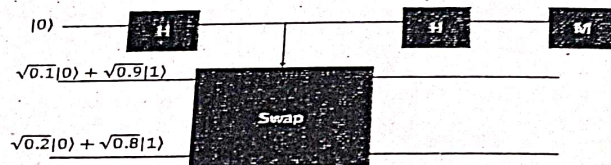
- (i) What are the probabilities of outcomes 0 and 1 if the first qubit of $|\phi\rangle$ is measured?
 (ii) What are the probabilities of outcomes 0 and 1 if the second qubit of $|\phi\rangle$ is measured?

- Q3. (a) Find the QFT inverse of $|2\rangle$ and $|14\rangle$. [5][CO3]
 (b) Explain Bernstein Vazirani Algorithm and draw the circuit for the same? [5][CO4]

- Q4. (a) For quantum state $|\phi\rangle = |0+\rangle$, find the value of $\langle\phi|H|\phi\rangle$ where $H = ZX$. [3][CO3]

- (b) Explain how data is encoded in Quantum Machine Learning? [2][CO4]

- (c) Find the probability that we get $|0\rangle$ after measurement gate M in the below circuit [5][CO3]



- Q5. (a) Explain Quantum Factoring Problem and draw the circuit for factoring $N=15$? (Take $m=7$ such that $\gcd(7,15)=1$) [5][CO4]

- (b) Explain Quantum Search Problem and its Oracle and Diffuser operator with the help of circuit. [5][CO4]

END TERM EXAMINATION

Nov-2024

ITY6413 Mobile Computing

Time: 3:00 Hours

Max. Marks: 40

Note: All questions are compulsory. Kindly check the paper code before start your exam.

All questions carry equal marks.

Assume suitable missing data, if any.

[M]: Marks allocated to the question.

[CO#]: Course Outcome number. [L#]: Level.

Q. No.	Question Description	[M] [CO#] [L#]
Q.1	a) How would you configure a wireless access point in a shared office space to ensure minimal interference and effective spatial reuse?	[3] [CO1] [L3]
	b) Give a situation where multiple devices are streaming data simultaneously, which multiple access protocol would best handle this load and why?	[3] [CO1] [L3]
	c) Describe a scenario where updating the VLR for a mobile device is necessary, and explain how it would affect call handling for that device.	[2+2] [CO2] [L6]
Q.2	a) How does 802.11ax IEEE standard improve user experience in high-density environments like stadiums and airports?	[3] [CO2] [L4]
	OR	
	What is the fundamental purpose of the PCF in the IEEE 802.11 standard, and how does it differ from the DCF?	

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- b) How does TCP handle packet loss differently in wireless networks, where packet loss is often due to interference rather than congestion? [4] [CO2] [L5]
- c) In a mobile banking system, you plan to use RSA for secure communication. How would you implement RSA key management to ensure that both the mobile device and the server can authenticate each other securely? [3] [CO3] [L6]
- Q3. a) How does Bluetooth Low Energy (BLE) differ from classic Bluetooth, and what are some of its common real-life applications? [2+2] [CO1] [L1]
- b) Explain the roles of the home agent and foreign agent in Mobile-IP and how they enable communication for a mobile node? [3] [CO3] [L2]
- c) Explain how data replication can help to improve data availability for mobile users who frequently move between network coverage areas. [3] [CO3] [L1]
- Q4. a) How do nodes use route discovery to establish a path when no route is available? [2] [CO4] [L2]
- b) In the context of Global State Routing (GSR), how do nodes maintain up-to-date routing information despite mobility in the network? [2] [CO4] [L3]
- c) Imagine a mobile network with a large number of nodes. How would you configure FSR to ensure that nodes far from the destination receive less frequent updates, thus, reducing the network load? [2] [CO4] [L5]
- d) In a highly mobile environment, nodes in a MANET frequently join and leave the network. This creates challenges in maintaining up-to-date routing information across the network. [2+2] [CO4] [L5]
- i. How would you ensure that routing tables are updated efficiently to reflect node mobility in such an environment?
- ii. What are the advantages and disadvantages of using proactive vs. reactive routing protocols in this context?

MOC-501 ANTENNA DESIGN AND ANALYSIS

TIME: 03 Hrs.

Maximum Marks: 40

Note:- Attempt any FIVE questions.
All the questions carry equal marks.
Assume suitable missing data, if any.

- Q.1.(i) Explain different regions of an antenna. Derive formula for critical distance (boundary between near field and far field) for short dipole. [CO-1] [3]
- (ii) The radiation intensity of an antenna is given by

$$U(\theta, \phi) = \cos^4 \theta \sin^2 \phi$$
 For $0 \leq \theta \leq \pi/2$ and $0 \leq \phi \leq 2\pi$ (i.e. in the upper half). It is zero in the lower half-space. Find the
 a) Directivity (dimensionless and in dB) [CO-1] [5]
 b) Elevation plane half-power bandwidth (in degrees)
- Q.2.(i) Explain YAGI-UDA with construction features, radiation mechanism and radiation pattern with suitable diagram(s). [CO-2] [4]
- (ii) Design a five turn helical antenna which at 400 MHz operates in the normal mode. The spacing between turn is $\lambda/50$. It is desired that the antenna possesses circular polarization. Determine the
 a) Circumference of the helix
 b) Length of a single turn
 c) Overall length of the entire helix [CO-2] [4]
 d) Pitch angle
- Q.3.(i) Derive formula for HPBW of LPDA. What are the advantages and limitations of LPDA? [CO-2] [3]
- (ii) A communication satellite is in stationary (synchronous) orbit about an altitude of 36000 Km with its transmitter radiating at 8 Watts. (Assume that transmitting antenna is isotropic). The transmitted signal is received by the 12 meter diameter

182 tracking parabolic antenna on the earth at the ISRO tracking station at Sriharikota. Assume no resistive loss in either antenna, perfect polarisation match and perfect impedance match of both the antenna. At a frequency of 2 GHz determine the following:

- a) Power density (watts/m^2) incident on receiving antenna.
- b) Power received by the receiving antenna whose directive gain is specified as 60dB.

[CO-2]
[5]

Q.4.(i) Compare the directivity of Broadside array with that of End fire array. (Support your arguments with derivations.)

[CO-3]
[4]

- (ii) Given a linear, broadside, uniform array of 10 isotropic elements, with a separation of $\lambda/4$ between the elements, find the directivity of the array factor and overall directivity of the array.

[CO-3]
[4]

Q.5.(i) Explain design procedure of rectangular microstrip antenna transmission-line model.

[CO-4]
[5]

- (ii) Design a rectangular microstrip antenna using a substrate (RT/duroid 5880) with dielectric constant of 2.2, $h = 0.1588$ cm (0.0625 inches) so as to resonate at 10 GHz.

[CO-4]
[3]

Q.6 Write Short note on with required expression for the following:

[3+3+2]

- a) Smart Antenna
- b) Antenna Pattern measurement
- c) Resonant Antenna and non-resonant antenna

[CO-5]

[CO-6]

[CO-2]

Total no. of Pages:3

Roll no.....

Ist SEMESTER M.Tech. (ECE)

END TERM EXAMINATION

Nov-2024

COURSE CODE: MOC 505 COURSE TITLE: Optical Comm. Systems

Time: 03:00 Hours

Max. Marks: 40

Note : All questions carry equal marks.

Assume suitable missing data, if any.

Q.1. (a) Elaborate the b-V graph for an optical fiber? Analyze the graph and explain how you will find out if a fiber is a single mode fiber?

[3][CO1][L2,4]

(b) A single-mode step index fiber has a core diameter of 7 μm and a core refractive index of 1.49. Estimate the shortest wavelength of light which allows single-mode operation when the relative refractive index difference for the fiber is 1%.

[2][CO1][L3]

Q.2 Consider an optical link of length 30 km is to operate at a wavelength of 1550 nm, and at a data transmission speed of 100 Mbps. The required bit error rate on the link is 10^{-9} . The power transmitted from the source is 0.01 mW. Splicing is done every 3 kms. Additionally, it is given that, splice loss is 0.4 dB/splice, connector loss is 1 dB/ connector and attenuation loss is 0.6 dB/km.

(a) Comment on the type of the optical fiber that should be used for this link. Give appropriate reasons.

[1][CO1][L3]

(b) Calculate the value of receiver sensitivity (minimum power at the receiver in dBm) for the given BER, if thermal noise dominates, the value of thermal noise standard deviation is 100nA, and the photodiode responsivity is 1 A/W.

[2][CO4][L3]

(c) Calculate the power budget of the given system and evaluate if it is viable or not.

[2][CO5][L5]

Q.3 (a) With the help of a block diagram, elaborate the need and working of a WDM system.

[2][CO5][L2]

(b) Explain, with the help of an energy state diagram, the principle of operation of EDFA. Analyze how the gain of an EDFA depends on the input optical power

[3][CO4,5][L2,4]

Q.4 (a) Explain the need for a QPSK modulation scheme in optical communication. Compare and contrast this with ASK and PSK with regards to its use in receiver configuration.

[3][CO2][L2]

(b) Consider a binary data stream 001011100101011. Apply Bipolar-RZ and Dicode-NRZ to line code this data stream.

[2][CO2][L3]

Q.5 Analyze the performance of an APD and a PIN photodiode in the thermal noise and the shot noise limited zones of operation of an optical receiver, using appropriate equations and the noise versus input power graph. Suggest whether an APD or a PIN would be preferable in each zone.

[5][CO4][L4]

Q.6 Differentiate between homodyne and heterodyne systems with the help of suitable equations. State their respective advantages and disadvantages, with proper explanations.

[5][CO3][L2]

OR

Derive the value of SNR for a heterodyne detection system. What is meant by the 3 dB penalty in a heterodyne system?

[5][CO3][L3]

Q.7 For a digital optical system, derive the value of BER (in terms of the factor Q) and the value of optimum threshold current, assuming Gaussian probability distribution for noise. Include both shot noise and thermal noise in your analysis. Comment on the significance of the Q factor. Show graphically, the relation between BER and the Q factor for this system.

[5][CO4][L3,4]

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Q.8 (a) Consider a silicon p-i-n photodiode incorporated into an optical receiver operating at a wavelength of $0.9 \mu\text{m}$ with the value of the resultant photocurrent, I_p , being 90.1 nA . The dark current in the device at this operating point is negligible and the load resistance is $4 \text{ k}\Omega$. The incident optical power at this wavelength is 200 nW and the post-detection bandwidth of the receiver is 5 MHz . The receiver uses an amplifier with a noise figure of 3 dB . For this system calculate:

- i. Shot noise generated in the system
- ii. Thermal noise in the load resistor at a temperature of 20°C
- iii. SNR in dB considering both thermal and shot noise.

[3][CO4][L3]

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(b) Consider a receiver 'A' with an NEP_A which is larger than that of another receiver 'B', with an NEP_B . Compare the input power required by these receivers to achieve the same value of SNR.

[2][CO4][L4]

Total no. of Pages: 3

Roll no.....

FIRST SEMESTER

M.Tech. (MOC)

END TERM EXAMINATION

Nov-2024

MOC-507

SEMICONDUCTOR OPTOELECTRONICS

Time: 3 Hours

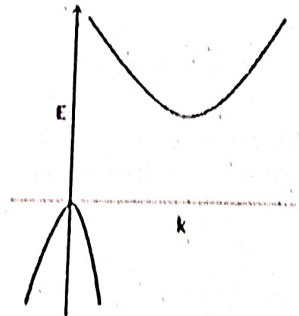
Max. Marks: 50

Note : Attempt any five (5) questions.
All questions carry equal marks.
Assume suitable data, if any.

Q.1

(a) Explain with diagram how energy bands are formed in metals, semiconductors and insulators. Also describe with examples the types of direct and indirect semiconductors. [3+2][CO1]

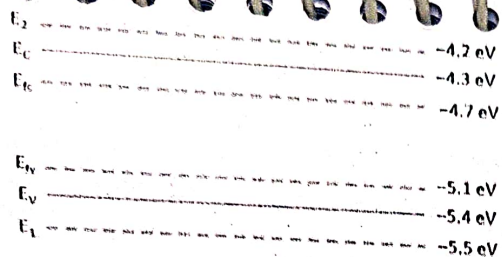
(b) From the E-k diagram given below, explain which bandgap semiconductor material is used. Also interpret whose effective mass (electrons/holes) will be greater. [3+2][CO1]



Q2.

(a) Describe briefly the occupation probability of electrons and holes in a semiconductor. The energy band diagram of a particular semiconductor in quasi-equilibrium at room temperature is shown below. Examine the occupation probability of electrons and holes at E_2 and E_1 respectively.

[3+2][CO2]



(b) Discuss $\rho(k)$, the density of states. What is the unit of $\rho(k)$. A semiconductor has intrinsic carrier density of $3 \times 10^{13} / \text{cc}$ and is n-doped with a doping concentration of $2 \times 10^{16} / \text{cc}$. What is the concentration of holes after doping?

[3+1+1][CO2]

Q3.

(a) At room temperature (300K), the energies corresponding to the band edges and the Fermi level of the particular semiconductor with $m_e = m_v$ are given by: $E_c = -4.2 \text{ eV}$, $E_v = -6.0 \text{ eV}$, $E_f = -5.2 \text{ eV}$.

- Identify and justify whether the semiconductor is p-type or n-type.
- Find the probability of occupation of electrons at the valence band edge.

[2+3][CO3]

(b) Differentiate between spontaneous emission and stimulated emission. Briefly describe what happens to the peak emission wavelength in LED when the temperature is increased.

[3+2][CO3]

Q4.

(a) Illustrate the difference between doping and alloying with examples. Also explain how alloying in a binary semiconductor leads to either increase or decrease in the bandgap energy.

[3+2][CO3]

(b) Explain a semiconductor (laser) amplifier and also discuss the functionality of semiconductor in i) thermal equilibrium and ii) quasi equilibrium.

[3+2][CO3]

Q.5

(a) Explain the working principle and spectral characteristics of PIN diode. A particular PIN photodetector has junction capacitance of 10 pF and load resistance of $1 \text{ k}\Omega$. Find the bandwidth of the detector.

[3+2][CO4]

(b) Describe in detail an Avalanche Photodiode, its working principle, gain characteristics and responsivity.

[5][CO4]

Q.6

Write a short note on any two of the following:

- Vertical cavity surface emitting lasers (VCSEL)
- Quantum well lasers
- Erbium doped fiber amplifier (EDFA)
- Semiconductor optical amplifier (SOA)
- Electro optic modulators (EOM)

[5+5][CO4, CO5]

Total no. of Pages:02

1st SEMESTER

Roll no.....

M.Tech (MOC)

END TERM EXAMINATION

Nov-2024

MOC 509: RF and Microwave

Time: 03:00 Hours

Max. Marks: 40

Note: All questions carry equal marks.

Assume suitable missing data, if any.

Q1. (a) Distinguish between the characteristic impedance and the input impedance of the line. Under what conditions will they be the same in a lossless line. How can the input impedance be made purely inductive, capacitive, infinite and zero?

(3)(CO1)

(b) A 50Ω transmission line is terminated with an impedance $Z_L = (30 + j40)\Omega$. Find the incident and reflected power if the input is $1.5 \cos(2\pi \times 50t)$ as well as the net power flow towards the load.

(3)(CO1)

(c) Find out the T-Parameters of the cascaded device whose S parameter matrices are as

(4)(CO3)

$$\begin{bmatrix} 0.1 & 0.8 \\ 0.8 & 0.1 \end{bmatrix}$$

and

$$\begin{bmatrix} 0.4 & 0.6 \\ 0.6 & 0.4 \end{bmatrix}$$

Q2(a). Explain the basic steps of fabrication of any planar component using photo lithography method.

(4) (CO2)

(b) What is the different between VNA and Spectrum analyzer and how-and what kind of the measurements of any two port device is done on VNA.

(4) (CO5)

(c) Find S parameters of a microstrip line component if measured VSWR=1.3 when the component is terminated with a matched load. It is also found that the power to the matched load is 60 mW for the input of 100mW.

(2)(CO3)

Q3(a) Synthesize a microstrip transmission line for a 50Ω characteristic impedance and a 90° degree phase shift at 2.5GHz . The substrate thickness is $d=0.127\text{cm}$ with $\epsilon_r = 2.2$ (Formulas are given on next page) (4)(CO2)

(b). Prove that it is impossible to construct a perfect matched, lossless, reciprocal three port junction. (3)(CO4)

(c) What is the use of metal coating in the fabrication of any microwave component and Explain the process of metal coating for waveguide devices. (3)(CO4)

Q4 (a). Design a Low pass fourth order maximally flat filter using only shunt stubs. The cutoff frequency is 8GHz . $\{N=4: g_1=0.7654, g_2=1.8478, g_3=1.8478, g_4=0.7654, g_5=1.00\}$ (5)(CO4)

(b) Show that a Periodic structure can exhibit pass band and stop band characteristic. (5)(CO4)

Formulas of Microstrip line

$$\epsilon_e = \frac{\epsilon_r + 1}{2} + \frac{\epsilon_r - 1}{2} \cdot \frac{1}{\sqrt{1 + 12d/W}}$$

$$Z_0 = \begin{cases} \frac{60}{\sqrt{\epsilon_e}} \ln \left(\frac{8d}{W} + \frac{W}{4d} \right) & \text{for } W/d \leq 1 \\ \frac{120\pi}{\sqrt{\epsilon_e} [W/d + 1.393 + 0.667 \ln (W/d + 1.444)]} & \text{for } W/d \geq 1. \end{cases}$$

$$\frac{W}{d} = \begin{cases} \frac{8e^A}{e^{2A} - 2} & \text{for } W/d < 2 \\ \frac{2}{\pi} \left[B - 1 - \ln(2B - 1) + \frac{\epsilon_r - 1}{2\epsilon_r} \left\{ \ln(B - 1) + 0.39 - \frac{0.61}{\epsilon_r} \right\} \right] & \text{for } W/d > 2. \end{cases}$$

$$A = \frac{Z_0}{60} \sqrt{\frac{\epsilon_r + 1}{2}} + \frac{\epsilon_r - 1}{\epsilon_r + 1} \left(0.23 + \frac{0.11}{\epsilon_r} \right)$$

$$B = \frac{377\pi}{2Z_0\sqrt{\epsilon_r}}$$

Total no. of Pages: 3

Roll no.....

3rd SEMESTER

M.Tech (MOC)

END TERM EXAMINATION

Nov-2024

MOC 5314, Semiconductor Microwave Devices

Time: 03:00 Hours

Max. Marks: 50

Note: All questions carry equal marks.
Assume suitable missing data, if any.

- Q.1 a) Sketch the energy-band diagram of zero-biased, reverse-biased, and forward-biased Schottky barrier diode. [2] [CO1] [BLT 3]
- b) An abrupt P-N junction made of silicon ($\epsilon_r = 11.7$) has the acceptor and donor concentrations of $N_A = 10^{18} \text{ cm}^{-3}$ and $N_D = 5 \times 10^{15} \text{ cm}^{-3}$ respectively. Assume device operates at room temperature, Determine: [3] [CO1] [BLT 3]
- Barrier voltage
 - Space charge width in p and n regions
 - Peak electric field across the junction
 - The junction capacitance for a cross-section area of 10^{-4} cm^2 .
- c) Draw the structure of a PIN diode, also sketch charge density, electric field, and potential distribution profile across the different regions. How does a PIN diode operate under various biasing conditions, and how can its behaviour be modelled using an equivalent circuit? [5] [CO2] [BLT 2]
- Q.2 a) Draw the structure of IMPATT diode. Explain how negative resistance can be achieved with this device? [2] [CO2] [BLT 2]
- b) A microwave BJT amplifier is used in a communication system operating at a frequency of 2 GHz. The Signal-to-Noise Ratio (SNR) at the input of the amplifier is measured to [3] [CO3] [BLT 3]

- 20 dB, when the SNR at the output is measured to be 15 dB. Calculate the noise figure (NF) of the amplifier.
- c) Draw and explain the structure of HEMT device. With the help of energy band diagram, explain the operational mechanism of the device. Explain how it is suitable for high frequency application. [5] [CO3] [BLT 2]
- Q.3 a) How do MESFETs differ from MOSFETs? Which of these transistors is more suitable for high-frequency microwave applications? [2] [CO3] [BLT 2]
- b) Discuss different techniques for improving noise performance in microwave BJT? [3] [CO3] [BLT 2]
- c) Draw the structure of microwave BJT. What design modifications are necessary to enhance the frequency response of a Microwave BJT beyond conventional low-frequency BJTs. [5] [CO3] [BLT 2]
- Q.4 a) Draw the small signal hybrid- π Ebers-Moll BJT model. Determine the transconductance and input resistance of BJT using this model. [2] [CO4] [BLT 2]
- b) Explain how S-parameter measurement is useful in device characterization? [3] [CO4] [BLT 1]
- c) Draw the small signal forward biased diode model. A conventional Si- based P-N diode is operated at 300°C has following parameters: $\tau_T = 200\text{ps}$, $R_s = 10\Omega$, $n = 1.2$, operating point of diode is $I_Q = 50\text{mA}$, $V_Q = 0.8\text{V}$. Calculate the differential resistance and capacitance and the impedance of a diode. [5] [CO4] [BLT 4]
- Q.5 a) Design a width of a MOSFET such that a specified current is induced for a given applied bias. Consider an ideal n-channel MOSFET with parameters $L = 1.25\mu\text{m}$, $\mu_n = 650\text{cm}^2/\text{V-s}$, $C_{ox} = 6.9 \times 10^{-8}\text{F/cm}^2$, and $V_T = 0.65\text{V}$. Design the channel width W such that $I_D(\text{sat}) =$

4 mA for $V_{GS} = 4\text{V}$. Also identify the region of operation and calculate the drain current for $V_{DS} = 4\text{V}$.

- b) Derive the expression for the short-circuit current gain of a BJT. Suggest methods to enhance the current gain for high-frequency applications. [5] [CO4] [BLT5]

OR

For a hybrid- π BJT model, plot the short circuit current gain in the frequency range from 10 MHz to 10 GHz. Assume the following parameters are given at collector bias point of 20mA and $T = 300^\circ\text{K}$: $\beta_0 = 140$, $C_\mu = 0.1\text{pF}$, $C_\pi = 5\text{pF}$.

Total No. of Pages: 1

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Roll no.....

3rd SEMESTER
M.Tech. (MOC)

End TERM EXAMINATION

Nov-2024

COURSE CODE: MOC601 COURSE TITLE: Microwave Measurement Techniques

Time: 3:00 Hours

Max. Marks: 40

Note: All questions are compulsory.
Smith chart will given
Assume suitable missing data, if any.

- Q.1 (a) Design a Matching Network to match a load $Y = (4+j5) \text{ m}\Omega$ to $Z = 50 \Omega$. Assume frequency of operation 6 GHz. (Use Smith Chart). Find the reflection coefficient (at the load end) and VSWR of a transmission line ($Z = 50 \Omega$) terminated with a load $Z = 60 + 40j$? [5][CO1]
(b) How can microwave power be measured using bolometer? Give the block diagram of a microwave power meter and explain its principle of operation. [3][CO1]
- Q.2 (a) How can frequency of a microwave signal be measured using a slotted waveguide terminated with a short? [4][CO1]
(b) Explain the block diagram of the Vector Network Analyzer (VNA). [4][CO2]
- Q.3 Explain 8-Term Method error model for two port VNA. Explain the different type of calibration method in detail. [4+4][CO2]
- Q.4 (a) Draw the block diagram of a superheterodyne spectrum analyser and explain the function of each block of it. What is meant by frequency resolution of a spectrum analyser? Which part of a spectrum analyser determines its frequency resolution and how? [4][CO3]
(b) How the sweep time and Resolution bandwidth (RBW) are related for an analog resolution filter? How the spectrum analyser accounts for the video and resolution bandwidths, when a discrete signal is present in addition to noise? [4][CO3]
- Q.5 Explain the following: [4+4] [CO4]
(i) Dynamic Range and Sources of Noise
(ii) Harmonic and Intermodulation Distortion

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NAME

TITLE

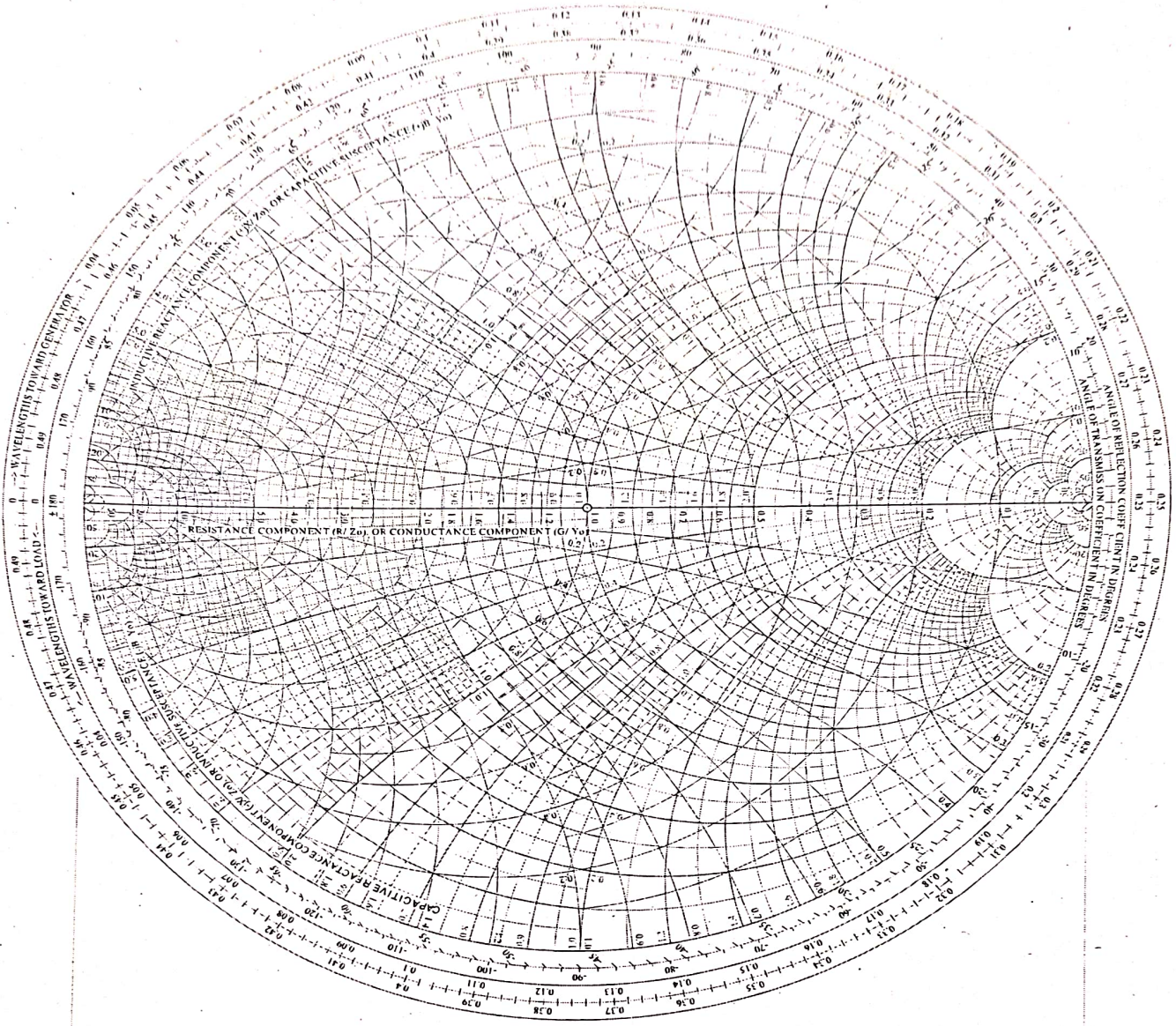
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SMITH CHART FORM ZY-01-N

DOLORE BY J. DOLORE UNIVERSITY OF FLORIDA 1937

DATE

NORMALIZED IMPEDANCE AND ADMITTANCE COORDINATES



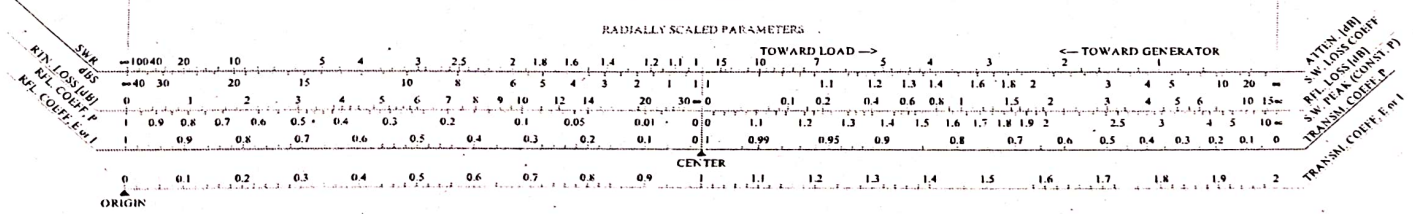
RADIALLY SCALED PARAMETERS

TOWARD LOAD →

← TOWARD GENERATOR

CENTER

ORIGIN



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Total No. of Page 1
ODD SEMESTER (1st Sem)
END SEMESTER EXAMINATION

Roll No...
Ph.D.
Nov-Dec 2024

MST-502: Design and Synthesis of Materials

Time: 3:0 Hours

Max. Marks: 40

Note: Answer all questions.
Assume suitable missing data, if any

Q1. Compare the quantum confinement and resulting structures like quantum dots, quantum wire and quantum wells and their physical significance. [6][CO#1]

Q2. What is the difference between the chemical and physical methods of synthesis? Compare these methods along with biological ones and discuss their advantages and disadvantages. [6][CO#2]

Q3. (a) Discuss the chemical vapour deposition (CVD) method with a suitable diagram and examples. [6][CO#3]

(b) Describe low-pressure chemical vapor deposition (LPCVD) with a suitable diagram and compare it with other CVDs. [6][CO#3]

Q4. Describe the laser ablation method of production of nanoparticles with a suitable diagram. Which is a common laser used for the process and why? [6][CO#4]

Q5. Discuss any *Two* of the following methods used to produce micro-nanoscale materials. [5×2=10][CO#3-5]

- (a) Ball milling
- (b) Sputtering
- (c) Electrospinning
- (d) Colloidal

—END—

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Total No. of Pages: 2

FIRST SEMESTER

END SEMESTER EXAMINATION

Roll No.

PhD Course Work [PHYSICS]

(December, 2024)

MST-504

Structure and Characterization of Materials

Time: 3:00 Hours

Max. Marks: 40

Note: Answer Any FIVE questions.
Assume suitable missing data, if any

1. Answer all the questions.

[2 x 4]

- [a]. Why there is breadth in peak of X-ray pattern of materials rather than a spike at the position of diffracting plane? Explain (CO1)
- [b]. Distinguish between atomic force microscopy (AFM) and piezo force microscopy (PFM). (CO3)
- [c]. Show the Schematic diagram of a typical X-ray emission spectrum showing $K_{\alpha 1}$, $K_{\alpha 2}$ and K_{β} line for Mo spectrum. (CO1)
- [d]. Explain skeleton and characteristic regions in FTIR. How skeleton region is helpful for the characterization in FTIR? (CO3)
- 2[a]. Explain the Imaging and Diffraction modes in TEM. Drawing a schematic diagram, describe working and principle of transmission electron microscope (TEM) to study the internal structure of materials. How HR-TEM provides better results than conventional TEM? (CO4)[5]
- [b]. How many electrons per second can directed at the given area of specimen, for a beam of e's generated by thermionic emission at high temperature of 2700 K and applied potential 40 kV, if the work function of filament material is 4.5 eV. (CO2) [3]

- 3[a]. What is X-ray photo electron spectroscopy (XPS)? Discuss basic principle and instrumentation of XPS. What type of ion is used for depth profiling and why? Write the name and values of thicknesses of different layers while depth profiling by XPS. (CO3) [5]

- [b]. A microscope consists of a 5X objective and a 20X ocular. The distance between the lenses is 15 cm. (a) Determine the overall magnification if the eye is relaxed (b) determine the focal length of the ocular lens (c) the focal length of the objective lens. (CO4) [3]
- 4[a]. What is scanning probe microscopy (SPM)? Discuss the working and principle of scanning tunneling microscopy (STM). Why non-conductive sample cannot be characterized by STM. (CO3) [5]
- [b]. What is atomic sensitivity in AFM? How is it related to distance (deflection) and voltage (force)? (CO2) [3]
- 5[a]. Discuss about Differential Thermal Analysis (DTA) technique. Describe the working principle and instrumentation of DTA with proper diagram. Write the physical and Chemical properties analysed by DTA. (CO5) [5]
- [b]. A thermogram of a magnesium compound shows a loss of 91.0 mg from a total of 175.0 mg used for analyst. Identify the compound either as MgO, MgCO₃, or MgC₂O₄. (CO5) [3]
6. Discuss briefly any **FOUR**. [2 x 4]
- [a]. Thermogravimetric analysis (TGA) (CO5)
- [b]. NaCl crystal structure (CO1)
- [c]. Fluorescence optical microscopy (FOM) (CO4)
- [d]. SE1 and SE2 in scanning electron microscopy (CO5)
- [e]. Non-Contact mode of Atomic Force Microscopy (CO3)
- [f]. Energy dispersive X-ray spectroscopy (EDS) (CO2)
- [g]. Magnetic force microscopy (MFM) (CO3)

FIRST SEMESTER
END SEMESTER EXAMINATION

M.Tech.(PSY)
NOV-DEC 2024

PSY – 501 ADVANCE POWER SYSTEM ANALYSIS

Time: 3hrs

Max Marks:40

Note: Answer any FIVE Questions. All questions carry equal marks. Assume suitable missing data, if any.

Q1. a. What is the significance of x/r ratio of a transmission line? Give typical values of x/r ratio of 220kV and 400kV line. 2

b. How the propagation of signal over transmission line can be explained using 'Modal theory'? 3

c. How the presence of ground return resistance and inductance will modify the series impedance matrix of a transmission line? 3

Q2. a. Explain mathematically how the bus admittance will be modified if a regulating transformer is connected between the two buses? 4

b. Determine the L and U matrix for the following Y_{bus} matrix: 4

$$Y_{bus} = -21j, 10j, 10j ; 10j, -15.8j, 5j ; 10j, 5j, -15j$$

Q3. a. The Y_{bus} matrix of 3 a bus system is given below:

$$Y_{bus} = -20j, 5j, 5j ; 5j, -20j, 5j ; 5j, 5j, -20j$$

There is no current injection at bus 1. Determine reduced Y_{bus} matrix using 'Matrix Partitioning Method'. 4

b. Discuss Z_{bus} building algorithm. What are the modifications used for this? 4

Q4. Consider a 3 bus system with generators at buses 1 and 3. The magnitude of voltage at bus 1 is 1.05 pu. Voltage magnitude at bus 3 is fixed at 1.04pu and real power at 200 MW. A load of 400MW and 250MVAR is connected at bus 2. Line admittances in per unit on a base of 100MVA are: $y_{12} = y_{13} = 10 - j30, y_{23} = 16 - j32$.

The line charging susceptances are neglected. Determine the initial power mismatch matrix of the system using N-R method. 8

Q5.a. Explain 'Equal Area Criteria' for determining the stability of a single machine infinite bus system. 4

b. The fuel inputs of two plants are given by:

$$dF_1/dP_1 = 0.03P_1 + 16 \quad \text{and} \quad dF_2/dP_2 = 0.03P_2 + 12$$

The loss coefficients of the system are given by $B_{11} = 0.005, B_{12} = -0.0012, B_{22} = 0.002$.

The load to be met is 200MW, determine the economic operating schedule and the corresponding cost of generation if, i) losses are coordinated ii) losses are included but not coordinated. 4

Q.6.a. In the given 3 bus system, bus 1, 2 and 3 are connected with each other through transmission lines of per unit impedances of $j0.1$. A generator of impedance $j0.25$ is connected at bus no. 1 and also at bus no.2. Calculate the voltages at the healthy buses and the current

through all the transmission lines when a solid 3-phase fault occurs on bus 3. Assume prefault voltages as 1 pu and prefault current as zero. 4

b. Derive the expression for fault current in a L-G fault and also show how the various sequence networks are connected under this condition. 4

2x4

Q.7. Write short notes on any TWO

- Short circuit capacity of a bus
- Kron's network reduction technique
- Swing Equation and its application in power system

Note: Answer any TEN Questions.

Assume suitable missing data, if any.

- Q.1 From fundamentals derive the swing equation of a single generator connected to a parallel line through the transformer. [4][CO3][BTL2]
- Q.2 Explain in detail about the point by point method of solution for transient stability. [4][CO2][BTL1]
- Q.3 Explain clearly how the angular stability problem occurs in power system. [4][CO1][BTL4]
- Q.4 Obtain computation of $C_p [C_p]^{-1}$. [4][CO1][BTL6]
- Q.5 A generator is connected to an infinite bus through an external impedance of jX_e . If $E_b = V_{to} = 1.0$ p.u. Find the initial conditions. Assume $X_e = 0.28$ p.u. Consider the generator data: $X_d = 1.8$, $X_q = 1.7$, $X'_d = 0.18$, $X'_q = 0.25$, $R_a = 10.0$, $T'_d = 0.5$ sec, $T'_q = 0.1$ sec, $H = 5$ Sec and $f = 50$ Hz. [4][CO3][BTL3]
- Q.6(a) What are sub-transient and transient inductance for a synchronous?
(b) What is power system inertia? How it is expressed? [4][CO1][BTL1]
- Q.7 Derive the flux linkage equation for synchronous machine system. [4][CO3][BTL1]
- Q.8 What is the importance of park's transformation? Apply it to transform electrical and mechanical equations of synchronous machine. [4][CO3][BTL2]
- Q.9 Draw the functional block diagram of excitation control system of a synchronous generator and explain each block. [4][CO3][BTL1]
- Q.10 From fundamentals obtain block diagram representation of SMIB. [4][CO4][BTL1]
- Q.11 Write a brief note on classification of power system stability [4][CO1][BTL4]
- Q.12 Discuss the following: i) State space equation for power System model.
ii) Basic concepts in applying PSS. [4][CO1][BTL4]

END TERM EXAMINATION

Nov-2024

COURSE CODE PSY-507COURSE TITLE: Power Electronics for Renewable Energy

Time: 03:00 Hours

Max. Marks: 40

Note : Answer any five questions out of seven.

All questions carry equal marks.

Assume suitable missing data, if any.

Q.1a Discuss conventional DC-AC converter configuration(s) for single-phase and three-phase systems. [4][CO#1][BTL#L2]

1b. Draw and explain isolated DC-DC converters. [4][CO#1][BTL#L2]

Q.2a Discuss carrier based PWM technique. What is bipolar and unipolar PWM scheme. [4][CO#4][BTL#L2]

b. Discuss the need of applying standard PI controller for control of power converters [4][CO#4][BTL#L3]

Q.3a. Discuss the need and importance of Clarke's and Park's transformations in the design of SRF-PLL. [4][CO#2][BTL#L4]

b. Explain SOGI-PLL. Evaluate and show the following plots considering single-phase 220V(rms), 50Hz sinusoidal input voltage (i) in-phase component, (ii) quadrature component (iii) theta (iv) angular frequency. [4][CO#2][BTL#L5]

Q.4a Develop electrical model of a PV cell. Explain how the cells need to be connected appropriately to form a 1kW PV array.

[4][CO#3][BTL#L3]

Q.10 b. What is the need of MPPT? Analyze any one technique listing briefly its advantages and disadvantages w.r.t other techniques. [4][CO#3][BTL#L4]

Q.5a Using suitable diagram, draw and discuss the control of a two stage grid connected PV system. [4][CO#3,4][BTL#L4]

b. Discuss partial/ full scale power converter based wind turbine classifications with suitable diagrams. [4][CO#3,4][BTL#L3]

Q.6a Explain why grid requirements for renewable integration are stipulated. Explain a few IEEE regulations in this regard. [4][CO#4][BTL#L2]

b. Discuss a practical circuit of an active single phase AC/DC full bridge rectifier highlighting its control scheme also. [4][CO#1][BTL#L4]

Q.7 Write short notes on (any two)

(i) Quadrature Signal Generators [4][CO#2][BTL#L2]

(ii) Control strategy for wind turbine system [4][CO#3,4][BTL#L4]

(iii) I-V and P-V characteristics of solar PV with irradiance and temperature variations [4][CO#3,4][BTL#L3]

END TERM EXAMINATION

November-2024

COURSE CODE: PSY-509

COURSE TITLE: Flexible AC Transmission Systems

Time: 3 Hours

Max. Marks: 50

Note : Answer any five questions.
Assume suitable missing data, if any.

- Q.1 (a) Define 'FACTS'. Elaborate on the classification of FACTS controllers / FACTS devices. [2] [CO1][BTL1]
(b) Draw neat diagrams of a TCR and a SVC. How is a SVC better than a TCR ? [2] [CO2][BTL2]
(c) Design per phase parameters of a SVC rated 3 phase, 11 kV, 50 Hz, +100 kVAR, -50 kVAR. [6] [CO2][BTL2]
- Q.2 (a) Draw the V-I and P- δ characteristics of a STATCOM and a SVC. Explain how STATCOM is better than a SVC [4] [CO3][BTL1]
(b) A SVC is connected to a single phase load bus. The SVC fixed capacitor has a value of 2.0 p.u. The bus voltage is 1.0 p.u. The SVC draws a fundamental lagging current of 0.5 p.u. when the firing angle is 120° . What is the fundamental current drawn by the SVC at a firing angle of 150° ? [6] [CO2][BTL4]
- Q.3 (i) Draw the STATCOM output voltage and the current (assumed sinusoidal) waveforms over a complete cycle for a STATCOM supplying reactive power to the bus. [2] [CO3][BTL2]
(ii) Repeat (i) when STATCOM is consuming reactive power from bus. [2] [CO3][BTL2]
(iii) Draw six separate circuit diagrams for only case (i) above indicating clearly on them which of the devices (G1-G4 and D1-D6) are conducting over the relevant portion of the waveforms. [6] [CO3][BTL4]
- Q.4 (a) Draw the schematic diagrams of a typical (i) STATCOM and (ii) SSSC. [2] [CO3][BTL1]

(b) For a SSSC, why V_{sc} is kept at 90 degrees to the I_{line} ? Explain with neat diagrams. 202
[2] [CO4][BTL2]

(c) Fig. 1 shows the equivalent circuit of a STATCOM connected to a load bus. The bus voltage is $1 \angle -20^\circ$ p.u. The coupling transformer reactance is 0.15 p.u. Assuming a lossless STATCOM, find the magnitude of the fundamental STATCOM output voltage ' V_{sh} ', if the STATCOM consumes a reactive power of 0.15 p.u. from the bus. [6] [CO3][BTL4]

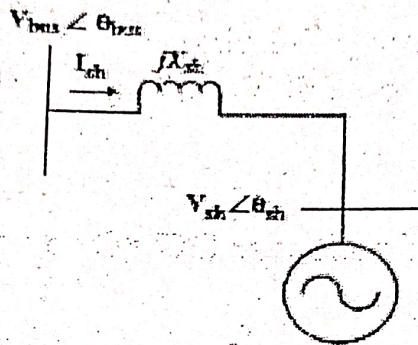


Fig 1: Equivalent circuit of a STATCOM connected to a bus

Q.5. (a) Derive an expression for the active power transfer P_{12} over a transmission line with SSSC operating in the capacitive mode. Also draw the power angle plots. How to achieve the different plots practically? Explain with neat diagrams. [4] [CO4][BTL4]

(b) Draw the three-phase connection diagram of a SSSC connected to a transmission line, showing clearly the connections in the individual phases. [6] [CO1][BTL6]

Q. 6. (a) What is the function of the DC capacitor in the SSSC. [2] [CO4][BTL2]

(b) Draw the schematic diagram of a UPFC. [2] [CO5][BTL1]

(c) Draw the three-phase connection diagram of a typical UPFC. [6] [CO5][BTL6]

Total No. of Pages:2

FIRST SEMESTER

END TERM EXAMINATION

PES-501 ADVANCED POWER SEMI CONDUCTOR DEVICES AND MAGNETICS

Roll No.....

M.Tech. (PES)

NOV-2024

Time: 3:00 Hours

Max. Marks: 40

Note: Answer ANY FIVE questions and all carries equal marks. Write the ANSWERS IN A SEQUENCE. Assume any data if missing and clearly mention the assumption.

- Q(1) (a) (i) What are the characteristics for an ideal power device?
(ii) Describe the characteristics for an ideal power rectifier?
(iii) How do the characteristics of actual power rectifiers differ from those for the ideal device?
(iv) Describe the characteristics for an ideal power transistor?
[4x1=4M][CO1][BTL1]
- (b) Compare Si-power semiconductor devices of Thyristor, Power BJT, Power MOSFET, GTO and IGBT in terms of various parameters such as (i) voltage and current ratings (ii) Linear/trigger (iii) gating (iv) voltage blocking (v) SoA (vi) conduction drop (vii) switching frequency (viii) turn ON/ OFF time
[4M][CO1][BTL2]

- Q(2) (a) Compare and summarize the material parameters for silicon (Si) and silicon carbide (4H-SiC)
[4M][CO2][BTL2]
- (b) Explain Structures and operation principle for two types of FRDs (fast recovery diodes) (i) PiN diode with a buffer Structure. and Doping profile (ii) Structure of self-adjusting P emitter efficiency diode (SPEED).
[4M][CO2][BTL2]

- Q(3) (a) Illustrate the basic structure and its doping profile for the silicon carbide power thyristor
[4M][CO3][BTL3]
- (b) An $N^+PN - P^+$ power thyristor structure with uniformly doped N^+ cathode, P-base, N drift and P^+ anode regions. The N^+ cathode region has a doping concentration of $2 \times 10^{19} \text{ cm}^{-3}$ and thickness of $10 \mu\text{m}$. The P-base region has a doping concentration of $2 \times 10^{17} \text{ cm}^{-3}$ and thickness of $20 \mu\text{m}$. The N-drift region has a doping concentration of $5 \times 10^{13} \text{ cm}^{-3}$ and thickness of $300 \mu\text{m}$. The P^+

Wire Size Table

SWG	Diameter with enamel (mm)	Area of bare conductor (mm ²)	R/km @20°C (Ω)	Weight (kg/km)
45	0.085	0.003973	4340	0.0359
44	0.097	0.005189	3323	0.0481
43	0.109	0.006567	2626	0.061
42	0.119	0.008107	2127	0.075
41	0.132	0.00981	1758	0.0908
40	0.142	0.011675	1477	0.1079
39	0.152	0.0137	1258	0.1262
38	0.175	0.01824	945.2	0.1679
37	0.188	0.02343	735.9	0.2202
36	0.218	0.02927	589.1	0.2686
35	0.241	0.03575	482.2	0.3281
34	0.264	0.04289	402	0.3932
33	0.287	0.05067	340.3	0.465
32	0.307	0.0591	291.7	0.5408
31	0.33	0.06818	252.9	0.6245
30	0.351	0.07721	221.3	0.7011
29	0.384	0.09372	184	0.8559
28	0.417	0.111	155.3	1.014
27	0.452	0.1363	126.5	1.245
26	0.505	0.1642	105	1.409
25	0.561	0.2027	85.1	1.851
24	0.612	0.2452	70.3	2.233
23	0.665	0.2919	59.1	2.655
22	0.77	0.3973	48.4	3.607
21	0.874	0.5189	33.2	4.702
20	0.978	0.6567	26.3	5.939
19	1.082	0.8107	21.3	7.324
18	1.293	1.167	14.8	10.537
17	1.501	1.589	10.8	14.313
16	1.709	2.075	8.3	18.678
15	1.92	2.627	6.6	23.64
14	2.129	3.243	5.3	29.15
13	2.441	4.289	4	38.56
12	2.756	5.48	3	49.22
11	3.068	6.818	2.5	61
10	3.383	8.302	2.1	74
9	3.8	10.51	1.6	94
8	4.219	12.97	1.3	116

anode region has a doping concentration of $2 \times 10^{19} \text{ cm}^{-3}$ and thickness of $50 \mu\text{m}$. The Shockley-Read-Hall (low-level, high-level, and space-charge generation) lifetime is 10 ns in the N^+ cathode and P^+ anode regions, $10 \mu\text{sec}$ in the P-base and N- drift regions. Ignore band-gap narrowing and Auger recombination. Use a bipolar diffusion constant D_a of $15 \text{ cm}^2/\text{s}$ for the on-state calculations. The structure has a linear cell geometry with an emitter width of 0.5 cm and length of 1 cm . What is the blocking voltage capability for the device?

[4M][CO3][BTL4]

Q(4) (a) Explain the cross section of planar power MOSFET with contributions of on-state resistance for 30V and 600V MOSFETs

[4M][CO4][BTL3]

(b) Determine the ideal specific on-resistances for n-channel 4H-SiC power MOSFET structures with breakdown voltages of 300, 600, 1000, and 5000 volts. Take into account the variation of the critical electric field and mobility with doping concentration.

[4M][CO4][BTL4]

Q(5) (a) illustrate the basic structure for an n-channel symmetric IGBT structure diagram

[4M][CO5][BTL3]

(b) Mention the steps in selecting a transformer core and windings for an isolated DC-DC converter.

[4M][CO5][BTL5]

Q(6) The buck converters input voltage and output voltage are 24V and 15V, respectively, with an output current of 1A. The inductor current ripple is 10% of the inductor current, and the capacitor voltage ripple is 2% of the capacitor voltage. Consider a switching frequency of 50kHz and design the inductor by using EE Core. Mention the area product and number of turns and verify whether the selected core window area is sufficient. Use the data given in the datasheet attached to design the inductor.

[4M][CO5][BTL6]

Datasheet for Design of Inductor

Cores without air gap	Mean length per turn (mm)	Mean magnetic length (mm)	Core cross-section area A_c (mm ²)	Window area A_w (mm ²)	Area product A_p (mm ⁴)
Pot Cores					
P18/11	35.6	26	41	27	1161
P26/16	52	37.5	94	51	4982
P30/19	60	45.2	136	75	10200
P36/22	73	53.2	201	101	20301
P42/29	86	68.6	264	181	47784
P66/56	130	123	715	518	370120
EE Cores					
E20/10/5	38	42.8	31	47.8	1481
E25/9/6	51.2	48.8	40	78	1120
E25/13/7	52	57.5	55	87	4785
E30/15/7	56	66.9	59.7	119	7104.3
E36/18/11	70.6	78	111	141	18471
E42/21/9	77.6	108.5	107	256	27192
E42/21/15	93	97.2	182	256	46592
E42/21/20	99	98	235	256	60160
E65/32/13	150	146.3	266	517	142842
UU Cores					
UU 15	44	48	32	59	1888
UU 21	55	68	55	101	5555
UU 23	64	74	61	136	8296
UU 60	183	184	196	1165	228340
UU 100	29.3	308	645	2914	1879530
Toroid					
T 10	12.8	23.5	6.2	19.6	121.52
T 12	19.2	30.4	12	44.2	530.4
T 16	24.2	38.7	22	78.5	1570
T 20	25.2	47.3	22	95	2090
T 27	34.1	65.94	61	165.1	6914.2
T 32	39.6	68	61	165.1	10071.1
T 45	54.7	114.5	93	615.7	57260.1

Other Details:

Current Density, $J = 3 \times 10^6 \text{ A/m}^2$
Winding Factor, $K_w = 0.6$
Maximum Flux Density, $B_m = 0.25 \text{ T}$
Air gap length, $l_g = 0.5 \text{ mm}$

Note: Questions No. 1 & 2 are compulsory.
 Answer any 7 of the remaining questions.
 Assume suitable data if necessary.
 Allotted marks are mentioned in the question.

1. Giving reasons explain briefly, why?

- [a] Diode bridge rectifiers operate with unity dpf .
- [b] Voltage doublers are not employed for large rating.
- [c] Conventional Buck converters are not prescribed for MPPT of PV panel.
- [d] Valley fill circuit for the diode bridge rectifier improve the pf only in the limited range.
- [e] Near sinusoidal AC side input current is obtainable only with boost type PFC.
- [f] Inverter switched with bipolar PWM require large input filter.
- [g] Constant band hysteresis control of sinusoidal current output VSI deals with variable frequency whereas, sinusoidal band hysteresis deals with variable current ripple.
- [h] Flyback converter employs coupled inductor to transfer power whereas, Forward converter employs transformer.

1x8

2 [a] Derive the design equations for the LC output filter for the single phase diode bridge rectifier.

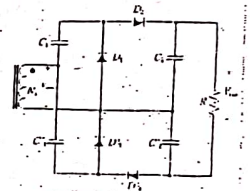
3

- [b] Derive the expression for the fundamental for the R & C parameters of a RCD turn-off snubber. Design a turn-off RCD snubber for a transistor switch operating at 100kHz with a duty ratio of 50% and transistor turn-off time of 0.1 μs . Operating voltage is 200V and load current is 10A. Use criterion that switch voltage reaches V_s when switch current reaches zero. Determine overall turn-off losses with and without snubber.

3

[c] Estimate the steady state output voltage of the circuit in the Fig.

2



3 [a] Using fourier analysis derive the equation of the voltage output of a thyristorised full bridge converter feeding load with large L/R ratio.

4

[b] Design a SEPIC converter for the following specifications:
 $V_m[3V-5.7V]$; $V_{out}=3.3V$; $P_{out}=8.25W$; $f_s=330kHz$. Assume 100% efficiency, voltage drop of 0.5V on diode during conduction, same current ripple for both the inductors (40% of maximum averaged inductor current), 10% ripple across coupling capacitor and 1% ripple at output voltage.

4 [a] Determine the range of the delay angle α and corresponding power delivered by a single phase full bridge converter feeding RLE load, so that the input power factor is at least 0.75 and the minimum output power delivered to a 5Ω load resistor is 1.2 kW. Assume converter is fed from 230V, 50 Hz supply, $L=125mH$, and $V_{dc}=24V$.

[b] The battery charger realized with a three-phase thyristor bridge rectifier fed from 415V, 50 Hz AC source with series RL impedance ($R=20\Omega$; $L=200\mu H$) on DC side connected in tandem with 8 units of 12V 62Ah lead acid battery packs. The nominal cell voltage is 2V, whereas, under deep discharge, the cell voltage reaches 1.8V and end of the constant current charging is marked at 2.267V per cell. Determine the change in the angle of triggering for the thyristors so the load current is held constant during charging of the battery pack. For the minimum battery voltage, the angle of triggering (α) for the thyristors is kept at $\alpha = 45^\circ$ to realize charging @C/4.

5 [a] For a buck converter with the following parameters: $V_m=80V$, $R_o=18\Omega$, $P_o=100W$, $L=0.4mH$, and $f_s=150kHz$. Determine the mode of operation, and estimate the range R_o for the converter to remain in the CCM.

[b] For the flyback converter, consider the case when the converter is required to deliver 500 W to a voltage bus at 48 V from a dc input voltage bus of 400 V while operating at switching frequency of 250 kHz. It is desired to operate the converter between 40% and 60% duty ratio and its magnetizing inductor ripple not to exceed 10% of its average value. Design for transfer ratio and magnetizing inductor value.

6 [a] A single phase grid connected full bridge MOSFET based Voltage Source Inverter (VSI) is switched with bipolar switching pattern having switching frequency $f_s (=17kHz)$. The coupling of grid is through LC filter. The active power fed into the grid is 5kW. There is no reactive power transaction. Assume: $V_{DC}=400V$, $V_{AC}=230V$ (50Hz), $L_f=4mH$, $C_f=5\mu F$. Calculate the rms current of the MOSFETs.

[b] A single phase full-bridge voltage-source inverter fed from $V_{dc}=150V$, feeding to a resistive load of $R=12\Omega$ at 50Hz. Sketch the waveforms for v_o , and i_{dc} (current drawn from DC bus) and determine the average power delivered to the load when producing one pulse per half cycle chopped from either side with $\alpha=10^\circ$.

END TERM EXAMINATION

Nov-2024

PES 507 Controller Design of Power Electronic Converter

Time: 03:00 Hours

Max. Marks: 40

Note : Answer any five questions
All questions carry equal marks.
Assume suitable missing data, if any and indicate it.

- Q.1 (a) Which parameters are determined by applying volt-sec balance and current-sec balance in DC-DC converters? Explain it with suitable example. [CO1, L1,2]
- (b) Mention the parameters required for designing the DC-DC converter. Explain the role of switching frequency. [4+4] [CO1, L1]
- Q.2 Draw the circuit diagram and equivalent circuits in each mode of ideal buck-boost converter. Derive the equations of inductor voltage, capacitor current and input current averaged over one switching period with labelled waveforms. [8] [CO2, L3]
- Q.3 Ideal Boost DC-DC converter has an input voltage of 12V and the output voltage of 24V. Load resistance is 10Ω . Inductance, capacitance and switching frequency values of the converter are $500\mu\text{H}$, $440\mu\text{F}$ and 40kHz respectively. Compute control to output transfer function. [8] [CO1, 2, L3]
- Q.4 For a given DC voltage regulator shown in Fig. 1, design $G_c(s)$ as PID compensator for full bridge converter.

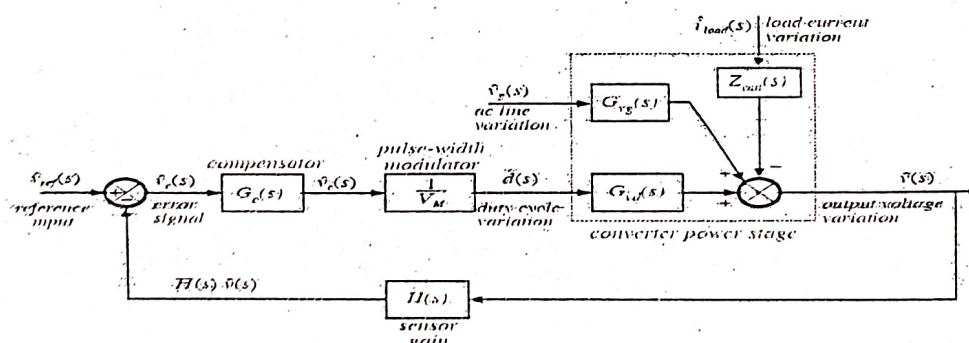


Fig. 1. Block Diagram of DC Voltage regulator

[8] [CO4, L3-6]

- Q.5 Draw the circuit diagram and equivalent circuits in each mode of flyback converter under continuous current operation. Draw the labelled waveforms of current/voltage through/across the controlled switch, inductor and capacitor in all operating modes. Write state space equations in each mode. [8] [CO2, L3-5]
- Q.6 Determine PD compensator parameters for forward converter having voltage mode control. Assume suitable phase margin and crossover frequency. [8] [CO2, 3, 4, L3, 5]
- Q.7 Determine PI compensator parameters for buck-boost converter having current mode control. Find control to output transfer function. Explain control scheme. [8] [CO2, 3, 4, L3, 5]
- Q.8 Determine equivalent control law for boost converter. Explain sliding mode control scheme with suitable diagrams. [8] [CO5, L3, 6]

Total No. of Pages: 02

Roll No.

FIRST SEMESTER
END-SEMESTER EXAMINATION

M.Tech.[PES]
(Nov-2024)

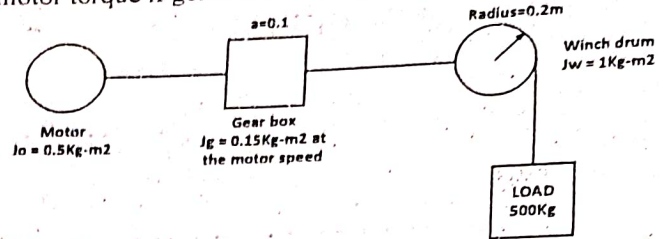
PES-509 Electric Drives and Systems

Time: 03 Hour

Max. Marks:40

- Q1. a. If the starting torque of a DC series motor, separately excited DC motor and a 3- phase induction motor are compared under normal rated supply conditions, which one of them develops the largest starting torque (as a ratio of the rated torque) and why? 10 CO1
- b. The speed of a motor is being sensed by an encoder having 400 holes uniformly carved along the periphery of a disc coupled to its shaft. The number of pulses counted is 25 for 200 msec. what is the speed of the motor in rpm?
- c. The critical speed for a particular value of firing angle for a single phase semi controlled separately excited DC motor drive will be less than the critical speed for a fully controlled converter case for the same firing angle assuming same magnitude of AC supply. Is this statement always TRUE? Justify.
- d. A DC shunt motor is originally running in clockwise direction. If the supply terminal are reversed and it is started afresh, in which direction it will rotate and why?
- e. Draw the torque speed characteristics of shunt DC motor while being braked by. i. Dynamic braking ii. Plugging also justify which develops higher braking torque.
- Q2. A paper cutting machine has a load torque requirement of 1000 KN-cm for 15 sec followed by a 100 KN-cm for 25 sec. the speed torque characteristics of the drive motor is given by $T = 18000 - 20N$. Where N is speed in rpm. The moment of inertia of the flywheel attached to the shaft + motor is 800 kgm². Calculate the maximum and minimum values of torque and speed. Derive any formula used. 7.5 CO2
- Q3. Derive the expression for voltage for a single-phase full converter fed DC motor drive, when current has ended before $\pi + \alpha$ and after $\pi + \theta$. Where α is the firing angle and $\theta = \sin^{-1}(E/V_m)$. draw suitable waveform as well. 05 CO3

- 210
- Q4. In the mechanism shown, motor drives the winch drum through a reduction gear with a gear tooth ratio of 0.1. the friction torque at winch shaft is 15N-m and at motor shaft is 10N-m. motor speed is 1500rpm. Calculate the equivalent moment of inertia of the drive referred to motor shaft and motor torque if gears have an efficiency of 90%.



- Q5. A 220V 960rpm 12.8A separately excited DC motor has armature resistance and inductance of 2Ω and 150mH. It is fed from a single phase half controlled rectifier with an AC source voltage of 230V, 50Hz. Calculate motor torque for $\alpha = 60^\circ$ and speed = 600rpm.
- Q6. A 3phase induction has an efficiency of 0.9 when the load is 37kW. At this load the stator copper and rotor copper losses each equals the iron loss. The mechanical loss are 1/3 of no load loss. Calculate the slip.

OR

A 230V 970 rpm 100A DC separately excited motor has an armature resistance of 0.05Ω . it is braked by plugging from an initial speed of 100rpm. Calculate

- Resistance to be placed in armature circuit to limit braking current to twice the full load value.
- Braking torque.
- Torque when the speed has fallen to zero.

XXXXXXXXXXXX

Total no. of Pages:

211

Roll no.....

1st SEMESTER

M.Tech.(PES)

MID TERM EXAMINATION

Nov.-2024

COURSE CODE: PES5301

COURSE TITLE: POWER ELECTRONICS
FOR PHOTOVOLTAIC AND WIND ENERGY SYSTEMS

Time: 01:30 Hours

Max. Marks: 40

Note : Attempt any five questions.
Assume suitable missing data, if any.

- Q.1 What should be the structure of a diversified energy sector that is fully resilient to the energy crisis? How the cogeneration of solar and wind energy may be helpful in meeting the growing energy demand from India's perspective. [8]
- Q.2 (a) Discuss the role of inertia in grid stability. How the large penetration of renewables may impact the overall stability of a given system? Please explain with the help of suitable example/case study. [8]
- Q.3 (a) Discuss the role of power electronics in harvesting the energy from intermittent renewables. How the ill effect of large penetration of renewables can be effectively managed by these power electronics devices? [4]
- (b) (a) A solar cell having an area of 100 cm^2 gives 3.1 A current and 0.5 V at maximum power point under standard testing conditions. The cell gives 3.5 A short circuit current and 0.6 V open circuit voltage. What is the maximum power point of the solar cell? Also find out the efficiency of the cell [4]
- Q.4 (a) Describe the working principle of standalone SPV system with only AC/DC load, electronics control circuit and battery. [4]
- (b) Give a brief control description on Grid tied renewable interfacing inverter. Discuss the criteria of sizing DC-link voltage and its capacitance. How the grid interfacing inverter can be helpful in mitigating the load harmonics and load reactive power compensation at PCC. [4]
- Q.5 (a) Explain the working principle of Doubly fed Induction Generator with its control diagram also comment on the slip power control methodology in DFIG. [4]
- (b) A 400KW, 3 Blade wind turbine is designed to deliver full power at a wind speed of 15m/sec. The blade length is of 48 meter, the rated speed is 48 rpm. If the turbine is rotating against a wind stream having density of 1.226 Kg/m^3 , then calculate swept area, available wind power to drive the turbine, capacity factor of turbine and TSR. [4]
- Q.6 Write short note on the following
- (a) Stationary reference frame as well as synchronously rotating reference frame. [4]
- (b) Betz Limit [4]

Where E_b is the back EMF and V_{dc} is the applied armature voltage. When initially the motor is started, the back EMF is zero because the speed is zero and hence the armature current,

$$I_a = \frac{V}{R_a}$$

Where, R_a is the armature resistance. Initially the current will be very large if no external resistance is included due to the back EMF being zero. So, the motor starter generally consists of a large resistance in series with the armature circuit which is cut down slowly as the motor picks up speed. Hence, we cannot increase the voltage abruptly. It is increased gradually. This is being emulated in this experiment with the help of a series rheostat R_{ext} . The initial current drawn I_a allows a finite value of electromagnetic torque to be developed depending upon the field current supplied. This torque allows the acceleration of the motor from zero speed provided this T_e is greater than the load torque T_L . The acceleration follows the equation

$$J \frac{d\omega}{dt} = T_e - T_L$$

Where, J = Moment of Inertia of the motor. Hence only after a minimum value of armature current is applied, the torque is able to overcome the moment of inertia.

Electric Braking: Electric Braking of DC motor can be done by three methods:

- i. Regenerative braking if the speed exceeds no-load value or when $T_L = 0$.
- ii. Dynamic braking or rheostat braking by including an external resistance across armature in place of DC supply.
- iii. Plugging or reverse current braking by connecting the power supply V in reversed mode.

The first method allows the mechanical energy stored in the rotor to be fed back to the battery by converting the kinetic energy into electrical energy. The second method, though, makes the machine work as a generator but it dissipates the power in the external resistance connected. The third method draws extra power from the external power supply and wastes both- energy drawn from the power supply as well as the kinetic energy stored in the rotor. The last two methods can be used for stopping the motor whereas the first one can bring it up to no-load speed.

Plugging: In Plugging or Reverse Current Braking the armature terminals or the supply polarity of a separately excited or shunt motor when running are reversed. Therefore, in plugging the supply voltage V and the induced voltage E_b which is also called back EMF will act in the same direction.

Thus, during plugging the effective voltage across the armature will be $(V + E_b)$ which is almost twice the supply voltage. The armature current is reversed, and a high braking torque is produced. An external current limiting resistor is connected in series with the armature to limit the armature current to a safe value.

Dynamic Braking (Rheostat Braking): In this braking method armature terminal disconnect from supply & connect to high value of resistance. When it is disconnected from the supply with field supply is remains on, the de machine

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MID TERM EXAMINATION

Nov.-2024

COURSE CODE: PES5301

COURSE TITLE: POWER ELECTRONICS

FOR PHOTOVOLTAIC AND WIND ENERGY SYSTEMS

Time: 01:30 Hours

Max. Marks: 40

Note : Attempt any five questions.
Assume suitable missing data, if any.

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Total No. of Pages: 02

Roll No.

M. Tech. (PES/C&I)

215

THIRD SEMESTER

END SEMESTER EXAMINATION

(NOV- 2024)

PES/C&I-6209 ARTIFICIAL INTELLIGENCE

Time: 3:00 Hours

Max. Marks: 50

Note: Answer all questions. Each question carry equal marks. Assume the missing data suitably (if any).

1. Answer the following questions in brief. [5x2=10]
 - (a) Differentiate between artificial intelligence and deep learning. [CO-1]
 - (b) Briefly describe the training data and testing data in respect of AI. [CO-2]
 - (c) Differentiate between back propagation and counter propagation network used in ANN. [CO-3]
 - (d) Write down any four important features of long short-term memory networks. [CO-4]
 - (e) Briefly describe the concept of loss function in deep learning. [CO-5]
2. What is linear regression? How linear regression is performed using least square method? Find the regression line for the data points (x, y) tabulated below: [CO-1] [10]

x	y
1	3
2	4
3	2
4	4
5	5

- 2/6
- 3(a). With the help of neat block diagram, explain how AI could be used for electrical load forecasting applications. [CO-2] [5]
- 3(b). Obtain the output of the neuron Y for the network shown in the figure 1 using activation functions as (i) Binary Sigmoidal and (ii) Bipolar Sigmoidal. [CO-3] [5]

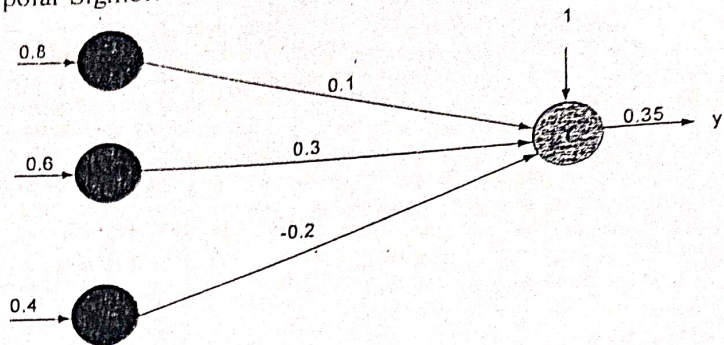


Figure 1

4. With the help of neat diagram, illustrate the role of activation function, forward propagation, weights and bias in neural network. [CO-3] [10]
5. Write short notes on any two of the following: [2x5=10]
- (a) Convolution Neural Network [CO-4]
 - (b) Types of Recurrent Neural Networks [CO-4]
 - (c) Logistic Regression [CO-1]
 - (d) Briefly describe the five application of AI in Electrical Engineering [CO-2]
 - (e) Challenges in Deep Learning [CO-5]

Total no. of Pages: 02

217
3rd SEMESTER
M.Tech (PES)

Roll no.....

END TERM EXAMINATION

Nov-2024

COURSE CODE_PES 6305

COURSE TITLE: Optimization Techniques in Electrical System Design

Time: 03:00 Hours

Max. Marks: 50

Note : Attempt any five questions.

All questions carry equal marks.

Assume suitable missing data, if any.

Q.1 (a) State a NLP problem with inequality constraints. Convert it into an equivalent unconstrained problem. State KKT conditions.

[5][CO1][BTL1,2]

(b) State the following LPP in standard form:

$$\begin{aligned} \text{Maximize } Z &= 5x_1 - 7x_2 + 15x_3 \\ \text{s.t. } 2x_1 + 4x_2 &\leq -8 \\ 2x_1 + 3x_2 + 4x_3 &\geq 7 \\ 8x_1 + 5x_3 &\leq 3 \end{aligned}$$

$x_1, x_2 \geq 0$, x_3 is unrestricted

[5][CO2][BTL1,2]

Q.2 Determine the initial basic feasible solution to the following transportation problem. Also test the optimality of the solution.

		To			Availability
From		E	F	G	
	A	2	7	4	5
	B	3	3	1	8
	C	5	4	7	7
Requirement	D	1	6	2	14
		7	9	18	

[10][CO2][BTL5]

Q.3 (a) What is a unimodal function? Define and explain mathematically.

[5][CO3][BTL1,2]

(b) Find the minimum of $f = x^2 - 1.5x$ in the interval $[0,1]$ within 10% of exact value by Golden section method. Show the interval graphically at the end of each experiment. [5][CO3][BTL3]

Q.4 Minimize $f(x) = \frac{x}{\log x}$ by quadratic interpolation method. [10][CO3][BTL5]

Q.5 (a) State the iterative approach used in unconstrained minimization. [5][CO4][BTL1]

(b) Minimize $f(x) = 2x_1^2 + 2x_1x_2 + x_2^2 + x_1 - x_2$ using steepest descent method. Take the starting point $X_1 = [0 \ 0]$ [5][CO4][BTL3]

Q.6 (a) Compare the Penalty function methods for optimizing a constrained nonlinear problem. [5][CO5][BTL4]

(b) Maximize $f(x) = 2x_1 + x_2 + 5$
s.t. $g(x) = x_1 + 2x_2^2 = 3$ using Lagrange multiplier method. Discuss the result. [5][CO5][BTL3, 5]

Q.7 (a) What is multistage decision problem? State two engineering problems that can be solved by dynamic programming. [5][CO6][BTL1]

(b) Find the second order Taylor series approximation of the function $f(x_1, x_2) = x_2^2 x_3 + x_1 e^{x_3}$ about the point $X^* = \{1, 0, -2\}$. [5][CO1][BTL2, 3]

Q. 8 Explain any two of the following:

- Fibonacci method
- Exploratory and Pattern move
- Principle of optimality
- Hessian Matrix

[10][CO3, 4, 6, 1][BTL2, 3]

M.Tech. (Power Electronics & Systems)**END TERM EXAMINATION****Nov-2024****PES6409****RESONANT POWER CONVERTERS****Time: 03:00 Hours****Max. Marks: 40**

Note: Question 1 is compulsory; Answer any Three questions from the remaining.
All questions carry equal marks.
Assume suitable missing data, if any.

Q.1 Discuss the following: [2.5×4=10][CO1-CO5][BTL1-BTL2]

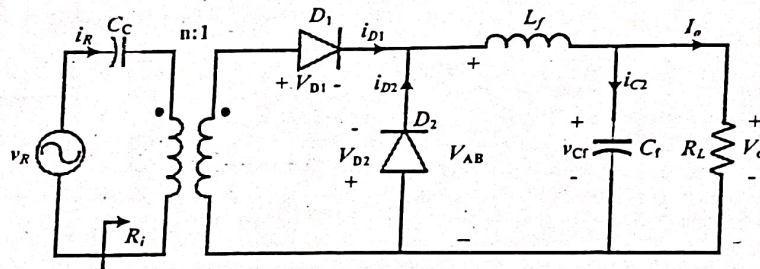
- (a). Series and Parallel resonant converters;
- (b). ZVS and ZCS.
- (c). Advantages of LLC Converter over Series Resonant Converter
- (d). Operation of series resonant converter at resonance frequency, below resonance frequency, and above resonance frequency.

Q.2 (a) Describe the basic operating principles of a resonant power converter. How do they differ from conventional hard-switched converters?

[5][CO2][BTL2]

- (b) Discuss the operation of class-D voltage driven half wave rectifier shown below and draw the waveforms for i_R , v_{D1} , i_{D1} , v_{AB} ; where $v_R = V_{Rm} \sin \omega t$. Find the total conduction loss (neglect ac conduction loss), assume the dc ESR of filter inductor is r_{LF} ; ON-state voltage drop across diode is V_f ; and ON-state resistance of the diode is R_D .

[5][CO2][BTL3]



Q.3 (a) Discuss the operation of half bridge series resonant converter in discontinuous current mode at 50% duty and without dead band of the

220

switches. Draw the waveshapes of i_{Lr} , v_{Cr} , and voltage across the switches. [5][CO1][BTL4]

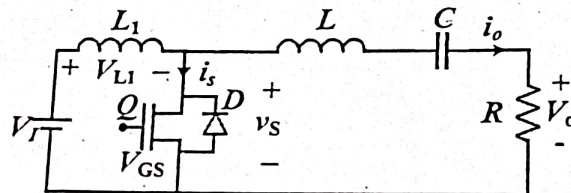
- (b) An LLC resonant converter operates with the following parameters: $V_1 = 400$ V, $L_r = 14$ μ H, $L_m = 70$ μ H, $C_r = 47$ nF, $f_n = 1$, transformer turns ratio $a = 1$, $\lambda = 0.2$, $P_o = 2000$ W. Find the input impedance, current, and voltage across the resonant capacitor at the operation point. [5][CO5][BTL6]

Q.4 (a) Discuss the working of full bridge LLC resonant converter and derive the mathematical relation for voltage gain with respect to quality factor of the converter. [5][CO2][BTL4]

- (b) An LLC resonant converter, with transformer turns ratio $a = 1$, operates with the following parameters: $V_1 = 400$ V, $L_r = 14$ μ H, $L_m = 70$ μ H, $C_r = 47$ nF, $f_s = 220$ kHz, $R_o = 50$ Ω . Calculate the values of the voltage and the power in the load resistor. [5][CO3][BTL5]

Q.5 (a) The half-bridge capacitor voltage clamped converter has the following specifications: $V_i = 400$ V, $V_o = 150$ V, $C_r = 40$ nF, $L_r = 30$ μ H, $f_s = 100 \times 10^3$ Hz. Calculate: (a) the resonant frequency; (b) the output average current and power; (c) the resonant inductor peak current; (d) the maximum switching frequency; and (e) output power. [5][CO3][BTL5]

- (b) Explain zero current switching (ZCS) technique and draw the current and voltage waveforms (i.e., v_s , i_s) in the class E ZCS inverter shown below. Design a Class E ZCS inverter to meet the following specifications: $V_i = 180$ V, $P_{Ri} = 250$ W, and $f_s = 200$ kHz. [5][CO5][BTL6]



- ii) Suppose we have a satellite image that has not been geo-referenced. Can we speak of geo-statistics on the pixel values? If yes, what are the coordinates and what are the attributes?

[2][L3][CO5]

6)

- a) For the following joint distribution of random variables X and Y obtain the $H(X)$, $H(Y)$, $H(X,Y)$, $H(X|Y)$ and $H(Y|X)$. [6][L3][CO5]

X \ Y	1	2	3	4
1	$\frac{1}{8}$	$\frac{1}{16}$	$\frac{1}{32}$	$\frac{1}{32}$
2	$\frac{1}{16}$	$\frac{1}{8}$	$\frac{1}{32}$	$\frac{1}{32}$
3	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$
4	$\frac{1}{4}$	0	0	0

- b) Define the mutual information and obtain mutual information $I(X,Y)$ in above example. Verify the relation $I(X;Y) = H(X) - H(X|Y)$. [4][L3][CO5]

*****All The Best*****

Total No. of Pages: 04

Roll No.:.....

I SEMESTER
M.Tech.

END TERM EXAMINATION

November-2024

RGeo 505 Probability, Statistics, and Information theory in
Geoinformatics

Time: 3 Hours

Max. Marks: 50

Note: Answer any five questions. (Assume suitable missing data, if any.)

- 1)
 - a) Two Fair dice are tossed 600 times. Let X denote number of times a total of 7 occurs. Use Normal Approximation to find $P(90 < X < 110)$. [2][L3][CO1]
 - b) Suppose a test is run at level 0.025, and that the test has a power of 95%. For each of this problem give your answer and a short explanation. [2][L3][CO2]
 - i) Assuming the null hypothesis, what is the probability of type I error.
 - ii) Assuming the alternative hypothesis, What is the probability of type II error.
 - c) Define Entropy, Conditional Entropy and Joint Entropy. [3][L2][CO1]
 - d) What are key difference between Relative Entropy and Mutual Information? [3][L3][CO3]
- 2)
 - a) A random sample of 1000 persons from Chennai city have an average height of 67 inches and another random sample of 1200 persons from Mumbai city have an average height of 68 inches. Can the samples be regarded that the average height of persons from both cities is equal with a standard deviation of 5 inches? Test at 2% level of significance. [5][L5][CO3]

- b) A taxi company is to decide whether to purchase brand A or brand B tires for its fleet of taxis. To estimate the difference in the two brands an experiment is conducted using 30 tires of each brand. The tires are run until they wear out. The results are

Mean(A): 36,300km

SD(A): 5000km

Mean(B): 38,100km

SD(B): 6100km

Compute a 90% confidence interval for $\mu_B - \mu_A$ assuming the populations to be normal. What do you conclude from the confidence interval obtained?

[5][L4][CO4]

- 3) The grades of a class of 9 students on a midterm report (x) and on the final examination (y) are as follows:

X - 77 50 71 72 81 94 96 99 67

Y - 82 66 78 34 47 85 99 99 68

- Estimate the linear regression line. [4][L3][CO3]
- Estimate the final examination grade of a student who received a grade of 85 on the midterm report. [2][L3][CO3]
- Find Covariance between X and Y. [2][L2][CO2]
- Evaluate the Correlation coefficient between X and Y. [2][L2][CO2]

4)

- a) Homeland Security and missile defence technology make it paramount that we be able to detect incoming projectiles or missiles. To make the defence successful, multiple radar screens are required. Suppose it is determined that three independent screens are to be operated and the probability that, any one screen will detect an incoming missile is 0.8. Obviously, if no screens detect an incoming projectile, the system is unworthy and must be improved.

- What is the probability that an incoming missile will not be detected by any of the three screens?
- What is the probability that the missile will be detected by only one screen?
- What is the probability that it will lie detected by at least two out of three screens? [3][L4][CO3]

- b) The random variable X takes values -1, 0, 1 with probability 1/8, 2/8, 5/8.

i) Compute $E[X]$

ii) Give the pmf of random variable $Y = X^2$ and use it to compute $E[Y]$.

iii) Compute $\text{Var}(X)$.

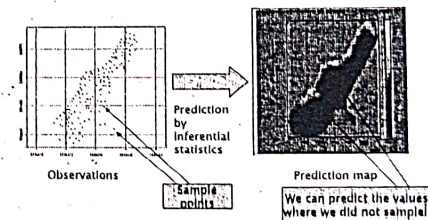
[3][L4][CO3]

- c) Discuss the importance of geo-statistics. Give two applications of geo-statistics based analysis for solving real-world issues. [4][L3][CO5]

5)

- a) The diameter of a ball bearing manufactured through a process is normally distributed with mean as 3cm and Std Dev as 0.005. The buyer sets the specifications as 3 ± 0.01 cm as acceptable limit. Find the percentage of scraped ball bearings? If the manufacturer wish to scrap only 5% of produce then what will be the range of diameter of admissible ball bearing? [4][L3][CO4]

- b) In the following figure, Meuse river floodplain in the southern Netherlands is shown. The copper (Cu) content of soil samples has been measured at 155 points (left side); from this we can predict at all points in the area of interest (right). Give Answers to the following questions:



- i) Suggest some methodologies to produce prediction map for Copper content using the known points. [4][L3][CO5]

Total No. of Pages- 01

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Roll No.

FIRST SEMESTER

M.Tech. by Research [Geospatial Technology]

END SEMESTER EXAMINATION

November 2024

RGEO 507: Remote Sensing, GIS, Advanced Surveying, Satellite Image Processing
Geodesy, and GNSS.

Time: 3:00 Hours

Max. Marks: 40

Note: Answer All Questions.
Answer in brief and in point form.
Assume suitable missing data, if any.

Q1. Answer in brief-

- (a) What are the different Elements of Visual Image Interpretation and describe them in detail. [4]
- (b) What are Atmospheric windows? What is the difference between LIDAR derived DSM, DTM and DEM. [4]

- Q2. (a) Describe the primary GNSS systems used worldwide? [4]
(b) Describe the principles behind GNSS positioning? [4]

- Q3. (a) Discuss the challenges and limitations of LiDAR technology [4]
(b) A LiDAR system emits a laser pulse that travels to a target and reflects back to the sensor in 100 microseconds. Calculate the distance between the LiDAR sensor and the target. [4]

- Q4 (a) A map projection has a scale of 1:50,000. What is the ground distance represented by 1 cm on the map? [4]
(b) A satellite image has a spatial resolution of 10 meters. If the image covers an area of 100 square km, how many pixels are in the image? [4]

- Q5 (a) A satellite sensor has a radiometric resolution of 8 bits. How many different digital numbers (DN) values can this sensor record? [4]
(b) A satellite orbits the Earth at an altitude of 700 km. Its sensor has a spatial resolution of 30 meters. What is the ground distance covered by a single pixel? [4]

Total No. of Pages 01

FIRST SEMESTER

END SEMESTER EXAMINATION

Roll No.

M.Tech. (IT)

Dec-2024

RITR-501: ADVANCED DATA STRUCTURES AND ALGORITHMS

Time: 3:00 Hours

Max. Marks : 40

Note : Attempt all Questions.

Assume suitable missing data, if any.

- 1) Given the following sequence of keys [8] [CO 1][BTL 6, 4]
10,20,5,15,25,30,35
- i) Construct a 2-3 tree by inserting the above sequence in order given. Draw the structure of the tree after each step and show the nodes if any.
- ii) Delete key 10 and show.
- iii) Compare 2-3 trees with binary search trees in terms of height, search time, and balancing. Describe two real-world applications where 2-3 trees are preferable over binary search trees
- 2) Given the directed flow network below with source s and sink t , use the Ford-Fulkerson method to determine the maximum flow.

[8][CO 4] [BTL 3]

Edge	Capacity	
$s \rightarrow a$	10	
$s \rightarrow b$	6	
$a \rightarrow b$	2	
$a \rightarrow t$	8	
$b \rightarrow t$	10	

- Draw the initial flow network with capacities.
- Identify augmenting paths and compute the flow along each.
- Update the residual capacities after each iteration.
- Write the final maximum flow from s to t .

3)

- a) A graph $G = (V, E)$ where $V = \{A, B, C, D, E\}$ and the edges are:
 $E = \{(A, B), (B, C), (C, D), (D, A), (A, C), (C, E), (B, D), (C, E)\}$.
 i) Determine if the graph has a Hamiltonian path. If it exists, list the path.
 ii) Determine if the graph has a Hamiltonian cycle. If it exists, list the cycle.
 b) What are some limitations of using graph isomorphism algorithms in real-world applications, and what are alternative approaches for approximate matching? [3][CO 3] [BTL 2]

4)

- a) Explain how collisions are resolved using linear probing and describe any potential issues that could arise. What are the different collision resolution techniques in hash tables, describe some of these. [5][CO 6] [BTL 1,2]
 b) Explain why the amortized time complexity of the **delete operation** in Fibonacci heaps is $O(\log n)$, even though the worst-case time complexity can be higher. [3][CO 2] [BTL 5]
 5) Compare and Contrast Approximation Algorithms and Geometric Algorithms. Analyse their primary applications and the types of problems they solve. [8][CO 5] [BTL 4]

OR

- 5) You are given the following universe [8][CO 5] [BTL 3]

$U = \{1, 2, 3, 4, 5\}$ and subsets:

$S_1 = \{1, 2\}, S_2 = \{2, 3, 4\}, S_3 = \{4, 5\}, S_4 = \{1, 5\}$.

- i) Use the **greedy approximation algorithm** to find an approximate solution for the minimum set cover problem. What subsets are included in the solution?

_____ End _____

Total No. of Pages 02

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Roll No.

First SEMESTER

M.Tech (RITR)

END SEMESTER EXAM

Nov-2024

RITR-505 FUNDAMENTALS OF DATA SCIENCE AND MACHINE LEARNING

Time: 3:00 Hours

Max. Marks : 40

Note : Answer any four questions.

Assume suitable missing data, if any.

Q.1 For the following data, compute the mean, standard deviation, mode, median, and outliers using z-score for each of the variables: A and B. Analyze the results obtained. [10][CO3]

A	101	110	92	84	108	99	112	102	98
B	-3	-5	0	-1	-4	1	2	-3	-2

Q.2 Explain different types of data distributions with the help of graphs and equations. Define the normal distribution and argue why it is more important than the other distributions. [10][CO1]

Q. 3 a) Describe the different file formats used for data storage. [5][CO1]

b) Write a single regular-expression (regex) for matching the date of "21st November 2024", also written as "21-11-24", and "21/11/2024", in some junk data (all three formats must be recognized by the regex). [5][CO2]

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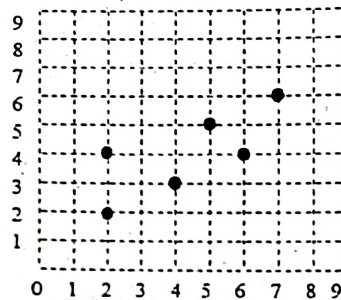
Q.4 Table 1 consists of various symptoms of Flu, and these symptoms are Temperature, Headache, and Motion Sickness.

Table 1				
Day $S^{(i)}$	Temperature x_1	Headache x_2	Motion Sickness x_3	Flu y
$S^{(1)}$	High	Yes	No	Yes
$S^{(2)}$	Very High	Yes	Yes	Yes
$S^{(3)}$	Normal	No	No	No
$S^{(4)}$	High	Yes	Yes	Yes
$S^{(5)}$	High	No	Yes	No
$S^{(6)}$	Normal	Yes	No	No
$S^{(7)}$	Normal	No	Yes	No

Determine the following: [a] Information gain for attributes x_1, x_2 and x_3 . [b] Choose the root node for the decision tree. [c] Grow the decision tree till all nodes are pure. [10][CO4]

Q.5 a) State and explain the K-Means Clustering Algorithm and also identify the stopping criterion of K-Means Clustering.

b) For the data points in below figure, perform hierarchal clustering, develop Dendrogram using single-link matrix distance approach



[10][CO5]

Total no pages- 02

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Roll no

I SEMESTER

M.Tech. (Research)/Ph.D. Chemical Engineering

END TERM EXAMINATION

Nov-2024

RPTE505 : POLYMER CHEMISTRY

Time: 3 Hours

Max. Marks: 40

Note : Attempt any **FOUR** questions.
All questions carry equal marks.
Assume suitable missing data, if any.

1. A] What are the key features of three nomenclature systems of polymers?
[5][CO5]
B] Derive the expression for rate of self-catalysed polyesterification.
[3][CO1]
C] Write the general characteristics of polymers.
[2][CO5]
2. A] Justify the statement 'Elemental composition of polymer is different than that of monomers in step polymerization whereas it is same in case of chain polymerization'.
[3][CO1]
B] Write the polymerization reactions for the formation of polyamides from (a) two different bifunctional monomers and (b) single monomer containing both types of functional groups.
[3][CO1]
C] Derive the Carother's equation.
[4][CO1]
3. A] Justify the statement, 'Ring opening polymerization has some aspects of both chain and step polymerization'.
[3][CO2]
B] Explain the Polymerization mechanism of isobutylene with BF_3 as catalyst and H_2O as co-catalyst.
[4][CO1]

- Q.4 Define Component-Based Software Engineering (CBSE) and describe its primary goal. In CBSE, components should be reusable and modular. Explain what is meant by "reusable" and "modular" in this context, and why these characteristics are important for CBSE. Identify two examples of software components in real-world applications and describe their purpose. [6 M]
[CO2,3,4]
[L2,L3]

- Q.5 Write a short note on (ANY 2 ONLY):

- Reverse Engineering
- Verification vs Validation
- ER Diagram with example
- RAD Model

[2*3 M]
[CO 2-5]
[L3,L4,L5]

Total no. of Pages:04

1st SEMESTER

END TERM EXAMINATION

Roll no.....

M.Tech.(SE)

Nov-2024

SWE-501 Software Requirement Engineering

Time: 03:00 Hours

Max. Marks: 40

Note: All questions carry marks at the end of the sentences. Assume suitable missing data, if any.

- Q.1 a) What is productivity? How is it related to effort. What is the unit of effort. [2*3 M]
[CO1]
b) Define cleanroom software engineering? Explain, which model is used in cleanroom engineering. [L1, L6]
- Q.2 a) What are various activities during software project planning? Describe any two software size estimation techniques. It seems odd that cost and size estimates are developed during software project planning- before detailed software requirements analysis or design has been conducted. Why do we think this is done? Are there circumstances when it should not be done? [3*4 M]
[CO 2]
[L2, L3,L5]
b) Discuss the objectives of modular software design. What are the effects of module coupling and cohesion? List the names of all its types.
c) A project size of 200 KLOC is to be developed. Software development team has average experience on similar type of projects. The project schedule is not very tight. Calculate the effort, development time, average staff size and productivity of the project.

Software Project	a _b	b _b	c _b	d _b
Organic	2.4	1.05	2.5	0.38
Semidetached	3.0	1.12	2.5	0.35
Embedded	3.6	1.20	2.5	0.32

Q.3 Read the following case study and answer the questions. [10 M]
[CO 3]
[L3, L4, L6]

FoodFast, an online food delivery startup, is developing a platform that connects customers with local restaurants. The application will allow users to browse menus, place orders, make online payments, and track deliveries in real time. The development team has prepared an SRS document to outline the functional and non-functional requirements for the FoodFast application.

The SRS document includes the following key sections:

- **Introduction:** Purpose, Scope, and Definitions
- **Overall Description:** Product Functions, User Classes, Operating Environment, Constraints
- **Functional Requirements:** Features for Customer, Restaurant, Delivery Personnel, and Admin modules

Questions:

- a) Identify and list at least three functional requirements for the FoodFast application that should be included in the SRS document. Explain why each requirement is essential for the application.
- b) Explain the role of the "Overall Description" section in an SRS document. What information would you expect to find in this section for the FoodFast application?
- c) FoodFast requires a secure payment system to handle transactions. Define two non-functional requirements that would support this need and describe how these requirements help improve security.
- d) The SRS document mentions the use of "User Classes and Characteristics." Explain the importance of defining user classes in the SRS and provide examples of at least two user classes for the FoodFast application.
- e) Design an outline for the "Functional Requirements" section of the SRS for FoodFast. Include at least three specific features you would expect to document for each user type (Customer, Restaurant Partner, and Delivery Personnel).

OR

Read the following case study and answer the questions.

An e-commerce company, QuickShop, is developing a system to streamline its online shopping operations. The system will allow customers to browse products, place orders, make payments, and track their deliveries. The system will also enable warehouse staff to update stock, process orders, and manage shipping. Administrators can access sales reports, monitor system activity, and manage user accounts. The development team has been asked to create detailed Data Flow Diagrams (DFDs) to illustrate how data flows through various processes in the system. [10 M]
[CO 4]
[L2, L4, L6]

Questions:

- a) Construct a Level 0 (Context Diagram) DFD for the QuickShop system, identifying and labeling all external entities, data flows, and major processes. Justify your choice of each external entity.
- b) Create a Level 1 DFD that breaks down the "Order Processing" process into detailed sub-processes. Include all relevant data stores, data flows, and interactions with external entities.
- c) The "Payment Processing" feature includes interactions with a third-party payment gateway and must ensure security and confidentiality of customer data. Analyze the data flows and security considerations that should be documented in the DFD. Suggest two ways to represent secure data handling in the DFD notation.
- d) Identify and describe at least four data stores that would be critical for the QuickShop system based on the case study. For each data store, explain the type of information it holds and why it is essential for system functionality.
- e) Evaluate the limitations of DFDs when modeling complex systems like QuickShop, especially in areas involving real-time data updates and interactions with external APIs. Suggest two alternative modeling techniques that could complement the DFD in this project.

- (ii) Draw use case diagram for Transport4You.
(iii) Write use case description of "Manage Passenger Details" use case.

[8][CO5] [BTL2, BTL6]

- Q.3 Identify entity class, interface class and control along with their relationships for the Transport4You given above.

[8][CO5][BTL2, BTL3, BTL6]

- Q.4 Draw sequence diagram of "Manage Passenger Details" (basic flow and at least 2 alternative flows) use case of Transport4You.

[8][CO5][BTL2, BTL3, BTL6]

- Q.5 Write the validity checks for "Manage Passenger Details" use case.

[8][CO2, CO5][BTL2, BTL6]

- Q.6 Design Initial Requirement Document for the Transport4You given above.

[8][CO5][BTL2, BTL3, BTL6]

- Q.7 Identify entity class, interface class, control class, and draw class diagram for the Transport4You given above.

[8][CO5][BTL2, BTL3, BTL6]

Total no. of Pages: 4

FIRST SEMESTER

END TERM EXAMINATION

SWE505: COURSE TITLE OBJECT ORIENTED SOFTWARE ENGINEERING

Time: 03:00 Hours

Max. Marks: 40

Roll no.

M.Tech

Nov-2024

Note : All questions carry equal marks.
Attempt any five questions.
Assume suitable missing data, if any.

- Q.1 (a) Describe Jacobson's Methodology.
(b) Explain macro and micro process of the Booch methodology.
(c) What are the various phases in object-oriented software development life cycle approach.
- [8][CO1, CO2, CO3][BTL2]
- Q.2 One of the key challenges faced nowadays by public transportation authorities is to offer personalized services to citizens. This requires the new Information and Communication Technologies (ICT) to be massively exploited. The goal of this project is to develop **Transport4You**: an intelligent public transportation manager that can help a Metropolitan Transportation Authority improve the services offered to citizens. At its core, the system should offer the following basic functionalities:
- allow a citizen to register into the system and pre-pay for a certain number of trips;
 - recognize when a registered citizen gets on a bus and determine the journey he/she performs, calculating the fare he/she has to pay, and deducting it from his/her credit;
 - when the citizen's credit is finished, allow him/her to pay the bus fare through the cell phone;
 - provide registered citizens with information about changes in the lines they use most frequently. Possibly, the system should be able to offer suggestions to registered citizens for alternative paths, for example because it determines that there are routes that are more optimized than the ones they usually take, or because there is a problem on some line that affects their intended path.
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Every bus of the MTA is equipped with a computer with both bluetooth and WiFi. We assume registered citizens have modern cell phones that are also equipped with either a bluetooth or a WiFi connection (or both). The system recognizes when a registered citizen boards the bus when it detects his/her cell phone on the bus. The registration phase happens through the system website. In this phase the citizen inserts the Bluetooth and/or WiFi identifier of its cell phone so that it can be used during the recognition process.

Registered passengers can either pre-pay for trips through the website or they can provide their credit card number and buy the ticket when they access a bus. In the first case, users charge money to their account. When the system detects that a passenger has boarded a bus, it automatically charges the ticket cost to the user's account, and, in case the user has enabled this feature, notifies the passenger through an SMS. The amount of the bus fare, T_COST , is a configurable parameter of the system. If the credit on the pre-paid account is smaller than T_COST , the system notifies the user through an SMS and detracts the unpaid amount from the next money recharge he/she performs. Should the passenger start other trips without recharging the account, the city police will be notified.

In case the registered passenger has chosen to pay by credit card, the system charges T_COST on the credit card whose number has been provided at the time of the registration (for the purpose of the project the interaction with the credit card payment system can be simulated). After it is purchased, a ticket is valid for T_VAL minutes from the time it is stamped (with T_VAL a configurable parameter of the system), even if the passenger gets on and off several buses during the interval of validity of the ticket.

The system infers the journey performed by a registered citizen by keeping track of the stop he/she is using to get in and out from buses. The journey can be obtained as the combination of the buses the citizen takes in the T_VAL amount of time, assuming that this time is enough to cover the entire trip.

The information gathered about the citizens' journeys are used to provide alerts in case a line is interrupted for any reason. In this case, in order to avoid citizens to be flooded with too many data, the system has to direct the alerts to those citizens that are most likely to be influenced by the problem. For instance, in the case a line is stopped from 8.00 to 9.00, someone who usually takes it at 10.00 should not be informed of the stop.

The following scenarios illustrate some possible interactions between users and system concerning the core functionalities described above.

Scenario 1: user registration Jane Doe uses a web interface to activate an account with the Transport4You system. For this, she chooses a username and password, then she provides her personal data (name, address, etc.), and the data of her cell phone: phone number, bluetooth address (if any), WiFi mac address (if any). After having activated the account, she logs onto the system and adds 20€ to her account (which she pays by credit card through an online transaction system).

Scenario 2a: the system detects a registered passenger entering the bus. The system detects that Jane Doe has boarded bus 35 at stop "Central Station" by sensing the bluetooth or WiFi device of her cell phone. It looks for the address of the device among those that are registered with the system and stores the information about the bus stop, the line she boarded, and the time of the boarding for future purposes.

Scenario 2b: the passenger leaves the bus Jane Doe decides to get out of the bus number 35 at stop "Main Square". After that stop, the system detects that Jane's phone is no more on board and therefore infers that she has left the bus. It also updates the data concerning the trip with the information about the stop where she has left.

Scenario 3: payment of the bus fare. When Jane Doe enters the bus at stop "Central Station", the system recognizes her (see Scenario 2a) and then checks the status of her account. As she has more than T_COST Euros on it, the system updates the account by subtracting the bus fare. The system sends Jane Doe an SMS informing her of the purchase; the SMS notification includes the information about the bus stop at which the system determined Jane boarded the bus, the line she boarded, and the time of the boarding.

Scenario 4: citizens are informed about changes in the lines. A major accident has occurred on the path of line 35. The police decide to block all streets entering "Central Station" for one hour. Therefore, MTA is forced to redirect bus number 35 on an alternative path passing close by "Central Station". The operator John Brown enters the new path into the Transport4You system. The system collects the information about all passengers that are likely to be affected by the problem and sends an SMS to them with the new path and schedule of the bus.

Draw the following using standard notations. If necessary, you can make suitable assumptions regarding the details of various features of Transport4You, but you must clearly write down the assumptions you make.

- (i) Identify use cases and actors.

Total no. of Pages: 3

Roll no.....

1st SEMESTER M.Tech.

END TERM EXAMINATION Nov-2024

COURSE CODE: SWE503, DSC503, RSWE

COURSE TITLE: Advanced Data Structures

Time: 03:00 Hours

Max. Marks: 40

Note: Assume suitable missing data, if any.
All questions are compulsory unless explicitly stated otherwise.

Q.1. A delivery company wants to plan its routes by ensuring that all their delivery points are connected using the least number of roads while minimizing the overall cost. This problem is represented using a weighted, connected graph.

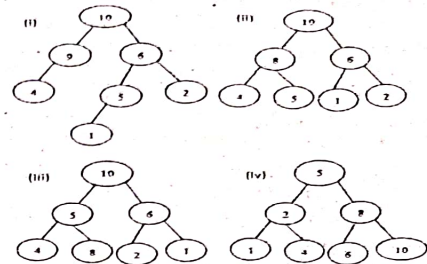
[a] Explain which algorithm (Prim's or Kruskal's) you would use to solve this problem. [3] [CO4] [BTL3]

[b] Provide a step-by-step explanation of how the algorithm would be applied to find the minimum spanning tree. [3] [CO4] [BTL4]

[c] Demonstrate the algorithm on a sample graph with 6 vertices and 8 edges. [3] [CO4] [BTL5]

Q.2. [a] Explain the differences between Digital Search Trees, Multiway Tries, and Compressed Tries, and discuss their ideal use cases in text processing. [4] [CO5] [BTL2]

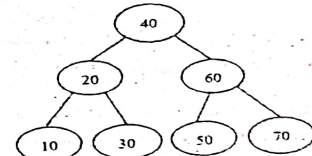
[b] Which among the following is max-heap? Explain the reason why it is and why it is not? [4] [CO5] [BTL4]



Q.3. [a] How many different binary trees are possible with n nodes? Explain with a suitable example. [4] [CO3] [BTL3]

[b] Write an algorithm to find all the nodes with height [+1, -1] in the AVL tree. Also, find the time complexity of your algorithm. [4] [CO3] [BTL6]

Q.4. [a] Write an algorithm to convert a sorted doubly linked list into a balanced binary search tree. For example, if the sorted doubly linked list contains values 10, 20, 30, 40, 50, 60, 70, the resulting balanced binary search tree should be: [4] [CO2] [BTL4]



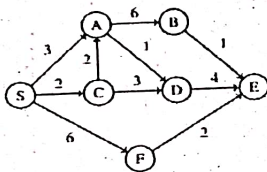
[b] Find the runtime complexity of the following functions:

[3] [CO2] [BTL3]

i) void function (int a) { if (a <= 1) return; if (a > 1) { printf("***"); function(a/2); function(a/2); } }	ii) void function (int n) { int i = 1; while (i < n) { j = n; while (j > 0) { j = j / 2; } i = 2 * i; } }	iii) $T(n) = 2T(\sqrt{n}) + \log n$
---	--	--

Q.5. [a] Execute Dijkstra's algorithm on the directed graph below, beginning from vertex S. Determine the order of vertex removal from the priority queue. Additionally, illustrate the resulting shortest-path tree.

[4] [CO] [BTL3]



[b] Differentiate between Depth-First Search (DFS) and Breadth-First Search (BFS) in terms of traversal approach, use cases, and time-space complexity.

[4] [CO4] [BTL2]

Total No. of Pages 02

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Roll No.

FIRST SEMESTER

M.Tech. (SWE/DSC/RDSC)

END TERM EXAMINATION

NOV2024

SWE 509/DSC 507/RDSC501 - MACHINE LEARNING

Time: 3:00 Hours

Max. Marks: 40

Note: Answer any Four questions. All questions carry equal marks.
Assume suitable missing data, if any.

Q1. A) Explain the CNN architecture with proper representations?

[5][CO2][L1]

B) What is Dimensionality Reduction? Discuss pros and cons for the same.

[5][CO4][L2]

Q2. A) Differentiate between Hard Margin SVM and Soft Margin SVM.

[5][CO2][L5]

B) What is Activation Function? Explain Different types of Activation function.

[5][CO3][L2]

Q3. A) How Unsupervised learning works? Explain with the examples and also their applications.

[5][CO2][L1]

B) Explain different types of Clustering with its application and examples?

[5][CO2][L2]

Q4. Discuss in details the following error metrics: [10][CO1][L3,L2]

a) Mean Absolute Error (MAE)

b) Root Mean Squared Error (RMSE)

c) R^2 Score (Coefficient of Determination)

P.T.O.

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The following table contains the actual (y_{true}) and predicted (y_{pred}) values from a regression model. Find value of above metrics for given dataset.

Actual (y_{true})	Predicted (y_{pred})
50	48.5
60	59.0
70	71.5
80	78.0
90	92.0

Q5. Given the points A(3, 7), B(4, 6), C(5, 5), D(6, 4), E(7, 3), F(6, 2), G(7, 2) and H(8, 4), Find the core points and outliers using DBSCAN. Take $\text{Eps} = 2.5$ and $\text{MinPts} = 3$ [10][CO5][L3]

Total no. of Pages: 1
FIRST SEMESTER

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Roll no.

M.Tech

Nov-2024

END TERM EXAMINATION

COURSE CODE SWEB23/DSCB23 COURSE TITLE RESEARCH PAPER WRITING

Time: 03:00 Hours

Max. Marks: 50

Note : Assume suitable missing data, if any.

- Q.1 What is the format of a systematic literature review report.
[5][CO4][BTL2]
- Q.2 (a) What are the various subsections of abstract section. Discuss with the help of an example case study.
(b) What are the various tools and techniques to be used during the data synthesis?
[10][CO4][BTL2, BTL3, BTL5]
- Q.3 What are the various steps in writing a research paper. Discuss the structure of a research paper.
[10][CO3][BTL2, BTL4]
- Q.4 (a) What are the various tools used to detect plagiarism?
(b) What is research misconduct? Why plagiarism is considered a serious offence in research? How plagiarism can be avoided?
[10][CO5][BTL2, BTL4]
- Q.5 Explain the steps in systematic literature review with the help of an example case study.
[15][CO2, CO4][BTL2, BTL6]

END TERM EXAMINATION

Nov-2024

COURSE CODE SWE/DSC 5405

COURSE TITLE ADVANCED OPERATING SYSTEM

Time: 03:00 Hours

Max. Marks: 40

Note : All questions carry equal marks.
Assume suitable missing data, if any.

- Q.1 (a) Explain how the kernel protects itself and other system components from the user mode. [4][CO1][BTL3]
(b) Three process P1, P2 and P3 arrive at time zero. The total time spent by the process in the system is 10ms, 20ms, and 30ms, respectively. They spent the first 20% of their execution time in doing I/O and the rest 80% in CPU processing. What is the percentage utilization of CPU using FCFS scheduling algorithm [4][CO2] [BTL5]
- Q.2 (a) Discuss how the operating system handles deadlock detection? [4][CO3][BTL1]
(b) Describe the different file allocation strategies. What are the advantages and disadvantages [4][CO3][BTL3]
- Q.3 (a) A shared variable x, initialized to zero, is operated on by four concurrent processes, W, X, Y, and Z, as follows. Each process, W and X, reads x from memory, increments by one, stores it in memory, and then terminates. Each process, Y and Z, reads x from memory, decrements by two, stores it in memory, and then terminates. Each process before reading x invokes the P operation (i.e., wait) on a counting semaphore S and invokes the V operation (i.e., signal) on the semaphore S after storing x to memory. Semaphore S is

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initialized to two. Explain with reason what is the maximum possible value of x after all processes complete execution? [4] [CO3][BTL5]

[4][CO4][BTL1]

(b) Explain these terms

i. Demand Paging

ii. Valid Invalid bits

Q.4 (a) Assume that a main memory with only 4 pages, each of 16 bytes, is initially empty. The CPU generates the following sequence of virtual addresses and uses the Least Recently Used (LRU) page replacement policy.

0, 4, 8, 20, 24, 36, 44, 12, 68, 72, 80, 84, 28, 32, 88, 92

How many page faults does this sequence cause? What are the page numbers of the pages present in the main memory at the end of the sequence? [4][CO4][BTL4]

(b) Describe what is Thrashing? Describe what is the Locality of reference, and how is it used to address thrashing? [4][CO4][BTL3]

Q.5 (a) Describe the Disk storage mechanism and what are the factors that affect the disk access time [4][CO5][BTL1]

(b) The head of a moving head disk with 200 tracks, numbered 0 to 199, has just finished a request at track 125 and is currently serving a request at track 143. The queue of requests is given in the FIFO order as 86, 147, 91, 177, 94, 150, 102, 175, and 130. Explain with steps what will be the total number of head movements required to satisfy these requests for SCAN algorithm? [4][CO5][BTL4]

Total No. of Pages 03

Roll No.

THIRD SEMESTER

M.Tech. (SWE + DSC)

END TERM EXAMINATION

November-2024

SWE6205, DSC6205 STATISTICAL TOOLS

Time: 3:00 Hours

Max. Marks: 50

Note: Attempt any five question. All questions carry equal marks.

Assume suitable missing data, if any.

Q1 [a] A partition of the sample space Ω is a collection of disjoint events $S_1, S_2, S_3, \dots, S_n$ such that $\Omega = \cup_{i=1}^n S_i$

(i) Show that for any event A , we have

$$P(A) = \sum_{i=1}^n P(A \cap S_i)$$

(ii) Use part (i) to show that for any events A, B , and C we have

$$P(A) = P(A \cap B) + P(A \cap C) + P(A \cap B^c \cap C^c) - P(A \cap B \cap C)$$

[5][CO1][BTL3]

[b] If X is a continuous random variable whose probability density function is given by

$$f(x) = \begin{cases} c(4x - 2x^2) & 0 < x < 2 \\ 0 & \text{otherwise} \end{cases}$$

Find the value of (i) c , (ii) mean of X .

[5][CO1][BTL1]

Q2 [a] Find the Mean & Standard Deviation from the following data:

X	10	20	30	40	50	60	70	80
Y	15	30	53	75	100	110	115	125

[5][CO2][BTL2]

[b] Weight of 10 students is as follows:

S. No.	1	2	3	4	5	6	7	8	9	10
Weight(kg)	38	40	45	53	47	43	55	48	52	49

Can we say that the variance of the distribution of weight of all students from which the above sample of 10 students was drawn is

equal to 20 kgs? Test this at 5 per cent and 1 per cent level of significance.

[5][CO3][BTL3, BTL4]

- Q3 [a] Calculate the first four moments about the mean from the following frequency distribution. Also, calculate the Moment Ratios β_1 and β_2 .

x	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-20
f	18	24	47	80	102	66	40	21	15

[5][CO2, CO3][BTL2]

- [b] Distinguish between the following:

- Confidence level and significance level
- Random sampling and non-random sampling

[5][CO3, CO4][BTL5]

- Q4 [a] A population has mean 1,542 and standard deviation 246.

- Find the mean and standard deviation of \bar{X} for samples of size 100.
- Find the probability that the mean of a sample of size 100 will be within 100 units of the population mean, that is, between 1,442 and 1,642.

[5][CO3][BTL2]

- [b] Narrate the various advantages and limitations of parametric and non-parametric tests. Briefly, describe the different non-parametric tests explaining the significance of each such test.

[5][CO4][BTL6]

- Q5 [a] You go to a party with 500 guests. What is the probability that exactly one other guest has the same birthday as you? Calculate this exactly and also approximately by using the Poisson probability mass function (PMF).

[5][CO1, CO2][BTL4]

NOTE: For simplicity, exclude birthdays on February 29.

- [b] Explain the following tests:

- Wilcoxon Signed Rank Test
- Mann-Whitney U Test

[5][CO5][BTL5]

- Q6 [a] A high school track and field coach is interested in determining if his new training program will improve his athletes 400 meter sprint time. He wishes to conduct an analysis. He obtains the permission of 7 athletes to record their sprint times both before and after his new training program which are shown below. According to a Wilcoxon signed-ranks test, at a 95% confidence level, do these scores provide evidence of an increase in median sprint time?

[5][CO5][BTL4]

Athlete	Sprint time before (sec)	Sprint time after (sec)
1	63	58
2	61	57
3	62	59
4	58	57
5	59	58
6	56	55
7	61	55

- [b] Define skewness and the Coefficient of skewness. Find the skewness of the given data: 25, 28, 26, 30, 40, 50, 40.

[5][CO2][BTL2]

- Q7 [a] What do you mean by multivariate techniques? Name the important multivariate techniques and explain the important characteristic of each one of such techniques.

[5][CO5][BTL6]

- [b] The mean of a certain production process is known to be 50 with a standard deviation of 2.5. The production manager may welcome any change in mean value towards the higher side but would like to safeguard against decreasing values of the mean. He takes a sample of 12 items that give a mean value of 48.5. What inference should the manager take for the production process on the basis of sample results? Use 5% level of significance for the purpose.

[5][CO4][BTL4]

Note : Attempt any 5 five questions.
All questions carry equal marks.
Assume suitable missing data, if any.

- Q.1 (a) What does elasticity mean in cloud computing? [8][CO1][BTL2]
(b) How does pay-as-you-go pricing benefit businesses?
- Q.2 What are the specific use cases where grid computing may still be preferred over cloud computing, especially in fields like scientific research? How does the difference in resource sharing models affect these use cases? [8][CO2][BTL4]
- Q.3 Evaluate the pros and cons of each service model (IaaS, PaaS, SaaS) for a fast-scaling tech startup. What factors should guide the selection of one model over another in the early and growth stages of a company? [8][CO3][BTL4]
- Q.4 An organization uses 50 virtual machines, each with 4 CPUs. They want to reduce the total CPU count by 20% while maintaining the same number of VMs. How many CPUs should each VM have after optimization? [8][CO2][BTL2]
- Q.5 (a) What is data encryption, and how does it secure information in the cloud? [8][CO4][BTL2]
(b) What is the difference between public and private clouds?
- Q.6 (a) How does cloud computing differ from traditional computing in resource provisioning? [8][CO1][BTL3]
(b) What role does AI play in optimizing cloud services?

Total No. of Pages 2

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Roll No.

M.Tech. (SPD)

FIRST SEMESTER

END SEMESTER EXAMINATION

NOV.-DEC. (2024)

**SPD-501 PROBABILITY THEORY AND RANDOM
PROCESS**

Time: 3 Hours

Max. Marks :50

Note : Question number 1 is compulsory. Attempt any four from remaining questions. Assume suitable missing data, if any.

1(a) If x is uniformly distributed random variable in the interval (c, d) with $c > 0$ and $y = ax^2$ then find the density function of the random variable y . [CO1](2)

(b) Describe the application of random variable in the following signal processing applications (i) sampling (ii) modulation. [CO2](2)

(c) State and prove Markov's inequality. [CO3](2)

(d) Draw the block diagram for generation of autoregressive moving average model. [CO4](2)

(e) Describe F distribution. [CO5](2)

2(a) State and prove central limit theorem. [CO3](5)

(b) Find the mean and variance of Chi-Square distribution. [CO5](2) (5)

3(a) State and prove the mean square periodic property of the autocorrelation sequence of a wide sense stationary process. [CO4](5)

(b) Let X_1 and X_2 be independently and identically distributed according to

$$f_{X_1}(x_1) = (1/2\pi) \exp(-x_1^2/2) \quad -\infty < X_1 < \infty$$

and similarly for X_2 . Determine the joint and marginal pdf of

$Y_1 = (X_1 + X_2)$ and $Y_2 = (X_1 - X_2)$. [CO3](5)

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4(a) Derive the mean and autocorrelation functions of the output random process $y(t)$ in terms of the input random process $x(t)$, assuming that $x(t)$ is a stationary process. The input random process is transmitted through a linear time invariant filter having impulse response $h(t)$. [CO4](5)

(b) Derive the Yule Walker equation for ARMA model and write in matrix form. [CO4](5)

5(a) Define the reliability and failure rates of an electronic device. Derive the reliability and failure rate of series and parallel inter-connected systems. [CO2](5)

(b) Find the mean and variance of Binomial distribution function. [CO1](5)

6(a) The random variable x is uniformly distributed in the $(-\pi/2, \pi/2)$ interval

$$f_x(x) = \begin{cases} 1/\pi & |x| < \pi/2 \\ 0 & \text{otherwise} \end{cases}$$

and $Y = \sin(x)$.

Find the characteristic function of Y and using that determine the density function of the random variable Y . [CO3](5)

(b) Consider the linear transformation of Gaussian random variables as $Y = AX$. The bivariate Gaussian pdf having the following covariance matrix

$$M = \begin{bmatrix} 4 & 1 \\ 1 & 4 \end{bmatrix}$$

Determine the transformation A that will result in uncorrelated random variables. [CO5](5)

Total no. of Pages:01

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I-SEMESTER

Roll no.....

M.Tech.

END TERM EXAMINATION

Nov-2024

SPD505

MACHINE LEARNING

Time: 03:00 Hours

Max. Marks: 40

Note : Question 5 is compulsory and attempt any six out of remaining.
Assume suitable missing data, if any.

- Q.1 Compare training and testing data. Explain stratified cross-validation technique. [5][CO1][BTL2,4]
- Q.2 Explain support vector machine with different kernel functions. [5][CO2][BTL2]
- Q.3 Formulate a decision-making problem using a Naïve Bayes classifier. [5][CO3][BTL6]
- Q.4 Relate underfitting and overfitting with ensemble learning. Analyse the role of boosting in ensemble learning. [5][CO3][BTL3,4]
- Q.5 Demonstrate K(=2)-Means algorithm over the data (185, 72), (170, 56), (168, 60), (179,68), (182,72), (188,77) up to two iterations and show the clusters. Initially choose first two objects as initial centroids. [10][CO4][BTL3]
- Q.6 Justify agglomerative clustering is more computationally expensive compared to divisive clustering by suitable example. [5][CO4][BTL5]
- Q.7 Illustrate the detailed analogy between ANN and BNN. [5][CO5][BTL3]
- Q.8 Describe following terms in reference of CNN [5][CO5][BTL2]
- (i) Activation functions
 - (ii) Zero padding
 - (iii) Flattening layer
 - (iv) Stride

Total no. of Pages: 02

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Roll no.....

SEMESTER

M.Tech.(SPDD)

END TERM EXAMINATION

Nov-2024

COURSE CODE :SPD 507 COURSE TITLE:Linear Algebra

Time: 03:00 Hours

Max. Marks: 50

Note : All questions carry equal marks.Solve any 5 out of 6.
Assume suitable missing data, if any.

Q.1(a) Let $u_1 = [1 \ 2 \ -1]^T$, $u_2 = [1 \ 0 \ 1]^T$, and $y = [3 \ 3 \ 3]^T$

i) Show that $\{u_1, u_2\}$ is an orthogonal basis for $W = \text{span}\{u_1, u_2\}$.

ii) Write y as sum of a vector \hat{y} in W and a vector z in W^\perp .

(b) Write about the idea of orthogonal projection.

Q.2(a) Fit a quadratic polynomial $p \in P_2$ to $(1,2), (0,0), (2,0), (-1,-2)$

(b) Find the closest point to y in $\text{span}\{u_1, u_2\}$ where

$y = [2 \ 4 \ 0 \ -2]^T$, $u_1 = [1 \ 1 \ 0 \ 0]^T$ and $u_2 = [0 \ 0 \ 1 \ 1]^T$.

Q.1(a) Let $u_1 = [1 \ 2 \ -1]^T$, $u_2 = [1 \ 0 \ 1]^T$, and $y = [3 \ 3 \ 3]^T$

i) Show that $\{u_1, u_2\}$ is an orthogonal basis for $W = \text{span}\{u_1, u_2\}$.

Q.3(a) Find $\cos(\theta)$ where θ is angle between

(b) Write about the idea of orthogonal projection.

$$A = \begin{bmatrix} 9 & 8 & 7 \\ 6 & 5 & 4 \end{bmatrix} \quad \text{and} \quad B = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix}$$

Where $\langle A, B \rangle = \text{tr}(B^T A)$; Hint $\cos(\theta) = \langle u, v \rangle / \|u\| \|v\|$

(b) Apply the Gram-Schmidt orthogonalization process to find an orthogonal basis & then an orthonormal basis for the sub-space U of \mathbb{R}^4 spanned by

$$v_1 = (1, 1, 1, 1); v_2 = (1, 2, 4, 5); v_3 = (1, -3, -4, -2)$$

Q.3(a) Find $\cos(\theta)$ where θ is angle between

Q.4(a)

Apply QR factorization to the following matrix:

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$$A = \begin{bmatrix} 1 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 1 \end{bmatrix}$$

Write concept and formula for each step.

(b) SVD of A is expressed as following factorization:

$A = U \Sigma V^T$; where U & V are orthogonal matrices & Σ is a diagonalized variance matrix. Use $A^T A$ to compute Σ . Also compute U and V.

[5 + 5][4,5#][3#]

Q.5(a)

Let W be the subspace of R^5 spanned by the following vectors:

$$u_1 = (1, 2, 1, 3, 2); u_2 = (1, 3, 3, 5, 3); u_3 = (3, 8, 7, 13, 8)$$

$$u_4 = (1, 4, 6, 9, 7); u_5 = (5, 13, 13, 25, 19). \text{ Calculate a basis of W consisting of the original given vectors \& find dim W.}$$

(b) Determine whether or not u and v are linearly dependent ; where

$$u = \begin{bmatrix} 1 & 3 & -4 \\ 5 & 0 & -1 \end{bmatrix} \quad v = \begin{bmatrix} 7 & 4 & -12 \\ -2 & 0 & 4 \end{bmatrix}$$

[5 + 5][2,4#][6#]

Q.6(a)

Find the dimension of a basis of the solution space W of the following homogeneous system:

$$x + 2y + 2z + s + 3t = 0$$

$$x + 2y + 3z + s + t = 0$$

$$3x + 6y + 8z + s + 5t = 0$$

Let W be the subspace of R^5 spanned by the following vectors:

$$u_1 = (1, 2, 1, 3, 2); u_2 = (1, 3, 3, 5, 3); u_3 = (3, 8, 7, 13, 8)$$

$$u_4 = (1, 4, 6, 9, 7); u_5 = (5, 13, 13, 25, 19). \text{ Calculate a basis of W consisting of the original given vectors \& find dim W.}$$

(b) Write short note on : (b) Determine whether or not u and v are linearly dependent ; where

i) LU decomposition

ii) Multi-Variate algebraic prediction

Note :

- Number of questions is indicative in nature.
- Font: Times New Roman.
- Font Size: 16.
- [M]: Marks allocated to the question.
- [CO#]: Course outcome number
- [BTL#]: Bloom's Taxonomy Level
- General guidelines : <https://www.dtu.ac.in/Web/notice/2023/dec/file1243.pdf>

i) LU decomposition

ii) Multi-Variate algebraic prediction

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Roll no.....

1st SEMESTER

M.Tech

24

END TERM EXAMINATION

Nov-2024

SPD509: Digital Hardware Design

50

Time: 03:00 Hours

Max. Marks: 40

Note: - Attempt any eight questions.

Q1. Explain HDL in detail along with its different types and need of the same. [5] [CO-1]

Q2. Explain Design flow with example.

[5] [CO-1]

Q3. What are ports with reference to Hardware design, explain with an example. [5] [CO-1]

03]

Q4. Design and code 1x4 De-Multiplexer.

[5] [CO-2]

Q5. Differentiate between ASM and FSM Machine with example.

01]

[5] [CO-4]

is it

Q6. Differentiate between pulse and fundamental modes of operation of FSM (with diagram also). [5] [CO-3]

04]

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- [a] What type of filter would you like to choose if the noise is periodic in nature? Describe notch filter approach to deal with such type of noise. [4, CO3, L3]
- [b] Develop the adaptive median-filtering algorithm when the spatial density of the impulse noise is 0.5. [4, CO5, L6]

Q.4 [a] Consider the simple 4×8 , 8-bit image: [5, CO3, L3]

21	21	21	95	169	243	243	243
21	21	21	95	169	243	243	243
21	21	21	95	169	243	243	243
21	21	21	95	169	243	243	243

- (i) Compute the entropy of the image
- (ii) Compress the image using Huffman coding
- (iii) Compute the compression achieved and the effectiveness of the Huffman coding with respect to maximum compression possible.

[b] Develop a general procedure for obtaining the normal representation (ρ and θ) of a line from its slope-intercept form, $y = ax + b$ in Hough Transform. Also find the normal representation of the line $y = -2x + 1$. [3, CO5, L6]

Q.5 [a] Derive the expression for Laplacian of a Gaussian (LoG) operator for edge detection and show that the average value of LoG operator, $\nabla^2 G(x, y)$, is zero. [5, CO5, L6]

[b] Show the validity of following duality expressions:

(i) $(A \oplus B)^c = A^c \ominus \bar{B}$

(ii) $(A \cdot B)^c = (A^c \circ \bar{B})$

[3, CO2, L2]

OR

How do the Fourier Descriptors help describe the boundary of a region? Explain. [3, CO2, L2]

Total No. of Pages 3

Roll no.....

1st SEMESTER, M.Tech. (SPD)

END TERM EXAMINATION (Nov, Dec-2024)

SPD5407, Soft Computing

Time: 3:00 Hours

Max. Marks: 40

Note: All questions are compulsory.
Assume suitable missing data, if any.

Q.1 (a) Assume a network with single neuron having four input with the initial weight vector as $W = [0 \ -1 \ 0 \ 1]^T$, needs to be trained using set of three input vectors as $x_1 = [1 \ -1 \ 1.5 \ 0]^T$, $x_2 = [1 \ -0.5 \ -1 \ -1.5]^T$ and $x_3 = [0 \ 1 \ -1 \ 1]^T$, taking learning rate = 0.1, find the weight vector after one Epoch of training the neuron through Hebbian learning. (Assume neuron to be bipolar binary)

(b) Explain in detail the architecture and working of Bi-directional associative memory.

[4+4=8][CO1, 2]

Q.2 (a) A perceptron is needed to classify two sets of patterns given as:

Class (1): $T = [-1, -1]^T$, $U = [-1, 1]^T$, target value -1

Class (2): $X = [1, 1]^T$, $Y = [1, -1]^T$, target value 1

Choose learning rate ' η ' as 0.5 and get the boundary line that separates the two classes. Take initial weight as $[1 \ 1]^T$ and activation function as signum with output as 1 for 'net' greater than zero and -1 for 'net' less than and equal to zero.

(b) Find the weight matrix that is needed to store a fundamental pattern (memory) given by the vector $A = [1 \ 1 \ 1 \ 1]^T$ in a four-node binary Hopfield network. Also, determine energy associated with the stored pattern and the pattern given by $P = [-1 \ 1 \ 1 \ 1]^T$. Take bias and external input to the network as zero.

[4+4=8][CO1, 3]

Q.3 (a) Explain the following with an example related to fuzzy set theory:

(i) α -cut and strong α -cut, (ii) Intersection and union of two sets, and (iii) Law of contradiction.

(b) Suppose, $R(x, y)$ and $S(x, y)$ are the two relations define over two crisp sets $x \in A$ and $y \in B$.

$$R = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix} \text{ and } S = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Find the following:

(i) $R \cup S$, (ii) $R \cap S$, (iii) R' , (iv) $(R \cup S)'$

(c) The membership function of a fuzzy set 'A' is assumed to follow a Gaussian distribution with mean $m = 10$ and standard deviation $\sigma = 1$. Gaussian membership function distribution is expressed as follows:

$$\mu_A(x) = \frac{1}{e^{\frac{1}{2}\left(\frac{x-m}{\sigma}\right)^2}}$$

Find α -cut, $A_{0.4}$

[3+3+2=8][CO3]

Q.4 (a) For the given membership functions as shown in the Fig. 1 below, determine the defuzzified output value for $C = C_1 \cup C_2$ by the following methods:

- Center of gravity method (CoG),
- Center of sums method (CoS), and
- Mean of maxima method (MoM)

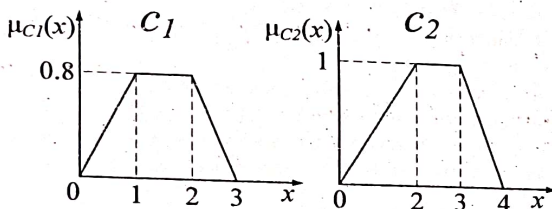


Fig. 1.

(b) Given $X = \{a, b, c, d\}$ and $Y = \{1, 2, 3, 4\}$ are the universe of discourse, $A = \{(a, 0.1), (b, 0.8), (c, 0.6), (d, 1.0)\}$ and $B = \{(1, 0.2), (2, 1.0), (3, 0.8), (4, 0.0)\}$ are the Fuzzy sets defined on X, Y , respectively. Determine the implication relation: If x is A then y is B using Zadeh's max-min rule.

[6+2=8][CO3]

Q.5 (a) Maximize the objective function $f(x,y) = y/x$, where x can take any value from $\{0, 1, \dots, 31\}$ and y can take any value from $\{1, 2, \dots, 127\}$ using genetic algorithm approach. To start with, select the initial population of size 4 as given $x = \{1, 10, 20, 31\}$ and $y = \{5, 10, 50, 120\}$. Show all the process of crossover, mutation and selection. Find the value of objective function and the new generation (x, y) after one iteration.

- Explain the following related to Genetic algorithm
- Encoding
- Crossovers

[6+2=8][CO4]

-----END-----

a) Explain how TD Learning is applied to the Cliff Walking problem. What are the key steps involved in updating the Q-values during training?

b) Describe the role of the epsilon-greedy policy in the TD learning process. How does it help the agent explore the environment while learning the optimal policy?

c) Explain the concept of Q-learning. How does it differ from other TD methods like SARSA? How is the Q-value updated in Q-learning?

d) If you run the TD learning algorithm for 1000 episodes, what kind of behavior or policy would you expect the agent to develop in the Cliff Walking problem? Discuss the exploration-exploitation trade-off and the effect of different values of epsilon.

e) Write out the general update rule for Q-learning and discuss how you would implement this algorithm to solve the Cliff Walking problem. Assume an initial Q-table is initialized to zero.

[10 Marks] [CO4]

Q4. (a) Discuss the types of problems where the Monte Carlo method is particularly useful. Provide at least two examples of real-world applications where Monte Carlo simulations are commonly applied. Suppose you are using the Monte Carlo method to simulate the stock price movement of a financial asset. Describe how the Monte Carlo method could be applied to estimate the future price distribution of the asset. What factors would influence the accuracy and reliability of the results obtained from the simulation?

[5 Marks] [CO2]

Q4. (b) How does Dynamic Programming help in solving RL problems when the model of the environment is known? How Dynamic Programming method is different from the Monte Carlo method and Temporal Difference learning? Provide an example of a real-world application where Dynamic Programming techniques, particularly Value Iteration or Policy Iteration, are used in Reinforcement Learning. Explain how these techniques are applied to solve the problem.

[5 Marks] [CO3]

Total number of pages: 04

Roll Number: _____

1st SEMESTER

M.TECH

END TERM EXAMINATION

Nov-Dec 2024

SPD601(Reinforcement Learning for Signal Processing)

TIME: 3:00 Hours

Max. Marks: 40

Q1. (a) In the comparison shown in Fig. 1:

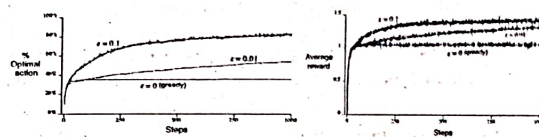


Fig. 1: Average performance of ϵ -greedy action-value methods on the 10-armed testbed. These data are averages over 2000 tasks. All methods used sample averages as their action-value estimates.

which method will perform best in the long run in terms of cumulative reward and probability of selecting the best action? How much better will it be? Express your answer quantitatively. [4 Marks] [CO1]

Q1. (b) In the Figure shown in Fig. 2:

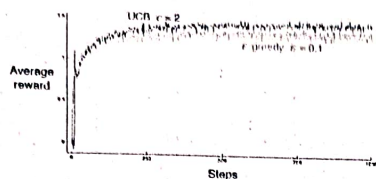


Fig. 2: Average performance of UCB action selection on the 10-armed testbed.

UCB Spikes In Fig. 2 the UCB algorithm shows a distinct spike in performance on the 11th step. Why is this? Note that for your answer to be fully satisfactory it must explain both why the reward increases on the 11th step and why it decreases on the subsequent steps.

[3 Marks] [CO1]

Q1. (b) What are eligibility traces? How forward and backward view of TD(λ) are different?

[3 Marks] [CO4]

Q2. (a) In Cognitive Radio Networks (CRNs), Consider the scenario where a secondary user (SU) needs to select a channel to access in order to maximize its throughput while avoiding interference with the primary users. The SU can observe the reward (e.g., channel quality, throughput, or signal-to-interference ratio) for each channel, but does not know the exact characteristics of each channel in advance. The goal is to efficiently select the best channel while adhering to the constraints of limited sensing time and avoiding interference with the primary users.

a) Explain the general problem of spectrum access in Cognitive Radio Networks and how Multi-Armed Bandit (MAB) algorithms can be applied to solve it.

b) Discuss the exploration vs. exploitation tradeoff in the context of using MAB algorithms for spectrum access in CRNs. Why is this

tradeoff crucial for cognitive radios, and how can algorithms like Epsilon-Greedy, UCB (Upper Confidence Bound), and Thompson Sampling help balance this tradeoff?

c) Compare their regret using UCB, Bayesian UCB, KL-UCB and Thompson Sampling algorithms? [6 Marks] [CO5]

Q2. (b) Q1. (c) Why multi-armed bandit(MAB) algorithms are referred as Online algorithms? How MAB algorithms can be used for information sensing and communication? Consider a scenario in RF network where a transmitter wants to transmit a signal to receiver through multiple reconfigurable intelligent surfaces(RIS) due to the lack of line-of-sight. How MAB can help us finding the optimal RIS so that the SNR received at the receiver is optimal. [4 Marks] [CO5]

Q3. Consider the Cliff Walking Problem in reinforcement learning. The agent starts at the top-left corner of a grid and needs to navigate to the bottom-right corner. The agent can take steps in the four cardinal directions (up, down, left, right). The grid contains a "cliff" in the middle, where stepping onto any of the cells in the cliff results in a large negative reward (e.g., -100), and the agent is returned to the starting position. The agent receives a small negative reward (e.g., -1) for each step taken, and the task is to reach the goal with the minimum total accumulated reward.

Problem Setup:

- The grid is a 4x12 grid (4 rows and 12 columns), where the starting point is at the top-left (0,0) and the goal is at the bottom-right (3,11).
- The cliff occupies all the cells in the fourth row except for the goal cell (3,11).
- The agent uses Temporal Difference (TD) Learning with an exploration strategy of epsilon-greedy and learns using a Q-learning algorithm.

Tasks:

1st- SEMESTER
M. Tech. (Structural Engg.) 264
END SEMESTER EXAMINATION (November - 2024)

Course Code: STE501

Course Title: Structural Dynamics

Time: 3:00 Hours

Maximum Marks: 40

Note: Answer ALL questions.
Assume suitable missing data, if any.

Q.1 Answer ALL parts of the following:

- (a) Justify that the equation of motion of a linear elastic structure is not affected by the gravity force. [2][CO-1]
- (b) Write any four examples of harmonic excitation. [2][CO-1]
- (c) Describe the Vibration Isolation and write its types. [2][CO-2]
- (d) Show that the resonant frequency for displacement amplitude of an SDOF system is given by: [2][CO-3]

$$\omega_r = \omega_n \sqrt{1 - 2\xi^2}$$

Q.2 Answer any TWO parts of the following:

- (a) A mass of 10 kg is suspended on a spring and set oscillating. It is observed that the amplitude reduces to 10% of its initial value after four oscillations. It takes 1 sec to do them. Determine the natural frequency, damping ratio, spring stiffness and actual damping coefficient. [4][CO-2]
- (b) A spring mass system k_1, m has a natural frequency of f_1 . If a second spring k_2 is attached in series with the first spring, the natural frequency is lowered to half of f_1 . Determine k_2 in terms of k_1 . [4][CO-2]
- (c) A mass of 5 kg is suspended on a spring and set of oscillating. It is observed that the amplitude reduces to 20 % of its initial value after 4 oscillations. It takes 1.0 sec to do them. Determine the damping ratio, natural frequency, spring stiffness and critical damping coefficient. [4][CO-2]

Q.3 Answer any TWO parts of the following:

- (a) Derive an expression for dynamic magnification factor for an undamped SDOF system subjected to harmonic loading, $F(t) = F_0 \sin(\omega t)$. [4][CO-3]
- (b) A vertical single cylinder diesel engine of 500 kg mass is mounted on springs with $k = 200$ kN/m and dampers with $\xi = 0.2$. The rotating parts are well balanced. The mass of the equivalent reciprocating parts is 10 kg and the stroke is 200 mm. Determine the dynamic amplitude of the vertical motion, the transmissibility and the force transmitted to the foundation. if engine is operated at 200 rpm. [4][CO-3]
- (c) What is Equivalent Viscous Damping? Show that the energy dissipated per cycle for viscous damping can be expressed by: [4][CO-3]

$$E_D = \frac{\pi F_0^2}{k} \frac{2\xi(\omega/\omega_n)}{[1-(\omega/\omega_n)^2]^2 + [2\xi(\omega/\omega_n)]^2}$$

Contd.....2

Q.4 Answer any TWO parts of the following: -2-

(a) Determine the Fourier series expression of the periodic excitation shown in Fig.1. 265

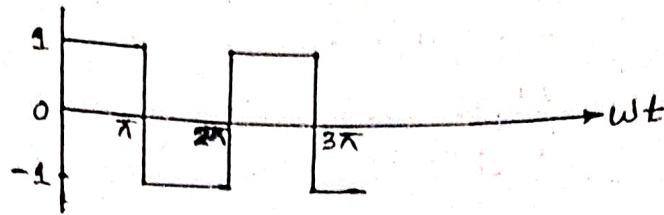


Fig.1

(b) A weight attached to a spring of stiffness 525 N/m has a viscous damping device. When the weight is displaced and released, the period of vibration is found to be 1.80 sec, and the ratio of consecutive amplitude is 4.2 to 1. Determine the amplitude and phase when a force $F = 2 \cos 3t$ acts on the system. [4][CO-4]

(c) A harmonic-loading machine for a single portal frame was operated at frequencies $\omega_1 = 16$ rad/s and $\omega_2 = 25$ rad/s with force amplitude of 2.5 kN, the response amplitude and phase relationships measured for the two cases were given below:
 $x_1 = 18.3 \times 10^{-3}$ cm and $\phi_1 = 15^\circ$
 $x_2 = 36.8 \times 10^{-3}$ cm and $\phi_2 = 55^\circ$
 Determine the mass, stiffness and damping of the SDOF system. [4][CO-4]

Q.5 Answer any TWO parts of the following:

(a) Determine the natural frequencies and mode shapes for the shear frame shown in Fig. 2. Take $EI = 5 \times 10^6$ Nm², $M = 500$ kNs²/m, storey height = 3 m, span = 5 m. [4][CO-5]

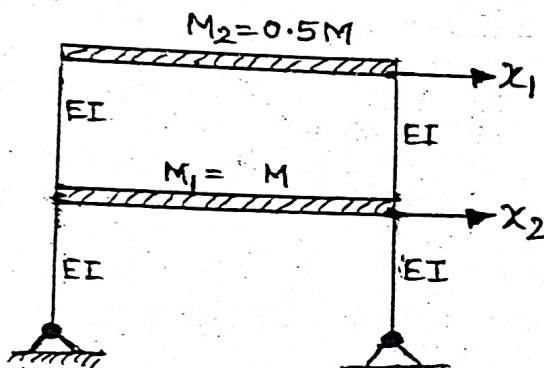


Fig. 2

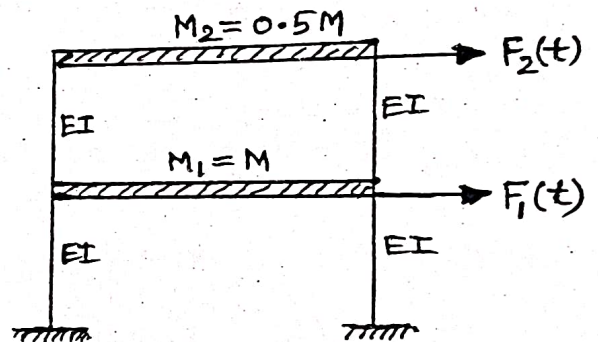


Fig.3

(b) Determine the response due to harmonic excitation for the shear frame shown in Fig. 3. Take $EI = 24 \times 10^6$ Nm², $M = 500$ kNs²/m, $F_1(t) = 0$, $F_2(t) = (10000 \sin 30t)$ kN. storey height = 3 m. [4][CO-5]

(c) Write the equation of motion for the MDOF system shown in Fig.4. Also determine the natural frequencies and mode shapes for the system. [4][CO-5]

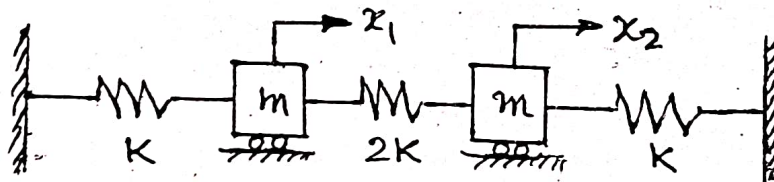


Fig. 4

FIRST SEMESTER

266

M. Tech. (STR)

Nov-2024

END TERM EXAMINATION

COURSE CODE: STE505 |

COURSE TITLE: APPLIED NUMERICAL METHODS

Time: 03:00 Hours

Max. Marks: 40

Note : All questions carrying marks are shown as M.
Assume suitable missing data, if any.

Q.1 A) If $Z = XY^3/8$, calculate percentage error in Z , when $X = 3.14 \pm 0.0016$ and $Y = 4.5 \pm 0.05$.

(C) Using Taylor's series for given $f(x)$, evaluate $f(1)$ by using third order approximations. $f(x) = x^3 - 3x^2 + 5x - 10$.

(D) The volume of a cylinder is given by $V = AL$, $A = \pi R^2$. If $R = 0.1$ m and $L = 0.5$ m, write MATLAB code /statements to find the volume of the cylinder. [M2+2+2][CO1, 2][BTL-2,3]

Q.2 Find a real root of the equation: $\sin(x) = x/2$, using Newton-Raphson method (correct to three decimal places). Given that the roots lie between π and $\pi/2$. [M4][CO2][BTL3]

Q.3 (A) State Cholesky method for factorisation.

(B) Solve given equation using Cholesky method of factorisation by hand calculation. [M2+4][CO2][BTL2,3]

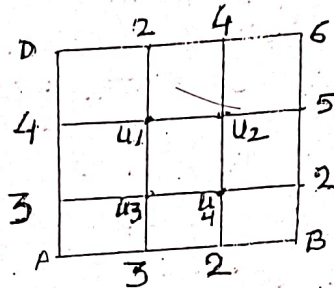
$$\begin{bmatrix} 8 & 20 & 16 \\ 20 & 80 & 50 \\ 16 & 50 & 60 \end{bmatrix} \begin{Bmatrix} x_1 \\ x_2 \\ x_3 \end{Bmatrix} = \begin{Bmatrix} 150 \\ 250 \\ 100 \end{Bmatrix}$$

- Q.4 (A) Explain briefly Lagrange interpolation method for linear polynomial case. 267
 (B) For given data, X_i and $f(X_i)$, evaluate functional value at $X=25$ using Lagrange interpolation method.
 $X_1=0, f(X_1)=3.85,$
 $X_2=20, f(X_2)=0.80,$
 $X_3=40, f(X_3)=0.21.$

- Q.5 (A) Explain with sketch the fourth order formula for solving ordinary differential equations (ODE) numerically. [M2+4][CO3][BTL3,4]
 (B) Solve the ODE as given below using fourth order Runge-Kutta method.

$$\frac{dy}{dx} = 3x + \frac{y}{2}, \quad y(0) = 1.$$

- Q.6 (A) Derive central finite difference formulation for second order ordinary differential equations.
 (B) Solve Laplace equation $u_{xx} + u_{yy} = 0$ numerically for the given mesh with uniform spacing and boundary conditions as shown. [M2+4][CO4][BTL3,4]
 Given $u_3 = 2$.



- Q.7 (A) Explain briefly variational principle in mechanics.
 (B) Describe application of variational principle in finite element method by steps involved in the process. [M3+3][CO4][BTL3]

Note: [M]: Marks allocated to the question. [CO#]: Course outcome number. [BTL#]: Bloom's Taxonomy Level.

Total No. of Pages _____
1ST/3RD SEMESTER

Roll no.

M.Tech. FT/PT

Nov-2024

268

END TERM EXAMINATION

STE 507/STE5403: DESIGN OF ADVANCED REINFORCED CONCRETE STRUCTURES

Time: 3.00 Hours

Max. Marks : 50

Note : Attempt any 4 questions.
All questions carry equal marks.
Assume suitable missing data, if any.

- Q.1 A cantilever retaining wall of 7 meter height (Fig. Ex. 11.2) 5
retains sand. The properties of the sand are $e = 0.5$, $\phi = 30^\circ$
and $G_s = 2.7$. Using Rankine's theory determine the active [CO5]
earth pressure at the base when the backfill is (i) dry, (ii)
saturated and (iii) submerged, and the resultant active force
in each case. In addition, determine the total water pressure
under the submerged condition.
- Q.2 Design a chimney of 25m height having external diameter 10
of 2m throughout height. Chimney has fire brick lining of [CO3]
18m above the base, with a air gap of 100mm. Assume the
temperature of the gases above as 11×10^{-6} per $^\circ\text{C}$ and $E_s =$
 $2.05 \times 10^5 \text{ N/mm}^2$. Use M 20 grade of concrete.
- Q.3 Design a circular water tank with flexible connection at the 5
base for the capacity of 400,000 litre. The tank rests on a [CO1]
firm level ground. The total height of the tank including a
free board of 200 mm should not exceed 3.5m. the tank is
open at top. Use M 30 and FE415.
- Q.4 Design the side walls of square of RCC tank of capacity 5
70000 litres of water. Depth of water in the tank is 2.8m, [CO1]
free board is 0.2m. Adopt M20 concrete and I Steel. Tensile
stresses in steel are limited to 100 N/mm^2 at water face and
 125 N/mm^2 away from face. Sketch the details of
reinforcement in the walls of the tank.
- Q.5 What are the types of reinforced concrete water tanks? 5
What are the forces acting on the dome of the water tank. [CO1]
What are the conditions to be considered for the cylindrical
tank situated underground. Sketch the variations of hoop
stress between the crown and base of the hemispherical top
cover dome carrying uniformly distributed load per unit
surface area.

Course Code: STE 523 & HWE 523 & GTE523

Nov-2024

Course Title: Introduction to AI Techniques

Time: 03:00 Hours

Max. Marks: 50

Note: 1) Attempt all questions; the internal choice is indicated wherever applicable.

2) Marks are indicative of time distribution. The use of a calculator is allowed.

3) Mobile/tablets/programming calculators are not permitted.

4) Assume suitable missing data, if any.

Q-1. (a) Explain the term ACF and how it is obtained? Further, how it helps in deciding whether the data fits in AR model or MA Model?

(b) Explain the principle of parsimony and its relevance in Time Series Modelling and ANN Modelling.

(c) Explain the term 'Stationarity of Series' and its relevance.

(4+3+3)

Q-2. What is the working principle of Genetic Algorithm with reference to unconstrained optimisation problem? Also explain the following with suitable application with reference to any civil engineering problem:

- I) Binary encoding.
- II) Fitness Function.
- III) Roulette Wheel Selection

(10)

Q-3. (a) Explain the term (i) Crossover (ii) Mutation in GA. What is being achieved towards optimization with these operations?

(b) How the convergence of solution is ensured in genetic algorithm using crossover and mutation?

(6+4)

OR

Q-4. (a) Solve the nonlinear optimization problem using GA technique

Minimize

$$(X_1 - 1.5)^2 + (X_2 - 4)^2$$

Subject to

$$4.5X_1 + X_2^2 - 18 \leq 0$$

$$2X_1 - X_2 - 1 \geq 0$$

$$0 \leq X_1, X_2 \leq 4$$

Show calculation for three generations. Use crossover probability as 80% and mutation probability of 3%.

(10)

270
Q-5. (a) What are the different learning methods in neural network. With reference to back propagation learning, explain the terms learning rate and momentum. For a given problem how the neural network architecture is worked out.

(b) Design an ANN for classification of soil from sample training data having variable likes percentage gravel, percentage sand, colour of soil, percentage fine aggregates, liquid limit and plastic limit.

(4+6)

Q-6. (a) Explain the need of Fuzzy systems for solving the problems where the data is inadequate or vague.

(b) Explain the 'Membership Function' showing overlapping. What is its purpose in a typical fuzzy system?

(c) What is Fuzzy inference system and how it works. Explain with any example of civil engineering.

(3+3+4)

Total no. of Pages: 2

1st SEMESTER

Roll no.....

M.Tech. (Str. Engg.)

END TERM EXAMINATION

Nov-2024

STE 5303/ 507 :Theory of Elasticity and Plasticity

Time: 03:00 Hours

Max. Marks: 50

Note : All questions carry equal marks.
Attempt any five questions.
Assume suitable missing data, if any.

- Q.1 The state of stress at a point in a body with respect to x, y, z axes is given below:

$$\begin{bmatrix} 100 & -40 & 10 \\ -40 & 120 & -20 \\ 10 & -20 & 180 \end{bmatrix} \text{ MPa}$$

Determine the principal stresses and their planes. Also determine the maximum shear stress and its plane. [10] [CO1] [BTL: L₁-L₅]

- Q.2 The strain tensor at a point in a body is given by:

$$\begin{bmatrix} 12 & 3 & 4 \\ 3 & 8 & -4 \\ 4 & -4 & 18 \end{bmatrix} \times 10^{-3}$$

Determine the normal and shearing strains on a plane whose direction cosines with respect to the coordinate axes are given by $l = m = n = 1/(3)^{0.5}$. [10] [CO2] [BTL: L₁-L₅]

- Q.3 The components of the strain tensor at a point in a body are given by $\epsilon_x = 0.005$, $\epsilon_y = 0.004$, $\epsilon_z = -0.002$, $\gamma_{xy} = 0.001$, $\gamma_{yz} = 0.0005$, $\gamma_{zx} = 0.002$. If the modulus of elasticity, $E = 2 \times 10^5 \text{ N/mm}^2$ and the Poisson's ratio is 0.25, determine the components of the stress tensor.

[10] [CO3] [BTL: L₁-L₅]

272

Q.4 A circular shaft of inner radius 30 mm and outer radius 75 mm is subjected to a twisting moment, so that the outer 25 mm deep shell yields plastically. Determine the twisting moment applied to the shaft. Assume yield strength in shear for the shaft material equal to 175 N/mm^2 and a linear stress-strain curve. Also calculate the associated angle of twist and the torque required for full yielding. ($G = 0.84 \times 10^5 \text{ N/mm}^2$).
[10] [CO4] [BTL: L1-L5]

Q.5 A rectangular beam having linear stress-strain behaviour is 60 mm wide and 80 mm deep. It is 3 m long, simply supported at the ends and carries a uniformly distributed load over the whole span. The load is increased so that outer 20 mm depth of the beam yielded plastically. If the yield strength of the beam material is 250 MPa, plot the residual stress distribution in the beam.
[10] [CO5] [BTL: L1-L5]

Q.6 The measured strains in three directions inclined at 60° to one another are: 500×10^{-6} , -120×10^{-6} and 200×10^{-6} . Compute the magnitude and direction of principal strains in this plane. If there is no shear stress perpendicular to the given plane, determine the principal stresses at the point. Take, $E = 2 \times 10^5 \text{ N/mm}^2$ and $\nu = 0.3$.
[10] [CO2] [BTL: L1-L5]

Total No. of Pages:03

Roll No.....

M.Tech./Ph.D. ISEMESTER **M.Toch. [Struct]**

END SEMESTER EXAMINATION

Nov./Dec.2024

STE5407: Reliability Analysis of Structures

Time: 3 Hours

Max. Marks:40

Note: Attempt any Five questions.
Assume suitable missing data, if any.
Use Standard Normal Table

- Q.1(a) Do you think that the use of factor of safety is related to the life of structure? [CO1][2] [BTL2]
(b) The test results of the compressive strength (N/mm²) of 50 concrete cubes obtained from a building project are given below:

17.24	16.18	16.53	15.20	18.40
19.73	17.24	20.53	19.38	23.42
17.60	18.76	20.00	20.36	20.27
19.82	20.09	21.78	19.82	19.11
21.42	22.31	21.86	21.15	20.36
13.60	14.98	15.08	18.01	14.93
13.96	15.64	15.56	16.09	13.96
13.87	15.75	12.11	17.18	16.20
15.65	16.27	14.83	13.24	15.03
13.96	15.58	17.36	16.29	16.71

Calculate the mean, the standard deviation, and the coefficient of variation of the strength of concrete for the given data. Plot a histogram. Determine the chance of getting a value less than 15 N/mm². [CO1][6][BTL3]

Q.2 (a) What do you understand when you get a negative correlation for a given set of data? Give an example in a civil engineering field where negative correlation appears?
[CO2][3] [BTL2]

(b) The yearly maximum wind speed follows the Type I distribution with parameters $\mu=97.6$ kmph, $\alpha=0.066$. Determine the return period of the design wind speed 158.1 kmph.
[CO2][5] [BTL3]

Q. 3 (a) The cube strength of concrete, X , follows the normal distribution with parameters mean $=30$ N/mm² and standard deviation $=4.5$ N/mm². Calculate the probability of getting a value for a strength (i) less than 25 N/mm² and (ii) less than 40 and greater than or equal to 30 N/mm².
[CO3][4] [BTL4]

274 (b) The compressive strength Z , of M15 concrete follows the lognormal distribution with mean $=24.04$ N/mm² and standard deviation $=5.76$ N/mm². Determine the probability of getting a strength less than specified value 15 N/mm².
[CO3][4] [BTL4]

Q.4(a) What is meant by return period? How is the return period calculated?
[CO4][3] [BTL1]

(b) The yearly maximum wind speed, X , observed at Pune follows the Type I extremal (largest) distribution. It is given: mean $=83.67$ kmph and standard deviation $=15.97$ kmph. Calculate the parameters of the distribution and determine the probability of the wind speed exceeding 117 kmph.
[CO4][5] [BTL5]

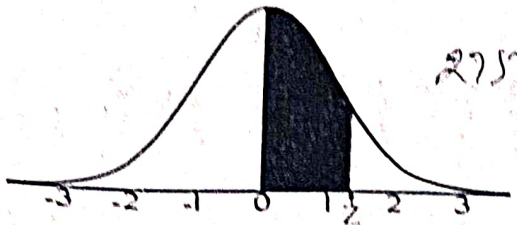
Q.5 (a) What is probability and reliability?
[CO5][2] [BTL2]

(b) The axial load carrying capacity of a column, R , is normally distributed with $\mu_R = 1000$ kN and $\sigma_R = 200$ kN. The column is subjected to an axial load, S , which is normally distributed with $\mu_S = 700$ kN and $\sigma_S = 300$ kN. Calculate the reliability of the column assuming R and S are independent.
[CO5][6] [BTL5]

Q. 6 A reinforced concrete beam of an effective span, 8m is subjected to live load. The cross section has been designed with M25 concrete and steel grade Fe250. The area of steel (A_{st}) is 1400 mm² and the self-weight of the beam 3 kN/m. It is given that the random variables, the cube strength of concrete (f_{cu}) and the yield strength (f_y) are normally distributed. Breadth of the beam (b) = 240 mm, Effective depth of the beam (d) = 480 mm, Mean Value of $f_{cu} = 30.28$ N/mm², Mean Value of $f_y = 320$ N/mm², SD of $f_{cu} = \sigma_c = 4.54$ N/mm² and SD of $f_y = \sigma_s = 32.0$ N/mm².

Calculate the probability of failure of the beam if the live load (L) is normally distributed with mean 6 kN/m² and standard deviation 3 kN/m².

[CO5][8] [BTL6]



STANDARD NORMAL TABLE (z)

Entries in the table give the area under the curve between the mean and z standard deviations above the mean. For example, for $z = 1.25$ the area under the curve between the mean (0) and z is 0.3944.

	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0190	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2969	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3513	0.3554	0.3577	0.3529	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990
3.1	0.4990	0.4991	0.4991	0.4991	0.4992	0.4992	0.4992	0.4992	0.4993	0.4993
3.2	0.4993	0.4993	0.4994	0.4994	0.4994	0.4994	0.4994	0.4995	0.4995	0.4995
3.3	0.4995	0.4995	0.4995	0.4996	0.4996	0.4996	0.4996	0.4996	0.4996	0.4997
3.4	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4998

III-SEMESTER 276
M. Tech [Structural Engineering]

END TERM EXAMINATION

Nov-2024

Course Code: STE-6201 Course Title: Sustainable Building Technologies

Time: - 3:00 Hours

Max. Marks: 40

Note: All questions are compulsory.

Assume suitable missing data, if any

- Q.1:- Explain through diagram, the conventional flow in construction with green construction and brief salient feature of the same. [4] CO[5]
- Q.2:- Brief the fundamental physiological 'comforts' as per GRIHA. [2] CO[3]
- Q.3:- Tabulate the resources consumed and waste generated by building system, the people who design, build and occupy them. [4] CO[2]
- Q.4:- Why and how you get your building rated as per GRIHA. [5] CO[5]
- Q.5:- Write full form for SVAGRIHA, LEEDS, ADaRSH and LCC. [2] CO[1]
- Q.6:- Compare M. sand, cement-soil-sand and Iron ore tailings as an alternative for river sand. [4] CO[1]
- Q.7:- What is the source for recycled aggregate (RCA)? Would the water absorption properties remain same for RCA and virgin one? [3] CO[2]
- Q.8:- What is C&D waste? Name any three locations in Delhi where C&D waste is stacked and name any two authorities controlling it. [3] CO[4]
- Q.9:- How the lap length can be removed / eliminated? Specify some material that can be used as an alternative for steel reinforcement in structures that are not heavily loaded. [3] CO[4]
- Q.10:- Draw the connection/ junction in bamboo construction. What are all the limitations in bamboo construction? [3] CO[3]
- Q.11:- Brief the historical trends in energy use and carbon emissions, the environmental consequences of fossil energy use. [3] CO[5]
- Q.12:- How AI can be used in monitoring land slide and road safety? [4] CO[5]

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IIIrd SEMESTER

M.Tech. STRUCTURAL ENGINEERING

END TERM EXAMINATION

Nov-2024

COURSE CODE: STE 6407

COURSE TITLE: RETROFITTING OF STRUCTURES

Time: 03:00 Hours

Max. Marks: 40

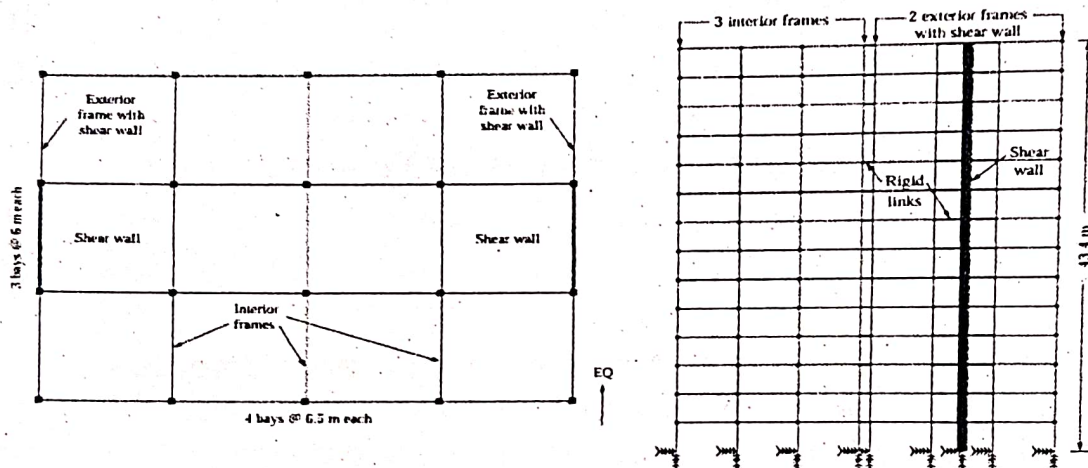
Note : Note: All questions are compulsory.

Use of IS 456:2000, IS 1893:2016, IS 13920:2016 is allowed.

Assume any missing data suitably.

A 14 storied building has a plan dimension, elevation and forces under different load cases as shown in Fig 1. Two shear walls are to be provided in each direction to resist seismic forces. Design the shear wall with M25 grade concrete and Fe 415 steel.

[10]
[CO3]
[BTL6]



Load case	Moment (kN-m)	Shear (kN)	Axial force (kN)	Axial load (kN) on boundary elements
1.5(DL+LL)	1747	71.06	10390	2454.5
1.2(DL+LL+EQZ)	17920	2658	8403	4532.5
1.2(DL+LL-EQZ)	20760	2772	8217	5040
1.5(DL+EQZ)	22630	3332	9114	5425
1.5(DL-EQZ)	25710	3456	8881	5970
0.9DL+1.5EQZ	23240	3356	5516	4808
0.9DL-1.5EQZ	25110	3431	5283	5120

Fig 1

Q2 Evaluate the performance of Weaknesses²⁷⁸ in Brick or Stone Masonry Walls where Poor Storey-to-Storey Bonding, Poor Wall-to-Roof Bonding and Inadequate Resistance to Vertical Bending in Masonry.

[5]
[CO3]
[BTL5]

Q3 Elaborate the step by step procedure of installation of seismic belt in Masonry structure.

[5]
[CO4]
[BTL3]

Q4 Comment on the statement "The type of damage in a masonry wall depends largely upon the direction of the seismic forces with respect to the alignment of the wall"

[5]
[CO4]
[BTL4]

OR

Categorize the earthquake damage grades in load bearing masonry walls.

[5]
[CO4]
[BTL2]

Q5 Distinguish between Repair, Restoration and Retrofitting of Structures.

[3]
[CO1]
[BTL3]

What are the advantages of Base Isolation as a Global retrofitting technique?

[2]
[CO2]
[BTL3]

Q6 Critically discuss the mechanism, reasons for the most common modes of failure of column in RC structure under seismic excitation and their design considerations to reduce the seismic damage.

[5]
[CO3]
[BTL4]

OR

Critically discuss the mechanism, reasons for the modes of failure of reinforced concrete shear walls and their design considerations to reduce the seismic damage.

Q7 What are the various preliminary forensic assessment done on existing or damaged bridge structures through NDT?

[5]
[CO5]
[BTL3]

- (b) If $\mu_n C_{ox} = 100 \mu\text{A}/\text{V}^2$, $V_{Tn} = 0.5 \text{ V}$, $I_{ref} = 0.1 \text{ mA}$, $(W/L)_{1,2,3,4} = 2\mu\text{m}/1\mu\text{m}$. find V_A , V_B , and the minimum output voltage $V_{X,min}$ so that all MOSFETs stay saturated. [5][CO2][BTL3]

End of question paper

Num. of Pages: 4

Roll Num.

M. Tech. FIRST SEMESTER

END TERM EXAMINATION

Nov-2024

COURSE CODE: VLS 501

Analog IC Design

Time: 3 Hours

Max. Marks: 40

- Note: • All questions are compulsory.
• Clearly specify any assumptions you make.
• Unless specified, all MOSFETs are in saturation.
• Do not waste time re-drawing the given circuits.

1. In the 2-stage op-amp shown in Fig. 1, operating point conditions are: $I_{D5} = 2 \text{ mA}$, $V_{ov1} = V_{ov2} = 0.2 \text{ V}$ (where V_{ov} means overdrive voltage); $I_{D7} = I_{D6} = 2 \text{ mA}$, $V_{ov6} = 0.4 \text{ V}$. Assume $\lambda = 0.01 \text{ V}^{-1}$ for all transistors.

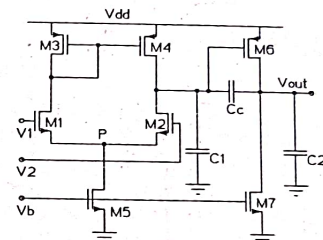


Figure 1: 2-stage unbuffered op-amp

- (a) Find low frequency gains (ignoring capacitances) of stage-1, stage-2, and the overall amplifier gain v_{out}/v_{in} , where v_{in} is the differential input. [5][CO3][BTL3]

- (b) Suggest two ways to increase the overall gain. Can this op-amp drive low impedance loads? If not, suggest an improvement so that it can drive low impedance loads.

[5][CO1,3][BTL5,6]

2. For the 2-stage op-amp in Fig. 1, C_1 is the total parasitic capacitance at drain of M2 due to stage-1 and stage-2; and its value is 0.1 pF. C_2 includes parasitics of stage-2 and the load; and its value is 10 pF. There are no other device capacitances present. **Use the operating point data given in question 1.**

- (a) If C_c is removed, write the high-frequency transfer function for the overall gain. Find the two pole frequencies in rad/s.

[5][CO4][BTL1,2]

- (b) What is the purpose of C_c ? If C_c is connected, find the approximate pole frequency due to output node. What should be the value of C_c if a gain bandwidth product (GB) (or gain cross-over frequency) of 10^9 rad/s is required?

[5][CO4][BTL3,5]

3. Consider the reference circuits in Fig. 2. M4 and M5 always have same sizes (identical transistors) and currents I_1 and I_2 are non-zero for all three circuits. $\mu_n C_{ox} = 100 \mu A/V^2$, $V_{Tn} = 0.5$ V.

- (a) For Fig. 2(a), if M1, M2, and M3 are identical with $W/L = 2\mu m/1\mu m$; and $I_1 = 0.1$ mA, find the values of V_1 , V_2 , and R . Find the value of R if the size of M3 i.e. $(W/L)_3$ is reduced to $1\mu m/2\mu m$ while M1 and M2 sizes are same as before.

[5][CO5][BTL3]

- (b) Between Figs. 2(b), and 2(c); which one is PTAT and which is CTAT (assume that BJT Q6 is n times wider than

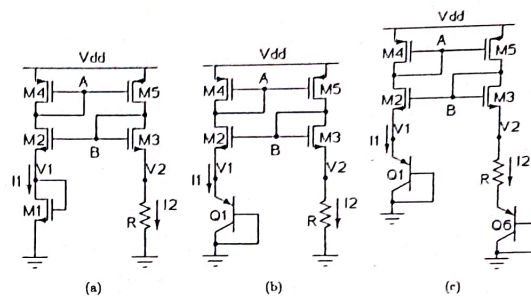


Figure 2: Reference circuits based on floating current mirror

BJT Q1)? Explain in detail why the given PTAT circuit generates a current proportional to absolute temperature?

[5][CO5][BTL1,2]

4. Consider the current mirror given in Fig. 3.

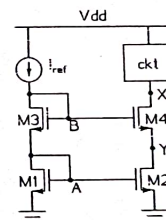


Figure 3: Current Mirror

- (a) What is the purpose of M3 and M4? Suppose due to the signals in the box circuit, ckt, voltage at node X has huge fluctuations. Will node Y see amplified or attenuated fluctuations compared to node X? Why?

[5][CO2][BTL5]

Total no. of Pages: 03

Roll no.....

1st SEMESTER

M.Tech.

END TERM EXAMINATION

Nov-2024

COURSE CODE VLS505 COURSE TITLE Digital IC Design

Time: 03:00 Hours

Max. Marks: 40

Note : Question 1 is compulsory.
Attempt any FOUR questions from the remaining.
Assume suitable missing data, if any.
All questions carry equal marks.

Q.1(a) Differentiate between short and narrow channel MOSFET. How does threshold voltage vary in each case when compared to long channel MOSFET? [2][CO1][U]

(b) Why are bit lines pre-charged prior to read operation? [2][CO6][U]

(c) Assuming $V_{DD} = 1.2V$, $V_{T,n} = 0.4V$ and $\gamma = 0$, compute the output voltage at F in Fig. 1 [2][CO3][Apply]

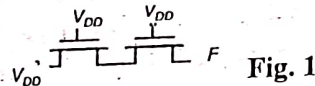


Fig. 1

(d) Will there be any charge sharing in (i) dynamic CMOS inverter (ii) dynamic 2 input NAND gate? Explain. [2][CO4][U]

Q.2(a) Design a CMOS inverter with switching threshold voltage of $\frac{2}{3}V_{DD}$.

What is the resulting ratio of W_P/W_N ? (Assume $L_P = L_N$, $\mu_N = 2.5\mu_P$, $|V_{TP}| = V_{TN} = 0.2 V_{DD}$). [4][CO2][Create]

(b) Describe the impact of constant electric field scaling on V_{OH} , V_{OL} , V_{IH} , V_{IL} of CMOS inverter. [4][CO1,2][U]

Q.3 (a) Analyze the circuit of Fig. 2 and find out the realized logic function? Is this a ratioed circuit? Explain. Assume all inputs swing as (0 to V_{DD}) and no body effect. [4][CO3][Analyze]

(b) Design a combinational circuit for $F = (A + B)(CD + E)$ using static CMOS and size the transistors using equivalent inverter method. Assume $(W/L)_{n,inv} = 2$; $(W/L)_{p,inv} = 4$. [4][CO3][Create]

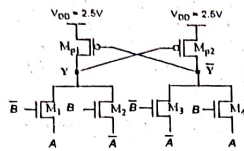


Fig. 2

Q.4(a) Consider the circuit of Fig. 3. (i). Give the logic function of x and y in terms of A, B, and C. Sketch the waveforms at x and y for the given inputs. Do x and y evaluate to the values you expected from their logic functions? Explain. (ii). Redesign the gates using np-CMOS to eliminate any race conditions. Sketch the waveforms at x and y for your new circuit. [4][CO4][Apply]

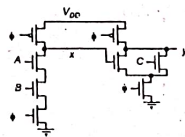
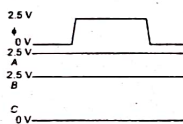


Fig.3

(b) For the D Flip-flop implementation shown in Fig. 4 answer the following (i) Is this a static or dynamic flip-flop? (ii) Is this positive edge triggered or negative edge triggered? (iii) Calculate t_{setup} , t_{CtoQ} and t_{hold} for this flop. [4][CO5][Apply]

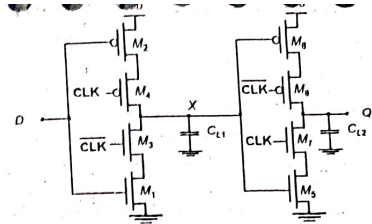


Fig.4

Q.5(a) Design positive edge triggered TSPC register? Compute various timing parameters? Does the slope of the clock affect the operation of TSPC register? [4][CO3][Create]

(b) A nonpipelined system performing ADD, MOD and LOG operations on an array A and B is depicted in Fig. 5. Determine the pipelined version of the circuit given in Fig. 5 and comment on improvement on clock frequency. [4][CO5][Apply]

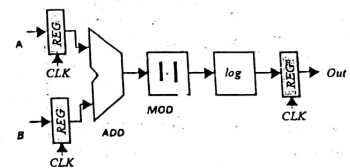


Fig. 5

Q.6 (a) For the circuit of Fig. 6, determine the maximum clock frequency for proper operation. ($t_{setup} = 2ns$, $t_{clktoq} = 10ns$; $t_{hold} = 1ns$; $t_{minCLB_A} = 2ns$; $t_{minCLB} = 1ns$; $t_{maxCLB_A} = 5ns$; $t_{maxCLB_B} = 6ns$). Comment on hold violation also. [4][CO5][Apply]

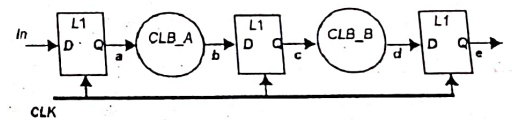


Fig.6

(b) Explain VLSI design flow with help of Gajski Y chart.

[4][CO6][U]

Also calculate the drain current for $V_{DS} = 4V$ and specify the region of operation.

5[b] Consider a silicon pn junction with the doping profile shown in Fig.3 at $T = 300 K$. [5][CO1]

(i) Calculate the applied reverse-biased voltage required so that the space charge region extends entirely through the p region.

(ii) Determine the space charge width into the n region with the reverse-biased voltage calculated in part (i).

(iii) Calculate the peak electric field for this applied voltage.

{Given: $n_i = 1.5 \times 10^{10} / cm^3$, $\epsilon_s = 11.7$, }

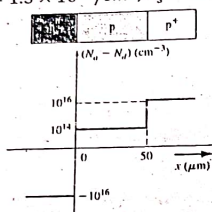


Fig.3

6 In MOS capacitor, if ϕ_s is the potential at the surface, and $\phi = 0$ is the potential in the bulk. Assume a Si MOS capacitor at room temperature. Answer the following questions. [10][CO2]

(i) Assume $N_A = 10^{17} cm^{-3}$ and compute $E_t - E_F$ and the related potential, which plays an important role in MOS electrostatics.

(ii) Assume $\phi_s = -\phi_F$ and sketch the energy band diagram and the charge density, $\rho(x)$ vs. position in the semiconductor.

(iii) Assume $\phi_s = 2\phi_F$ and sketch the energy band diagram and the charge density, $\rho(x)$ vs. position in the semiconductor.

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Total No. of Pages 4

Roll No.

I SEMESTER
M.Tech (VLSI)

End Semester Examination

November-2024

VLS-507, Semiconductor Device & Modelling

Time: 3 Hours

Max. Marks: 50

Note: Answer any five questions

All questions carry equal marks

Use the answer sheet space judiciously

Assume suitable missing data, if any.

1[a] An n^+ polysilicon device is fabricated on a p-type substrate. It [5][CO2]

has $N_A = 5 \times 10^{16} atoms/cm^3$, $N_D = 3.5 \times 10^{20} atoms/cm^3$, $n_i = 1.5 \times 10^{10} / cm^3$, $t_{ox} = 7 nm$. The oxide layer has $4 \times 10^{10} positive ions/cm^2$. Calculate

i) Maximum depletion layer width in substrate

ii) Maximum and minimum capacitance per unit area on CV characteristics

iii) Flatband Voltage

iv) Zero bias threshold voltage

v) Threshold voltage when $V_{SB} = 2 V$.

1[b] Derive the mathematical relation between charge (Q) and [5][CO3]

voltage (V) of an ideal MOS capacitor in depletion and inversion region considering the p-type substrate, also plot Q-V characteristics in depletion and inversion region based on the derived expressions.

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2[a] An electron is described by a wave function given by $\psi(x)$ [2][CO1]

$\sqrt{\frac{2}{a}} \cos\left(\frac{\pi x}{a}\right)$ for $-\frac{a}{2} < x < \frac{a}{2}$. The wavefunction is zero elsewhere. Calculate the probability of finding the electron between

- $0 < x < \frac{a}{4}$
- $\frac{a}{4} < x < \frac{a}{2}$

2[b] Consider an ideal MOS capacitor fabricated in p-substrate. [5][CO3]

Explain the Body effect in 3 terminal MOS capacitor. Draw the space charge diagram as a function of position in the semiconductor. Does the source contact always kept positive w.r.t bulk substrate? Justify your answer.

2[c] Assume that $\psi_1(x, t)$ and $\psi_2(x, t)$ are solutions of the one-dimensional time dependent Schrodinger's wave equation. Show that $\psi_1 + \psi_2$ is a solution. [3][CO1]

3[a] Two possible conduction bands are shown in the E versus k [2][CO1] diagram given in Fig.1. State which band will result in the heavier electron effective mass, state why?

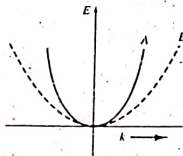


Fig.1

3[b] A simplified E versus k curve for a hole in the valence band is [3][CO1]

given in Fig.2. Assume a value of $a = 12 \text{ \AA}$. Determine the relative effective mass $|m_p^*/m_0|$. {Given: $m_0 = 9.11 \times 10^{-31} \text{ kg}$ }

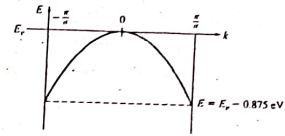


Fig.2

3[c] (i) At what energy above the Fermi energy E_F (in terms of kT) [5][CO1] is the Fermi-Dirac probability function within 1% of the Boltzmann approximation?

(ii) What is the value of the Fermi-Dirac probability function at this energy? {Given: $n_i = 1.5 \times 10^{10} / \text{cm}^3$ }

4[a] Sketch the energy band diagram of zero-biased, forward [3][CO2] biased and reverse-biased Schottky barrier diode.

4[b] How does drain-induced barrier lowering (DIBL) occur in [4][CO3] short-channel MOSFETs, and what is its effect on device performance?

4[c] Explain the role of substrate doping and gate oxide thickness [3][CO3] in mitigating short channel effects.

5[a] Design a width of a MOSFET such that a specified current is [5][CO3] induced for a given applied bias. Consider an ideal n-channel MOSFET with parameters $L = 1.25 \mu\text{m}$, $\mu_n = 650 \text{ cm}^2/\text{V} \cdot \text{s}$, $C_{ox} = 6.9 \times 10^{-8} \text{ F/cm}^2$, and $V_T = 0.65 \text{ V}$. Design the channel width W such that $I_D(\text{sat}) = 4 \text{ mA}$ for $V_{GS} = 5 \text{ V}$.

Total no. of Pages: 2

Roll no.....

1st SEMESTER

M.Tech

285

END TERM EXAMINATION

Nov-2024

VLS-509

Digital Design with HDL

Time: 03:00 Hours

Max. Marks: 40

Note : All questions carry equal marks.
Assume suitable missing data, if any.

- Q.1 For each of the following cases, show the state diagram that describes a one- input one- output machine having the following specifications:
- (i) An output symbol $Z=1$ is to be produced to coincide with every occurrence of the input symbol 1 following a string of two or three consecutive 0s at the input. At all other times, the output symbol is to be 0.
 - (ii) Regardless of the input symbols, the first two output symbols are 0s. Thereafter, the output symbol Z is a replica of input symbol x but delayed by two time units, that is $Z(t) = Z(t-2)$ for $t \geq 3$.
- [8][CO#2][BTL#Synthesis]
- Q.2 (i) Define the following terms in System Verilog and mention their respective analogue in Verilog: Class, Object, Handle, Property.
- [4][CO#4][BTL#Knowledge]
- (ii) Explain with the help of examples how new Objects are created in System Verilog. Also, explain allocation of multiple objects with the help of example.
- [4][CO#4][BTL#Application]
- Q.3 (i) What all design inputs can be randomized in designing an FSM. Explain any four.
- [4][CO#5][BTL#Analysis]
- (ii) What is the difference between Functional coverage and Code coverage? Also explain the types of code coverages.
- [4][CO#5][BTL#Understanding]

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- Q.4 For the given Verilog code, determine throughput, latency and draw the RTL schematic. Rewrite its pipelined version and determine throughput, latency and draw the RTL/schematic.

```
Module power3 (  
    output [7:0] XPower, output finished, input [7:0]X, input clk, start);  
    reg [7:0] ncount; reg [7:0] XPower; assign finished = (ncount == 0);  
    always @ (posedge clk)  
    if (start) begin  
        XPower <= X;  
        Ncount <= 2;  
    end  
    else if (!finished) begin  
        ncount <= ncount-1;  
        XPower <= XPower*X;  
    end  
endmodule
```

[8][CO#3][BTL#Evaluation]

OR

With the help of Verilog example, explain the methods to improve timing performance of a digital design.

[8][CO#3][BTL#Evaluation]

- Q.5 (i) Design a Reduced coefficient multiplier for the circuit which multiplies an input by two coefficients namely, 45 and 15. Also, explain its functioning.

[4][CO#2][BTL#Synthesis]

OR

Design a Reduced coefficient multiplier for the circuit which multiplies an input by two coefficients namely, 45 and 23. Also, explain its functioning.

[4][CO#2][BTL#Synthesis]

- (ii) Design an FIR filter with and without pipelining and show its effect on sampling frequency.

[4][CO#2][BTL#Synthesis]

*****END*****

Total No. of Pages:3

Roll No.

FIRST SEMESTER

M.Tech. - VLSI & Embedded Systems

END SEMESTER EXAMINATION

NOV-2024

VLS5312: ORGANIC FLEXIBLE ELECTRONICS

Time: 3 Hours

Max. Marks: 50

Note: Attempt any Five Questions.

All questions carry equal marks. Assume suitable missing data, if any.

Q.1 (a) Demonstrate that pre-charge bitlines at $V_{DD}/2$ is a better option for read operation. Also, develop the expression for pull-up ratio during write cycle. What is the trade-off between read and write operation in SRAM cell. [5] [CO5][BTL3]

(b) Determine the values of threshold voltage - V_T , Mobility - μ , and current on-off ratio in saturation region using data given in Table 1 for P-Type OTFT with $W = 5\mu m$, $L = 100 nm$ and PVP dielectric layer of $50nm$. Also find the value of channel resistance and contact resistance at $V_{GS} = -5 V$. [5] [CO1/CO3][BTL3]

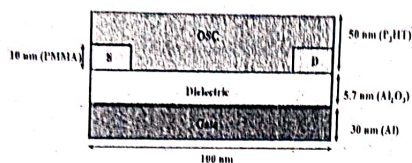
Table 1

$V_{DS} = -5.0 V$	
$V_{GS} (V)$	$I_D (A)$
0	-5×10^{-11}
-1	-2×10^{-08}
-2	-0.5×10^{-03}
-3	-4×10^{-03}
-4	-8×10^{-03}
-5	-5×10^{-02}

Q.2 (a) Describe the ATLAS code for BGBC structure mentioned below. Also include the statements for drain characteristics with V_{DS} varying

from 0 to -5V and $V_{GS} = 0V$, $V_{GS} = -2V$ and $V_{GS} = -5V$. Consider channel length and width of 80nm and 1000nm, respectively.

[5] [CO1/CO3][BTL2]



(b) State why the performance of BGBC structure is lower than that of BGTC. Provide the solution to improve the performance of BGBC structure without adding additional gate and dielectric layers.

[5] [CO2][BTL1]

Q.3 (a) Explain the role of different layers in organic LED structure. Why the performance of OLED does not much affect on electron blocking layer (EBL). Also, state whether hole block layer impacts the performance like EBL. Justify your answer.

[5] [CO4][BTL2]

(b) Design the circuit for given expression using all p-OTFT. Justify the working of circuit for input combination; ABCDEF=010010.

$$Y = (A+B+C)' + (D)' + (E+F)'$$

[3] [CO5][BTL6]

(c) Discuss the use of solar cell as a bio sensor to detect the diseases.

[2] [CO4][BTL1]

Q.4 (a) Analyze the possible reasons for obtaining low NM_L and low NM_H for organic all-p inverter. Discuss the research scope to achieve improved noise margins.

[5] [CO3][BTL4]

(b) Evaluate the values of V_{Xmax} , V_{Xmin} and bootstrap capacitor; C_B , if $V_{DD} = 5V$, $V_{OL} = 0.1V$ and $C_S = 10nF$. Consider V_T for all transistors equals to 0.5V. Also, draw the circuit for all-p TFT based inverter with bootstrapping technique.

[3] [CO3][BTL5]

(c) Present the TFT arrangement for NAND gate using p-type transistor only. Expend the circuit for SR flip flop using NAND gates only.

(2) [CO5][BTL3]

Q. 5 (a) Compute the Bandwidth and Gain (in dB) of dual gate OTFT (mentioned below) based common source amplifier with values of components mentioned below in table 2. Also make Hybrid- Π models for low, high and mid frequency response. Consider SiO_2 of 5nm and Al_2O_3 of 10nm.

(5) [CO1/CO3] [BTL3]

Table 2

R_1	0.5 M Ω	R_{S1}	1k Ω	R_L	5 M Ω
R_2	6 M Ω	R_{S2}	100 Ω	C_{ox}	1.5 nF/cm ²
R_c	1.5 M Ω	CC_1	1 nF	W	500 μm
R_{ch}	500k Ω	CC_2	0.1 nF	L	2 μm
R_D	1 M Ω	C_{S1}	1 μF	g_m	8.2 nA/V
L_D (overlapping contact length)					100 nm

(b) State the structure and channel formation of vertical TFT and single gate dual channel TFT with proper labeling of all layers.

(3) [CO2][BTL1]

(c) State one possible combination of materials with their possible values for flexible p-type OTFT and hybrid p-type TFT. (2) [CO1][BTL1]

Q. 6 (a) Develop the expressions for V_{OH} , V_{OL} , V_{IL} and V_{IH} for a DLL configuration based all-p inverter circuit. State the limitations and benefits of this configuration over ZVLL.

(5) [CO5][BTL6]

(b) Describe the structure and expressions of current and device resistance for cylindrical OTFT. Also, state its benefits.

[5] [CO2][BTL1]

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Total No. of pages: 2
1ST SEMESTER
End Semester Examination

Roll No.
M.Tech (VLSI & ES)
NOV 2024

VLS 601 Embedded Systems

Time : 3 Hrs

Maximum Marks: 40

Note: Question No 1 is compulsory. Answer any 7 questions from remaining. Assume missing data if any.

- | | | | |
|---|---|---|-------------|
| | | | CO2 |
| 1 | a | MOVF COUNTL, F;
btfsc STATUS, Z;
decf COUNTH, F;
decf COUNTL, F;
Explain the function of the above code | 1 L2 |
| | b | Content of INTCON Register is 0x80
What do you infer from this | 1 CO2 |
| | | | L3 |
| | c | How many invisible registers are there in ARM processor? | 1 CO1
L2 |
| | d | Digital Signal Processor prefers circular Addressing Mode. Why? | 1 CO1
L3 |
| | e | What is the function of dirty bit? | 1 CO4
L1 |
| 2 | a | Does PIC support analog input / output devices? If so configure PIC for interfacing two analog devices, one as input and other as output device. | 2 CO3
L4 |
| | b | Write an assembly language program using PIC microcontroller for adding the decimal numbers stored at 0x10...0x13 and 0x14...0x17 and stores the sum in 0x20..0x23. | 3 CO3
L4 |

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- 3 Write an assembly language program to find out the number of positive numbers in a series of "n" 32-bit numbers 5 CO3
L4
 - 4 Write an ARM processor-based assembly language program to add a series of 'n' 16 bit numbers. 5 CO4
L3
 - 5 Differentiate between the following instructions CO4
 - a STMIA R10!, {R0-R7} and MRC CP_2 ADD R0, CR0, CR1 3 L3
 - b BGE Loop and BLX R0 2
 - 6 a What are the features of Digital Signal 2 CO3
b Processors Explain different methods of 3 L2
rounding used in removing guard bits in Digital Signal processor
 - 7 Define Interrupt Latency and explain 5 CO3
methods to reduce interrupt latency in ARM L3
microcontroller
 - 8 Explain different CACHE mapping policies 5 CO4
L3
 - 9 Write short notes on any two 4 CO1
+
4 L1
 - a. ARM 7 TDMI
 - b. AHB and APB Signals
 - c. Exception modes of ARM micro Controller

Total no. of Pages:

Roll no.....

1st SEMESTER

29)

M.Tech

END TERM EXAMINATION

Nov-2024

VLS 6207

Selected Topics in VLSI

Time: 03:00 Hours

Max. Marks: 50

Note : All questions carry equal marks.
Assume suitable missing data, if any.
Attempt any five questions

Q.1 Write a constrained random class in System Verilog with the following types of constraints and explain their function:

- (i) Parameterized
 - (ii) using inside operator
 - (iii) using := dist operator
 - (iv) using :/ dist operator
 - (v) bidirectional constraint
- [10][CO#5][BTL#Application]**

Q.2 Define critical path in a digital circuit. Which parameter is improved by adding register layers to the critical path in a circuit. Explain with the help of a Verilog example. **[10][CO#2][BTL#Understanding]**

Q.3 Draw the RTL schematic for the following code:

```
module adder(  
    output reg [7:0] Sum,  
    input [7:0] A, B, C, input clk);  
    reg [7:0] rA, rB, rC;  
    always @(posedge clk) begin  
        rA <= A;  
        rB <= B;  
        rC <= C;  
        Sum <= rA + rB + rC;  
    end  
endmodule
```

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Rewrite the code with Register Balancing and explain its effect on timing.
[10][CO#2][BTL#Understanding]

Q.4 "Dynamic power dissipation drops off with the square of the core voltage, but reducing voltage will have a negative impact on performance." What other measures can be taken to reduce dynamic power dissipation on an FPGA based design besides reducing voltage power supply?
[10][CO#3][BTL#Application]

Q.5 (i) How 'logic' variable in system Verilog is different from 'reg' in Verilog?

(ii) What is the purpose of \$isunknown operator in system Verilog?

(iii) If a statement is written in system Verilog as

```
Int md[2][3] = '{0,1,2}, {3,4,5}';
```

What will be the output corresponding to the statement

```
Foreach (md[i,j])
```

```
$display ("md[%0d][%0d]=%0d, I, j, md[i][j]);
```

(iv) Write the output for the following code in system Verilog

```
Initial begin
```

```
Bit [31:0] src[5] = '{5}{5}';
```

```
$display (src[0], src[0][0], src[0][2:1]);
```

(v) What is the function of foreach operator in system Verilog?

[10][CO#4][BTL#Application]

Q.6 (i) Add the following using floating point arithmetic:

(a) $3 + (3/4)$

(b) $3 - (1 + 2^{-22} + 2^{-23})$

[4][CO#1][BTL#Application]

(ii) (a) Consider a Xilinx Vertex FPGA slice with 4 input LUT and fast carry logic. Design a reduced coefficient multiplier using these cells in order to multiply 125 and 75.

[4][CO#1][BTL#Synthesis]

(b) Explain why most FPGA vendors choose LUT as the fundamental building block.

[2][CO#1][BTL#Knowledge]

*****END*****

Total no. of Pages:01

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III-SEMESTER

Roll no.....

M.Tech.

END TERM EXAMINATION

Nov-2024

VLS6301

SPEECH PROCESSING

Time: 03:00 Hours

Max. Marks: 50

Note : All questions carry equal marks.
Assume suitable missing data, if any.

Q.1 Draw and explain ASR system with different models.

[6][CO1][BTL2]

Q.2 Design discrete domain Short Time Fourier Transform (STFT) algorithm.

[6][CO2][BTL6]

Q.3 Write short notes

[10][CO3][BTL1,2]

(i) Critical Band Analysis

(ii) Bark Scale

(iii) Cepstrum

(iv) Windowing

Q.4 Design Mel Frequency Cepstral Coefficients (MFCC) algorithm.

[6][CO3][BTL6]

Q.5 Demonstrate Dynamic Time Warping (DTW) with restrictions on the warping function. Evaluate the shortest distance between two vectors A and B by DTW, which are defined as:

[10][CO4][BTL3,5]

$A = [1, 3, 4, 9, 8, 2, 1, 5, 7, 3]$ & $B = [1, 6, 2, 3, 0, 9, 4, 3, 6, 3]$

Q.6 Discriminate Gaussian Mixture and Hidden Markov models.

[6][CO5][BTL4]

Q.7 Demonstrate task specific voice control and dialog system in detail.

[6][CO5][BTL3]

M.Tech.

END TERM EXAMINATION

Nov-2024

COURSE CODE: VLS6401

COURSE TITLE: Mixed Signal Design

Time: 03:00 Hours

Max. Marks: 40

Note :

- (i) Attempt any five (5) questions.
- (ii) All questions carry equal marks.
- (iii) Assume suitable missing data, if any.

Q.1

(a) Design a first-order, low pass switched capacitor circuit that has a low frequency gain of +10 and a -3 dB frequency of 1 kHz. Use a clock frequency of 20 kHz. [4][CO1]

(b) Develop the equivalent resistance expression for the series switched capacitor resistor emulation circuit. [4][CO1]

Q.2

(a) A PLL incorporates a VCO and a PD (phase detector) having the characteristics as shown in fig. 1. Explain in detail, what happens as the input frequency varies in the locked condition. [4][CO2]

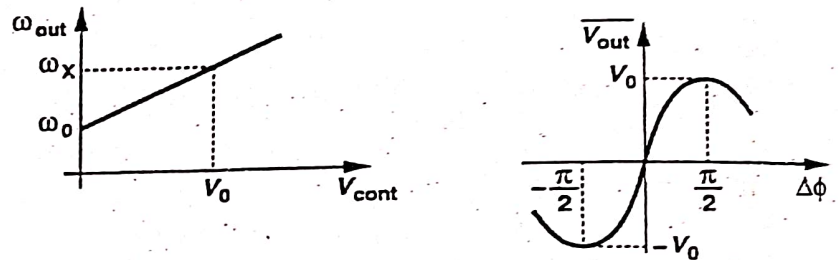


Fig. 1

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(b) Explain briefly the dynamics of a simple phase locked loop (PLL). A cellular telephone incorporates a 900 MHz phase locked loop to generate the carrier frequencies. If $\omega_{LPF} = 2\pi \times (20 \text{ kHz})$ and the output frequency is to be changed from 901 MHz to 901.2 MHz, how long does the PLL output frequency take to settle within 100 Hz of its final value ?

[3+1][CO2]

Q.3

(a) Explain the problem of lock acquisition in a PLL and how it can be rectified in modern PLLs.

[4][CO2]

(b) Illustrate a basic charge-pump PLL? Explain your answer with suitable diagrams and equations.

[4][CO3]

Q.4

(a) Describe the static characteristics of digital-to-analog converter (DAC). Assume that a DAC uses an op-amp in inverting configuration with $C_1 = C_2$ and $A_{vd}(0) = 1000$. Determine the largest resolution of the DAC if V_{ref} is 1V and assuming worst case condition.

[3+1][CO3]

(b) Explain the operation of serial charge-redistribution DAC with suitable diagrams.

[4][CO3]

Q.5

(a) Discuss the operation of a pipeline analog to digital converter (ADC) with suitable diagrams and waveforms.

[4][CO3]

(b) Assume that the sampled analog input to a 4-bit pipeline ADC is 2.00 V. If V_{REF} is equal to 5V, determine the digital output word and the analog equivalent voltage.

[4][CO4]

Q6.

Write a short note on any two of the following:

- i) Binary-scaled D/A converter
- ii) Thermometer code D/A converter
- iii) Successive approximation register A/D converter
- iv) Flash A/D converter
- v) Time-interleaved A/D converter

[4+4][CO4]