# QUESTION PAPERS FOR END TERM THEORY EXAMINATIONS
## May-2024



# M.Tech., MTPT, M.Sc., MBA, EMBA, M.Des., 2nd, 4th & 6th SEMESTER

# INDEX

## M.TECH/MTPT/Ph.D.

## M.Sc.

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SECOND SEMESTER

END SEM EXAMINATION

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Roll. No...............
Ph.D (AC)

MAY 2024

## ACPT-902 ANALYTICAL TECHNIQUES FOR MATERIALS CHARACTERIZATION

**Time: 3 Hours**                                          **Max. Marks: 50**

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

1. Explain the working of DSC with the help of a suitable block diagram. Justify the use of this technique in industry.                    10

2. What do you know about the X-ray diffraction? Discuss the instrumentation of this technique and applications in research work.                    10

3. Explain the working of thermogravimetric analyzer with the help of block diagram. Discuss the TGA thermogram of calcium oxalate.                    10

4. How scanning electron microscopy is useful for the characterization of polymeric materials? Discuss its importance by assuming suitable examples.

    10

5. What is the difference between transmission electron microscopy and scanning electron microscopy? Discuss the working and utility of TEM.    10

6. What do you mean by scanning tunnelling microscopy? Explain the working of this technique using its block diagram and its applications.    10

7. What is atomic force microscopy? Discuss its instrumentation and applications in research and development.                    10

8. Write short notes on any two of the following:                    5 x 2
    a) X-ray fluorescence
    b) Neutron diffraction
    c) Particle size analyzer

**M.Tech.(AI) 2ndSemester**
**END SEMESTER EXAMINATION**          **(May – 2024)**
                    **AI502    Machine Learning**
**Time: 3: Hours**                              **Max. Marks: 40**

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

**Q1.**  **(i)** Explain major steps of data cleaning during data pre processing.
   **(ii)** List various steps of Principal Component Analysis and illustrate them for following data set:
   (2,1), (3,5), (4,3), (5,6), (6,7), (7,8)

                                    **[3,5]**

**Q2.**  **(i) (a)**Illustrate the steps to induct the decision tree for the data set given in Table 1 , **(b)** write down the rules that can be obtained from the decision tree, **(c)** predict the class for < Amit, middle, high >
   **(ii)** Further calculate gain ratio and Gini index for attribute income.

   **(iii).** Illustrate the different methods for pruning the decision tree.

                                    **[4,2,2]**

| Sno | name | age | Income | Loan-Decision |
|-----|------|-----|--------|---------------|
| 1 | Ramesh | young | Low | No |
| 2 | Nimesh | young | High | No |
| 3 | Ritesh | middle | High | Yes |
| 4 | Mahesh | middle | Low | No |
| 5 | Shailesh | Senior | Low | Yes |
| 6 | Ramesh | senior | medium | yes |
| 7 | Mohan | senior | high | yes |
| 8 | Madhav | middle | low | no |

**Table 1**

**Q3.** **(i)** Build Naïve Bayes Classifier for above Table 1 and predict the class for

< Ravi, middle, high >

**(ii)** What are the various factors which are evaluated to compare different classification techniques.

**(iii)** Explain the steps of k cross validation where k = 10 and 1 data elements as data sex1, x2,.......x100 where each xi set of attributes with classified with defined class.

**(iv)** What is Accuracy evaluation of model using .*632 bootstrap.*

[2,3,2,1]

**Q4.** The following table shows midterm exam and final exam marks for students in a database course:

| $x$ Midterm exam | $y$ Final exam |
|---|---|
| 72 | 84 |
| 50 | 63 |
| 81 | 77 |
| 74 | 78 |
| 94 | 90 |
| 86 | 75 |
| 59 | 49 |
| 83 | 79 |
| 65 | 77 |
| 33 | 52 |
| 88 | 74 |
| 81 | 90 |

**(i)** Use the method of least squares to find an equation for prediction of a student's final exam marks based on midterm exam marks in the course.

**(ii)** Predict the final exam grade of a student who received 86 on midterm exam.

**(iii)** Describe ROC curve to evaluate accuracy.

[4,2,2]

**Q5. (i)** The following table contains the attributes name, Gender, Test-1, Test-2, Test-3 and Test-4 where gender is a symmetric attribute and the remaining trait attributes are asymmetric.

| Name | Gender | Test-1 | Test-2 | Test-3 | test-4 |
|------|--------|--------|--------|--------|--------|
| Devan | M | N | N | P | N |
| Caroline | F | P | P | P | N |
| Erik | M | N | P | N | P |

For asymmetric attribute values, let the value of P be set to 1 and value of N be set to 0.
  a.  Show the contingency matrix for each pair .
  b.  Compute the simple matching coefficient for each pair.
  c.  Compute the Jaccard coefficient for each pair.

**(ii)** Consider following objects to be arranged in to clusters. Each object has attributes test1 (categorical variable) ,test 2 as ordinal variable and test 3 as ratio scaled variable:

| Object id | test1 | test2 | test3 |
|-----------|-------|-------|-------|
| 1 | code-A | excellent | 450. |
| 2 | code-A | excellent | 250 |
| 3 | code-B | fair | 174 |
| 4 | code-C | good | 1350 |

Find the inter object distances and identify two nearest objects and two objects having maximum distance .

[4,4]

**Q6.** Suppose that the data mining task is to cluster the following eight points with (x, y)   representing location into three clusters, you can take any three points as seed points The distance is Manhattan distance

. A1(2; 10);  A2(2; 5);  A3(8; 4);  A4(5; 8);  A5(7; 5);  A6(6; 4); A7(1; 2); A8(4; 9)

   i) Use the k-means algorithm to show only three clusters and the cluster centers after the first round of execution.

   ii). Using the above data, show steps for the Agglomerative Hierarchical Clustering to construct  dendogram

                                       **[4,4]**

**Q7.** Write short notes on( any two):
   **(a)** Bagging &  boosting
   **(b)** Partition based methods for clustering.
   **(c) Rand**om Forest  and boosting
   **(d)** BIRCH method of clustering

                                         **[4,4]**

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# END TERM EXAMINATION

May-2024

## COURSE CODE- AI504
## COURSE TITLE- ARTIFICIAL NEURAL NETWORK(ANN)

Time-3:00 Hours

Max. Marks-40

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

Q1. (a) Compare and contrast LSTMs with traditional RNNs in terms of their ability to model long-term dependencies in sequences. [CO4]

(b) Explain the concept of vanishing gradients in deep neural networks. How does it affect training, and what are some techniques used to mitigate this problem? [CO3]

(c) Explain how back propagation can be used to solve the XOR problem which is not linearly separable ? [CO2]

(d) Suppose you have a multi-layer perceptron (MLP) with 100 input neurons, 50 hidden neurons, and 10 output neurons. If you increase the size of the training dataset from 1000 samples to 5000 samples, how does it impact the total number of parameters in the network? [CO1]

(e) Given a multi-layer perceptron (MLP) with an input layer of size 20, a hidden layer with 30 neurons, and an output layer with 10 neurons, calculate the total number of parameters in the network. Assume each neuron has a bias term. [CO1][2x5=10M]

Q2. (a) Suppose you have a simple feedforward neural network with one input layer consisting of 2 neurons, one hidden layer consisting of 2 neurons, and one output neuron. The activation function is ReLU (Rectified Linear Unit) for hidden layers and sigmoid for the output layer. The initial weights from the input to the hidden layer are [w11,

$w_{12}$], [$w_{21}$, $w_{22}$] where $w_{11}$ =0.5, $w_{12}$ = -0.6, $w_{21}$ = 0.1, $w_{22}$ = 0.8, and from the hidden to the output layer are [$w_{31}$, $w_{32}$] where $w_{31}$ = -0.9 and $w_{32}$ = 0.2. Given an input vector [0.7, 0.3], calculate the output of the network. Use a learning rate of 0.05 and perform backpropagation for one iteration using target output 0.6?                              [CO2] [6M]

(b) Consider an image with dimensions 400 x 400 pixels represented as a matrix. If we convolve this image with a filter/kernel of size 10x10 using no padding and a stride of 2, what will be the dimensions of the output feature map?                                      [CO3] [4M]

Q3. (a) How does an LSTM based architecture help in solving the problem of gradient explosion in recurrent networks? Explain with the help of the gating structure of an LSTM cell.            [CO4] [5M]

(b) Given an LSTM network with a single LSTM layer followed by a linear layer (fully connected) for classification, where the input size is 30, hidden size is 50, and output size is 10, calculate the total number of parameters in the LSTM network.                     [CO4] [5M]

Q4 (a) Describe the internal structure of an GRU unit and explain the purpose of each component (input gate, update gate, reset gate, candidate activation, final hidden state, and output gate).  [CO5] [5M]

(b)   Explain the concept of attention mechanisms in recurrent neural networks (RNNs). How do attention mechanisms improve the performance of RNNs on tasks involving long sequences, such as machine translation or text summarization?                     [CO4][5M]

## AI5202: HEURISTIC METHODS

Time: 3:00 Hours    Max. Marks: 50

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

1.  Refer to the maze shown below. Here M represents Mario and P represents Peach and the goal of the game is to get Mario and Peach to find each other (that is land up in same block). In each move, both Mario and Peach take turns. They can move one block at a time in one of the possible directions – up, down, right, left within the grid of cells. Cells marked in Gray are the restricted block where a move is not allowed.

    [a]  Construct a mathematical model to solve above problem with following components: Representation of solutions, Objective Function, Evaluation Function, Constraints, if any

    [b]  Define a heuristic function for convergence to optimal solution.

    [c]  Based on the type of solution representation you have chosen, what is the size of the solution space?

    [d]  Give the procedure for solving the above problem using any of the heuristic algorithm.

    | 5 | | | | | | ▓ | ▓ | P | | |
    |---|---|---|---|---|---|---|---|---|---|---|
    | 4 | ▓ | ▓ | ▓ | ▓ | | | | | | |
    | 3 | ▓ | ▓ | ▓ | ▓ | | | | | | |
    | 2 | | | | | | | | | | |
    | 1 | M | | ▓ | ▓ | | | | | | |
    | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

                                                    [2+1+2+5][CO2,CO3]

2.  [a]  Differentiate between heuristic and meta-heuristic algorithms and give an example for each.
                                                    [4][CO1]

    [b]  What is GRASP Algorithm? The figure given below shows the map of a fictional country with four provinces: Boro, Rabh, Brill and Tole. The map colouring problem requires you to colour each province red, blue, or green without using the same colour for any two neighbour provinces. Explain how the map colouring problem can be solved using GRASP algorithm in the context of problem formulation and steps.

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[2+4][CO3]

3. A telecommunication company needs to find the shortest route to connect the network nodes-a, b, c, d to minimize the cost involved. The cost of connecting any a pair of nodes is as given: [0 4 7 6 4 0 8 2 7 8 0 5 6 2 5 0]. Find the minimum cost required using Ant Colony Optimization. Consider the following values for parameters. The influencing parameter $\infty=1$, $\beta=2$, Rate of pheromone evaporation 0.5, Number of ants=2. Perform the steps of calculation with two ants for one iteration.

[10][CO2]

4. Given set of items with following weight and values. Determine using Particle Swarm Optimization, the items to collect in a bag of 50Kgs such that it maximizes the value. Weight(A,B,C,D)={10,10,40,20}. Value(A,B,C, D)={10,20,30,40}. The parameters for the algorithm are as given below: Number of particles: 3. The inertial weight w is set to 0.9, the cognitive weight $c_1$ is set to 1.5 and the social weight $c_2$ is set to 1.5. $r_1=r_2=0.5$. Initial velocity is zero. The initial particles are chosen randomly. Following equations are used for velocity and position update:

$$V_i(t+1)=wv_i(t)+c_1r_1*(p_i-x_i)+c_2r_2(p_g-x_i)$$
$$X_i(t+1)=x_i(t)+v_i(t+1)$$

Where $x_i(t)$ and $v_i(t)$ refers to position and velocity of the particle in $t^{th}$ generation and $p_i$ is the best position of particle i and $p_g$ refers to best position of entire swarm found so far.

[10][CO2]

5. Explain the following with respect to Genetic Algorithm.
   [a] What are the advantages of Genetic Algorithm?
   [b] What are the various operators in Genetic Algorithm?
   [c] Explain single point and two-point cross over with an example.
   [d] What is a Roulette Wheel Selection technique and Why is it used?

[2+2+2+4][CO3]

6. [a] Explain Great Deluge Algorithm? How is it different from Hill Climbing?

[4+2][CO2]

   [b] A chemical manufacturing company sells sulfuric acid at a price of $200 per ton(Revenue). The daily total production cost in dollars for x tons is $C(x)=150000+145.5x+0.0025x^2$. Using single variable optimization technique find how many tons of sulfuric acid should the manufacturer produce to maximize daily profits?

[4][CO3]

## II SEMESTER

## M.Tech

# END TERM EXAMINATION                    *May-2024*

### AI5304 :: Pattern Recognition

Time: 03:00 Hours                                    **Max. Marks: 40**

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

Q.1    a) What is the significance of Receiver Operating Characteristics curve? Explain with the help of an example.          **[4][CO1]**

b) Calculate the city-block distance and Euclidean distance between the two data points $X_1(1,3)$ and $X_2(2,3)$.          **[4][CO2]**

Q.2    a) Why is dimensionality reduction required? Discuss Principal Component Analysis methodology in detail.          **[4][CO3]**

b). Discuss the limitations of the k-means algorithm. How can they be overcome?          **[4][CO4]**

Q.3    a) Identify the performance of a model as per the given confusion matrix by calculating any 4 performance metrics:          **[4][CO2]**

|       |         | Predicted class ||
|-------|---------|---------|---------|
|       |         | Class 1 | Class 2 |
| **Real** | Class 1 | 677  | 177 |
| **class** | Class 2 | 17 | 766 |

b) Discuss P norm and its mathematical interpretation. With the help of an example of your choice, explain L0 Norm, L1 Norm, and L2 Norm.          **[4][CO1]**

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Q.4 Apply k-means clustering algorithm over the following data. Wr
all the steps of algorithm and mention appropriate assump
wherever necessary.
(Given: No. of objects: 7, No. of clusters: 2 and data points A,B
each object in the below table).

| A | 7 | 14 | 25 | 6 | 29 |
|---|---|----|----|----|----|
| B | 15 | 9 | 10 | 12 | 11 |

[8][C

Q.5 Differentiate between the following:                    [4x2=8][C
a) True Positive Rate and False Negative Rate
b) Hierarchical Clustering and Non-Hierarchical Clustering
c) Eigen Vector and Eigen Value
d) Posterior Probability and Prior Probability

# END TERM EXAMINATION  May, 2024

## AI5402 NATURAL LANGUAGE PROCESSING

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] Consider the following corpus of tweets regarding a review of some restorant. Perform tokenization, cleaning (punctuation, special characters removal, and lowering), stopword removal, and stemming. Create vocabulary from the corpus. **[4] [CO1]**

| Review | Sentiment |
|---|---|
| Food was delicious, truly delicious! Service was amazing. Ambiance amazing. #delicious #amazing | Positive |
| Terrible experience! Food was cold, service cold and disappointing. #terrible #cold | Negative |
| Amazing food, delicious ambiance. Service amazing. #amazing #delicious | Positive |
| Food quality terrible, service disappointing. Cold and terrible experience. #terrible #disappointing | Negative |

[b] Consider vocabulary created in 1[a] and obtain vector representations for each tweets using Bag of Words (BoW) approach. List two major disadvantages of BoW. **[2+2] [CO1, CO3]**

2.[a] Suppose, you're using Naive Bayes for sentiment analysis on movie reviews. In your training dataset of 800 reviews (500 positive, 300 negative), the word "awesome" appears in 80% of positive reviews and 10% of negative reviews, while "dull" appears in 5% of positive reviews and 20% of negative reviews. Now, you are given a new review "The film was awesome but the pacing was dull,". Find the polarity (negative or positive) of the above review? **[4] [CO2]**

[b] Consider a sentiment analysis model that uses logistic regression to classify tweets as positive or negative. The model is trained with coffients $w_0 = 0.1, w_1 = 0.5$, and $w_2 = 0.6$. Consider a new tweet in retorant reviews: "Delicious food but disappointing service.". Let the

tweet is vectoried as $[1, x_1, x_2]$, $x_1$ and $x_2$ are sum of positive and frequencies (in corpus given in 1[a]) of each in the tweet. Find the polarity of the above tweet using the said logistic regression model.

**[4] [CO2]**

**3.[a]** Given a text dataset consisting of the following three sentences: "The cat sat on the mat."; "The dog sat on the log."; "The cat chased the rat." Calculate the probability of the word that follows "cat" based on a bi-gram model. Assume all words are treated as lowercase, and punctuation is ignored for simplicity. Identify which word is most likely to be predicted after "cat" according to the bi-gram model probabilities.

**[4] [CO3]**

**[b]** Suppose you have a corpus containing the sentence "Sunshine brightens the mood and warms the earth", and you are training a skip-gram model for word embeddings with a window size of 2. The current target word is "mood". What are the context words for "mood" according to the window size specified? If the vocabulary size of the model is 10, and the dimension of the embeddings is 4, how many parameters does the model need to learn?

**[2+2] [CO3]**

**4.** Answer any TWO of the followings.

**[a]** Consider a simple RNN designed for language modeling. The vocabulary consists of three words: {START, hello, END}, encoded as one-hot vectors. The RNN has one hidden layer with two neurons. The initial hidden state $h = [0, 0]^T$ and the sequence input to the RNN is 'START', followed by 'hello'. The bias for the hidden layer and output are $[0, 0]^T$ and $[0, 0, 0]^T$ respectively. The weight matrices are given as:

$$W_{hl} = \begin{bmatrix} 0.5 & -0.5 & 0 \\ 0.3 & 0 & -0.3 \end{bmatrix}, W_{hh} = \begin{bmatrix} 0.1 & 0 \\ 0 & 0.2 \end{bmatrix}, W_{oh} = \begin{bmatrix} 0.1 & -0.1 \\ -0.1 & 0.1 \\ 0 & 0 \end{bmatrix}$$

Calculate the output probabilities for each word in the vocabulary after processing 'START'.

**[4] [CO4]**

**[b]** Consider an LSTM cell with an input vector of size 2, a hidden state vector of size 2, and a current input of [0.5,−0.5]. Assume the forget gate, input gate, and output gate biases are all set to zero for simplicity, and the corresponding weight matrices for forget gate, input gate and cell state are given as below:

$$W_f = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0.2 & 0 & 0 \end{bmatrix}, W_i = \begin{bmatrix} 0.5 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}, W_c = \begin{bmatrix} 0.2 & 0 & 0 & 0 \\ 0 & -0.1 & 0 & 0 \end{bmatrix},$$

Given the that the initial hidden state $h_{t-1}$ and cell state $c_{t-1}$ both are zero vectors, find the update for the cell state $c_t$ for this timestep.

[4] [CO4]

[c] Explain the role of the forget gate in an LSTM cell and discuss how it contributes to the model's ability to avoid the vanishing gradient problem. Illustrate your explanation with a mathematical representation of the forget gate's function.

[4] [CO4]

5. Answer any TWO of the followings.

[a] Consider a Transformer model is being trained on a corpus with minibatch of size 1. Let a sentence "The cat sat" is being processed in self-attention layer. The initial embedings for tokens are: $The = [1, 0]$, $cat = [0, 1]$, $sat = [1, 1]$. The transformation matrices are given as $W^Q = W^K = W^V = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$. Calculate the query, key, and value vectors for each token. Also, compute the attention scores for each pair of query and key.

[4] [CO4]

[b] Consider the sentence in 5[a] again, compute the final output vector of first attention layer for the token "sat" by applying the attention weights to the value vectors. Also, explain the significance of the values obtained.

[4] [CO4, CO5]

[c] Compare and contrast the Transformer architecture with recurrent neural networks (RNN). Also, explain the need of the positional encoding in Transformers.

[4] [CO5]

---Best of Luck---

**FIRST SEMESTER**                        **Ph. D(AM)**

**END SEMESTER EXAMINATION**        **MAY 2024**

## AM-501B GRAPH THEORY AND PETRI NETS

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

**Note: Answer any Five. All questions carry equal marks.**

Q1(a) Prove that a connected graph is Eulerian iff it can be decomposed into circuits.

(b) Prove that a graph $G$ is disconnected iff its vertex set $V$ can be partitioned into two disjoint subsets $V_1$ and $V_2$ such that there exists no edge in $G$ whose one vertex is in $V_1$ and the other in $V_2$.

Q2(a) Prove that in any tree, there are at least two pendant vertices.

(b) Show that the distance between vertices of a connected graph is a metric.

Q3 (a) Define binary tree. Prove that

(i) The number of vertices in a binary tree is always odd.

(ii) The number of pendant vertices in a binary tree is $(n+1)/2$, where n is the number of vertices in the binary tree.
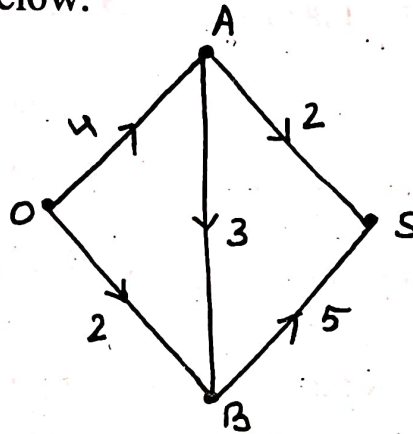
(b) Describe Dijkstra's algorithm and hence find the shortest path from the vertex 'a' to the vertex 'f' of the graph given below:
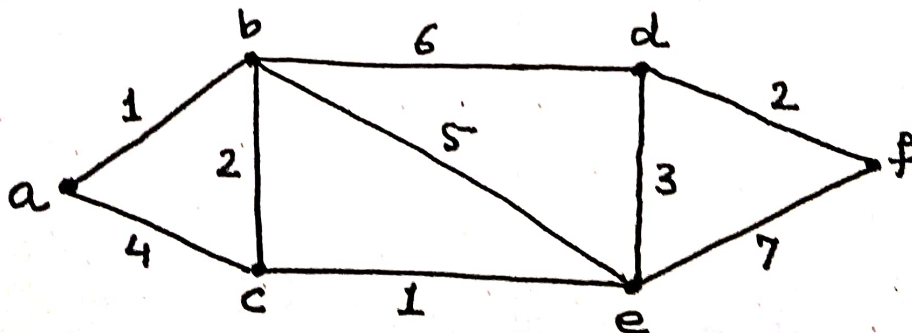
Q4(a) Prove that every cut-set in a connected graph $G$ must contain at least one branch of every spanning tree of $G$.

(b) Using Ford-Fulkerson algorithm find the maximum flow in the network given below:



Q5(a) Prove that a graph is a tree iff it is minimally connected.

(b) Define the Ring sum of two graphs and complement of a graph. Show that a graph is self-complementary if it has $4n$ or $4n+1$ vertices.

Q6(a) Define reachability tree of a Petrinet. Show that the reachability tree of a Petrinet is finite

(b) Define boundedness, safeness, conservation and liveness in a Petri net. Whether the Petri net given below is bounded, safe, conservative and live?
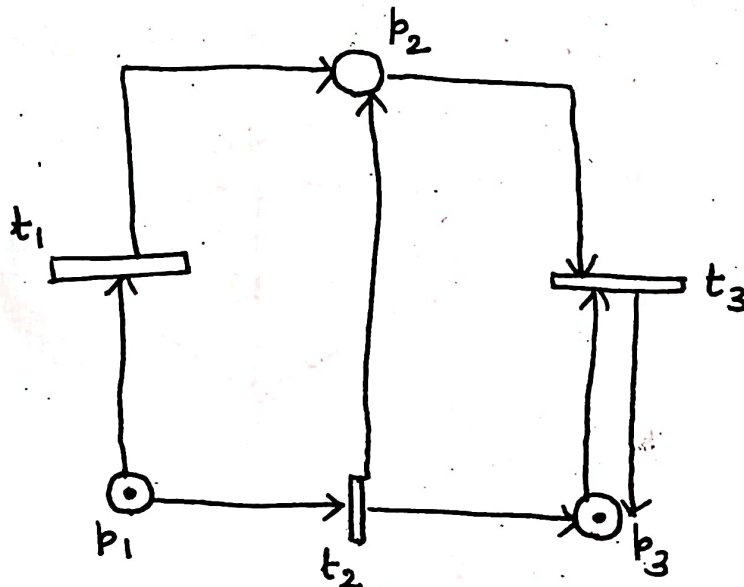
## I/II SEMESTER
## Ph.D.

**END TERM EXAMINATION**                              **MAY-2024**

### AM-501C Introduction to Mathematical Software

**Time: 3 Hours**                                    **Max. Marks: 50**

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**Note: Answer any five questions. (Assume suitable missing data, if any.)**

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1) (i) Describe the need for an operating system. Explain the key functions performed by an operating system.                              (CO1) (6)

   (ii) Discuss the various features offered by Microsoft Excel that make it a versatile tool for data organization, analysis, and visualization. Illustrate each functionality with a suitable example.                    (CO5) (4)

2) (i) What are loops in C programming? Describe the different types of loops supported in C with examples.                              (CO2, CO4) (5)

   (ii) Discuss the concept of strings in C programming. Also, explain the commonly used built-in string library functions in C.          (CO4) (5)

3) (i) Write a program in C to generate the Fibonacci series up to n number of terms.                                                      (CO4) (5)

   (ii) How to typeset the following mathematical expressions and table in LaTeX                                                   (CO5)(1+1+1+2)

   (a) $\begin{bmatrix} 2 & 1 \\ 3 & 4 \end{bmatrix}$

   (b) $\sum_{n=1}^{\infty} \frac{1}{n^s} = \prod_p \frac{1}{1-p^{-s}}$

   (c) $e^x = 1 + \frac{x}{1!} + \frac{x^2}{2!} + \frac{x^3}{3!} + \cdots, \quad -\infty < x < \infty$

(d)

| Country List | | | | |
|---|---|---|---|---|
| Country Name or Area Name | ISO ALPHA 2 Code | | ISO ALPHA 3 Code | ISO numeric Code |
| Afghanistan | AF | | AFG | 004 |
| Albania | AL | | ALB | 008 |
| Algeria | DZ | | DZA | 012 |

4) (i) Write a LaTeX code snippet to create a Beamer presentation. The presentation should include the following elements: a title of the presentation, an outline slide, a slide with an image and a caption and a slide with two columns, each containing different content. Ensure that each slide has an appropriate title. ( CO5) (5)

(ii) Write a program in MATLAB to calculate the factorial of a given number using a loop and display the result. (CO3, CO4) (5)

5) (i) Solve the linear system Ax=b for x in MATLAB using two different ways. Also write the commands to verify your answer. (CO3, CO4) (5)

(ii) Use Mathematica to create a single row of three plots, each representing a different function. The functions to plot are as follows:

a) Absolute value of $x$ over the range −1 to 1.
b) Floor function of $x$ over the range −2 to 3.
c) Modulus function of $x$ with respect to 1 over the range 0 to 3 (CO3, CO4) (5)

6) (i) Consider the function f(x) = x^3 - 6x^2 + 11x - 6. Using Mathematica, solve the above equation for x and plot the resulting solutions on a graph, indicating the roots with red points. Include labels for the axes and a title for the plot. (CO3, CO4) (5)

(ii) Differentiate between set and set delayed in Mathematica with suitable examples. (CO3,C04) (5)

**************All The Best*************

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# SECOND SEMESTER

PhD[AM]

# END TERM EXAMINATION

*May -2024*

## AM 502B: GENERAL RELATIVITY AND COSMOLOGY

*Time: 3:00 hours*

*Max. Marks: 5*

**Note : (1)** Attempt any **five** questions.
**(2)** Each question has equal marks.
**(3)** Assume suitable missing data, if any.

Q.1 [a] What are inertial and non-inertial frames? Give an example of ea
How has it been established that earth is not an inertial frame?

[b] Show that $ds^2 = dx^2 + dy^2 + dz^2 - c^2 dt^2$ is invariant un
Lorentz transformation.

Q.2 [a] Discuss the concept of space and time in special relativity theor
Discuss Minkowski's four dimensional space-time continuum.

[b] Explain the principle of equivalence and the principle of gene
covariance.

Q.3 [a] Write the Einstein's field equations for the perfect fluid and
discuss its geometrical and physical significances.

[b] Derive the conservation or fluid equation for a perfect fluid fro
first law of thermodynamics.

Q.4 [a] Derive the acceleration equation from Friedmann equation a
discuss its significance.

[b] Using Friedmann equation and conservation equation, prove th
$\rho \propto a^{-3}$ and $a \propto t^{2/3}$ for the matter-dominated phase of t
universe.

Q.5 [a] Show that de Sitter's model corresponds to completely empty
universe without matter or radiation.

**P.T.**

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[b] Using Chaplygin gas equation of state $p = -A/\rho^\alpha$ in Friedmann equation and conservation equation, find the solution of energy density.

Q.6 Write the short notes on **any two** of the following.
   [a] Scalar field and its significance
   [b] Inflationary model
   [c] Schwarzchild singularity.

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Total No. of Pages : **01**

Ist Semester    **END SEMESTER EXAMINATION**    **Ph.D. (AM)**

**PAPER CODE - AM-504B**      **Apr./May-2024**

**TITLE OF PAPER -** Advanced Mathematical Methods

TIME: 03 HRS      MAX. MARKS:50

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

     Assume suitable missing data, if any.

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1. Compute     (10)

$$\sum_{j=1}^{\infty} \frac{2j+3}{j^2(j+1)^2(j+2)^2(j+3)^2}.$$

2. Find Taylor or Frobenius series solutions about the point at $n = \infty$  (10) for:

$$a_{n+1} = \left(1 + \frac{1}{n^2}\right) a_n.$$

3. Compute three terms in the continued-exponential expansion of the  (10) series:

$$\sum_{n=0}^{\infty}(-z)^n.$$

4. Use second-order perturbation theory to find approximations to the  (10) roots of the following equations:

$$x^2 + x + 6\varepsilon = 0.$$

5. Find the asymptotic behavior of     (10)

$$y' + \left(\epsilon x^2 + 1 + \frac{1}{x^2}\right) y = 0, \quad y(1) = 1.$$

6. Find the controlling factor of the leading behaviour to:     (10)

$$a_{n+1} = n a_n.$$

**EVEN SEMESTER**
**END SEMESTER EXAMINATION**

**Ph.D. Course Work**
**(MAY-2024)**

**AM 505B: Advanced Algebra**

Time: 3:00 Hours

**Max. Marks: 50**

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

Q1. Let Z be the center of a group G. Show that if G/Z is cyclic then G
is Abelian.

Q2. Define ring of fractions for a ring R with identity and hence find
ring of fractions of Z.

Q3. Compute explicitly all the conjugacy classes of $S_3$.

Q4. Let M be a module over a commutative ring R. Assume that M
contains two finite basis $\beta_1 = \{v_1,........, v_m\}$ and $\beta_2 = \{w_1,........, w_n\}$.
Then prove that $m = n$.

Q5. Let R be a Von Neumann regular ring, the prove that the
following conditions are equivalent:
  i) Every principal left ideal is generated by an idempotent.
  ii) Every principal left ideal is a direct summand of R.
  iii) Every finitely generated left ideal is generated by an idempotent
  iv) Every finitely generated left ideal is a direct summand of $_RR$.

Q6. Let J(R) denote the Jacobson radical of a ring R with 1. Show that
$y \in J(R)$ iff $1 - xyz \in U(R)$ (the group of units of R) for any
$x, z \in R$.

**- END -**

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**II SEMESTER**

# M.Tech. [BIOINFORMATICS]

END TERM EXAMINATION    *May-2024*

## COURSE CODE BIO502

## COURSE TITLE Advances in 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) Define phylogenetics and explain the importance of constructing phylogenetic trees. Provide an example of a phylogenetic tree and interpret its evolutionary relationships using suitable terminology.

   (b) Compare and contrast different tree-building methods.

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

2. (a) Explain the historical perspectives of pharmacogenomics and its current status in personalized medicine.

   (b) Evaluate the management of pharmacogenomic information using databases such as PharmGKB and DrugBank.

   [4+4] [CO# BIO-501.3]

3. (a) Describe the role of PDB and MMDB in storing and providing access to structural information.

   (b) Discuss the importance of visualizing structural information from databases like PDB in understanding molecular functions.

   [4+4] [CO# BIO-501.2]

4. (a) A tech company wants to develop a system that recognize handwritten digits in a large dataset. Which machine learning approach would you recommend for this task, and why? Outline the steps and procedures you would follow to build and train the model.

(b) Discuss the potential challenges and limitations of the approach you chose for recognizing handwritten digits. How would you address these challenges to improve the model's accuracy and performance?

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

5. (a) Define genetic markers and microsatellites. Explain how genetic markers are used in population studies.

(b) Describe software tools commonly used for SNP and mutation visualization. Provide a step-by-step guide on using one such tool.

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

6. Propose a research project that combines knowledge from human genetic variation databases and pharmacogenomics databases to improve personalized medicine. Define the specific objectives of your research project, including the target population and medical conditions of interest. Outline the steps involved in integrating genetic variation data with pharmacogenomic information and include ethical and social issues revolving around personalized medicine advancements.

(Application and ethical based) [8] [CO# BIO-501.3]

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Roll no..............

**II SEMESTER**

**M.Tech.**

**END TERM EXAMINATION**    *May-2024*

**BIO 504 High throughput Structural Biology**

Time: 03:00 Hours    *Max. Marks: 45*

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

**Q.1** a) Define the following terms and differentiate them:
[1*4] [CO# BIO504.1]

1) Cell and Organelle,
2) Atoms and Molecules,
3) Gene and Genome,
4) Amino acids and Proteins.

b) What do you understand by local and global optimization?
Discuss their advantages and disadvantages. [3][CO# BIO504.4]

c) Differentiate between light and electron microscope.
[3][CO# BIO504.2]

**Q.2** a) Describe structural biology and its needs. How has structural biology played a key role in the understanding of biomolecules? Comment upon its historical development and progression.
[5][CO# BIO504.1]

b) What is circular dichroism (CD) spectroscopy? Describe the working principle of CD. List its applications.
[3][CO# BIO504.3]

c) Differentiate between homology modeling and ab initio modeling prediction.
[2][CO# BIO504.3]

**Q.3** a) What are the various constituents of DNA? Explain various structural forms of DNA. Differentiate these forms A-DNA, B-DNA, and Z-DNA.
[5][CO# Bio504.1]

b) Differentiate between crystalline and amorphous structures of proteins.
[3][CO# Bio504.2]

c) Explain how a right-handed circularly polarized light beam can be obtained from two linearly polarized light beams.
[2][CO#BIO504.3]

**Q.4 a)** Three-dimensional structure analysis is important for understanding the functions of proteins at the molecular level. What are various methods available for the analysis of protein structures? **[5][CO#BIO504.3]**

**b)** What are the basic models involved in protein structure prediction? Discuss comparative modeling in detail. **[5][CO#BIO504.5]**

**Q.5** Optical density of a 400 bp long 1 ml DNA solution was found to be 0.05. How many DNA molecules are present in the solution? (Given 1 base pair = 650 Dalton or 650g/mol, Optical density of 1 OD corresponds to 50 µg DNA/ml] **[5][CO#BIO504.3]**

## II SEMESTER
## M.TECH. (BIOINFORMATICS)

**END SEMESTER EXAMINATION**                    **May 2024**

**BIO-5308**                    **IMMUNOINFORMATICS**

Time: 3 Hours                    Max.Marks: 50

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

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1. Explain using suitable schematic representations for the following:     CO# 1,2

   a. How IgM is the most prevalent immunoglobulin in primary response and is part of the BCR.

   b. IgG1 with V1D1J1 is formed by gene rearrangement, assuming there are 12 each of V,D,J segments.

2. Explain in detail, how bioinformatics is useful in solving the following immunological problems:                    CO# 3, 4

   a. Classification of haplotypes in HLA supertypes, to predict susceptibility of a population to a particular ailment.

   b. Role of TAP in antigen presentation and TAP binders in accurate prediction of T cell epitopes                    CO# 2,3

3. Write short notes on the following :

   a. Adaptive immunity in modulating the immune response and its role in preventing autoimmunity

   b. Hypersensitivity

4. a. Explain the role of innate immune system in preventing tumor progression. Using suitable examples explain different databases and tools that employ the role of innate immune system for prediction of effective therapy specially in case of cancers.

   b. How does MHC II prevent endogenous antigen loading in the ER lumen? How does T helper cell modulate the B cell response?                    CO# 1, 5

5. Compare and contrast the following using detailed explanation and suitable examples:                    CO# 2,4

   a. T cell and B cell epitope prediction

   b. TCR and BCR signaling pathways                    CO# 4,5

6. Explain the following using suitable case studies:

   a. Neural network in immune-informatics

   b. Choice of SVM as a suitable tool in peptide prediction

**IInd SEMESTER**

**M.Tech. BIOINFORMATICS**

**END TERM EXAMINATION**     *May-2024*

## BIO 5402 ADVANCED GENETIC ENGINEERING

Time: 3:00 Hours            *Max. Marks: 40*

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

Q.1. With the help of given arbitrary sequence (i) prepare atleast two sets of primers and load EcoRI (G^AATTC), BamHI (G^GATCC), XhoI (CTCGAG), HindIII (AAGCTT), XbaI (TCTAG^A), SmaI (CCC^GGG) in the primers together with Tm of each primer: 5'-CTCAGACTAGCATGGACCGAG-CAGCAACAATTCACGATAACTTAGCCGATTGCTAATACTAGCTT ACGTTACGACATGAACTAATACGCCGGATCGATCGACTAACATT C-3'. How would you analyze PCR curve and describe the limiting factors of PCR and primer designing per se. (ii) Describe the usage of master mix and why do we need different Taq polymerases? (iii) Define "HOT start, nested PCR and non-specific PCR" (iv) Why do we need semi-quantitative PCR? Define this with pictorial representation.     [08][3]

Q.2. Certain gene expression is extremely poor for transfection. In order to avoid such situations and viral mediated gene transfer is advisable. Describe the viral mediated gene delivery and how would you get the virus with gene of interest. How would we achieve the viral MOI, PFU and CFU? Also explain the process of Electroporation.     08][1]

Q.3 Explain the different physical and chemical based strategies of gene cloning. Describe any one expression vector containing a promoter of bacterial origin.     [08][2]

Q.4 How cis-acting elements are important for eukaryotic gene expression? Explain the usage of super shift assay and role of antibody in it? What is co... sequence and describe the importance of 3' UTR?                    [08][4]

Q.5 Explain any two of the following DNA-protein interaction techniques.
(i) Yeast-two-hyridization (Y2H)
(ii) Microinjection
(iii) Confocal co-localization
(iv) Fluorescence resonance energy transfer (FRET)                    [08][5]

Q.6 Explain the protocol of DNA extraction with composition and function o buffers. Compare the Southern and Northern hybridization techni...
[08][4]

Q.7 What are the tools of recombinant DNA technology? Explain the working protocol and application of recombinant DNA technology with a approp diagram. Briefly discuss the role of recombinant DNA technology in huma health and disease.                    [08]

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**M.Tech. ( C&I)**                                  *II Semester*

**END SEMESTER EXAMINATION**           *(MAY-2024 )*

**C&I-502 INTELLIGENT CONTROL**

*Time: 3:00 Hours*                            *Max. Marks: 40*

| **Note:** | 1. Attempt FIVE questions. |
|---|---|
| | 2. Assume suitable missing data, if any. |

Q.1[a] Explain fuzzy logic control (FLC) using Mamdani model? Draw block diagram and implement FLC for Servomotor control. Write MATLAB code.

[CO2]

[b] Explain Servomotor control using artificial neural networks with appropriate derivations and block diagrams. Assume suitable architecture.    [4+4][CO3]

Q.2 [a] A two input, single output, two layer feedforward neural network has the hidden layer weights=[0.35 0.75;0.25 0.65;0.15 0.55] and output layer weights=[0.22 0.47 0.36]. The bias values are 0.5 and 0.45 respectively. Consider a sigmoidal function as activation function in hidden layer. What is the output of the neural network if the input is $[0.20 \ 0.70]^T$ ?    [CO3]

[b] Find the change in weights using backpropagation algorithm if given target is 0.28 and η=0.6.    [4+4][CO3]

Q.3 Explain different terms with examples

[a] Positive and negative semidefinite functions    [CO1]

[b] Bias and threshold    [CO3]

[c] Activation functions    [CO3]

[d] Weights    [2 marks each][CO3]

Q.4 [a] Why defuzzification has been done? Explain defuzzification method with suitable examples.    [CO2]

[b] Approximate the two functions y=sin(x) and $y=x^2$ by fuzzy models. Choose the membership functions and type of fuzzy inference you think will work best. Make one rough (small number of rules) and one finer approximation for each function.    [3+5][CO2]

Q.5 It is believed that the output of a plant y is linearly related to the input, x, that is y=w1*x*x+w2.

[a] What are the values of w1 and w2 if the following measurements are obtained: x=2, y=5; x=-2, y=1, x=5, y=7. [CO3]

[b] Apply a test input x=3 and find the value of y using suitable method.

[4+4][CO3]

Q.6[a] On a cold winter morning, your mother tells you, "The temperature is about -10°C." Represent this piece of information by

i) A crisp set ( a crisp membership function), [CO2]

ii) a fuzzy set.

[b] Compare biological neuron with artificial neuron. Write down the strength and weaknesses of a human brain with respect to a computer. [4+4][CO3]

Q.7 [a] What is the difference between unsupervised and supervised learning?

[b] How adaptive control has been done using neural networks? Explain it by giving an example with suitable diagram and derivations. [3+5][CO3]

Q.8 [a] Explain different type of norms used for signals. [CO1]

[b] Explain state feedback linearization control.

[3+5][CO1]

**M.Tech (C&I)**

End Term Examination (May, 2024)
**C&I-504 PROCESS CONTROL**

Maximum Marks: 40

Time: 3 Hours

Note: Question 1 is compulsory. Answer any four questions from remaining.
Write your name and Roll number on answer sheets and question papers.
Assume suitable missing data, if any.

(1x8)    C01

**Q1.** Answer the following questions in brief.
[a] Write model equations of 03 analogous systems including one mechanical, one electrical and one fluid systems.
[b] In 03 term P,I,and D controller, which term/mode can give zero offset.
[c] In baking process of bread in an oven if oven temperature is a controlled variable and room temperature is a disturbance variable then can you use a feedforward control scheme to regulate the oven temperature?
[d] Write input and output relation of a delay element in time domain and develop its transfer function.
[e] What are the values of pressure for fully closed and fully open position of a fail open valve?
[f] State the effects on a process variable (PV), if the proportional gain is set too high?
[g] In a Boiler fuel and air flow control, in order to ensure supply of an air rich mixture of fuel, which type of control strategy is used?
[h] In a Jacketed Stirred Tank heater, identify the input and output variables.

**Q2.** Develop process model for the following level control system using mass balance equation. All notations and symbols have their usual meaning.    2x4    C02
[a] If both inflow and outflow rate are initially equal and after some time the outflow rate is suddenly decreased through valve, then derive the time domain expression for level in the tank.
[b] For the inflow and out flow profiles given below for above fluid system, draw the profile of level in the tank.



Fig.1
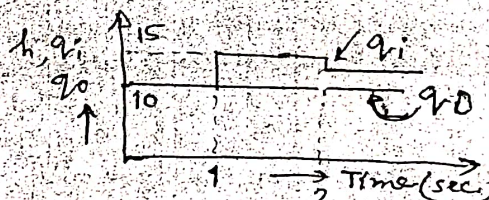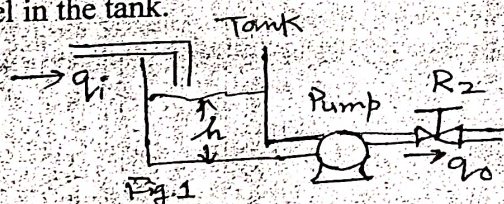
**Q3.** [a] Derive the condition for an inverse response for parallel arrangement of two first order processes with individual transfer functions,    C02
$g_{p_1} = \frac{k_1}{\tau_1 s+1}$ and $g_{p_2} = \frac{k_2}{\tau_2 s+1}$. Discuss the effect of addition of zeros on the inverse response of the system.    04

[b] Consider the following first order plus time delay process $\frac{e^{-\theta s}}{(\tau s+1)}$

For a unit step change in the set point determine closed loop step response of this process and sketch the time response behavior for $\tau=2$ sec. and $\theta=2$ sec.    04

**Q3.** [a] What is the master and slave variables in cascade control? Draw a neat block diagram for cascade control scheme in a fired furnace and derive the closed-loop transfer function relating the primary set point to the primary process output for a cascade-control system.    C01

Also discuss the criterion in selecting control variables in inner/outer loops in a cascade control structure. **04**

[b] Draw process instrumentation (PI) diagram for batch reactor temperature control using Split-range temperature control strategy, and explain the control operation with cold glycol valve and hot glycol valve control. State nature of both valve. **04**

Q4. [a] List in a table all input and output devices for the drilling process shown in Fig.2. CO4
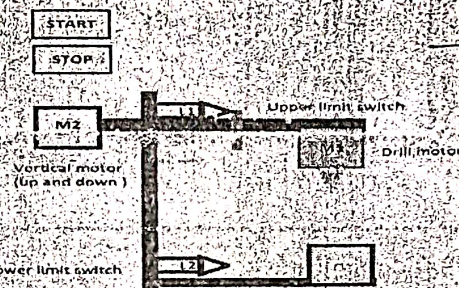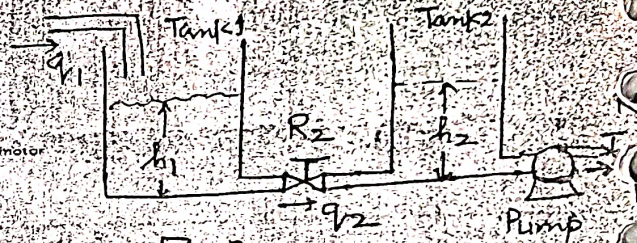


Fig.2          Fig.3

[b] The Fig.2 shows a drilling process that needs to be controlled using PLC. Make a ladder logic PLC program for the implementation of the process. The sequence of operation is as follows:

(i). At the beginning of the drilling cycle the Upper Limit Switch is closed

(ii). The START button starts the drilling cycle (push button)

(iii). The drill motor M1 must start. At the same time, the vertical motor M2 must start to descend the drill

(iv). The drill will stop at the Lower Limit Switch. At this time, the vertical motor starts to ascend the drill.

(v). The drill motor must stop just at the upper position. Wait for a new drilling cycle

(vi). Stop button is optional (push button) **08**

Q5[a]. Two interacting liquid level control (first order process) are operating in series as shown in Fig3. It is desired to control liquid level h2 by manipulating flow rate q3. Derive the overall transfer function h2/q3 of the process. **04**   CO2

[b]   Find the steady state gain and time constant of the following processes and sketch their expected unit step response (plot them in a single figure). **04**   CO2

(i) $\frac{1.2}{(2s+1)}$   (ii) $\frac{1}{(s+1)}$

Q6[a] Consider the block diagram of feedback controlled process shown in Fig.4 where

$$G_c = Kc, \quad G_v = 2, \quad G_m = 0.25 \quad \text{and} \quad Gp = \frac{4e^{-s}}{(5s+1)}$$   **04**   CO2

Derive the closed loop transfer function for set point Ysp and using Pade first order approximation find the range of proportional controller gain Kc for stable operation of this process.

[b] The first order process is defined as $Gp = \frac{k}{(Ts+1)}$. Determine the offset due to step set point change in process with P controller having gain Kc. **04**

Q7. [a] Draw a schematic and also a block diagram for a pneumatic PI controller and explain its operation to control the pressure. Derive transfer function of the controller pc(s)/e(s). State the condition of valve resistance and stiffness of the bellows under which PI controller acts as an on- off controller. **04**   CO1

[b] What is the ratio control? Which type of processes use ratio control? Explain different approaches for implementing ratio control. CO1

**04**
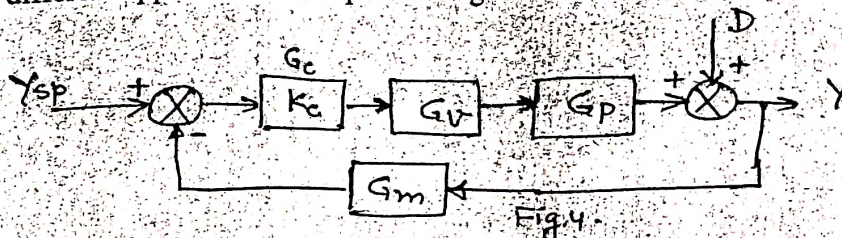


Fig.4.

2nd Semester

M.TECH

END TERM EXAMINATION                               May-2024

C&I 5206    MACHINE LEARNING

Time: 3.00 Hours                                   Max Marks: 50

> Note: All the questions are compulsory.

**Q1) Write the correct answer and justify:**          [10] [CO 1,2,3,4,5]

(i) A random variable $X$ is normally distributed with the mean 35 and variance 81. So which of the following is correct?

A.) $E(X) = 45$                          B.) $P(X> 55) = P(X <-55)$

C.) $P(X> 45) < P(X>15)$              D.) $P(X> 45) = P(X < 25)$

(ii) What does the term "overfitting" refer to in supervised learning?

A.) Model is too simple to capture patterns

B.) Model learns the training data too well, but does not generalize

C.) Model is not learning from the data

D.) Model performs well on both training and testing data

(iii)    $P(A^C \cap B)$ is equal to

A.) $P(B) - P(A \cap B)$                    B.) $P(B) - P(A \cup B)$

C.) $P(B) + P(A \cup B)$                    D.) $P(B) + P(A \cap B)$

(iv)   Which of the following is not a type of learning?

A.) Semi-unsupervised Learning   B.) Supervised Learning

C.) Unsupervised Learning         D.) Reinforcement Learning

(v)    Real -Time decisions, Game AI, Learning Tasks, Skill Acquisition, and Robot Navigation are applications in ....

A.) Unsupervised Learning: Clustering

B.) Supervised Learning: Classification

C.) Reinforcement Learning

D.) Unsupervised Learning: Regression

(vi)    Let $X$ be normally distributed with mean $=14$ and **variance** $= 81$, the value of $b$ for which $E\ (X - b)$ is least is

_____ .

(vii)   Suppose $F(x,y) = \dfrac{x^2}{2} + \dfrac{y^2}{3}$ be a scalar field , the magnitude of gradient of the point $(1,3)$ is _____ .

(viii)  The angle between two vectors $\bar{A}_1 = [2\ 6\ 14]^T$, and $\bar{A}_2 = [-12\ 8\ 16]^T$ in radians is _____ .

(ix)    A die is loaded so that the probability of getting face 'x' is proportional to 'x'. The probability of an odd no. occurring when the die is rolled would be _____ .

(x)     For a random variable 'X' ($-\infty < x < \infty$) following normal distribution, the mean is 100. If the probability is $P = 0.39$ for $x \geq 110$, then $P\ [90 \leq x \leq 110]$ is _____ .

**Q2)**  A. Write short notes on Gradient Descent Algorithm? Explain with a pseudo code?    **[5] [CO5]**

B. Run the Gradient Descent algorithm on the error function

$F\ (w_0,\ w_1) = \dfrac{1}{2}w_0^2 + w_1^2$ starting at the point $W^{(0)} = [2,2]^T$

and using step size of $\dfrac{1}{2}$. Output the weight parameters $W^{(1)}$ , $W^{(2)}$ , $W^{(3)}$ , where W vector corresponds to $[w_0,\ w_1]^T$.    **[5] [CO5]**

**Q3)** A factory produces two types of light bulbs, type A and type B. Type A bulbs have a lifespan that follows a normal distribution with mean 800 hours and standard deviation 100 hours, while type B bulbs have a lifespan that follows a normal distribution with mean 1000 hours and standard deviation 150 hours. The factory produces 60% type A bulbs and 40% type B bulbs. If you pick a bulb at random and it lasts for atleast 900 hours, what is the probability that it is a type A bulb?
**[Refer Table 1]**                                    **[10] [CO1]**

**Q4)** A. Sketch the MSE (Mean Squared Error) on the below graph. Where does its minimum occur? Draw a star on your MSE plot where the minimum occurs. Elaborate your answer.           **[4] [CO4]**
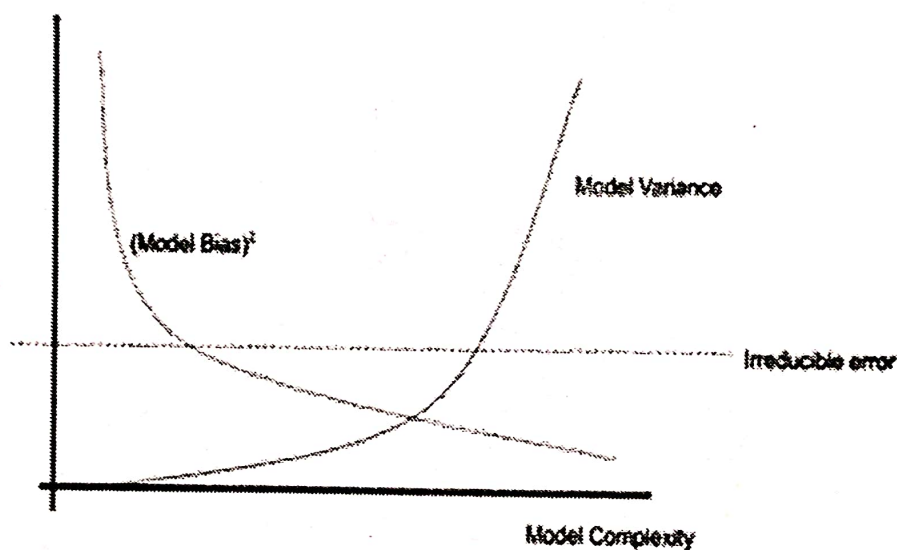


B. What is meant by overfitting and underfitting of data with examples?
**[6] [CO4]**

**Q5)** A. Explain the Loss function used in the machine learning algorithms. Also explain in detail about the Regression and Classification based Loss functions?           **[4]   [CO2]**

B. What is meant by False Positives? What is meant by confusion matrix of a binary classification problem? Give relevant examples. Also, explain how this can be extended to multi- class problem with an example?
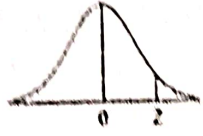**[4] [CO2]**

C. Consider the function $f(x) = f(x_1, x_2) = (x_1 + x_2^2)$

[1+1 CO3]

(i) Derive the gradient of $f(x)$?
(ii) Derive the Hessian of $f(x)$?

**Reference:** You may refer the following table (Table 1) for **Question 3.**

**Areas of the Standard Normal Distribution**

The entries in this table are the probabilities that a standard normal random variable is between 0 and $z$ (the shaded area).

| z | 0.00 | 0.01 | 0.02 | 0.03 | 0.04 | 0.05 | 0.06 | 0.07 | 0.08 | 0.09 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | .0000 | .0040 | .0080 | .0120 | .0160 | .0199 | .0239 | .0279 | .0319 | .0359 |
| 0.1 | .0398 | .0438 | .0478 | .0517 | .0557 | .0596 | .0636 | .0675 | .0714 | .0753 |
| 0.2 | .0793 | .0832 | .0871 | .0910 | .0948 | .0987 | .1026 | .1064 | .1103 | .1141 |
| 0.3 | .1179 | .1217 | .1255 | .1293 | .1331 | .1368 | .1406 | .1443 | .1480 | .1517 |
| 0.4 | .1554 | .1591 | .1628 | .1664 | .1700 | .1736 | .1772 | .1808 | .1844 | .1879 |
| 0.5 | .1915 | .1950 | .1985 | .2019 | .2054 | .2088 | .2123 | .2157 | .2190 | .2224 |
| 0.6 | .2257 | .2291 | .2324 | .2357 | .2389 | .2422 | .2454 | .2486 | .2517 | .2549 |
| 0.7 | .2580 | .2611 | .2642 | .2673 | .2704 | .2734 | .2764 | .2794 | .2823 | .2852 |
| 0.8 | .2881 | .2910 | .2939 | .2967 | .2995 | .3023 | .3051 | .3078 | .3106 | .3133 |
| 0.9 | .3159 | .3186 | .3212 | .3238 | .3264 | .3289 | .3315 | .3340 | .3365 | .3389 |
| 1.0 | .3413 | .3438 | .3461 | .3485 | .3508 | .3531 | .3554 | .3577 | .3599 | .3621 |
| 1.1 | .3643 | .3665 | .3686 | .3708 | .3729 | .3749 | .3770 | .3790 | .3810 | .3830 |
| 1.2 | .3849 | .3869 | .3888 | .3907 | .3925 | .3944 | .3962 | .3980 | .3997 | .4015 |
| 1.3 | .4032 | .4049 | .4066 | .4082 | .4099 | .4115 | .4131 | .4147 | .4162 | .4177 |
| 1.4 | .4192 | .4207 | .4222 | .4236 | .4251 | .4265 | .4279 | .4292 | .4306 | .4319 |
| 1.5 | .4332 | .4345 | .4357 | .4370 | .4382 | .4394 | .4406 | .4418 | .4429 | .4441 |
| 1.6 | .4452 | .4463 | .4474 | .4484 | .4495 | .4505 | .4515 | .4525 | .4535 | .4545 |
| 1.7 | .4554 | .4564 | .4573 | .4582 | .4591 | .4599 | .4608 | .4616 | .4625 | .4633 |
| 1.8 | .4641 | .4649 | .4656 | .4664 | .4671 | .4678 | .4686 | .4693 | .4699 | .4706 |
| 1.9 | .4713 | .4719 | .4726 | .4732 | .4738 | .4744 | .4750 | .4756 | .4761 | .4767 |

[Table 1]

Roll no.........

# 2nd SEMESTER
# M.Tech.

END TERM EXAMINATION

*March-2024*

COURSE CODE:C&I 5306
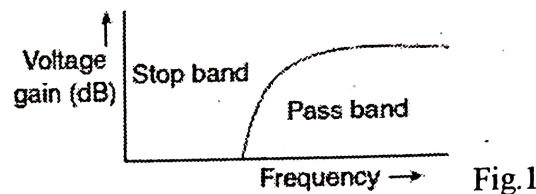COURSE TITLE: Analog Filter Design

*Time: 3:00 Hours*

*Max. Marks: 50*

**Note :**
If necessary, make appropriate assumptions and approximations and state them
You must solve all the questions and their parts in the serial order

Q1. Identify the filter that has the following frequency response in Fig.1        [2] [CO#1]



Fig.1

Q2. Determine the transfer function and response of the circuit depicted in Fig. 2.        [5] [CO#2]
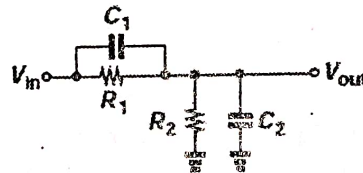


Fig.2

Q3. Briefly explain any THREE of the following:        [5X3=15] [CO#3,4]
   (i)     LC Ladder Filters
   (ii)    FDNY Techniques.
   (iii)   Cauer Filters
   (iv)    Chebyshev Filters.

Q4. A fourth-order filter has zero transmission at $\omega = 0$, $\omega = 2$ rad/s, and $\omega = \infty$. The natural modes are $-0.1 \pm j0.8$ and $-0.1 \pm j1.2$. Find T(s).        [3] [CO#2]

Q5. Find the Chebyshev transfer function that meets the following low-pass filter specifications: fp = 1 kHz, Amax = 1 dB, fs = 15 kHz, Amin = 25 dB, dc gain = 1.        [5] [CO#4]

Q6. Design the KHN circuit of Fig. 3 to realize a bandpass filter with a centre frequency of 1 kHz and a 3-dB bandwidth of 50 Hz. Use 10nF capacitors. Give the complete circuit and specify all component values. What value of centre frequency?        [5] [CO#4]
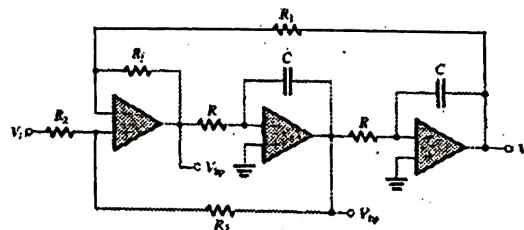


Fig.3

Q7. Explain Tow-Thomas Biquad filter and its operational principles.        [5] [CO#3]

Q8. Explain 2nd-Order Active Filters Based on the Two-Integrator-Loop Topology        [5] [CO#3]

Q9. The transfer function of a first-order low-pass filter (such as that realized by an RC circuit) can be expressed as $T(s) = \omega_o / (s + \omega_o)$, where $\omega_o$ is the 3-dB frequency of the filter. Calculate of $|T|$, $\varphi$, G, and A at $\omega_o = 0$ and $0.50\omega_o$        [5] [CO#2]

## II Semester

## M.Tech. (Control and Instrumentation)

END TERM EXAMINATION                    May 2024

Course code:  C& I 5402          Course Title: Intelligent Instrumentation

M.M.: 50

Time Allowed: 3:00 Hrs

Note:

- *Attempt any five questions.*
- *All questions carry equal marks.*
- *Assume missing data suitably.*

Q 1. (a) What are the key components and functionalities of a HART network connection, and how does it enhance communication between field instruments and control systems in industrial settings?

(b) Compute the non-linearity produced by the voltage excited bridge circuits in various configurations. The bridges are excited by 10 V source. The bridges use 100 $\Omega$ resistive sensors that make 0.1 $\Omega$ full-scale change in their resistances. Express the non-linearity in terms of % of full-scale output.

Q 2. (a) How does signal conditioning enhance RTD measurement accuracy, and what techniques are typically employed?

(b) Find the change in the resistance value of a metal strain gauge of 240 $\Omega$ resulting from a strain of $1000 \mu m/m$. Find the change in resistance of a RTD (120 $\Omega$) for an increase in temperature of $1^\circ C$. The temperature coefficient of resistance of the RTD is $0.004 \Omega/\Omega/^\circ C$.

Q 3. (a) Find resolutions of 4-bit, 8-bit and 12-bit DACs operating with 10 V internal reference. Express the resolution in percentage also.

(b) List data encapsulation and the series of actions taking place when data are transferred from a host on one network to host on another network using TCP/IP and Ethernet protocols.

Q 4. (a) What are the various mechanisms for ADC? Describe in detail C technique with its relative merits and demerits for ADC.

(b) Explain in detail the functioning of RS-232 serial communication. What are it limitations and applications? Compare RS-232, 422 and 485 modes of seri communication.

Q 5. (a) Compare and contrast ISA bus with PCI bus.

(b) A 1 Hz sine wave is sampled at three different rates i.e. at 4, 8, and 16 samples/s Show the reconstructed waveforms schematically.

Q 6. (a) What are the advantages of Virtual Instrumentation as compared to conventional desktop instruments?

(b) Compare graphical programming with Conventional programming techniq

Q 7. Write the short notes on any two

    (i) Filtering Power Supply
    (ii) Signal Conditioning
    (iii)Access methods used by LAN.

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**M.Tech.(CSE) 2nd Semester**
**End SEMESTER EXAMINATION**       **(May – 2023)**

CSE502                             Distributed System
**Paper Code**                     **Title of the subject**
**Time: 3: Hours**                  **Max. Marks: 40**

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

**Q1.** Answer following to the point

a. Compare performance of Monolithic Kernel and Micro kernel.

b. How is failure transparency different from fault tolerant system?

c. Difference between state full server and stateless server?

d. Difference between Synchronous and asynchronous message passing.

[2,2,2,2]

**Q.2 (a)** Illustrate with diagrams consistent ordering and Casual ordering in many to many communications and write protocol to implement these ordering.
   **(b)** Describe the different steps to implement RPC mechanism. How parameters passing issues are solved? Explain the process of server binding with the help of diagram.

[4,4]

**Q.3 (a)** Describe the architecture of of Distributed Shared Memory. What are the various design issues?
   **(b)** Describe centralized and distributed protocol for implementing sequential consistency in Replicated Migrating Block in DSM

[2,3,3]

**Q.4 (a)** Explain Berkelay algorithm for clock synchronization giving example.

**(b)** Suppose there is a group of five processes working on shared data. Explain how mutual exclusion can be achieved using Centralized approach. What happens when coordinator crashes?

**(c)** Work the complexity of Bully and ring algorithm for election of coordinator.

[4,4]

**Q.5 (a)** Suggest some policies for estimating the load of a node in DS. Give any two methods to locate a node for transfer of the process if the current node is overloaded.

**(b)** The cost of migrating the process is the measure of the time taken to migrate the address space. Explain different techniques to transfer address space and evaluate them for cost.

[4, 4]

**Q.6 (a)** Describe Primary back up protocol for maintaining consistency in replicated files. Explain its merits and demerits.

**(b)** Describe the working of Quorum protocol for replica consistency with the help of an example where total number of replicas is 14 and
(i) Nr.= 5 and Nw = 10
(ii) Nr.= 2 and Nw = 13
Discuss the efficiency of above two cases

**Q.7** Write short notes on any two from followings: [4,4]
(i) Reliable distributed system
(ii) Case study: RPC
(iii) File semantic and file caching schemes with case study..
(iv) Thrashing In Distributed Shared Memory

[4, 4]

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Roll no............

May-2024

END Term Examination

M.Tech. (CSE)

Second Semester

Paper Code: CSE 504

Advanced Computer Network

Duration: 3:00 Hours

Max Marks: 40

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

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Q1. a) What is the concept of layering in computer networks? Give its advantages and disadvantages. [4][CO1]

b) List two ways in which WiMAX is similar to 802.11, and two ways in which it is different from 802.11. [4][CO5]

Q2. a) A token bucket scheme is used for traffic shaping. A new token is put into the bucket every 5 μsec. Each token is good for one short packet, which contains 48 bytes of data. What is the maximum sustainable data rate? [4][CO2]

b) Explain the congestion control techniques. How we can avoid the starvation. [4][CO4]

Q3. a) A large number of consecutive IP addresses are available starting at 198.16.0.0. Suppose that four organizations, A, B, C, and D request 4000, 2000, 4000, and 8000 addresses respectively, and in that order. For each of these, give the first IP address assigned, the last IP address assigned, and the mask in the w.x.y.z/s notation. [4][CO3]

b) Explain TCP header. What is 3-way handshaking. [4][CO3]

Q4. a) A client sends a 128-byte request to a server located 100 km away over a 1-gigabit optical fibre. What is the efficiency of the line during the remote procedure call? [4][CO2]

b) Explain overlay networks also describe RON, P2P, and CDN. [4][CO4]

Q5. a) The round trip propagation delay for a 10 Mbps Ethernet having 48-bit jamming signal is 46.4 ms calculate the minimum frame size. [4][CO1]

b) Explain IEEE802.3 frame format in detail. [4][CO1]

END

SECOND SEMESTER
END SEMESTER EXAMINATION
(May-2024)

## CSE-5214 ADVANCES IN MULTIMEDIA TECHNOLOGY

Time: 3 Hours

Max. Marks: 50

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

**Q1.** Answer the following questions briefly:
   **a)** How do digital fonts affect the way multimedia apps look and feel?   [CO1]
   **b)** Describe the architecture of a modern multimedia system and explain the function of its key components.                                    [CO1]
   **c)** Evaluate the critical role of QoS mechanisms in managing network resources and prioritizing multimedia traffic to maintain optimal performance and user experience.                                     [CO5]
   **d)** What are the underlying reasons for implementing security measures in multimedia applications? Evaluate the importance of securing multimedia applications in protecting sensitive data, ensuring user privacy, and preventing unauthorized access or tampering with multimedia content. [CO1]
   **e)** What are the various obstacles that may arise while attempting to guarantee accessibility in multimedia applications, and what are some of the strategies that can be employed to overcome these impediments?          [CO6]

[2+2+2+2+2=10]

**Q2. a)** You are a data scientist working for a popular streaming service that delivers audio content to millions of users worldwide. Your team is tasked with ensuring the highest possible audio quality while optimizing bandwidth usage and maintaining compatibility across various devices and network conditions. How would you approach the challenges of sampling and quantization to enhance audio quality in the streaming service, considering factors such as fidelity, intelligibility, bandwidth efficiency, and device compatibility? Provide a detailed plan outlining

the key considerations, methodologies, and potential trade-offs involved in optimizing these processes for real-time application in the streaming service.

[CO2](4)

b) How do various techniques employed in low bit rate speech compression contribute to the reduction of speech data size, and what trade-offs must be considered when implementing these techniques to ensure acceptable audio quality?

[CO3](3)

c) An audio recording has a bit rate of 128 kbps and a sampling rate of 44.1 kHz. What is the maximum duration of the recording that can be stored on a 16 GB flash drive?

[CO5](3)

Q3. a) How the selection and application of specific techniques in low bit rate speech compression influence the balance between reducing speech data size and maintaining acceptable audio quality? Analyze the trade-offs inherent in implementing these techniques within the context of optimizing speech compression for real-world applications.

[CO3](4)

b) A speech signal has a bandwidth of 4 kHz and is sampled at a rate of 8 kHz. What is the minimum number of bits required to quantize each sample without introducing significant quantization noise?

[CO5](3)

c) What are some of the challenges associated with integrating multimedia content into web applications, and how can they be addressed? Discuss the importance of optimizing multimedia content for web delivery, and describe the techniques used to achieve this.

[CO6](3)

Q4. a) You are a lead engineer at a renowned camera manufacturer tasked with improving the color representation capabilities of the company's latest digital camera model. Your objective is to enhance image quality and color accuracy to meet the demanding expectations of professional photographers and videographers. As a lead engineer, analyze the impact of different color models on image and video quality in digital photography. Evaluate the strengths and weaknesses of popular color models such as RGB, CMYK, and HSV, and discuss their suitability for accurately representing color in various real-world scenarios, from studio photography to outdoor videography. Propose a strategy for selecting and implementing an optimal color model to ensure superior color fidelity and accuracy in the company's digital camera products.

[CO4](5)

**b)** You are a senior developer at a leading e-commerce platform that heavily relies on multimedia content such as images and videos to showcase products to customers. Your task is to improve the platform's performance by optimizing the delivery of multimedia content to users with varying internet speeds and device capabilities. As a senior developer, analyze the effects of different image compression techniques and file formats on multimedia content within the e-commerce platform. Assess the advantages and limitations of popular compression methods like lossy and lossless compression, as well as file formats such as JPEG, PNG, and WebP. Furthermore, propose strategic approaches for optimizing loading times and playback performance to accommodate users with diverse internet speeds and devices. Consider factors such as adaptive content delivery, responsive design, and content caching to enhance the overall user experience in browsing and interacting with multimedia-rich product listings on the e-commerce platform. **[CO4,5,6](5)**

**Q5. a)** You are a content strategist working for a leading educational technology company specializing in interactive multimedia learning experiences. Your team is tasked with developing engaging educational content that utilizes non-linear storytelling techniques to enhance student comprehension and retention. However, you must also navigate the complex ethical and legal landscape to ensure the responsible use of these technologies. As a content strategist, analyze the impact of employing non-linear storytelling techniques in interactive educational content on student engagement and motivation. Furthermore, evaluate the ethical and legal considerations that arise when creating and distributing multimedia and hypermedia content within the educational context. Propose strategies for addressing these considerations to ensure the responsible and ethical use of interactive technologies in enhancing student learning experiences. Consider factors such as data privacy, accessibility, intellectual property rights, and content accuracy in your recommendations for promoting ethical practices in educational content creation and distribution. **[CO4,5](5)**

**b)** What are some of the key data models and standards that are used in multimedia and hypermedia communication, and how do they facilitate interoperability between different systems and applications? **[CO6] (5)**

**Q6. a)** Describe the different types of multimedia and hypermedia delivery systems, and explain how they can be used to optimize content delivery and user experience. **[CO4](4)**

**b)** How does the incorporation of interactive elements in hypermedia communication impact user engagement and learning outcomes? Evaluate the effectiveness of interactivity in facilitating active participation and knowledge acquisition, and analyze the potential implications for enhancing user experiences and educational outcomes in diverse contexts. You are a learning experience designer at a prominent online education platform dedicated to providing high-quality courses to learners worldwide. Your team is exploring ways to leverage interactivity within course content to improve user engagement and learning outcomes. However, you must also consider the challenges and opportunities associated with implementing interactive elements effectively. As a learning experience designer, analyze the role of interactivity in hypermedia communication for enhancing user engagement and learning outcomes in online courses. Evaluate the effectiveness of various interactive features such as quizzes, simulations, and interactive discussions in promoting active participation and knowledge retention among learners. Furthermore, discuss the potential benefits and challenges of incorporating interactivity into course content delivery, considering factors such as instructional design principles, technological capabilities, and learner preferences. Propose strategies for maximizing the educational value of interactive elements while addressing potential barriers to effective implementation. **[CO4](4)**

**c)** A video has a resolution of 1920 x 1080 pixels, and a frame rate of 30 frames per second. What is the total data rate of the video in bits per second? **[CO6] (2)**

**Q7.** Write a short note on (**any Five**):

a) Object oriented data model                                **[CO5] (2)**
b) Dithering                                              **[CO4] (2)**
c) Data acquisition                               **[CO2] (2)**
d) Multimedia Distributed Processing Model     **[CO1] (2)**
e) Orchestration                                  **[CO2] (2)**
f) Noise quantization                         **[CO2] (2)**

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**End Term Examination**

**Second Semester**

May-2024

M.Tech (CSE)

**Paper Code: CSE5304 Information and Network Security**

**Duration: 03 Hours**

**Max Marks: 40**

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**Note:** All questions are compulsory.

Marks for questions are indicated alongside

Assume suitable missing data, if any.

------------------------------------------------

Q1. Answer any four questions in short: [8][CO1,2]

a) What is denial of service attack?

b) What is masquerade? Which principle of security is breached because of it?

c) How can Caeser cipher be cracked?

d) Describe the different variants of P-boxes used in modern ciphers.

e) Distinguish between a mono-alphabetic and poly-alphabetic cipher.

Q2. a) Consider the scenario where user A wants to send bulk data (in GBs) to user B. Data exchange has to be done in confidential manner. The key which is used for encryption can be intercepted by an attacker. Which is the most efficient and protected way to achieve secure communication? Justify your answer in detail. [4][CO3]

(b) What is the idea behind man-in-the-middle attack? [2][CO3]

(c) What is the purpose of the SSL alert protocol? [2][CO4]

Q3. a) Differentiate between MD5 and SHA-1 algorithm. [4][CO3]

(b) How does HMAC works? Discuss some of the disadvantages of HMAC. [4][CO4]

Q4. a) Given key $K = \begin{bmatrix} 17 & 17 & 5 \\ 21 & 18 & 21 \\ 2 & 2 & 19 \end{bmatrix}$ and plaintext ="ney". Find out the cipher text applying Hill cipher. Is Hill cipher strong against cipher text only attack or known plain text attack? Justify the answer. [6][CO2]

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(b) What are the benefits of remote access VPNs?                    [2][CO5]

Q5. Define the following terms (any four):                    [8][CO1,2,5]

    a) PGP
    b) Demilitarized Zone
    c) Vernam Cipher
    d) Feistel cipher
    e) WAP

END

**II -SEMESTER**                                                    **M.Tech.(CSE)**
**END SEMESTER EXAMINATION**                       **May- 2024**

CSE 5402 WIRELESS AND MOBILE COMMUNICATION

Time: 3:00 Hours                                              Max. Marks: 40

**Note:     Answer any five questions**

**Q.No. 1**

A. Why do we need different MAC frame format in wireless environment?
Explain subfields of MAC frame of IEEE 802.11 standard.      **04   CO1**

B. How CSMA/CD is different from CSMA/CA? Explain working of CSMA/CA
with RTS/CTS.                                                     **04   CO1**

**Q.No. 2**

A. Explain authentication & ciphering in GSM and describe the
responsibilities of various subsystems of the Cellular system architecture.
**04   CO2**

B. If a specific FDD cellular system has total band width 66 MHz and if system
uses two 100 KHz simplex channels to provide full duplex voice and
control channels, compute the number of channels per cell if number of
cells in a cluster is 7(seven). If 1MHz of the allocated spectrum is
dedicated to control channels, determine an equitable distribution of
control channels and voice channels in each cell for the system.   **04   CO2**

**Q.No. 3**

A. Compare features of TORA with DSR and explain the route creation and
route maintenance by using TORA assuming that at time t link fails
between node D and node E. For following network.      **04   CO4**
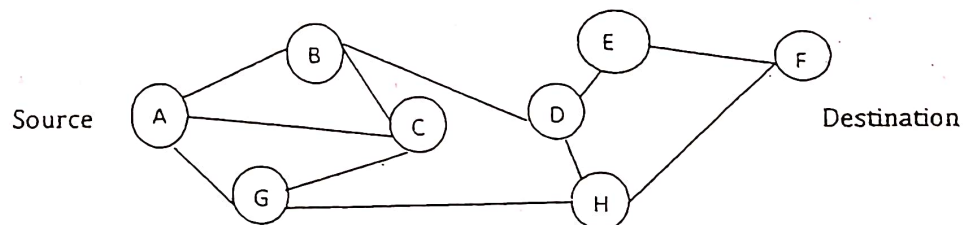
B. Explain Packet flow mechanism in mobile IP network and also illustrate agent discovery and registration procedures in Mobile IP.    04   CO3

## Q.No. 4

A. What is Bluetooth? Describe the general format of packet and packet header in Bluetooth technology. And also Sketch the Protocol stack and describe its various layers briefly.    04   CO2

B. Describe the Route discovery and Route maintenance mechanisms of Adhoc on demand Distance vector (AODV) Routing Algorithm and compare it with DSDV algorithm.    04   CO4

## Q.No. 5

A. What is WAP? What is the role of WSP and WTLS in WAP protocol stack. Explain WAP architecture.    04   CO5

B. What kind of problems may arise if TCP is implemented over wireless Networks? Explain and also discuss different approaches for TCP improvement.    04   CO3

## Q.No. 6

A. What are various modulation techniques used at physical layer in wireless networks? Why QPSK is better than PSK explain with example and compare it with ASK and FSK modulation techniques.    04   CO1

B. What are the Data management issues in mobile computing? How Data Management is done in Mobile Computing? Explain it by giving suitable example.    04   CO5

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Total No. of Pages 2
SECOND SEMESTER
END SEM EXAMINATION

Roll No. ....
M.Tech.(CAAD)
May,2024
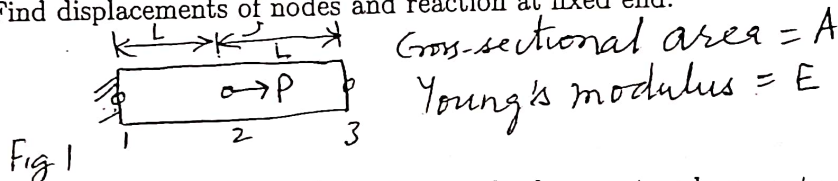
CAD███-502 FINITE ELEMENT METHOD

Max Marks : 40

Time: 3 hr

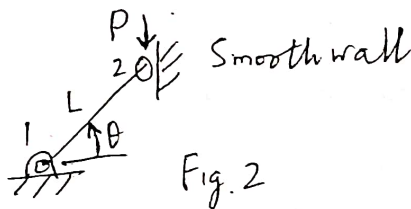Note: Answer any five questions.
    Assume suitable missing data, if any.
    All questions carry equal marks.

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.

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

Fig 1

(b) For the bar shown in Fig. 2, find unknown displacement and support reactions. Use the given truss element stiffness matrix.

Smooth wall

$$K = \frac{EA}{L}\begin{bmatrix} \cos^2\theta & \cos\theta\sin\theta & -\cos^2\theta & -\cos\theta\sin\theta \\ \cos\theta\sin\theta & \sin^2\theta & -\cos\theta\sin\theta & -\sin^2\theta \\ -\cos^2\theta & -\cos\theta\sin\theta & \cos^2\theta & \cos\theta\sin\theta \\ -\cos\theta\sin\theta & -\sin^2\theta & \cos\theta\sin\theta & \sin^2\theta \end{bmatrix}$$

Fig. 2

2(a) For the cantilever in Fig. 3, calculate the end displacement. Use a single element. Use the given beam element stiffness matrix.
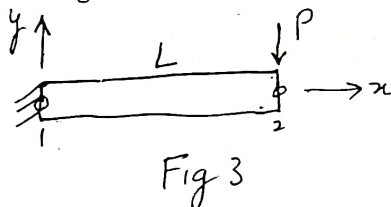
$$K^{(e)} = \frac{EI}{L^3}\begin{bmatrix} 12 & 6L & -12 & 6L \\ 6L & 4L^2 & -6L & 2L^2 \\ -12 & -6L & 12 & -6L \\ 6L & 2L^2 & -6L & 4L^2 \end{bmatrix}$$

Fig 3

(b) Consider the rod in Fig. 4 rotating at constant angular velocity $w$ rad/s. Determine the nodal displacements and axial stress at Gauss points in the rod using two linear elements. Consider only centrifugal force. Ignore bending of the rod. Use parameters $E, \rho, A, L$ to describe the geometric and material properties of the bar.

Fig 4
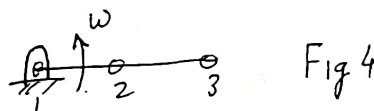
Q 3(a) Fig. 5 shows a 4-node element. The values of nodal temperatures are $q = \{10, 0, 0, 0\}$. Find coordinates and temperature of the point corresponding to local coordinates $\xi = 0, \eta = 0$.
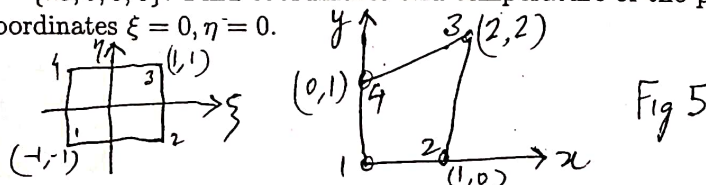
Fig 5

(b) Find area of the quadrilateral in Fig. 5 using Gauss quadrature. Find temperature gradient at the point corresponding to local coordinates $\xi = 0, \eta = 0$.

4. 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. 6)

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

Develop expressions for element stiffness matrix and force vector.



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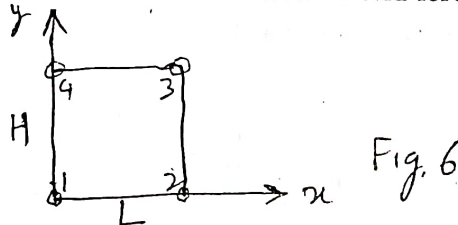
5(a) For the plane stress situation, derive expressions for stiffness matrix and force vector. Assume constant body force.

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

Q 6(a) Develop expressions for mass matrix and stiffness matrix for a bar undergoing axial dynamic loading. Use 1-d linear interpolation. Use parameters $E, A, L$ to describe the geometric and material properties of the bar.

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

$$\Pi = \frac{1}{2}\int_0^L T(\frac{dw}{dx})^2 dx + \int_0^L \frac{1}{2}kw^2 dx - Pw_L \tag{1}$$

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.

AB is the cable under constant tension T'



Frictionless roller

Cable on distributed vertical springs of stiffness K per unit length of cable
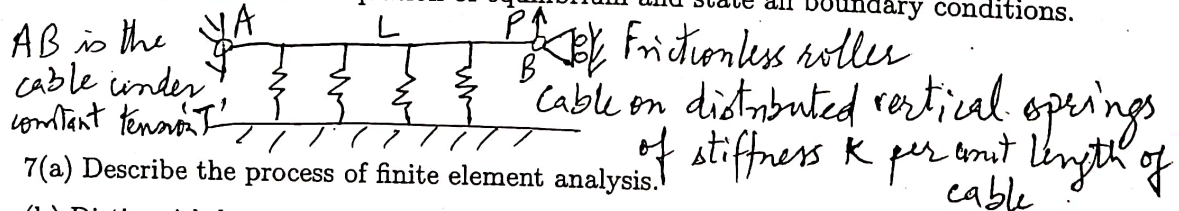
7(a) Describe the process of finite element analysis.

(b) Distinguish between strong and weak formulations. Describe different ways you can model and analyse the cantilever problem using FEM.

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Total No. of Pages 1        Roll No. ....
SECOND SEMESTER        M.Tech.(CAAD)
END SEM EXAMINATION        May,2024

## CAD-504 Computer Aided Design

Time: 3 hr        Max Marks : 40

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

1(a). How do you represent a curve and a surface parametrically? How do you find the length of a curve?    CO[1]

1(b). How will a vector be transformed if it is rotated by an angle $\theta$ about the x-axis?    CO[1]

2(a). Perform a perspective transformation of a point (3,2,4) onto the x=0 plane from a center of projection $x_c = -2$. Find the vanishing points of the above transformation.    CO[2]

2(b). Suppose the center of an object is at (4,3,0). It is desired to rotated the object by 90° clockwise about its center in yz-plane. Find the required transformation matrix for any point (x,y,z).    CO[2]

3(a). Find equation of a cubic spline curve with coordinates of end points (0,1) and (1,0) with corresponding tangent vectors (1,1) and (1,0) respectively.    CO[3]

3(b). Given (1,1),(2,3),(4,3) and (3,1) the vertices of a Bezier polygon, determine the equation of the curve. Find any five points on the curve.    CO[3]

4(a). For the quadratic B-spline curve defined by the polygon having vertices (1,1),(2,3),(4,3) and (3,1), determine the equation of the curve. Find any five points on the curve. Use the parametrized basis functions on the interval $0 \leq t \leq 1$ as given below:
$N_1 = 0.5(1-t)^2$, $N_2 = 0.5 * (-2t^2 + 2t + 1)$, $N_3 = 0.5t^2$.    CO[3]

4(b). Determine the point on the bilinear surface defined by corner points (0,0,1),(1,1,1), (1,0,0) and (0,1,0) corresponding to u=v=0.5 in parametric space given by $-1 \leq u,v \leq 1$.    CO[3]

5(a). Consider a line segment with end points (1,1,0) and (6,2,0) lying in the xy plane. Rotate the line about the x-axis. Parametrize the line using parameter t, $0 \leq t \leq 1$. Determine the point on the surface obtained by rotating the line at $t = 0.4$, angle of rotation= 60 degrees.    CO[3]

5(b). Describe either a Coons bicubic surface or a Bezier surface patch?    CO[4]

6(a). Discuss the role of computer graphics and challenges involved?    CO[1]

6(b). How is a picture represented and prepared in computer graphics?    CO[4]

7(a). Describe parametric representation of a circle, ellipse, parabola and hyperbola.    CO[2]

7(b). What is a general conic equation satisfied by a conic curve? What is its standard form for a central conic? What is the equation of a general quadric surface and the standard form for a central quadric?    CO[2]

Note: 1. Attempt any five questions.
2. Assume missing data , if any
3. Notations have their usual meaning.

Q-1 (a) Define and derive the expression of acoustic intensity. How does it differ from specific acoustic intensity?        [5] [CO1]

(b) (a) Assume a layer of fluid 2 separates fluid 1 from fluid 3.

(i) Compare the pressure reflection coefficient for a plane wave travelling in fluid 1 that reflects normally from the layer with that for a plane wave travelling in fluid 3 that reflects normally from the layer.

(ii) Repeat (i) for the power reflection and transmission coefficients.

[5] [CO1]

Q-2 (a) Define power transmission and reflection coefficients.

[2] [CO1]

(b) Define and derive the expression of principal of reciprocity.

[3] [CO2]

(c) Discuss in detail the different traffic noise prediction models.

[5] [CO5]

Q-3 (a) Explain with diagram the term A, B, C and D weighting networks. Why are they needed? [5] [CO4]

(b) The proportional bandwidth filters has $f_u/f_l=r=2^{1/n}$. (i) show that $f_u=f_c (r)^{1/2}$ and $f_l=f_c /(r)^{1/2}$ (ii) show that the bandwidth w of each band, $w= f_c [(r)^{1/2}-(r)^{-1/2}]$ [3] [CO2]

(c) Show that as the distance from a point source doubles, the sound intensity level decreases by 6 dB. [2] [CO3]

Q-4 (a) Explain the effect of noise pollution and their method of analysis along with their mitigation strategies. [5] [CO5]

(b) An acoustic signal of three tones each of different frequency and different effective pressure amplitude: $P_1= 5\times10^{-2}$ Pa, $P_2= 7\times10^{-2}$ Pa and $f_1=104$ Hz, $f_2=190$ Hz.
Find the intensity of each of the following bands: (i) 100 to 110 Hz (ii) 100 to 150 Hz. [5] [CO2]

Q-5 (a) A worker in a bottle manufacturing plant is rotated in various shops as -
(i) Palletiser Unit- where SPL is 100 dB (A)          ½ hrs
(ii)Washer Unit-   where SPL is 97 dB (A)          ½ hrs
(iii)Decapping Unit- where SPL is 92 dB (A)          1 hrs
(iv)Packing Unit- where SPL is 87 dB (A)          4 hrs
(v)Bottle inspection Unit- where SPL is 86 dB (A)          2 hrs

Is the daily does exceed. If yes, suggest alternate schedule of duration of his stay in different units so that the daily does not exceed. [5] [CO3]

**OSHA standard:**
(Only figure in bold represent OSHA -1970 standard)

| Sound level dB (A) | Permissible daily dose | |
|---|---|---|
| | Hr. | Min. |
| 86 | 13 | 56 |
| 87 | 12 | 08 |
| **92** | **6** | **04** |
| **97** | **3** | **02** |
| **100** | **2** | **00** |

(b) Explain the terms TTS and PTS as used in hearing conservation. Explain the significance of permissible duration of noise exposure from OSHA.

[5] [CO3]

Q-6 (a) Discuss various component of Sound Level Meter.

[2] [CO4]

(b) How do you do the correction for background noise.  [2] [CO4]

(c) Discuss in detail the dosimeter and sound intensity analyser.

[2] [CO4]

(d) Discuss various methods to control industrial noise.  [4] [CO5]

*Second Semester*
**B. Tech. (M.Tech, CAD)**
**End Semester Examination**    *(May, 2024)*
CAD-5304 DYNAMIC BEHAVIOUR OF MATERIALS
*Time: 3 hrs*    *Max. Marks: 50*

**Note:** Attempt **ANY FIVE** questions. Assume suitable missing data, if any.

(1) (a) Explain the term wave and write different types of waves. Describe mechanical and electromagnative waves.    [3+2] [CO1]

(b) A travelling harmonic wave on a string has a frequency of 30Hz and a wavelength of 60cm. Its amplitude is 2mm (i) Write the equation for this wave in SI units.(ii) Find displacement if position is 30cm at moment of 2 sec.    [2+3] [CO1]

(2) (a) Derive the plastic wave equation.    $\dfrac{\partial^2 u}{\partial t^2} = \dfrac{\left(\dfrac{d\sigma}{d\varepsilon}\right)}{\rho_0} \dfrac{\partial^2 u}{\partial t^2}$

The symbols have their usual meaning    [5] [CO2]

(b) Explain the experimental set up of split Hopkinson pressure bar with neat sketch. Also write expression for strain rate, strain and stress induced in specimen.    [5] [CO3]

(3) (a)Explain experimental technique for intermediate testing machine
(i) Compressed Gas Machine (ii) Rotary Flywheel    [2.5+2.5] [CO3]

(b) What is dislocation dynamics? Derive relation between shear strain rate and dislocation velocity i.e $\dot{\gamma} = \rho bV$    [1+4][CO3]

(4) (a) Explain the Jhonson Cook Modal for plasticity used for high strain rates with mathematical expression.    [5] [CO4]

(b) Write three different mechanism of plastic deformation and explain the relativistic effects in detail.    [2+3] [CO4]

(5) (a) Explain ductile and brittle fracture (in terms of intergranular and transgranular) with neat sketch. Explain toughening methods for ceramic materials. [3+2] [CO5]

(b) Explain limiting crack speed in dynamic fracture. [5] [CO5]

(6) Write short notes on any THREE.

(a) Explosive welding and forming.

(b) Shear bands, its limitations and applications in manufacturing.

(c) Define strain rate and show strain rate effects on flow stress and ductility.

(d) Explain the difference between quasi-static and dynamic loading with neat sketch. [10] [CO1] [CO3] [CO4] [CO6]

Roll No.:_____

SECOND SEMESTER

**M.Tech. [CAAD]**

# END SEMESTER EXAMINATION

*May-2024*

## CAD-5402 ENGINEERING TRIBOLOGY AND BEARING DESIGN

*Time: 3:00 Hours*

*Max. Marks :50*

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

1. [a] Define tribology and with the help of neat flow chart illustrate the relationship between operating conditions and type of wear.

   [b] Discuss the different layers formed on the base nascent metal after the fabrication process and exposed to environmental condition.

2. [a] With the help of sketch discuss in detail the mechanisms of adhesive, abrasive, corrosive and fatigue wear.

   [b] With the help of schematic diagrams, describe capillary viscometer and density measuring device used in laboratory as per international standard.

3. [a] With the help of schematic diagrams, describe pin on disc test and write the procedure for determination of specific wear rate and coefficient of friction in fully flooded and starved condition of lubrication.

   [b] Write the laws of wear and classify the wear.

4. [a] With the help of neat sketch, describe the terminology used in hydrodynamic journal bearing and enumerate the design procedure of full journal bearing considering shaft diameter D, shaft speed $\omega$ and radial load W.

[b] Describe Full and half Sommerfeld boundary conditions.

5. Write the assumptions and deduce the expression for the Generalized Reynolds Equation. Also explain all the specific terms in it ie Poiseuille, Couette, squeezing action etc.

6. [a] Draw and explain the different zones of Stribeck curve..

[b] How does the viscosity and speed of the shaft affect the Stribeck curve?

7. Describe with the help of example on any two of the following:

[a] Lubrication by solids

[b] Mechanism of cavitation wear.

[c] Mechanism of gas lubrication and

[d] impact wear.

8. Estimate the performance parameters of a full journal bearing having parameters: Dynamic viscosity of lubricant ($\eta$)= 20mPa.s, Journal radius (rj)=25 mm, Bearing length (L)= 25mm, Journal speed = 3062rpm, Load (W)=1000N, and Radial clearance (c)=0.00005m. (Use the table for the solution).

**Table 3.4.3.2  Performance characteristics of full journal bearing [Raimondi and Boyd, 1958]**

| L/D | ε | $h_{min}$ | $\theta_d$ | $\alpha/\beta$ | S | φ | $\frac{R_J}{c}f$ | $\frac{Q}{R_J cNL}$ | $\frac{Q_L}{Q}$ | $\frac{J\gamma\Delta t}{P}$ | $\frac{P}{P_{max}}$ | $\theta_{P_{max}}$ | $\theta_{ro}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ∞ | 0 | 1.0 | 0 | — | ∞ | (70.92) | ∞ | * | 0 | ∞ | ---- | 0 | (149.38) |
| | 0.1 | 0.9 | " | .308 | .240 | 69.10 | 4.80 | 3.03 | * | 19.9 | .826 | 0.0 | 137 |
| | .2 | .8 | " | .314 | .123 | 67.26 | 2.57 | 2.83 | * | 11.4 | .814 | 5.6 | 128 |
| | .4 | .6 | " | .328 | .0626 | 61.94 | 1.52 | 2.26 | * | 8.47 | .764 | 14.4 | 107 |
| | .6 | .4 | " | .349 | .0389 | 54.31 | 1.20 | 1.56 | * | 9.73 | .667 | 20.8 | 86 |
| | .8 | .2 | " | .383 | .0210 | 42.22 | .961 | .760 | * | 15.9 | .495 | 21.5 | 58.8 |
| | .9 | .1 | " | .412 | .0115 | 31.62 | .756 | .411 | * | 23.1 | .358 | 19 | 44 |
| | .97 | .03 | " | ---- | | | | | * | ---- | | ---- | ---- |
| | 1.0 | 0 | " | — | 0 | 0 | 0 | 0 | * | ∞ | 0 | --/0 | 0 |
| 1 | 0 | 1.0 | 0 | — | ∞ | (85) | ∞ | -- | 0 | ∞ | ---- | 0 | (119) |
| | 0.1 | 0.9 | " | .279 | 1.33 | 79.5 | 26.4 | 3.37 | .150 | 106 | .540 | 3.5 | 113 |
| | .2 | .8 | " | .294 | .631 | 74.02 | 12.8 | 3.59 | .280 | 52.1 | .529 | 9.2 | 106 |
| | .4 | .6 | " | .325 | .264 | 63.10 | 5.79 | 3.99 | .497 | 24.3 | .484 | 16.5 | 91.2 |
| | .6 | .4 | " | .360 | .121 | 50.58 | 3.22 | 4.33 | .680 | 14.2 | .415 | 18.7 | 72.9 |
| | .8 | .2 | " | .399 | .0446 | 36.24 | 1.70 | 4.62 | .842 | 8.00 | .313 | 18.2 | 52.3 |
| | .9 | .1 | " | .426 | .0188 | 26.45 | 1.05 | 4.74 | .919 | 5.16 | .247 | 13.9 | 37.3 |
| | .97 | .03 | " | .457 | .00474 | 15.47 | .514 | 4.82 | .973 | 2.61 | .152 | 7.1 | 20.5 |
| | 1.0 | 0 | " | — | 0 | 0 | 0 | 0 | 1.0 | 0 | 0 | 0 | 0 |
| 1/2 | 0 | 1.0 | 0 | — | ∞ | (88.5) | ∞ | -- | 0 | ∞ | ---- | 0 | (107) |
| | 0.1 | 0.9 | " | .273 | 4.31 | 81.62 | 85.6 | 3.43 | .173 | 343 | .523 | 5.8 | 99.2 |
| | .2 | .8 | " | .292 | 2.03 | 74.94 | 40.9 | 3.72 | .318 | 164 | .506 | 11.9 | 92.5 |
| | .4 | .6 | " | .329 | .779 | 61.45 | 17.0 | 4.29 | .592 | 68.6 | .441 | 16.9 | 78.8 |
| | .6 | .4 | " | .366 | .319 | 48.14 | 8.10 | 4.85 | .730 | 33.0 | .365 | 17.1 | 64.3 |
| | .8 | .2 | " | .408 | .0923 | 33.31 | 3.26 | 5.41 | .874 | 13.4 | .267 | 15.3 | 44.2 |
| | .9 | .1 | " | .434 | .0313 | 23.66 | 1.60 | 5.69 | .939 | 6.66 | .206 | 11 | 33.8 |
| | .97 | .03 | " | .462 | .00609 | 13.75 | .610 | 5.88 | .980 | 2.56 | .126 | 3.8 | 19.1 |
| | 1.0 | 0 | " | — | 0 | 0 | 0 | | 1.0 | 0 | 0 | 0 | 0 |
| 1/4 | 0 | 1.0 | 0 | — | ∞ | (89.5) | ∞ | -- | 0 | ∞ | ---- | 0 | (99) |
| | 0.1 | 0.9 | " | .271 | 16.2 | 82.31 | 322 | 3.45 | .180 | 1287 | .515 | 7.4 | 98.9 |
| | .2 | .8 | " | .291 | 7.57 | 75.18 | 153 | 3.76 | .330 | 611 | .489 | 13.5 | 85 |
| | .4 | .6 | " | .331 | 2.83 | 60.86 | 61.1 | 4.37 | .567 | 245 | .415 | 17.4 | 70 |
| | .6 | .4 | " | .370 | 1.07 | 46.72 | 26.7 | 4.99 | .746 | 107 | .334 | 16.4 | 55.5 |
| | .8 | .2 | " | .414 | .261 | 31.04 | 8.80 | 5.60 | .884 | 35.4 | .240 | 11.5 | 39.7 |
| | .9 | .1 | " | .439 | .0736 | 21.85 | 3.50 | 5.91 | .945 | 14.1 | .180 | 8.6 | 27.8 |
| | .97 | .03 | " | .466 | .0101 | 12.22 | .922 | 6.12 | .984 | 3.71 | .108 | 4 | 17.7 |
| | 1.0 | 0 | " | — | 0 | 0 | 0 | | 1.0 | 0 | 0 | 0 | 0 |

s 4

Roll no..................

# SECOND SEMESTER
## M.TECH.(DSC)
### END SEMESTER EXAMINATION

May 2024

DSC502

Data Preparation and Analysis

Time 03:00 hours

Max. Marks: 40

Note 1: Attempt any eight questions. Each question carries equal marks.
        Assume suitable missing data, if any.
   2: Students are allowed to bring their own Z-tables for required questions.

Q1.In the following grouped data, X are the mid-values of the class intervals and c is a constant. If the arithmetic mean of the original distribution is 35·84, find its class intervals. [5][CO2]

| X−c : | −21 | −14 | −7 | 0 | 7 | 14 | 21 | Total |
|---|---|---|---|---|---|---|---|---|
| f : | 2 | 12 | 19 | 29 | 20 | 13 | 5 | 100 |

Q2. Complete a table showing the frequencies with which words of different numbers of letters occur in the extract reproduced below (omitting punctuation marks) treating as the variable the number of letters in each word, and obtain the mean and standard deviation of the distribution :

"Her eyes were blue : blue as autumn distance — blue as the blue we see, between the retreating mouldings of hills and woody slopes on a sunny September morning : a misty and shady blue, that had no beginning or surface, and was looked into rather than at." [5][CO2]

Q3. The arithmetic mean and the standard deviation of a set of 9 items are 43 and 5 respectively. If an item of value 63 is added to the set, find the mean and standard deviation of 10 items. [5][CO2]

Q4.(a) What do understand by levels of data variables. Explain different levels by taking suitable examples.

(b) Define Data Collection from repositories, also explain mining data from software repositories. [5][CO1, CO5]

Q5.(a) What do you mean by attribute reduction and extraction, explain with few methods.

(b) What do you understand by outlier analysis? Explain important method to remove outliers with examples. [5][CO4, CO5]

Q6. A random sample n=50 males showed a mean average daily intake of dairy products equal to 756 grams with a standard deviation of 35 grams. Find a 95% confidence interval for the population average?

[5][CO3, CO5]

Q7. In a recent poll of 200 households, it was found that 152 households had at least one computer. Estimate the proportion of households in population that have at least one computer. Construct a 95% confidence interval to estimate the population proportion. [5][CO3]

Q8. A sample of size 400 was drawn and the sample mean was found to be 99. Test whether this sample would have come from a normal population with mean 100 and standard deviation 8 at 5% level of significance. [5][CO3]

Q9. The mean life time of a sample of 400 fluorescent light tube produced by a company is found to be 1570 hours with a standard deviation of 150 hours. Test the hypothesis that the mean lifetime of the bulbs produced by the company is 1600 hours against the alternative hypothesis that it is greater than 1600 hours at 1% level of significance. [5][CO3, CO5]

SECOND SEMESTER

## M.Tech. (DSC)

# END SEMESTER EXAMINATION

MAY-2024

## DSC 504 - 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.

1 [a] Explain the following       (CO3)[5]
    (I)   Challenges of machine learning
    (III) Define PCA

  [b] Explain Sigmoid and Tanh activation functions used in artificial Neural Network.     (CO4)[5]

2 [a] How supervised learning work? Explain with example and also write its application.     (CO1)[5]
  [b] Discuss types of Clustering methods with their applications.     (CO3)[5]

3 [a] Comparison between ID3, C4.5 and CART decision tree with respect to splitting criteria, attribute types, missing value handling and pruning.     (CO3)[5]

  [b] Explain Descriptive Statistics with example.     (CO4)[5]

4 [a] Discuss Margin of Error and Level of Confidence in Inferential Statistics?     (CO1)[5]
  [b] Explain types of regression used in data science.     (CO2)[5]

5   What is dimensionality reduction? Discuss their advantages, disadvantages and approach used for dimension reduction.     (CO4)[10]

SECOND SEMESTER

M.Tech. (SE/DSC)

END SEMESTER EXAMINATION          May-2024

DSC5202/SWE5204– PREDICTIVE MODELLING

Time: 3:00 Hours                                      Max. Marks: 5(

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

Q1 [a] What is hypothesis testing. Explain the steps involved in hypoth testing?

[b] Find the line of regression of y on x for the following data. Also estin y when x=32?

| x | 23 | 27 | 28 | 28 | 29 | 30 | 31 | 33 | 35 | 36 |
|---|----|----|----|----|----|----|----|----|----|----|
| y | 18 | 20 | 22 | 27 | 21 | 29 | 27 | 29 | 28 | 29 |

[2x5=]

Q2 [a] Describe the measures of central tendency? Discuss the concept examples?

[b] Describe the categories of attribute reduction methods?

[2x5=]

Q3 [a] What is outlier analysis? Discuss its importance in data analysis?

[b] A confusion matrix for 100 patients is as follows:

|  |  | Actual values | |
|---|---|---|---|
|  |  | Cancer | No cancer |
| Predicted values | Cancer | 45 | 18 |
|  | No cancer | 12 | 25 |

Find Accuracy, Precision, Recall, F1 score and Specificity?

[2x5

Q4 Differentiate between:
[a] One-tailed and Two-tailed test
[b] Prediction and Interpretation
[c] Type I and Type II errors
[d] Univariate and Multivariate analysis

[4x2.5=1

Q5 [a] What is cross validation? Explain three different types of cross validati
[b] A company operates four machines on three separate shifts daily
following table presents the data for machine breakdowns resulted du
6-month time period.

| Shift | Machine | | | | Total |
|-------|------|------|------|------|-------|
| | A | B | C | D | |
| 1 | 10 | 12 | 6 | 7 | 35 |
| 2 | 10 | 24 | 9 | 10 | 53 |
| 3 | 13 | 20 | 7 | 10 | 50 |
| Total | 33 | 56 | 22 | 27 | 138 |

Test the hypothesis that for an arbitrary breakdown, the machine causing breakdown and the shift on which the breakdown occurred are independe

[2x5-

Q6 Write short note on
[a] chi-square test
[b] ROC curve and AUC

[2x5

# END TERM EXAMINATION    May-2024

## PAPER CODE: DSC 5406
## TITLE OF PAPER: Deep Learning

Time: 3:00 Hours    Max. Marks : 40

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**Note :** Attempt any 5 questions.
Assume suitable missing data, if any.

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Q.1[a] Differentiate between Machine Learning and Deep Learning.

[b] Explain key features of KNN and working of KNN with an example.

CO#1 [3+5]

Q.2[a] In CNN model, what is the role of convolution layer, polling layer, and connect neural network.

[b] How is CNN model better than ANN model?

[c] Compare R-CNN, Fast R-CNN, and Faster R-CNN.

CO#2, CO#3  [3+2+3]

Q.3[a] Explain RNN Model. Give 4 applications of RNN Model.

[b] Explain LSTM Model with it's advantages and disadvantages.

CO#3 [4÷4]

Q4. [a] What is BERT Model?

[b] Explain Image Classification Vs Image Segmentation with example.

CO#5 [4÷4]

Q5. Briefly explain the following:

     i. Transfer Learing

     ii. Max Pooling

     iii. Data Augmentation

     iv. Convolution Padding

CO#1, CO#4 [2*4]

Q6. [a] Explain Stochastic Gradient Descent and Batch Gradient Descent. Which one is better? Justify.

[b] Consider the following ANN, where $h_1$, $h_2$ and $O_1$ are hidden layer and output layer neurons respectively; and $b_1$, $b_2$, and $b_3$ are biased values of respective neurons. Give the $w_1$, $w_5$, $b_1$ updating formula while performing training. Assume other hyper-parameters and specify them.

CO#5 [4+4]
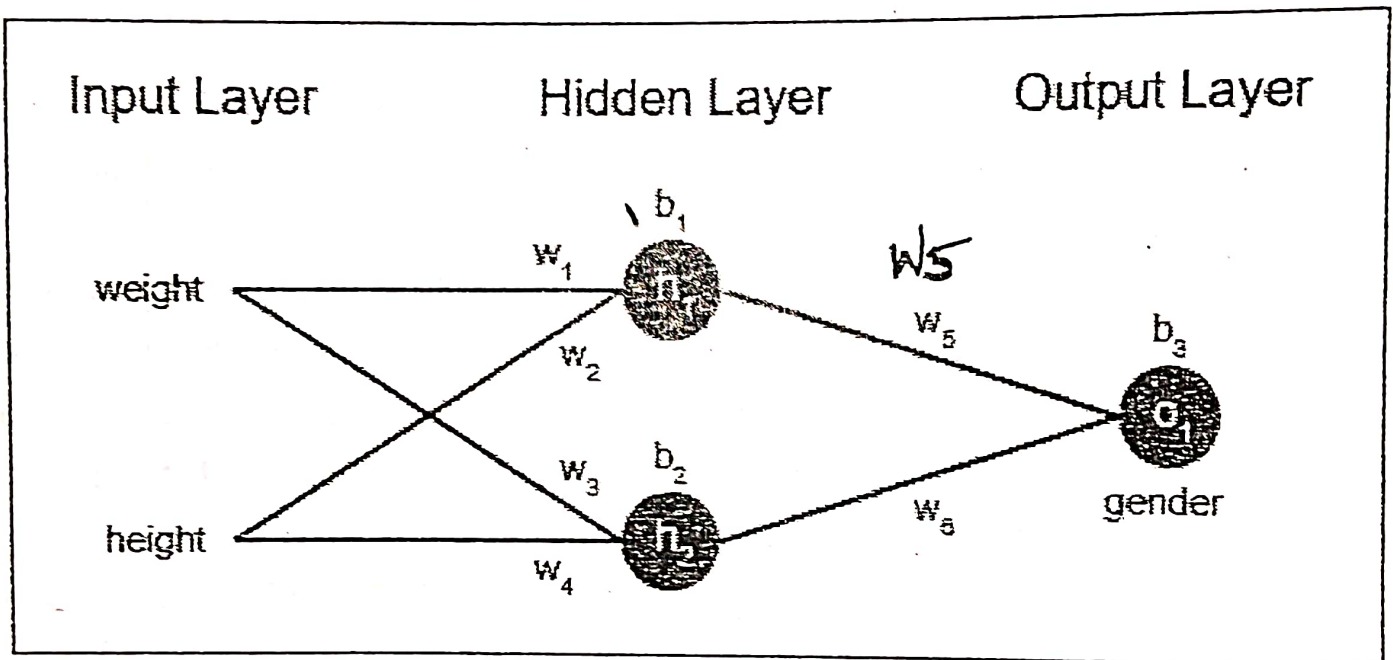
Total no. of Pages:02

FOURTH SEMESTER (Part Time)

END TERM EXAMINATION

ENE5202

Time: 03:00 Hours

Roll no..............

M.Tech

MAY-2024

ENVIRONMENTAL POLICY & LAW

Max. Marks: 50

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

Q.1(a) Examine the principal elements of the Hazardous Waste (Management and Handling) Rules, 1989, and their importance in overseeing the management and disposal of hazardous waste in India. [5][CO1]

(b) Outline the main agenda items discussed at the Rio Conference. How did the conference aim to merge environmental conservation with objectives for sustainable development? [5][CO3]

Q.2 (a) Analyze how India's environmental laws addressed the Bhopal Gas Tragedy. Discuss key legal provisions, enforcement, and the aftermath. Evaluate their effectiveness in preventing similar disasters and delivering justice to victims. [5][CO4]

(b) How does the EIA Notification 2006 under the Environment (Protection) Act, 1986, define the scope and necessity of environmental impact assessments for projects? [5][CO1]

Q.3 (a) Discuss the major environmental laws in India for environmental protection. Explain the role of regulatory bodies in enforcing these laws and ensuring compliance with the standards. [5][CO1]

(b) Explain sustainable development and its importance in environmental law. Explore how sustainability principles shape the creation and execution of environmental policies and regulations. [5][CO2]

Q.4 (a) Discuss the significance of the Air (Prevention and Control of Pollution) Act, 1981 in the context of India's environmental policy. How has it contributed to the nation's efforts to manage air quality? Explain. [5][CO1]

(b) Compare and contrast the precautionary principle with the polluter pays principle. How do these concepts differ in their approach to environmental responsibility? Explain. [5][CO2]

Q5. (a) Discuss how the CPCB and SPCBs implement the Environment (Protection) Act, 1986, including their strategies for monitoring compliance and enforcing environmental standards. [5][CO2]

(b) A multinational corporation's industrial activities are causing significant river pollution, impacting local communities' livelihoods. Discuss how the Polluter Pays Principle can be utilized to mitigate this issue and outline the legal options available for affected parties to seek justice. [5][CO4]

Q.6 Discuss briefly
(a) MoEFCC [2.5][CO2]
(b) The Wildlife (protection) Act, 1972 [2.5][CO1]
(c) Key provisions of the Water Act, 1974 [2.5][CO1]
(d) Stockholm conference [2.5][CO3]

II/IV SEMESTER  **M.TECH. (ENE)**
END SEMESTER EXAMINATION  MAY – 2024
EN-5306  GREEN TECHNOLOGY AND SUSTAINABILITY
Time: 3 Hours  *Max. Marks: 50*

**Note:** *Attempt any five questions*
*Assume suitable missing data if any*

1. a) Briefly outline the need of green technology in respect of pollution control with suitable examples. What are the limitations of green chemistry? Discuss.  5[CO1]
   b) Compare the different configurations/units for urban stormwater treatment.  5[CO2]

2. What is 'industrial ecology'? How does industrial complexing help in minimizing the environmental effects? Discuss with suitable examples.  10[CO4]

3. Delhi Technological University (DTU) has taken some green initiatives to manage the organic food waste generated from the mess and canteen? Describe, in detail, the technology being used for treatment and management of food waste. What are its environmental benefits? Explain.  10[CO2]

4. Write short notes on any two
   a) Atom Economy  5[CO1]
   b) Environmental Leap-Frogging  5[CO2]

5. 'Agriculture is a major contributor for environmental degradation.' Justify the statement. What agro-ecological practices would you suggest to overcome it, in India? 10[CO3]

6. 'ECO-SAN' has significantly improved the quality of living in rural areas. Discuss the green technologies being used to manage waste and improve environmental quality.  10[CO5]

## II$^{nd}$ SEMESTER

## M.Tech.

# END TERM EXAMINATION          *May-2024*

## ENE5402 GLOBAL WARMING AND CLIMATE CHANGE

*Time: 3:00 Hours*                                    *Max. Marks: 50*

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**Note** : All questions are compulsory.

   Assume suitable missing data, if any.

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1. [a]    Consider the following four ways to heat a house. The first is a new high-efficiency pulse-combustion gas furnace; the second is a conventional gas furnace; the third is an electric pump that delivers 2.5 units of energy to the house for each unit of electrical energy that it consumes (the other 1.5 units are heat taken from the ambient air); and the fourth is conventional electric heating. Using the new pulse-combustion gas furnace as a "standard", rate the other options in terms of carbon emissions, that is, by the ratio (C emissions option i)/(C emissions pulse furnace). Assume the electrical power plant burns coal.

| Option | Description | Furnace efficiency (%) | Power plant efficiency (%) | [C emissions i] / [C emissions 1] |
|--------|-------------|------------------------|----------------------------|-----------------------------------|
| 1 | Pulse-gas | 95 | - | 1 |
| 2 | Conventional gas | 70 | - | ? |
| 3 | Heat pump | 250 | 33 | ? |
| 4 | Electric | 100 | 33 | ? |

[7.5][CO5]

[b]     Do you think "Carbon Capture and Storage" technique is going to play an important role in combating climate change in times to come? Why or Why not?                                                    [2.5] [CO4]

2. [a].    A 0.27 km² lined landfill contains 2.4 million tons of waste. At its current level, the landfill emits 2000 metric tons of $CO_2$ and 2000 metric tons of Methane per year, with traces of other compounds. Looking only at the methane and $CO_2$ emissions, what are the total emissions per year in terms of $CO_2e$? Assume methane has a GWP of 21.        5 [CO4]

[b]     As per the diagram given below, analyze how this particular feedback mechanism might influence global warming?
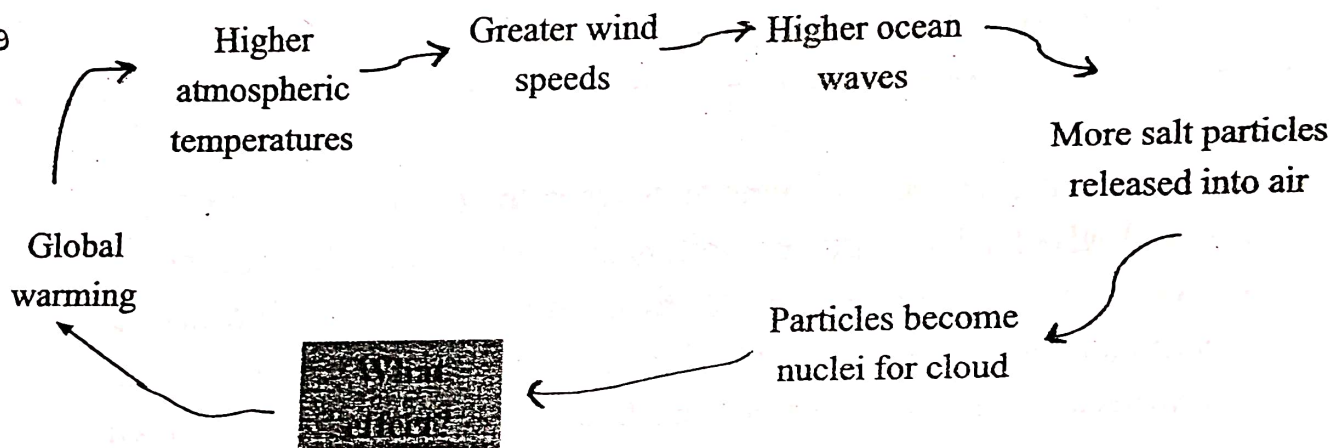


[2.5] [CO5]

[c]    What are the salient features of the ongoing international agreement to combat climate change.                    [2.5][CO4]

3. [a]What are the challenges being experienced by India in implementing various Carbon Capture and Storage techniques?        [5] [CO4]

[b]The problem of solid waste management is a burning issue across the country. As an Environmental Engineer, suggest ways to manage the solid waste in a manner that may help the municipality earn carbon credits as well.                    [5] [CO5]

4. [a] A water treatment plant consumes one kilowatt hour of electricity for every 3.5 kilo liter for water it treats. The plant gets its electricity from a coal fired power plant with an emission factor of 680 kg $CO_2$/MWh. If the facility treats 12 million liters of water each month, how many metric tons of carbon dioxide does it emit each year? Assume that the other emission from water treatment plant are negligible. [5] [CO4]

[b] What are the various catalytic reactions that goes on in the atmosphere in relation to Ozone? Briefly explain. [5] [CO5]

5. Briefly explain the following:

[a] Differentiate between "Adaptation" and "Mitigation" with reference to Climate Change [2][CO3]

[b] When we experience Ozone hole, which category of UV rays - out UVA, UVB and UVC has the highest tendency to reach the earth's surface and why? [2] [CO2]

[c] Briefly explain the role of IPCC in combating global warming. [2][CO4]

[d] Why do you think "Carbon Capture and Storage" technique is going to play an important role in combating climate change in times to come? [2] [CO4]

[e] Is the reduction of emissions of Carbon Dioxide (CO2) from a chemical process more climatically effective than the reduction of emission of Nitrous Oxide (N2O)? [2] [CO5]

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SECOND SEMESTER      **M.Tech [Geotechnical Engineering]**

# END TERM EXAMINATION                    *May-2024*

## COURSE CODE GTE-502 COURSE TITLE: ROCK MECHANICS

*Time: 03:00 Hours*                     **Max. Marks: 40**

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

Q.1  Design Tunnel support for 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.

Assume :

Finished width of tunnel = 13.00 m , Lining thickness = 400.0 0  mm Payline = 100 mm , Thickness of shotcrete tc = 50  mm, Excavated height of Tunnel  = 9.90 m, Excavated width of tunnel = 14.10 m, Diameter of rock bolt = 25 mm, Length of Rock Bolt = 2+ 0.15 B/ESR Where B is excavated width ESR =Excavation Support Ratio = 1.3 For Highway Tunnel, Length of Rock Bolt Required = 3.6 m Provided Length of rock bolt = 5.0 m characteristic compressive strength of shotcrete = 35 N/mm2 Yield strength of rock bolt (fy) = 500 N/mm2 Factor of Safety for bolt = 1.5

Find I. Vertical Support Pressure for Crown II. Ultimate Wall Support Pressure III. Roof and wall support pressure IV. Load carried by Shotcrete V. Load carried by bolt VI. Check support system compatibility for crown and walls          [10] [CO3]

Q.2  (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][CO4]

66

(b) Evaluate the short term stability for the dam shown in Fig. The embankment consists of a saturated soil for which the angle of shearing resistance $\phi_u = 0^0$ and the undrained cohesion $c_u = 70 kN/m^2$. The calculation is to be carried out for the reservoir depth of 18m and for the case where the reservoir has been completely emptied.
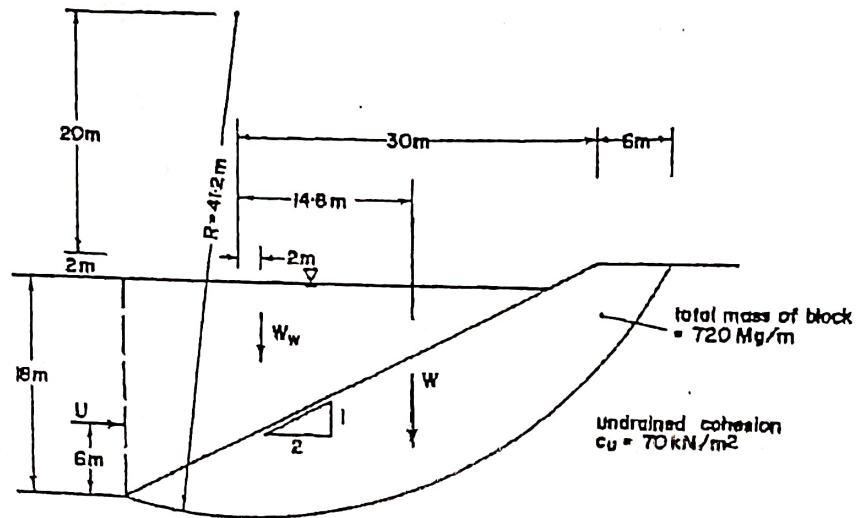


Q.3 (a) Explain observational method for Tunnelling in Rock Masses.

[5][CO 5]

(b) Explain with suitable figures typical applications of various measuring instruments in Tunnelling.

[5][CO 5]

Q.4 Write short notes on following
(a). Q- system of rock classification
(b). Cyclic shear test
(c). Griffith's crack propagation theory
(d). UDEC for numerical modelling in Rock Engineering
(e). Tunnel boring machine

[2][CO 1]
[2][CO 2]
[2][CO 2]
[2][CO 2]
[2][CO5]

6 7

Second Semester
M.Tech.

**END TERM EXAMINATION** May-2024
GTE-504 : Soil Dynamics and Machine Foundation

Time: 03:00 Hours Max. Marks: 40
Note: All questions carry equal marks.
Assume suitable missing data, if any.

Q1. (a) A body weighs 1 KN. A spring and a dashpot are attached to the body in the manner shown in Figure 1. The spring constant is 2 N m$^{-1}$. The dashpot has a resistance of 0.001 KN at a velocity of 0.6 m sec$^{-1}$. Determine the following for free vibration:
i. damped natural frequency of the system
ii. damping ratio
iii. the ratio of successive amplitudes of the body ($Z_n / Z_{n+1}$)
iv. amplitude of the body 5 cycles after it is disturbed assuming that at time t = 0, z = 25 mm.
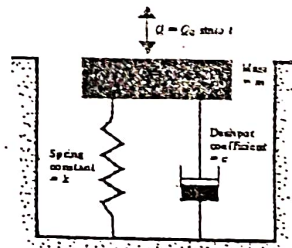

Figure 1

(b) Explain the following
i. How the waves are produced in an elastic compared to a plastic medium?
ii. What is the possible response of a psudo-plastic medium on the event of dynamic disturbance?
iii. Explain longitudinal shear wave and torsional waves propagation using graphical representation of medium and the dynamic loading in the resonant column test.
iv. What is the effect of infinite medium and elastic half space compared to stress waves in a forwarding supported by a single pile? [CO1-5]

Q2. A turbo generator has a weight of 10 KN and operates at 3600 rpm. It is mounted on a foundation designed to withstand dynamic loads. If the foundation is modeled as an elastic homogeneous half-space with a dynamic stiffness of 3.5 MN/m, determine the natural frequency of the system and

**68**      compare it to the operating frequency of the turbo generator to ass
      potential resonance issues.        [CO1-2]

Q3. Explain the dynamic properties of geo-materials and their significance in the analysis and design of foundations for different types of machinery. What the propagation of waves in a confined granular media as of a tank as used laboratory and its implications?       [CO1-3]

Q4. (a) List various types of damping with illustrative examples. What are governing equation of motion for linear and non-linear vibration? Also tabulate similarities and differences with illustrative examples.
      (b) Compare the wave velocity in short and long bars for the following cases;
        i.   longitudinal elastic waves in a bar without constraints
        ii.   longitudinal elastic waves in a bar with constraints
        iii. torsional waves in a bar wrt resonance column test      [CO2]

Q5.      (a) A reciprocating engine has a weight of 50 KN and operates at 1800 rpm. If the engine is mounted on a foundation supported by a single pile with a dynam stiffness of $2 \times 10^6$ N/m, calculate the amplitude of vibration experienced by the engine due to its operational dynamics.       [CO2

(b) A concrete foundation is 2.5 m in diameter. The foundation is supporting a machine. The weight of the machine and the foundation is 280 KN. The mach imparts an oscillating force $Q = Q_0 \sin \omega t$. Given, $Q_0 = 28$KN, operating frequency of 2.5 cps, soil supporting the foundation with a unit weight of 19 KNm$^{-3}$, sh modulus of 44.8 MPa, and poisson's ratio of 0.3.
Determine;
       i.   The resonant frequency
       ii. The amplitude of vibration at the operating frequency.      [CO2-4

SECOND SEMESTER
M.Tech.

END TERM EXAMINATION

COURSE CODE: GTE5208          COURSE TITLE: WASTE TO ENERGY

Time: 03:00 Hours          Max. Marks: 50

> Note: 1) Attempt all Questions.
> 2) Marks are indicative of time distribution. The use of calculators is allowed.
> 3) Mobile/tablets/programming calculators are not permitted.

Q.1    Draw the schematic diagram of any two of the followings:
(i)    Two stage anaerobic digestion.
(ii)   Gasification system
(iii)  Pyrolysis system                                      [5+5][CO3]

Q.2    Explain the process of incineration of the waste having following composition.

| Component | Wet weight(Kg) | Dry Weight(KG) | Compositions (Kg) | | | |
|---|---|---|---|---|---|---|
| | | | C | H | O | N |
| Food wastes | 15 | 4.5 | 2.16 | 0.29 | 1.69 | 0.12 |
| Paper | 45 | 42.3 | 18.40 | 2.54 | 18.61 | 0.13 |
| Cardboard | 10 | 9.5 | 4.18 | 0.56 | 4.24 | 0.03 |
| Plastics | 10 | 9.8 | 5.88 | 0.71 | 2.23 | - |
| Garden trimmings | 10 | 4.0 | 1.91 | 0.24 | 1.52 | 0.14 |
| Wood | 5 | 4.0 | 1.98 | 0.24 | 1.71 | 0.01 |
| Total | 95 | 74.1 | 34.51 | 4.58 | 30.00 | 0.43 |

Also estimate the chemical composition, energy content and possible energy recovery of this solid waste by incineration.          [10][CO5]

Q.3A   Explain the Phenomena of production of odours from municipal solid waste landfills. What are the possible gases emanating from a typical landfill? Also write the reactions involved.

Q.3B   Explain the steps involved in energy/gas recovery from a typical engineered MSW landfills, along with appropriate diagram.          [5+5][CO 1&2]

Q.4A   Explain and differentiate the air emissions from (i) incinerator (ii) anaerobic digestion (iii) Pyrolysis.

Q.4B   Explain the design requirement of wet scrubber. Also explain the processes involved in scrubbing using appropriate diagram.

Q.4C   Explain the possible energy recovery process from agro based waste like 'Parali', which is at present a serious air pollution concern in Punjab/Delhi.

[3+4+4][CO2&3]

Q.5A.  Explain the required control conditions and limitations of:
(i) Gasification
(ii) Pyrolysis
Q.5B.  Explain the various stages of anaerobic digestion. In which of the stage/stages VFA monitoring is required? What is to be done if the monitored value of VFA is reasonably high?          [4+6][CO 3&4]

## 2nd SEMESTER
## M.Tech. [GTE]

END TERM EXAMINATION                    *May-2024*

### GTE 5304 Soil-Structure Interaction

*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 is soil-structure interaction? As a Geotechnical specialist, explain the importance of soil-structure interaction.          [5][CO1]

b) What is soil exploration? List the objectives of soil exploration          [5][CO1]

Q.2 a) What is modulus of sub-grade reaction? Explain in details.          [5][CO2]

b) What role does soil type play in influencing subgrade modulus, and how does it impact the design of pavements?          [5][CO2]

Q.3 a) Explore the impact of concentrated and distributed loads on beams resting on elastic foundations.          [5][CO4]

b) Define seismic waves. What is the free field response of a site and list the importance?          [5][CO4]

Q.4 a) Tabulate the differences between p-waves and s-waves.          [5][CO5]

b) Analyse the effect of embedment on dynamic soil-structure interaction and discuss how different levels of embedment influence structural response.          [5][CO5]

Q.5 a) Explain the characteristics and effects of seismic loads on structures and analyse the influence of soil properties on the seismic response of structures.          [5][CO6]

b) Differentiate contact pressures under perfectly flexible footings and perfectly rigid footings. Support your answer with neat sketches for sand and clay.          [5][CO6]

Q.6 Write short note (any two):                    7½              [5x2][CO2-CO6]
   a) Beam on elastic foundation
   b) Winkler's idealization method
   c) Foundations of finite rigidity

Total no. of Pages: 03

Roll no.........

II Semester

M.Tech.

End Term Examination

May-2024

II SEMESTER M.Tech. (GEOTECHNICAL ENGG)

GTE-5402 THEORETICAL SOIL MECHANICS

Time: 3hr

Max Marks: 40

Note: Assume the missing data, if any.

1. Attempt **all** questions.

a. If the linear and quadratic strain invariants are 0.082 and -0.00133 respectively, determine orthogonal normal strain and orthogonal shear strain.
CO-1

b. Explain the distribution of contact stress over footings resting on a semi-infinite soil.
CO-2

c. What are true cohesion and true angle of shearing resistance?      CO-3

d. What is the criteria for determination of angle of wall friction on the basis of angle of shearing resistance?      CO-5

(2x4=8)

2. Attempt any **Two** parts-

a. For 3-D problems, write down the compatibility equation in terms of stresses in Cartesian's coordinate system.      CO-1(4)

b. A stress system has three principal values $\sigma_1$= 220 kPa, $\sigma_2$ = 169 kPa and $\sigma_3$ = 70 kPa. Find the normal and shear stresses on a plane, the normal of which is inclined at $50^0$ and $60^0$ with respect to $\sigma_1$ and $\sigma_2$ direction respectively. Draw Mohr's circle.      CO-1(4)

c. A large thin plate is subjected to certain boundary conditions on its thin edges (with zero stress vector on its large faces) leading to stress function

$\Phi = Ax^2y^3 - By^5$.

(i) Use the bi-harmonic equation to express A in terms of B

(ii) Calculate the strain components in terms of B, modulus of elasticity and Poisson's ratio

(iii) Check if the compatibility equation is satisfied          CO-2 (4)

3. Attempt any **Two** parts-

a. A line load of 100 kN/m is applied at the ground surface at an angle $45^0$ with the horizontal. Plot the variation of $\sigma x$ and $\sigma z$ at a depth of 3.0 m below the ground surface.          CO-2 (4)

b. Describe Krikpatrik's theory with the help of hollow cylinder test, for cohesionless soils.          CO-3 (4)

c. A stress system has three principal values $\sigma_1 = 83.$ kPa, $\sigma_2 = -133$ kPa and $\sigma_3 = 10$ kPa. If the yield strength of the material is 190 kPa, determine the factor of safety based on

(i) Von Mises' criteria

(ii) Tresca's criteria          CO-3 (4)

4. Attempt any **Two** parts-

a. Discuss the concept of critical soil mechanics with a suitable example.          CO-4 (4)

b. A consolidated drained test at a constant cell pressure of 120 kPa, was conducted on a sample of normally consolidated clay. At failure the deviator stress is 140 kPa. What is the value of critical state frictional constant in compression? If an extension test were to be carried out, determine the mean effective and deviatoric stresses at failure.  CO-4 (4)

c. What is rheological model. Explain Hookean, Newtonian and Yield stress models in details.          CO-5 (4)

5. Attempt any **Two** parts-

a. A 8.0 m high retaining wall with back face inclined 20° with vertical retains cohesionless backfill ($\Phi$= 35°, $\gamma_t$ = 19.5 kN/m³ and $\delta$= 20°). The backfill surface is sloping at an angle 10° to the horizontal. If the retaining wall is located in a seismic region ($\alpha_h$= 0.1), determine total active earth pressure using Mononobe's equation. Assume the value of $\alpha_v$ as $\alpha_h/2$.                                    CO-5 (4)

b. Explain active state earth pressure based on Dubrova's method of redistribution of pressure. How this theory is different from Rankine's theory of earth pressure.                                    CO-5 (4)

c. Derive expression for the factor of safety based on Bishop's method of slope stability analysis for the case of a submersed slope of an earth dam. Explain how this method is different from Janbu's method.                                    CO-5 (4)

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Total No. of pages 3
THIRD SEMESTER
END SEMESTER EXAMINATION

Roll No..............
M. TECH(IEM)
MAY 2024

IEM 5210 Contemporary Issues in Industrial Engineering and Management

Max. Marks: 50

Time 3 Hours

| Note: | Assume suitable missing data, if any |
| | Answer ALL QUESTIONS |

1. Explain some of the major contemporary issues of industrial management. (Marks 10) # (CO# 1,2)
2. Discuss the sustainability in industry 4.0 paradigm with an example. (Marks 10) # (CO# 3)
3. Explain the impact of IOT on manufacturing industry in detail. (Marks 10) # (CO# 4)

*Case studies:*

*One of the state audit reports of the comptroller and auditor general (CAG) of India reviewed the affairs of the Tamil Nadu Industrial Development Corporation (TIDCO). His assessment was mainly concerned with the joint sector projects finalized by the corporation during (1987-92). In that report he had also mentioned the ordeals, which some of the companies set up much were still facing. It has been brought out in the report that every alternative project finalized during 1987-92 had tended to fail. It also mentions that several companies, which had been set up before that period, were still languishing (around the year 1993). In the following brief case studies, we summarize the problems faced by some of these companies.*

***Asian Bearing Ltd.*** *This company had been promoted in 1974 in the joint sector by TIDCO and a private co-promoter, which the technical collaboration of a German firm. For forging the inner and outer rings of bearing, a new technology was adopted by the company instead of the traditional process of cutting them out from seamless tubes. Since the foreign collaborator due to which basic constraints were created. Even though the commercial production started only in 1992, it ran into serious difficulties. As a result of this non-performance, the company was declared sick by the Board for Industrial Financial Reconstruction (BIFR) in 1988 and subsequently a scheme for its revival was suggested. While implementing the above scheme, balancing equipment had to be installed and certain sops were to be granted by all the institutions involv3d. Even though some more corrective*

1

loss up to 1991-92 exceeded Rs. 21 crores, which swallowed TIDCO's investment of over Rs. 2.5 crores.

***Fibre Pipes India Ltd.*** Fibre pipes India Ltd. was set up in the joint sector in 1981 to manufacture "pitch fibre pipes" from pitch tar and waste paper for use in water supply, sewerage disposal and electrical wiring. The plant started working from 1986 but its maximum capacity utilization was as low as 9 percent. This was because of every poor sales of the products. The company had assumed that the fibre pipes would be used by the Tamil Nadu Water Supply & Drainage Board, the Metro Water Board and the Telecommunications Department. Unfortunately, these customers did not show any interest in the above products because they found the products were of poor quality and technically, they did not withstand high pressure. As a desperate attempt to salvage the company, the management decided to diversify its operations to produce asphaltic sheets. Here the company assumed that the sale of the product would be handled by another form owned by the co-promoter. However, the company found itself in great trouble, as there was no demand for this new product. Subsequently the company had an accumulated loss of Rs. 2.5 crores by March 1992. For TIDCO, this was another shock because they had invested over Rs. 60 lakhs in this project.

***Industrial Diamonds of India Ltd.*** This unit was set up by TIDCO in 1986 in association with a co-promoter. The commercial production starred in 1989. However, the company had a tough time when it faced stiff competition from imported industrial diamonds. As a result, the company had to look for new products to be added as an alternative. It was observed in 1989 that saw-grade diamonds had good scope in the marble/granite industry. Since the demand for the product was projected by a reputed consultancy firm based on their market survey, the company decided to diversify to produce saw-grade diamonds. Finally when the saw-grade diamonds were manufactured by the company, there were no takers. It was found that the company's product was suitable only for handling marble and not for granite as envisaged in the project report. To overcome this difficulty, a new technology was obtained from an American firm in 1991. The products manufactured through this new technology were found to be too costly as the new technology was prohibitively high and was impacting on the cost of production. This had driven the company to a situation that they could not make any profits out of these sales.

Questions.

4. What a critique on the role of Tamil Nadu Industrial Development Corporation in handling the above three projects especially with regard to project formulation. (Marks 10) (CO# 3)

5. Identify the various dimensions that should have been looked into critically in each of three projects so that the chances of their success could have improved substantially. (Marks 10) (CO# 4)

   (OR)

   Suggest a general framework for analysis taking into consideration the aspects that you would like to look into as indicated in above question. (Marks 10) (CO#5)

**(II) SEMESTER**
**M. Tech (IEM)**

END TERM EXAMINATION     *MAY-2024*

**COURSE CODE: IEM 5304**

**COURSE TITLE: INTERNATIONAL LOGISTICS & WAREHOUSING 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) Explain the concept of Supply Chain Management and its [5][CO1] relationship with Logistics in Global Trade.
(b) What are some ways that a firm such as Wal-Mart from [5][CO1] out sourcing decisions?

Q.2   (a) Describe the concept of last-mile delivery and its [5][CO2] importance in transportation logistics.
(b) Explain Ocean Transportation as a mode of international [5][CO2] transportation. Discuss its advantages and disadvantages.

Q.3   (a) Explain the different models of inventory used by [5][CO3] warehouses to effectively stock the goods.
(b) Explain the Role of Modern Warehousing in Logistics and [5][CO3] integrating with ROBOTICS.

Q.4   (a) Describe the difference between upstream and [5][CO4] downstream supply chain risks. Provide examples of each.
(b) Describe the concept of the triple bottom line approach in [5][CO4] sustainable logistics and provide examples of each component.

Q.5   (a) Explain the concept of reverse logistics and its role in [5][CO5] sustainable logistics practices.

(b) Discuss the environmental benefits of implementing [5][CO5] reverse logistics practices. How can reverse logistics contribute to waste reduction and resource conservation?

Q.6 (a) Explain the concept of remanufacturing and its role in [5][CO5] reverse logistics.

(b) What is global supply chain management? What is the [5][CO4] role of international logistics in global supply chain management?

Q.7 (a)What are the barriers to international trade? List and [5][CO1] explain all the types of barriers to international trade.

(b)Discuss the role of multinational corporations in driving [5][CO1] economic globalization. Provide examples to support your answer.

2ⁿᵈ Sem M.Tech

## END SEMESTER EXAMINATION          May-2024
### IEM 5404: Industry 4.0 and Smart Manufacturing

Time: 3:00 Hours                                        Max. Marks : 40

**Note:** 1. Attempt and FIVE questions; assume missing data if any.
2. Substantiate your answers with illustration and examples.

1a  Three key drivers for Industry 4.0 success are think value, not tech; think people, not tools; and set clear targets from the start. Discuss each of these drivers with 2-3 examples from diverse areas.          [CO1]

1b  What do you understand by the cyber physical system? With the help of neat diagrams, discuss any two systems at DTU which you feel can be upgraded as Cyber Physical System. What would be the value proposition for the students, faculty, university and society? What are major challenges you are anticipating and how are you going to overcome them?          [CO2, 4

2a  Differentiate between Micro controllers and Microprocessors. Draw a neat well leveled diagram of Arduino board.          [CC 4

2b  In the context of computer networks, write brief notes on (i) Router; (ii) Gateway and (iii) Firewall          [CC 4

3a  What do you understand by sustainable manufacturing? Briefly discuss the role of industry 4.0 in manufacturing sustainability.          [CC CO

3b  Write brief notes on carbon credits and life cycle assessment.          [CC

4a  What do you understand by Augmented Reality? How virtual reality is different from augmented reality? Give at least two examples of each.          [CC CO 4

4b  3D printing helps in reducing product development time and inventories. Justify with examples.          [CC CO

&o    What are the major challenges restricting the wide applications of 3D printing?     4

5a    What are the major elements of a Robotics system? Explain with the help of a neat diagram. What is meant by degree of freedom of a Robotics system?     [CO1, CO2]

4

5b    What is Smart manufacturing? How robotics systems helps in achieving the goals of Smart Manufacturing?     [CO1, CO2]

4

6a    Industry 4.0 helps in enhancing quality, predicting equipment health and reducing cost? Explain with examples by identifying appropriate technology and the processes     [CO4, CO5]

4

6b    Compare and contrast the Level 1 IOT system and level 5 IOT system with examples.     [CO2]

4

7    Write brief notes     [CO1]

     (a)    Design principles of Industry 4.0     8
     (b)    Temperature sensors
     (c)    Big Data
     (d)    Smart devices

# Delhi Technological University

## END SEMESTER EXAMINATION    May 2024

### IEM-504, Supply Chain Management

Time: 3:00 Hours

Max. Marks : 50

Note : (i) Question No. 1 is compulsory, Answer any Four questions from the rests.
(ii) All questions carry equal marks.
(iii) Assume suitable missing data, if any.

1. A-One Electronics is an electronic equipment manufacturing company. The company has a single manufacturing facility in the city 'X'. A-One Electronics distributes its products through five regional warehouses located in 'A', 'B', 'C', 'D', and 'E'. In the current distribution system, the State is partitioned into five major markets, each of which is served by a single regional warehouse in their market. That is, in the current distribution system, each customer is assigned to a single market and receives deliveries from one regional warehouse. The warehouses receive items from the manufacturing facility. Typically, it takes about two weeks to satisfy an order placed by any of the regional warehouses. Currently, A-One provides tier customers with a service level of about 90 percent. In recent years, A-One has seen a significant increase in competition and intense pressure from its customers to improve service level and reduce costs. To improve service level and reduce costs, A-One would like to consider an alternative distribution strategy in which the five regional warehouses are replaced with a single, central warehouse that would process all customer orders. This warehouse should be one of the five existing warehouses.

Table 1 provides historical data that includes weekly demand for this product for the last 12 weeks in each of the market areas. An order (placed by a warehouse to the factory) costs Rs. 5,500 (per order), and inventory carrying costs are Rs.1.25 per unit per week. The cost of inbound and outbound transportation costs per unit (in Rs.) is given in Table 2. It provides information about inbound and outbound transportation costs per unit from each of the existing regional warehouses to all other market areas (assuming a particular regional warehouse becomes the centralized warehouse).

To improve the customer service level up to 97% (z=1.88), find the location for central warehouse out of these five existing warehouses which will be economical. What will be the minimum total cost of inventory?     [CO1&3][10]

Table 1

| City (Warehouse) | Week | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| A | 33 | 45 | 37 | 38 | 55 | 30 | 18 | 58 | 47 | 37 | 23 | 55 |
| B | 26 | 35 | 41 | 40 | 46 | 48 | 55 | 18 | 62 | 44 | 30 | 45 |
| C | 44 | 34 | 22 | 55 | 48 | 72 | 62 | 28 | 27 | 95 | 35 | 45 |
| D | 27 | 42 | 35 | 40 | 51 | 64 | 70 | 65 | 55 | 43 | 38 | 47 |
| E | 32 | 43 | 54 | 40 | 46 | 74 | 40 | 35 | 45 | 38 | 48 | 56 |

Table 2

| CITY | Inbound cost / unit | Outbound Cost/Unit | | | | |
|---|---|---|---|---|---|---|
| | | A | B | C | D | E |
| A | 12 | 13 | 14 | 14 | 15 | 17 |
| B | 11.5 | 14 | 13 | 22 | 15 | 17 |
| C | 11 | 14 | 22 | 13 | 15 | 16 |
| D | 9 | 15 | 15 | 15 | 13 | 22 |
| E | 7 | 17 | 17 | 16 | 22 | 13 |

2. (a) How is information systems/technology important for a supply chain? Justify it with respect to Bullwhip Effect.

(b) What are the factors influencing the amplification of Bullwhip effect? Discuss with their remedies.                    [CO2][5+5]

3. (a) Discuss the quantification of Bullwhip Effect in the cases of centralized and decentralized information systems.

(b)   Discuss the various types of relationships between the buyer and supplier with their advantages and disadvantages.

[CO3&4][5+5]

4. (a) Discuss the role of inventory management in effective supply chain management.

(b)   Explain the process of supplier evaluation and selection in a supply chain.

[CO2&4][5+5]

5. (a) Explain the term Collaborative Planning, Forecasting and Replenishment (CPFR).

(b)   Why do firms outsource? Give some reasons for outsourcing.

[CO4&5][5+5]

6. Write the short notes on            [CO4,5,6][2.5× 4=10]

(a) Push-Pull Supply Chain strategy

(b) Continuous and periodic inventory review policy

(c) Newsvendor Model

(d) Everyday Low Pricing (EDLP)

**II SEMESTER**

**M.Tech.(TY)**

# END TERM EXAMINATION          *May-2024*

## COURSE CODE: ISY5314  COURSE TITLE: Cyber Security and Law

Time: 03:00 Hours                                    Max. Marks: 50

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

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Q.1  Discuss in detail Cybercrime provisions under IT Act, 2000 and types of cyber crimes.                                          [10][CO1]

Q.2  Design a robust microchip design startup financial model and business model.                                          [10][CO2]

Q.3  a. Explain the Stateless of HTTP and how it is good and bad.
b. Design procedure to host multiple websites on one machine.
[5X2][CO3]

Q.4  a. Explain Public Key Infrastructure and its standards in India.
[5][CO4]

b. Explain Data diddling with an example.          [5][CO4]

Q.5  Write a short note on the following:
a. Merchandising
b. Professional Ethics
c. Copyright Infringement
d. Information security audit

[2.5X4][CO1,CO2,CO3,CO4]

## 2nd SEMESTER
## M.Tech.

END TERM EXAMINATION                    **May-2024**

**ITY502       HIGH PERFORMANCE 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. | |
|---|---|---|
| **Q. No.** | **Question Description** | **[M] [CO#]** |
| **Q.1** | (a) Define uniprocessor system, multiprocessing system, and parallel processing system. | [2] [CO1] |
| | (b) Distinguish between loosely coupled and tightly coupled multiprocessors. | [2] [CO1] |
| | (c) Discuss about the different parallel algorithm in SIMD architectures. | [2] [CO1] |
| | (d) Explain Flynn's classification of parallel processing system with neat diagrams. | [2] [CO1] |
| **Q.2** | (a) If a computer A runs a program in 10sec and computer B runs the same program in 15sec, then how much faster is computer A than B? | [2] [CO2] |
| | (b) Amdahl's law quantifies overall performance gain due to the improvement in part of a computation" Justify and prove the statement. | [2] [CO2] |

| | | |
|---|---|---|
| | ) Explain Granularity, Concurrency and Dependency Graph. | [2] [CO2] |
| | (d) Assume that a task is 25% parallelizable. What is the speed up gained by running on a dual core machine with respect to single core machine? | [2] [CO2] |
| Q3. | (a) Write short note on the following:<br>  (i) Cloud Computing<br>  (ii) Green Computing<br>  (iii) Grid Computing | [3] [CO3] |
| | (b) Explain cloud deployment models and different types of cloud service models? | [3] [CO3] |
| | (c) What are the advantages and disadvantages of serverless computing? | [2] [CO3] |
| Q4. | (a) Explain Parallel Matrix-Matrix Multiplication algorithm with an example. | [3] [CO4] |
| | (b) The following table shows the no of instructions of a program | |

| Arithmetic | Store | Load | Branch | Total |
|---|---|---|---|---|
| 500 | 50 | 100 | 50 | 700 |

| | | |
|---|---|---|
| | (i)   Assuming that arithmetic instructions take 1 cycle, load and store take 5 cycles and branch takes 2 cycles. What is the execution time of a program in 2GHz processor? | [2] [CO4] |
| | (ii)   Find the cpi of the program. | [1] [CO4] |
| | (iii)   If the no. of load instructions can be reduced to half, what is the speed up and cpi? | [2] [CO4] |

| Q5. | (a) What is PBS? Explain with neat diagram how PBS works for job submission in any HPC system? | [2] [CO2] |
|---|---|---|
| | (b) Describe CUDA Architecture in details with neat diagram. | [2] [CO1] |
| | (c) Illustrate MPI routines and Explain Non-blocking communications using MPI. | [2] [CO4] |
| | (d) Design a simple CUDA kernel function to multiply two integers. | [2] [CO3] |

*********************************************End*********************************************

## 2nd SEMESTER

## M.Tech. (ITY)

# END TERM EXAMINATION

# MAY-2024

## IT-504 Advanced Computer Networks

Time: 3:00 Hours

Max. Marks: 40

**Note:** All questions are compulsory. Kindly check the paper code before starting 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 | [M] [CO#] |
|---|---|---|
| Q.1 | (a) In the context of IoT networks, describe the idea of multi-homing. Examine its importance with regard to load balancing, network resilience, and reliability. | [5] [CO1] |
| | (b) Discuss at least three protocols commonly used in IoT networks, such as MQTT, CoAP, and HTTP. | [3] [CO1] |
| | (c) How actuation and sensing enable the collection of data and the execution of actions in response to that data? | [2] [CO1] |
| Q.2 | (a) In edge computing contexts, explain the function of Service-oriented Architecture (SoA). How may SoA help with the deployment and administration of edge services? | [5] [CO2] |
| | (b) Explain the various communication patterns commonly used in IoT networks, such as point-to-point, publish/subscribe, and mesh networking. | [3] [CO2] |

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(c) Provide instances of how edge computing improves the effectiveness and performance of IoT applications. [2] [CO2]

Q3. (a) Explain the following: [2+3][CO3]
- Wireless HART Vs ZigBee
- DASH Vs TVOD Vs SVOD

(b) Explain Software-Defined Networks' (SDN) function in edge computing scenarios. Discuss the benefits and challenges of implementing SDN in edge computing architectures. [5] [CO3]

Q4. (a) Explain design and functionality of CDNs in edge contexts. How CDNs are utilized to improve content delivery performance and reduce latency? [5] [CO4]

(b) Describe Reverse Precision Time Protocol (PTP) and why it's important for edge situations to achieve sub-microsecond clock synchronization precision. Provide examples of applications where precise timing is essential. [3] [CO4]

SECOND SEMESTER

M.Tech. (IT)/Ph.D.

END SEMESTER EXAMINATION     MAY 2024

IT-5410 MACHINE LEARNING AND APPLICATIONS

TIME DURATION: 180 Minutes                     Max. Marks: 40

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

**Question No. 1**                                                        [4]

[a] How does machine learning contribute to the advancement of Industry 4.0, and what are some examples of its role in revolutionizing modern industries? ·                                                          [CO1]

[b] What is inductive learning, and how does it differ from other forms of machine learning? Additionally, could you provide examples of how inductive learning is applied in real-world scenarios to solve practical problems?                                                            [CO1]

**Question No. 2**                                                        [4]

[a] A data analyst is examining the correlation between the number of hours spent studying and the exam scores of 10 students. The following data represents the hours studied (in hours) and the corresponding exam scores (out of 100):

Hours Studied (X): [10, 8, 6, 12, 14, 9, 7, 11, 13, 15]

Exam Scores (Y): [85, 75, 65, 90, 92, 80, 70, 88, 91, 94]

Calculate the Pearson correlation coefficient between the hours studied and exam scores. Interpret the significance of the result.          [CO2]

[b] A data analyst is using gradient descent to optimize a Linear Regression Model for predicting housing prices based on square footage. The analyst starts with an initial guess for the coefficients ($\beta_0$ and $\beta_1$) of the linear equation $y = \beta_0 + \beta_1$, where $x$ represents the square footage and $y$ represents the housing price. The analyst uses the Mean Squared Error (MSE) as the cost function to minimize. Given the following dataset:
   Square Footage ($x$): [1000, 1500, 2000, 2500, 3000, 3500, 4000]
   Housing Price ($y$): [300000, 400000, 500000, 600000, 700000, 800000, 900000]

Using gradient descent with a learning rate ($\alpha$) of 0.0001 and starting with initial coefficients $\beta_0=100$ and $\beta_1=100$, compute the updated coefficients after one iteration. Also, calculate the MSE before and after the iteration.

## Question No. 3

[a] A machine learning engineer is training a binary classification model to predict whether emails are spam (1) or not spam (0) based on certain features. The engineer uses cross-entropy loss as the loss function to measure the performance of the model during training. Given the following dataset:

True labels: [0, 1, 1, 0, 1, 0, 0, 1, 1, 0]

Predicted probabilities: [0.2, 0.8, 0.7, 0.3, 0.6, 0.4, 0.1, 0.9, 0.85, 0.25]

Calculate the cross-entropy loss for this model. Explain the significance of the result in the context of model evaluation.

[b] A data scientist is using Naive Bayes classification to predict whether emails are spam or not spam based on the presence of certain keywords. The data scientist has trained a Naive Bayes model using a training dataset with the following features and labels:

*Features:*
- Email 1: "free", "offer", "money"
- Email 2: "discount", "sale"
- Email 3: "click", "link", "website"
- Email 4: "urgent", "action", "required"
- Email 5: "exclusive", "limited", "time"

*Labels:*

- Email 1: Spam
- Email 2: Not Spam
- Email 3: Not Spam
- Email 4: Spam
- Email 5: Spam

Given a new email with the following words: ***"free"***, ***"discount"***, ***"click"***, ***"urgent"***, ***"limited"***

predict whether the new email is spam or not spam trained using Naive Bayes classification model. [CO3]

[4]

## Question No. 4

[a] Consider a dataset with the following two-dimensional feature vectors and their corresponding class labels:

| X | 2 | 4 | 3 | 6 | 5 |
|---|---|---|---|---|---|
| Y | 3 | 2 | 6 | 3 | 4 |
| Class | A | A | B | B | B |

Classify the unknown sample (4.5, 3.5) using K-Nearest Neighbours (K-NN) algorithm with K=3. [CO3]

[c] Suppose we have a dataset consisting of two classes: Class A and Class B, each represented by two-dimensional feature vectors. We want to find the hyperplane that best separates these two classes in the feature space. Given the following feature vectors and corresponding class labels:

**Class A:**
- *Feature vectors:*

  - (2,3)
  - (4,2)
  - (3,6)

**Class B:**
- *Feature vectors:*

  - (6,3)
  - (5,4)

Find the equation of the hyperplane that separates these two classes. Also, explain the significance of the result in the context of machine learning. [CO4]

## Question No. 5

[4]

[a] Consider a dataset consisting of students' exam scores and whether they passed or failed a course. We want to build a decision tree classifier to predict whether a student will pass or fail based on their exam scores. Given the following dataset:

| Exam 1 Score | Exam 2 Score | Exam 3 Score | Result |
|---|---|---|---|
| 70 | 75 | 80 | Passed |
| 60 | 65 | 70 | Failed |
| 80 | 85 | 90 | Passed |
| 55 | 50 | 65 | Failed |
| 75 | 80 | 85 | Passed |
| 65 | 70 | 75 | Passed |
| 45 | 55 | 60 | Failed |
| 90 | 95 | 100 | Passed |

Construct a decision tree (Gini Index) based on this dataset to predict whether a student will pass or fail. Also, explain the significance of the result in the context of machine learning.

[CO5]

[b] Consider, we have a dataset consisting of five data points in a two-dimensional space:

Data points:

- (2,3)
- (4,2)
- (3,6)
- (6,3)
- (5,4)

Using the Agglomerative Hierarchical clustering algorithm with single linkage (Nearest Neighbour) as the linkage criterion, cluster these data points into two clusters. [CO5]

FIRST SEMESTER                    **PhD Course Work [PHYSICS]**
END SEMESTER EXAMINATION              **(May, 2024)**

**NST-502          ANALYTICAL TECHNIQUES**

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].** Write deference between point, line and areal type detectors.
                                                              (CO2)
**[b].** List the information deduced form the scanning electron microscopy (SEM) and transmission electron microscopy (TEM).          (CO4)
**[c].** Determine the transmission factor of 1 mm lead screen for $MoK_\alpha$ radiation, with mass absorption coefficient, 141 $cm^2$/gm for this target and density of lead is 11.34 $gm/cm^3$.          (CO2)
**[d].** Distinguish between atomic force microscopy (AFM) and scanning tunneling microscopy (STM).                              (CO3)

**2[a].** What is Atomic Force Microscopy (AFM)? Explain the principle and working of AFM in contact mode. Why contact mode is not useful for the characterization of biological sample? Write the example where contact mode would give best result.          (CO4) **[5]**
**[b].** Explain the adhesion force measurement using AFM showing the proper force vs distance curve with contraction and retraction of cantilever and tip positons.                              (CO4) **[3]**

**3[a].** Explain the basic principle and instrumentation of X-ray Photo Electron Spectroscopy. Write the different characteristics studied/ analyzed by XPS.                              (CO3)**[5]**
**[b].** Drawing a proper diagram explain the cantilever and tip interaction with the specimen to measure magnetic force using magnetic force microscopy (MFM)                              (CO3) **[3]**

**4[a].** Explain the use of backscatter and secondary electrons in SEM. Describe the principle and working of field emission scanning electron microscope (FE-SEM). Why FE-SEM is superior over SEM. (CO4) **[5]**

**[b].** An electron beam of brightness, $10^{10}$ $Am^{-2}sr^{-1}$ is focused to a spot of diameter 100 nm at the specimen. What is the current density within the spot and what is the dose rate in electrons per square nm per second? Take the convergence angle to be 0.04 radians. (CO4) **[3]**

**5[a].** What is Differential Scattering Calorimetry (DSC)? Explain the principle, working and application of Differential Scattering Calorimetry (DSC) for material synthesis. Write applications of DSC. (CO5) **[5]**

**[b].** A mixture of $CaCO_3$ and CaO is analyzed using TGA technique. TGA curve of the sample indicates that there is a mass change from 145.3 mg to 115.4 mg between 500–900 °C. Calculate the percentage of $CaCO_3$ in the sample. (CO5) **[3]**

**6.** Discuss briefly any **FOUR**. **[2X4]**
**[a].** Structure factor calculation for NaCl structure (CO1)
**[b].** Multiplicity and Absorption Factor (CO1)
**[c].** Energy Dispersive Spectroscopy (EDS) (CO3)
**[d].** Bright field optical microscopy (BFOM) (CO4)
**[e].** Differential thermal analysis (DTA) (CO5)
**[f].** Scanning Tunnelling Microscopy (STM) (CO4)

## NST504: Design and Synthesis of Nanostructures

Time: 3:00 Hours                    Max. Marks: 40

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

Q1. Complete the following with suitable answers.          [14×0.5=7]
 (a) Sol-gel method is ......................... approach.
 (b) Sol-gel method is known since ............
 (c) The sol-gel is a ..................... of solid particles.
 (d) The gel is a .......................... mass.
 (e) Sol-gel method is ..............chemical process.
 (f) ............. undergo hydrolysis and polycondensation reactions.
 (g) Formation of an inorganic continuous network containing the metal centers with ...............
 (h) After the drying process, the liquid phase is removed from the gel and ............... is performed.
 (i) One of the advantages of the sol-gel method can get uniform and ...................powder.
 (j) Metal nanoparticles particularly ..............nanoparticles are prepared by the chemical reduction method.
 (k) The ................ and citrate solution are used as reducing agents in chemical reduction method.
 (l) The transparent colorless solution is changed into pale yellow from ...............in the chemical reduction method.
 (m) How many types of vapor-phase deposition techniques are present?.............
 (n) $SiCl_4 + 2H_2O \rightarrow SiO_2 +$ ...................

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Q2. Compare the physical, chemical and biological nanoparticle synthesis methods, and discuss their advantages and disadvantages. [7]

Q3. Discuss the laser ablation method of production of nanoparticles. Which laser is commonly used in this method and why? [6]

Q4. Discuss chemical vapour deposition (CVD) and low-pressure chemical vapor deposition (LPCVD) methods in detail with suitable diagrams and examples and compare the LPCVD with other CVDs. [10]

Q5. Discuss Two of the following. [5×2=10]
   (a) Ball milling method
   (b) Sputtering method
   (c) Electrospinning method
   (d) Bottom-up and Top-down approaches

--------------------------------XXX----------------------------------

SECOND SEMESTER                          93         M.Tech. (PES )
END TERM EXAMINATION                              MAY-2024
PES-502 Advanced Power Semi Conductor Devices and Magnetics
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)** 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

**(b)** Consider the single-switch, single input power processing circuit given in Fig. 1(a). Assume the source voltage, $v_s(t)$, is a triangular waveform with a peak voltage, $V_p$, and frequency, $f = \dfrac{1}{T}$, as shown in Fig. 1(b). Assume the switch is ideal and initially was off and its control works in such a way that it toggles every time $v_s(t)$ crosses zero. Use $Vp = 12\,V, R = 10\,\Omega, and\ T = 1\,ms$. (a) Calculate the average and rms values for the output voltage.          [4+4=8M] [CO1]
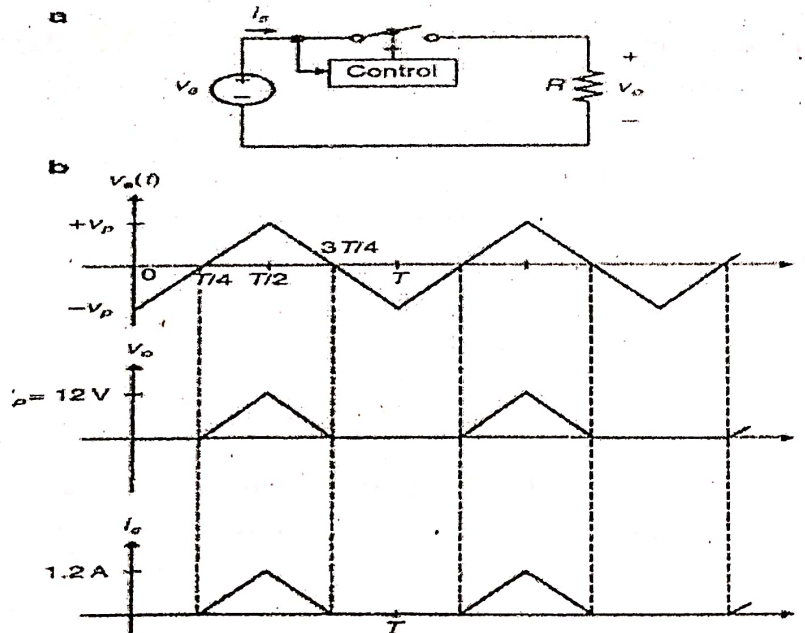


Fig.1(a) ,(b)

**Q(2) (a)** Compare and summarize the material parameters for silicon(Si) and silicon carbide (4H-SiC)

**(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).                                   [4+4=8M][CO2]

**Q(3)** 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 $2 \times 10^{19} cm^{-3}$ and thickness of $10\mu m$. The P-base region has a doping concentration of $2 \times 10^{17} cm^{-3}$ and thickness of $20\mu m$. The N- drift region has a doping concentration of $5 \times 10^{13} cm^{-3}$ and thickness of $300\mu m$. The $P^+$ anode region has a doping concentration of $2 \times 10^{19} cm^{-3}$ and thickness of $50\mu m$. The Shockley-Read-Hall (low-level, high-level, and space-charge generation) lifetime is $10\ ns$ in the $N^+$ cathode and $P^+$ anode regions, $10\ \mu sec$ in the P-base and N- drift regions. Ignore band-gap narrowing and Auger recombination. Use an ambipolar diffusion constant $D_a$ of $15\ cm^2/s$ 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?           [8M][CO3]

**Q(4) (a) (a)** Explain Principle of operation with help structure diagrams for SiC Planar MOSFET, SiC Trench-gate MOSFET.

**(b)** Determine the ideal specific on-resistances for n-channel 4H-SiC power MOSFET structures with breakdown voltages of 300 and 600V. Take into account the variation of the critical electric field and mobility with the following doping concentration, mobility and depletion width.

| Breakdown Voltage (Volts) | Doping Concentration (cm$^{-3}$) | Mobility (cm$^2$/V-s) | Depletion Width (cm) |
|---|---|---|---|
| 300 | 2.15 x 10$^{17}$ | 566 | 1.24 x 10$^{-4}$ |
| 600 | 8.55 x 10$^{16}$ | 720 | 2.78 x 10$^{-4}$ |

[4+4=8M][CO4]

**Q(5)** 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.           [8M] [CO5]

**Q(6) (a)** Explain the role of relative permeability in (i). Energy storage of inductor (ii). Power transfer in transformer

**(b)** Mention the steps in selecting a transformer core and windings for an isolated DC-DC converter.           [2+6=8M][CO5]

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# APPENDIX - I

Physical, Electrical and Magnetic characteristics of ferrite cores

| CORES without air gap | mean length per turn $l_t$ mm | mean magnetic length $l_m$ mm | core cross section area $A_c \times$ 100 mm² | window area $A_w \times 100$ mm² | area product $A_p \times 10^4$ mm⁴ | effective relative permeability $\mu_r \pm 25\%$ | $A_L$ nH/turns² $\pm 25\%$ |
|---|---|---|---|---|---|---|---|
| POTCORES - CEL HP₃C grade, (*Philip 3B7 grade) | | | | | | | |
| P 18/11 | 35.6 | 26 | 0.43 | 0.266 | 0.114 | 1480 | 3122 |
| P 26/16 | 52 | 37.5 | 0.94 | 0.53 | 0.498 | 1670 | 5247 |
| P 30/19 | 60 | 45.2 | 1.36 | 0.747 | 1.016 | 1760 | 6703 |
| P 36/22 | 73 | 53.2 | 2.01 | 1.01 | 2.010 | 2030* | 9500* |
| P 42/29 | 86 | 68.6 | 2.64 | 1.81 | 4.778 | 2120* | 10250* |
| P 66/56 | 130 | 123 | 7.15 | 5.18 | 37.03 | | |

EE - CORES - CEL HP₃C grade

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| E 20/10/5 | 38 | 42.8 | 0.31 | 0.478 | 0.149 | 1770 | 1624 |
| E 25/9/6 | 51.2 | 48.8 | 0.40 | 0.78 | 0.312 | 1840 | 1895 |
| E 25/13/7 | 52 | 57.5 | 0.55 | 0.87 | 0.478 | 1900 | 2285 |
| E 30/15/7 | 56 | 66.9 | 0.597 | 1.19 | 0.71 | | |
| E 36/18/11 | 70.6 | 78.0 | 1.31 | 1.41 | 1.847 | 2000 | 4200 |
| E 42/21/9 | 77.6 | 108.5 | 1.07 | 2.56 | 2.739 | 2100 | 2613 |
| E 42/21/15 | 93 | 97.2 | 1.82 | 2.56 | 4.659 | 2030 | 4778 |
| E 42/21/20 | 99 | 98.0 | 2.35 | 2.56 | 6.016 | 2058 | 6231 |
| E 65/32/13 | 150 | 146.3 | 2.66 | 5.37 | 14.284 | 2115 | 4833 |

## Appendix

| CORES without air gap | mean length per turn $l$, mm | mean magnetic length $l_{\sim}$ mm | core cross section area $A_c \times 100$ mm$^2$ | window area $A_{\sim} \times 100$ mm$^2$ | area product $A_r \times 10^4$ mm$^4$ | effective relative permeability $\mu_r \pm 25\%$ | $A_L$ nH/turns$^2$ $\pm 25\%$ |
|---|---|---|---|---|---|---|---|
| | | | UU - CORES | | | | |
| UU 15 | 44 | 48 | 0.32 | 0.59 | 1.190 | | 1100 |
| UU 21 | 55 | 68 | 0.55 | 1.01 | 0.555 | | 1425 |
| UU 23 | 64 | 74 | 0.61 | 1.36 | 0.823 | | 1425 |
| UU 60 | 183 | 184 | 1.96 | 11.65 | 22.83 | | 1900 |
| UU 100 | 29.3 | 308 | 6.45 | 29.14 | 187.95 | | 3325 |
| | | | TOROIDS - CEL HP$_3$C | | | | |
| T 10 | 12.8 | 23.55 | 0.062 | 0.196 | 0.012 | 2300 | 765 |
| T 12 | 19.2 | 30.40 | 0.12 | 0.442 | 0.053 | 2300 | 1180 |
| T 16 | 24.2 | 38.70 | 0.20 | 0.785 | 0.157 | 2300 | 1482 |
| T 20 | 25.2 | 47.30 | 0.22 | 0.950 | 0.213 | 2300 | 1130 |
| T 27 | 34.1 | 65.94 | 0.42 | 1.651 | 0.698 | 2300 | 1851 |
| T 32 | 39.6 | 73.00 | 0.61 | 1.651 | 1.010 | 2300 | 2427 |
| T 45 | 54.7 | 114.50 | 0.93 | 6.157 | 5.756 | 2300 | 2367 |

**Also, Consider the following data while answering the questions related to magnetics:**

Window Factor, $K_w = 0.4$

Crest Factor, $K_c = 1$

Current Density, $J = 3$ A/mm$^2$

Magnetic Flux density, $B_m = 0.25$ T

Relative permeability, $\mu_r = 1500$

## A2.6 American wire gauge data

| AWG# | Bare area, $10^{-3}$ cm$^2$ | Resistance, $10^{-6}$ Ω/cm | Diameter, cm |
|------|------|------|------|
| 0000 | 1072.3 | 1.608 | 1.168 |
| 000 | 850.3 | 2.027 | 1.040 |
| 00 | 674.2 | 2.557 | 0.927 |
| 0 | 534.8 | 3.224 | 0.825 |
| 1 | 424.1 | 4.065 | 0.735 |
| 2 | 336.3 | 5.128 | 0.654 |
| 3 | 266.7 | 6.463 | 0.583 |
| 4 | 211.5 | 8.153 | 0.519 |
| 5 | 167.7 | 10.28 | 0.462 |
| 6 | 133.0 | 13.0 | 0.411 |
| 7 | 105.5 | 16.3 | 0.366 |
| 8 | 83.67 | 20.6 | 0.326 |
| 9 | 66.32 | 26.0 | 0.291 |
| 10 | 52.41 | 32.9 | 0.267 |
| 11 | 41.60 | 41.37 | 0.238 |
| 12 | 33.08 | 52.09 | 0.213 |
| 13 | 26.26 | 69.64 | 0.190 |
| 14 | 20.02 | 82.80 | 0.171 |
| 15 | 16.51 | 104.3 | 0.153 |
| 16 | 13.07 | 131.8 | 0.137 |
| 17 | 10.39 | 165.8 | 0.122 |
| 18 | 8.228 | 209.5 | 0.109 |
| 19 | 6.531 | 263.9 | 0.0948 |
| 20 | 5.188 | 332.3 | 0.0874 |
| 21 | 4.116 | 418.9 | 0.0785 |
| 22 | 3.243 | 531.4 | 0.0701 |
| 23 | 2.508 | 666.0 | 0.0632 |
| 24 | 2.047 | 842.1 | 0.0566 |
| 25 | 1.623 | 1062.0 | 0.0505 |
| 26 | 1.280 | 1345.0 | 0.0452 |
| 27 | 1.021 | 1687.6 | 0.0409 |
| 28 | 0.8046 | 2142.7 | 0.0366 |
| 29 | 0.6470 | 2664.3 | 0.0330 |
| 30 | 0.5067 | 3402.2 | 0.0294 |
| 31 | 0.4013 | 4294.6 | 0.0267 |
| 32 | 0.3242 | 5314.9 | 0.0241 |
| 33 | 0.2554 | 6748.6 | 0.0236 |
| 34 | 0.2011 | 8572.8 | 0.0191 |
| 35 | 0.1589 | 10849 | 0.0170 |
| 36 | 0.1266 | 13608 | 0.0152 |
| 37 | 0.1026 | 16801 | 0.0140 |
| 38 | 0.08107 | 21266 | 0.0124 |
| 39 | 0.06207 | 27775 | 0.0109 |
| 40 | 0.04869 | 35400 | 0.0096 |
| 41 | 0.03972 | 43405 | 0.00863 |
| 42 | 0.03166 | 54429 | 0.00762 |
| 43 | 0.02452 | 70308 | 0.00685 |

# END TERM EXAMINATION

## *May-2024*

## PES 504 Controller Design of Power Electronic Converters

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) Explain any two real life applications of controller design in power electronic converters.

(b) Mention the steady state parameters and transient parameters required for designing the DC-DC converter. Explain the role of switching frequency in designing the DC-DC converter.

**[4+4] [CO1]**

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] [CO1]**

Q.3 Ideal Boost DC-DC converter has an input voltage of 12V and the output voltage of 48V. Load resistance is 10Ω. Inductance ,capacitance and switching frequency values of the converter are 200µH ,600µF and 50kHz respectively. Compute line to output transfer function and control to output transfer function. **[8] [CO2]**

Q.4. The open loop gain transfer function *T(s)* of a DC voltage regulator shown in Fig. 1. is as follows:

$$T(s) = T_0 \frac{\left(1 + \frac{s}{\omega_z}\right)}{\left(1 + \frac{s}{Q\omega_{p1}} + \left(\frac{s}{\omega_{p1}}\right)^2\right)\left(1 + \frac{s}{\omega_{p2}}\right)}$$
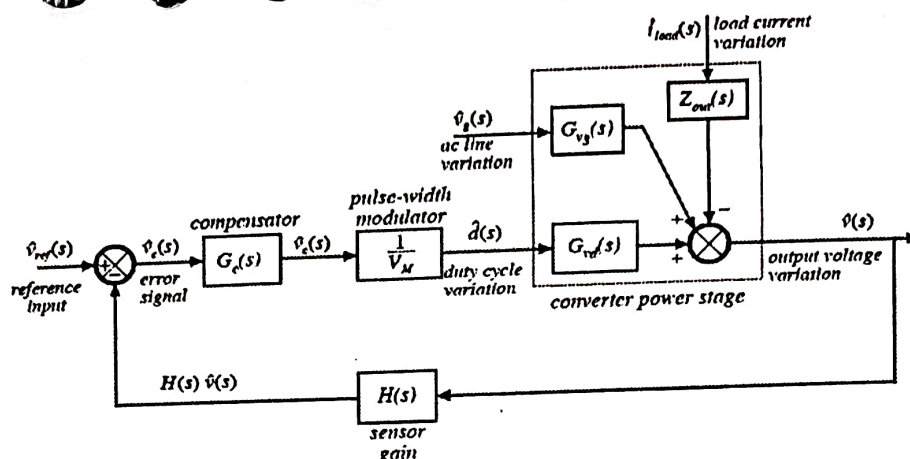
Fig. 1. Block Diagram of DC Voltage regulator

The values of $f_{p1}$, $f_z$ and $f_{p2}$ are in increasing order.

(a) Draw the bode magnitude plot of the above transfer function for quality factor greater than 0.5.

(b) On the same plot, construct the asymptotic bode magnitude plots of $\frac{T}{1+T}$ and $\frac{1}{1+T}$ for magnitudes of T greater than one and less than one.

(c) Explain the roles of the respective plots $\frac{T}{1+T}$ and $\frac{1}{1+T}$ on reference voltage, variations in input voltage and variations in load current. **[8] [CO3]**

Q.5 Draw the circuit diagram and equivalent circuits in each mode of forward converter 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] [CO4]**

Q.6 What is the difference between circuit averaging and average circuit modelling of power electronic converters? Write down steps to develop average circuit model of buck converter. **[8] [CO5]**

Q.7 Design PID controller parameters for single input single output flyback converter having voltage mode control. Find the stability of designed system. **[8] [CO5]**

Q.8 Write short notes on (any TWO)

(a) Current mode control of boost converter **[CO4]**

(b) Sliding mode control of buck converter **[CO5]**

(c) Adaptive control of non-isolated converters **[CO5]**

**(4 Marks each)**

Total No. of Pages: 01

98

Roll No. ......................

M. Tech. (PES)

SECOND SEMESTER

END SEMESTER EXAMINATION

(May- 2024)

## PES-5206 MACHINE LEARNING

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 deep learning and artificial neural network.                                                                 [CO-1]

    (b) List some advantages of multilayer perceptron over single layer perceptron.                                                        [CO-2]

    (c) How the missing or corrupted data in a dataset is handled?          [CO-3]

    (d) What is bias and variance in a machine learning model?              [CO-1]

    (e) Differentiate between SVMs and neural network.      [CO-4]

2. What is 'training set' and 'test set' in a machine learning model? How the data is distributed among training, validation, and test sets? Discuss the significance of normalization in the development of ML models.                                            [CO-1] [10]

3. Classify the neural networks based on interconnections. Also highlight the advantages and limitation of each.      [CO-3] [10]

4. Discuss the significance of regression analysis in machine learning. Briefly describe the different types of regression.      [CO-2] [10]

5. Write short notes on **any two** of the following:          [2x5 =10]

    (a) Methodology for Load forecasting using ANN or Fuzzy Logic                                                                       [CO-4]

    (b) Reinforced learning                                                 [CO-2]

    (c) Decision tree                                                       [CO-3]

    (d) K-mean clustering                                                   [CO-3]

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## SECOND SEMESTER

## M.Tech. (Power Electronics & Systems)

## END TERM EXAMINATION     May-2024

## COURSE CODE: PES-5312    COURSE TITLE: PULSE WIDTH MODULATION FOR POWER CONVERTERS

Time: 03:00 Hours             Max. Marks: 40

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

**Q.1** Discuss the following:            [2×5=10] [CO1, CO2]

(a) Overmodulation of an inverter,

(b) Phase opposition disposition modulation,

(c) Triplen carrier ratios,

(d) Switching function representation of three phase converter,

(e) Diode clamped multilevel inverter.

**Q.2** (a) Discuss the third harmonic reference injection, compare the fundamental magnitude of output voltage and THD for k = 1/4 and 1/6.

                                  [5×2=10] [CO2, CO4]

(b) Naturally sampled sine-triangle modulation for three-phase voltage source inverter.

**Q.3** Derive the mathematical relation for **two-level** naturally sampled **sine-sawtooth PWM** for **single-phase inverter** output voltage using double Fourier series expansion and Jacobi-Anger expansion. (Assume phase offset angle for fundamental $\theta_o$ and carrier $\theta_c$ waveform is zero.)

                                        [10] [CO3, CO4]

(a) Find the fundamental rms value of inverter output voltage, if the dc link voltage is 400V, modulation index is 0.98, and fundamental frequency of inverter output voltage is 50 Hz.

(b) Comment on the magnitude of odd carrier harmonic and associated sideband harmonics in inverter output voltage.

(c) Comment on the magnitude of even ($2m$) carrier groups harmonic and odd sideband harmonics in inverter output voltage.

**Q.4 (a)** What is space vector pulse width modulation (SVPWM)? Compare SVPWM with SPWM and third harmonic injection PWM in terms of their peak fundamental component magnitude and THD performance.

[2×5=10] [CO3, CO4]

**(b)** A three-phase voltage source inverter with a DC link voltage of 450 V. The switching frequency ($f_s$) is 1.8 kHz. Assume ideal conditions and neglect any voltage drop across the switches. Calculate the duration of each active state ($T_1$, $T_2$, $T_0$) for the generation of reference voltage vector $V_{ref} = 200\angle 40°$. Draw the respective switching sequence.

**Q.5** A three-phase two-level inverter with $V_{dc} = 400V$, star connected load with impedance of $8+j6\Omega$ at $f_o = 50Hz$. The inverter is operated under space vector modulation (SVM) with the switching frequency of 3.6 kHz.

[2+6+2 = 10] [CO4]

**(a)** Calculate sampling time $T_s$ and corresponding step angle of SVM reference ($\Delta\theta$).

**(b)** Calculate corresponding space vector magnitude, modulation index and sector number at which reference vector will locate within the hexagon for the instantaneous reference voltages given below:

| (i) | $V_a*$ | $V_b*$ | $V_c*$ |
|---|---|---|---|
| | -113.2V | 73.9V | 39.3 |

| (ii) | $V_a*$ | $V_b*$ | $V_c*$ |
|---|---|---|---|
| | -70.8 | 203.9 | -133.1 |

**(c)** Calculate the peak fundamental component of output phase current for Q.5 (b) part (i) under shaded region.

Note: Assume suitable missing data, if any.
Q.1, Q2 and Q3 are compulsory. Attempt any other 2 from the rest.
Attempt all parts of a question at one place (Marks may not be awarded otherwise).

**1** Giving reasons by explaining (*very briefly*), why?
   (i)   Hybrid modulation offer advantageous over Unipolar modulation for the single phase non-isolated grid connected PV inverter.
   (ii)  Current tracking control is suitable for Grid Supportive Inverters(GSI), whereas, PWM control is suitable for Grid Forming Inverters(GFI).
   (iii) Master-slave configuration is suited for medium-low capacity microgrids($\mu$G) involving large number of GSI, whereas, GFI are tied with large capacity $\mu$Gs.
   (iv)  A fast and a slow PLL are employed for Islanding detection based on PLL scheme.
   (v)   Synchronous reference theory based grid synchronization is the preferred choice over $i_d$-$i_q$ and IPT.
   (vi)  LCL filters are chosen over LC filter for GCI.
   (vii) GCI inverters always work in step down mode for power transfer from DC side to grid side.
   (viii) SOGI PLL offer robust performance even under distorted mains.        **1x8**

**2 [a]** Compare the different modulation schemes for operation of full bridge single phase grid connected PV inverter on the basis of leakage currents, EMI, quantum of switching ripples, frequency of switching ripples, filter requirements and involvement of reactive power.        **4**

   **[b]** Draw neat circuit diagrams of H5, Heric and H6 PV inverters, write their salient features in bullet points, tabulate their comparison of merits/demerits.        **4**

**3 [a]** Design a 10kW three phase grid connected string PV inverter with LC filter for 415V, 50Hz distribution feeder. Select a suitable level/capacity of:
   i)   DC bus voltage
   ii)  DC bus capacitor having 50ms holdup time with 3% change in DC voltage
   iii) AC side inductor to restrict current ripple to less than 15%
   iv)  Ripple filter(*AC side capacitor*) for 10kHz switching frequency.        **4**

distribution feeder. The PWM switching frequency of the inverter is 10kHz $ $ the DC bus voltage is 800V. Design the LCL filter which mandates follow $ $ constraints.

   i) *the peak value of the ripple current through inverter side inductor ($i_{L1}$) < 3 %
     of the rated current. Assume triangular wave shape of the ripple.*
   ii) *the rms value of the ripple current through grid side inductor ($i_{L2}$) < 0.3%
     the rated current.*
   iii) *grid side inductor and capacitor of the LCL filter provide the same rea*
     *power.*      4

**4 [a]** Derive the transfer function from fundamentals for second order General
Integrator using adaptive notch filter approach. Draw the block diagram and
explain briefly how it can be used to realize in-phase and quadratic si
generator (QSG).      4

**[b]** From the fundamentals explain the realization of PLL. Explain throu
block diagram how reverse Park transformation can realize QSG.      4

**5 [a]** Using SRF theory to extract the fundamental current component for opera
of Grid Supportive Inverter(GSI) to supply only requisite real power
requirements and balance capacity for reactive power to the connected load
the feeder. Use block diagrams to explain the control of GSI using SRF theory.

**[b]** Discuss briefly the islanding detection for Grid supported inverters with
different techniques using frequency drift and harmonic injection.      1

**6 [a]** Explain how modulation technique/switching scheme turns the same 3-phase
IGBT inverter into *Grid Forming* and *Grid Following inverters*. Comment on
the selection of the suitable value of the interface inductor in each case. Brie
discuss their roles and requirements in Master-Slave operation of the microgrid.

**[b]** What is Non-Detection zone in respect of islanding detection for the grid
connected inverters. Identify the constraints in terms of real and reac
powers.

**[c]** Briefly explain through neat diagrams single stage and double stage
inverter with MPPT operation.

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lo 3

# VI SEMESTER

## M.Tech/PhD

END TERM EXAMINATION                               *May-2024*

### PTE 502: Polymer Processing

Time 3:00 Hours                                    **Max. Marks: 40**

> **Note:** All questions are compulsory
>   Assume suitable Missing data, if any

| Q.No. | | Marks | CO |
|---|---|---|---|
| 1 | Justify the statement with suitable example | | |
| [a] | Dispersive and distributive mixing of additives in polymer take place simultaneously in internal batch mixer | 4 | 1 |
| [b] | Addition of glass fibers improves the mechanical properties of polymer composite. A company added glass fiber filler in the Polypropylene matrix to improve the mechanical properties. However, after compounding, no improvement was observed. Write the cause and suggest suitable compounding formulation. | 2 | 2 |
| 2[a] | Compare the properties following PVC formulations. | 4 | 2 |

| Component | Formulation 1 (PHR) | Formulation 2 (PHR) |
|---|---|---|
| PVC | 100 | 100 |
| Diisononyl phthalate | 55 | 35 |
| Tri xylyl Phosphate | - | 20 |
| Calcium carbonate | 10 | - |
| China Clay | - | 10 |
| Antimony oxide | 5 | - |
| Tribasic lead sulphate | 4 | 4 |
| Stearic acid | 0.5 | 0.5 |

| | | | |
|---|---|---|---|
| [b] | Why are thermoplastic sheets used in thermoforming process? | 2 | 4 |

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3[a] Write the mechanism of antiaging agents.     4    3
 [b] Differentiate between exothermic and endothermic blowing   2    3
agents.

4 [a] Discuss the mixing mechanisms on two roll mill with neat   4    1
diagram
 [b] Why is polymer powder used as raw material for rotational   2    4
molding process?

5 [a] Discuss the working of single screw extruder with neat   4    1
diagram.
 [b] Write the functions of feed throat and breaker plate.    2   

6 [a] Explain the cycle diagram of injection molding process   3    1
 [b] Why are thin articles produced on injection molding   2    4
Machines?

7 [a] Discuss the process of dip coating using PVC plastisol.   3    1
 [b] What is biaxial orientation? How are biaxial oriented films   2
produced?

## SECOND SEMESTER

## M.Tech.

**END TERM EXAMINATION**                    **May 2024**

**COURSE CODE: SWE 502      COURSE T ITLE: SOFTWARE TESTING**

**Time: 03:00 Hours**                    **Max. Marks:  40**

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

Q.1   (a) What is mutation testing? What is the purpose of mutation score? Why higher order mutants are not preferred?          [3][CO5]

(b) What are the limitations of testing? Discuss with the help of examples.                    [2][CO1]

(c) Differentiate between

(i) Alpha, Beta and Acceptance Testing

(ii) Testing, Quality assurance and Quality Control          [3][CO6]

Q.2   Consider the following program

```
        #include<stdio.h>
        #include<conio.h>
        #include<string.h>
        #include<stdlib.h>
1       void main()
2       {
3           char login[100];
4           char password[100];
5           int valid =0;
6           printf("Enter the username: ");
7           scanf("%s",login);
8
9           printf("\nEnter the password: ");
10          scanf("%s",password);
11
12          if(strlen(login) == 11)
```

```
13        {
14   if(strlen(password)>4&&strlen(password)<16)
15           {
16               valid=1;
17           }
18         else
19           {
20               valid=-1;
21           }
22        }
23       else
24        {
25           valid=-2;
26        }
27   if (valid==1)
28   {
29     printf("\nLogin successful");
30   }
31   else if(valid==-1)
32   {
33     printf("Password is not in correct format");
34   }
35   else
36   {
37     printf("\nLogin ID is not in correct format");
38   }
39   getch();
```

Draw the control flow graph and DD path graph for the above program segment. Determine the cyclomatic complexity and find the independent paths. [8][CO4]

Q.3   Consider the program given in Q.2. Generate test cases for all du paths, all uses paths and all definition paths. [8][CO5]

Q.4   Consider the program given in Q.2. Consider all variables and generate possible program slices. Design at least one test case from every slice. [8][CO5]

Q.5   Consider the program given in Q.2. Generate two first order mutants. Design a test suite of five test cases and calculate the mutation score of the test suite.                                                   [8][CO5]

Q.6  (a) Why is functional testing also known as black box testing? Discuss with the help of examples.                                                   [3][CO3]
     (b) What is regression testing? Explain the various steps of the regression testing process. Which step is the most important and why?                                                                         [5][CO6]

Q.7   Consider a program for the determination of the nature of roots of a quadratic equation. Its input is a triple of positive integers (say a, b and c) and values may be from interval [0, 100]. The output may have one of the following words: [Not a quadratic equation, Real roots, Imaginary roots, Equal roots]. We are allowed to add new conditions as per our requirements.
     (a) Create equivalence classes and generate test cases          [4][CO3]
     (b) Develop a decision table and generate test cases            [4][CO3]

**M.Tech.** II SEMESTER

## END TERM EXAMINATION      *May-2024*

## COURSE CODE SWE 504      COURSE TITLE: ESE

Time: 03:00 Hours      Max. Marks: 40

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

Q.1   Write short note on (any two):
I.   Replicated and repeated results
II.   Fabrication, Falsification and Plagiarism
III.   One-tailed and two-tailed tests      [8][CO1, 4]

Q.2   What is research misconduct? Why plagiarism is considered a serious offense in research? How plagiarism can be avoided?
     [8] [CO2]

Q.3   Which metric is best suited for measuring inheritance? Why LCOM is not considered a valid metric? Justify your answer with a valid example.
     [8] [CO3]

Q.4   Identify the categories to which the following threats belong:

I.   Does the treatment introduced have a statistically significant effect on the outcome we measure?
II.   Did the treatment/change we introduced cause an effect on the outcome?
III.   Can other factors also have had an effect?
IV.   Does the treatment correspond to the actual cause we are interested in?
V.   Does the outcome correspond to the effect we are interested in?
VI.   Is the cause-and-effect relationship we have shown valid in other situations?
VII.   Can we generalize our results?
VIII.   Do the results apply in other contexts?      [8] [CO5]

Q.5 Discuss various performance measures to evaluate the performance of the prediction models. [8] [CO4]

## OR

The mean lifetime of a sample of 400 light tubes produced by a company is found to be 1570 hours with a standard deviation of 150 hours. Test the hypothesis that the mean lifetime of the tubes produced by the company greater than 1600 hours. Assume value $\alpha=0.05$.

[8] [CO4, CO5]

**Constants:**

| Level of Significance | Two-Tailed Test ($H_o: u = u_0$ versus $H_a: u <> u_0$), | One-Tailed Test ($H_o: u <= u_0$ versus $H_a: u > u_0$) | One-Tailed Test ($H_o: u >= u_0$ versus $H_a: u < u_0$) |
|---|---|---|---|
| | | Rejection Point(s) | |
| | $z_{/2}$ and $-z_{/2}$ | $z$ | $-z$ |
| 10% | $z_{0.05} = 1.645$ $-z_{0.05} = -1.645$ | $z_{0.10} = 1.28$ | $-z_{0.10} = -1.28$ |
| 5% | $z_{0.025} = 1.96$ $-z_{0.025} = -1.96$ | $z_{0.05} = 1.645$ | $-z_{0.05} = -1.645$ |
| 1% | $z_{0.005} = 2.575$ $-z_{0.005} = -2.575$ | $z_{0.01} = 2.33$ | $-z_{0.01} = -2.33$ |
| Decision Rule | Reject $H_o$ if $z < -z_{/2}$ or $z > z_{/2}$ | Reject $H_o$ if $z > z_{/2}$ | Reject $H_o$ if $z < -z_{/2}$ |

**M.Tech. (SWE/DSC)**

END SEMESTER EXAMINATION

MAY-2024

SWE 5406/DSC 504 - MACHINE LEARNING

Max. Marks: 40

Time: 3:00 Hours

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

1 [a] Explain the following     (CO2)[5]
  (I) Well posted learning problems with example
  (III) Define Reinforcement Learning.

  [b] Explain the types of activation functions used in artificial Neural Network.     (CO4)[5]

2 [a] How unsupervised learning work? Explain with example and also write its application.     (CO2)[5]

  [b] Explain K-Mean Clustering algorithm and write different measure for the distance between two clusters.     (CO3)[5]

3 [a] How to calculate Information Gain and entropy? Explain with example.     (CO3)[5]

  [b] Explain Descriptive Statistics with example.     (CO1)[5]

4 [a] What do you mean by support in SVM? Explain Support Vector Machine with example?

  [b] Explain multi linear regression model with example.     (CO3)[5]

5 The Indian Railways have been training 2 different machine learning methods which attempt to predict whether a train will arrive at its final destination on time or not, using a number of input features corresponding to weather conditions, train priorities, ongoing repair works etc. (for this purpose, 'on time' is defined as no more than 10 minutes after its scheduled time). The methods have been tested on a common set of 500 train runs, and the results are as follows:

|                             | Actually on time | Actually late |
|-----------------------------|------------------|---------------|
| Method 1 predicted on time  | 131              | 155           |
| Method 1 predicted late     | 19               | 195           |
| Method 2 predicted on time  | 82               | 72            |
| Method 2 predicted late     | 68               | 278           |

Suppose we set up a simple probabilistic model for this as follows: $\theta$ is the prior probability of a train being late; $p$ is the probability of a late prediction from Method 1 if the train is on time (also called the *False Positive Rate (FPR)*); and $q$ is the probability of a late prediction from Method 1 if the train is in fact late (also called the *True Positive Rate (TPR)*).

[a] Write down the joint likelihood of the data for Method 1, as a function of the three model parameters $\theta$, $p$, and $q$. Obtain maximum likelihood estimates for each of these parameters.

(CO2) [4]

[b] Suppose the loss matrix for this prediction task is defined as follows:

|                    | Actually on time | Actually late |
|--------------------|------------------|---------------|
| Predicted on time  | 0                | 1             |
| Predicted late     | K                | 0             |

Using the parameter estimates computed above, obtain the expected loss for Method 1 as a function of $K$.

(CO4) [2]

[c] Obtain the expected loss for Method 2 as well (you can compute its FPR and TPR directly, without doing the maximum likelihood derivations again); which is the preferable method? What is the critical value of $K$ at which this preference changes?

(CO3)[4]

**SECOND SEMESTER**

**END TERM EXAMINATION**

**SPD502PATTERN ANALYSIS AND MACHINE INTELLIEGENCE**

**Time: 3 Hours**                                              **Max. Marks :40**

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**Note:** All questions are compulsory and are of equal marks.

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**Q.No.1. (a).** Write about Fractional Brownian motion. How can it be helpful in design of impulse response to detect any given pattern. [C0-1, CO-2, CO-4]

**(b).** How can any self - Similarity help in Dimension reduction. Write the importance of Hurst parameter. [C0-1, CO-3, CO-4]

**Q.No.2. (a).** Write about the Discrete Wavelet decomposition process. Also write, why filter is used after decimator. [C0-1, CO-2, CO-3, CO-4]

**(b).** Write various steps to apply Local Linear Embedding on the manifold. Also write the properties which are satisfied by LLE. [CO-2, CO-5]

**Q.No.3. (a).** Write about the ISOMAP algorithm for Dimension reduction. Write drawbacks of the technique. [CO-3, CO-4]

**(b).** Where do we use graph-based methods. Write and explain mathematically the method of Laplacian Eigenmaps. [C0-1, CO-3]

**Q.No.4. (a).** Write about the method of Independent Component Analysis 2nd & 4th Cumulants. [CO-1,CO-3,CO-4]

**(b).** Given the matrix

$$X = \begin{bmatrix} 6 & 6 \\ 0 & 1 \\ 4 & 0 \\ 0 & 6 \end{bmatrix}$$

Compute its Singular Value Decomposition or Principal Component Analysis. [CO-3, CO-5]

**Q.No.5.** Write short notes on the following:

**(a).** Feature Selection based on Statistical Hypothesis.

**(b).** Support Vector Machine

**(c).** The Peaking Phenomenon
[CO-1, CO-3]

## 2ⁿᵈ SEMESTER

## M.Tech. ( SPD )

# END TERM EXAMINATION          *May-2024*

## SPD504: EMBEDDED SYSTEM DESIGN

*Time: 03:00 Hours*                    *Max. Marks:  40*

**Note:**    Assume any missing data

All questions carry equal marks

### Q.1

a. Explain the Status register of PIC microcontroller          [1][CO2]

b. Differentiate between RISC and CISC processor          [2][CO1]

c. What is the purpose of prescalar and postscalar in PIC and explain its role in CCP module          [2][CO3]

d. Differentiate among various timers used in PIC.          [3][CO3]

### Q.2

a. Explain various instruction sets given below:

    I.    MLA Rd, Rm, Rs, Rn

    II.    ORR   r0, r1, r2;

    III.   ADC r0, r1, r2;

    IV.   ADD r0,r1,r1 LSL#1

    V.   LDR r0,[r1,#4]!

    VI.   LDMIB r1, {r3,r5,r6}   ;          [3][CO2]

b. let the value of r0 = 0x00000000 & r1 = 0x00009000 and
Mem32[0x00009000] = 0x01010101
Mem32[0x00009004] = 0x02020202
Mem32[0x00009008] = 0x03030303
Mem32[0x0000900C] = 0x04040404

Evaluate the value of r0 and r1 after execution of LDR r0,[r1,#8]!
[2.5][CO2]

c. After the execution of below instruction
        MOV R0, #10
        MOV R1, #20
        CMP R0, R1
        ADDNE R2, R0, R1
        ADDEQ R3, R0, R1

What are the final values of R2 and R3 after executing the above instructions? [2.5][CO2]

## Q.3

a. Differentiate among privileged modes of ARM processor.
[3][CO2]

b. Draw, label and explain thumb architecture in ARM. What is the effect on code density in ARM processor in T-mode of operation? Justify your answer. [3][CO2]

Or

Explain the AMBA with neat diagram. [3][CO5]

c. Analyze how the pipeline capabilities of ARM7TDMI microcontroller enhance the efficiency and discuss the limitations that affect this efficiency. [2][CO2]

## Q.4

a. Differentiate the various addressing modes of DSP Processor and explain the rounding techniques. [4][CO4]

b. What is a Very long Instruction Word (VLIW) Processor? Draw its simple architecture. Compare it with clustered VLIW. [4][CO4]

Q5.

a. What are the various features of SOC and illustrate key approach for SOC design? Also explain the reconfigurable computing

[3][CO3]

b. Draw a neat sketch for TI-OMAP and explain various components of it. [3][CO3]

c. What are various classes of platforms in SOC. Explain any one.

[2][CO3]

II-SEMESTER

## M.Tech.

# END TERM EXAMINATION     *May-2024*

## COURSE CODE-SPD5406    COURSE TITLE-SPEECH PROCESSING

Time: 03:00 Hours        Max. Marks: 40

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

[5] [CO1,CO2]

Q.1 Define following terms
(i) Vocal Organs
(ii) Speech Perception
(iii) Phonemes
(iv) Heisenberg Principle

Q.2 Define non-stationary signal processing and what are the design steps of discrete domain Short Time Fourier Transform (STFT) with waveform analysis. [5] [CO2]

Q.3 Design and explain wavelet decomposition by using two channel filter bank architecture. [5] [CO2]

Q.4 List speech feature extraction algorithm and explain steps of Linear Prediction Coefficients (LPC). [5] [CO3]

Q.5 Explain 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]

$$A = [1, 3, 4, 9, 8, 2, 1, 5, 7, 3] \ \& \ B = [1, 6, 2, 3, 0, 9, 4, 3, 6, 3]$$

Q.6 Design Gaussian Mixture Model (GMM) and provide solution for maximum likelihood estimation problem. [5] [CO5]

Q.7 Demonstrate task specific voice control and dialog system in detail. [5][CO5]

## II SEMESTER

## M.Tech. (SPD)

**END TERM EXAMINATION**    *May-2024*

**SPD6203**    **MALTIRATE SIGNAL PROCESSING**

**Time: 03:00 Hours**    **Max. Marks: 50**

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

Q.1  Determine $Y(z)$ for the system shown in Fig. 1 in terms of $X(z)$. Also determine the $y(n)$ of the system.    [M=5] [CO2]
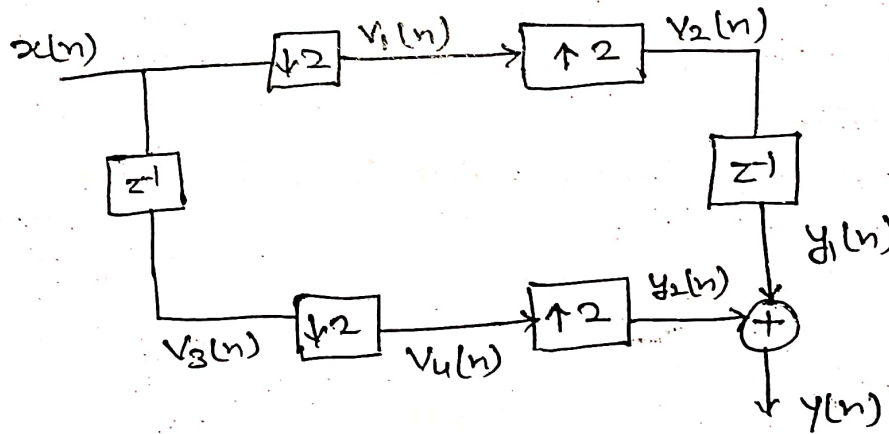


Fig.1

Q.2  Show that, if $H_0(z) = \frac{1}{\sqrt{2}}[1 + z^{-1}]$, then we can construct a two-channel prefect reconstruction (PR) quadrature mirror filter (QMF) bank. Also, Compute the output of analysis filter bank. [M=8] [CO4]

Q.3  Drive the expression for output of synthesis filter bank of two-channel quadrature mirror filter bank. Also, Compute the condition of prefect reconstruction and aliasing cancellation.    [M=7] [CO4]

Q.4  Show that the upsampler is a linear and time-variant system.    [M=5] [CO1]

Q.5 Design a rational sample rate converter with a rational conversion factor $\frac{L}{M} = \frac{2}{3}$ [M=5] [CO3]

Q.6 Derive the output expression for frequency domain characteristics of downsampler by $M$. Also, explain the aliasing effect of on frequency domain characterstics for $M = 3$. [M=8] [CO2]

Q.7 Define steps for the design of quadrature mirror filter bank using Grunwalde-Letnikov definition of fractional derivative. [M=4] [CO5]

Q.8 Realize the fractional order system $A(z) = 1 + z^{-1}C(z^2)$ using parallel and cascade structure. [M=2] [CO1]

Q.9 Explain the algorithm used for image denosing based on fractional integrator. [M=3] [CO5]

Q.10 Draw the analysis and synthesis block of two-channel graph wavelet filter bank. [M=3] [CO5]

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Total no. of Pages: 02                    Roll No.............
2nd SEMESTER                    M.Tech. (Structure Engineering)
END SEMESTER EXAMINATION                    May – 2024
STE-502 ADVANCED THEORY OF STRUCTURES
Time: 3:00 Hrs.                    Max. Marks: 40

Note :
- Q. 1 is compulsory, thereafter attempt any three from remaining questions.
- Assume suitable missing data, if any.

1. Find the displacements at A and forces in the members AB, AC and AD of the truss shown in Fig. 1, assuming the stress-strain diagram of the material is bi-linear i.e. initial modulus 200 $kN/mm^2$ and post-yield modulus is 25 $kN/mm^2$. The yield strength of the material is 280 $N/mm^2$. All members have cross sectional area of 100 $mm^2$. The applied force P is 44 kN. All members are of 1000 mm length except AB. (13) (CO1)
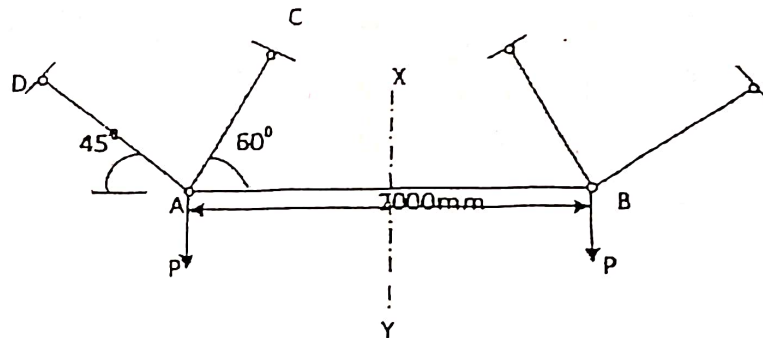


Fig. 1

2. Write down stiffness matrix in structural axis system for a space truss member. The member is having cross-sectional area and modulus of elasticity as 100 $mm^2$ and 200 $kN/mm^2$ respectively. The member is connecting joints X (4, 3, 2) and Y (7, 8, 9). (9) (CO2)

3. Find out equivalent joint load vector for a 4 m long member of grid frame, on which the load is acting from one side and the loaded area consists of triangular shape of values 0 at the ends and linearly increasing to 2m width at 2m from ends. Floor load may be taken as 40 kN/m². (9) (CO3)

4. Drive stiffness matrix for a curved member of 3.5 m radius, which subtends an angle of 45⁰ at the centre. Cross-section of the member is 0.3 m wide and 0.5 m deep. Elastic modulus of the material and Poisson's ratio are 25 kN/mm² and 0.25 respectively. The loading plane and structure plane are mutually perpendicular. (9) (CO4)

5. Write down the steps required for the non-linear elastic analysis of frames? (9) (CO5)

## II SEMESTER
## M.Tech. [Civil Engg.][Structural Engg.]

END SEM EXAMINATION                                    May 2024
STE 504 **FINITE ELEMENT METHOD OF STRUCTURAL ANALYSIS**
Time: **03 Hours**                            Max. Marks: **40**

Q 1: Attempt any four questions from the following:     **[2x4=8][CO1-5]**

a) Explain the use of the energy norm to minimize discretization error and establish criteria for achieving monotonic convergence.

b) Define Essential and Natural Boundary conditions

c) Develop the shape function for node 4 in barycentric coordinates $(L_1, L_2, L_3)$ for a 10 noded cubic triangular element as shown in figure Q1(c).



Figure Q1 (c)
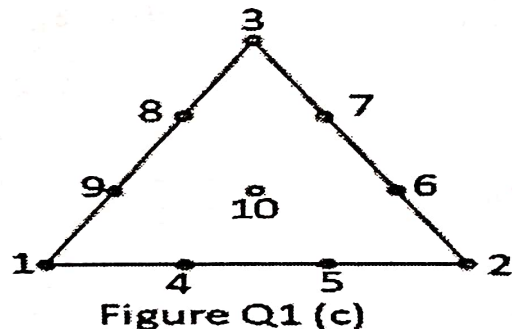
d) Explain geometric isotropy.

e) Explain compatibility and completeness criteria for the faster convergence.

f) Explain k-refinement.

Q2: Attempt any three of the following:                 **[4x3=12][CO2]**

a) For the cubic function $f(\xi) = \alpha_0 + \alpha_1\xi + \alpha_2\xi^2 + \alpha_3\xi^3$ over $\xi\in[-1,1]$, employ Gauss Quadrature to convert the integration into a

numerical integral. Determine the sampling points and their corresponding weight factors using condition equations.

b) For a three noded triangular element shown in figure Q2(b), show that the det J = 2A.
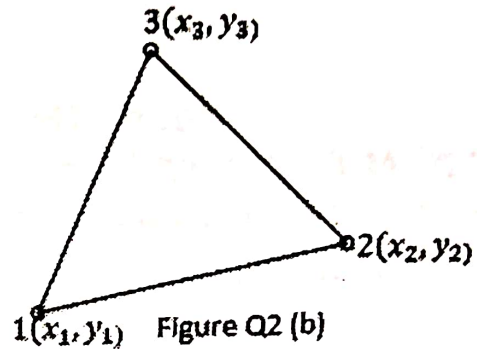


Figure Q2 (b)

c) Define the limits of integration for a quadratic triangular element and integrate the following relation.

$$\iint (4L_1 - 1)^2 \det J \, dL_2 dL_3$$

d) Figure Q2(d-1) shows the region bounded by the lines of constant $\xi$ and $\eta$ on the parent element. Utilize iso-parametric mapping to establish a one-to-one correspondence and determine the location of this region on the global element, as given in Figure Q2(d-2). Additionally, compute the equivalent area on the global element.



Parent Element
Figure Q2(d-1)

Global Element
Figure Q2 (d-2)
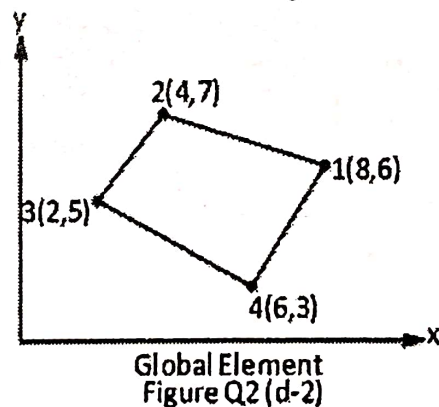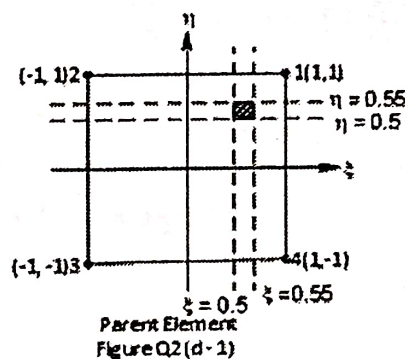
e) Take a suitable example and explain the variational formulation using Rayleigh Ritz method.

Q3. Attempt any two of the following:                    [5x2 =10][CO3-4]

a) Derive the stiffness matrix for a slender prismatic bar used as a 2-noded truss element utilizing the 2-noded parent line element of the

[2]

Lagrangian family. The element is oriented along the member axes coordinate system.

b) Figure Q3(b) depicts 4-noded rectangular elements I and II for plate bending problems based on Love-Kirchoff's plate theory, with one translational and two rotational degrees of freedom at each node. Define a displacement model based on generalized coordinates that meets compatibility and completeness requirements. Assess the suitability of the displacement model at the interface between the two elements.
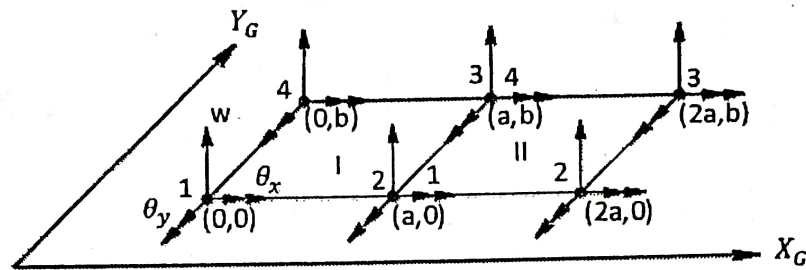
Figure Q3 (b)

c) Shape functions for a 2-noded beam element having one translational and one rotational degree of freedom at each node are as follows:

$$[N_1 \ N_2 \ N_3 \ N_4] = \left[\left(1 - 3\left(\tfrac{x}{L}\right)^2 + 2\left(\tfrac{x}{L}\right)^3\right)\left(x - 2\tfrac{x^2}{L} + \tfrac{x^3}{L^2}\right)\left(3\left(\tfrac{x}{L}\right)^2 - 2\left(\tfrac{x}{L}\right)^3\right)\left(-\tfrac{x^2}{L} + \tfrac{x^3}{L^2}\right)\right]$$

Define the B matrix and determine $k_{11}, k_{12}$ and $k_{22}$.

Q4. Attempt option (a) or the other two options(b) and (c) of the following:

**[10 or 5x2=10][CO5]**

a) Take t=1.0, E=1.0 and $v$ =0.25,to develop stiffness matrix for a plane strain 4-noded quadrilateral element as shown in figure Q4(a-2) and parent element Q4(a-1), attempt steps as follows:

I. Define Displacement field and strain displacement relationship.

II. Develop the relation for Jacobian.

III. Apply 2x2 Gauss Quadrature rule and evaluate $J, \det J, and \ J^{-1}$ at Gauss point 1.

[3]

IV. Develop B matrix for application at GP-1 and write steps to get [k] matrix for the element.
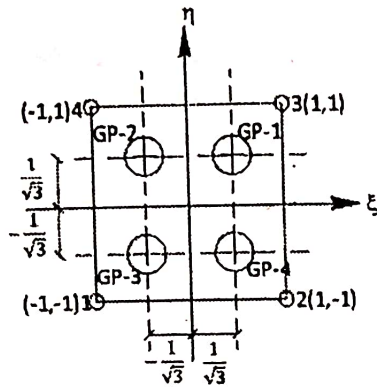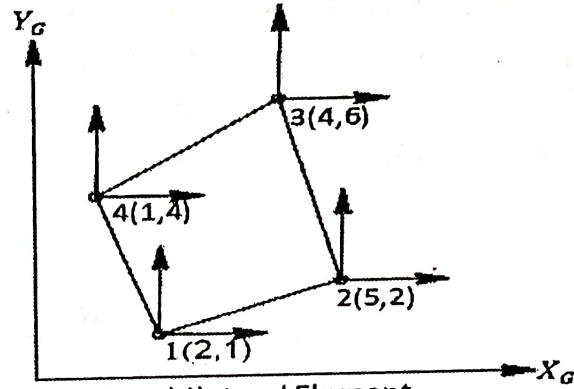
**Iso-parametric Parent Element**



Figure Q4 (a-1)



Quadrilateral Element
Figure Q4 (a-2)

b) Define the state variable for an axisymmetric structure problem, derive the relation for the strain vector, state stress vector, and provide the constitutive relationship, adopting cylindrical polar coordinates.

c) Calculate the load vector using the 3-point Gauss Quadrature rule for a quadratic 2D rectangular element of the serendipity family with thickness $t$ and dimensions as shown in Figure Q4(c). The applied load is $p_x$ per unit area on edge 1-2-3.
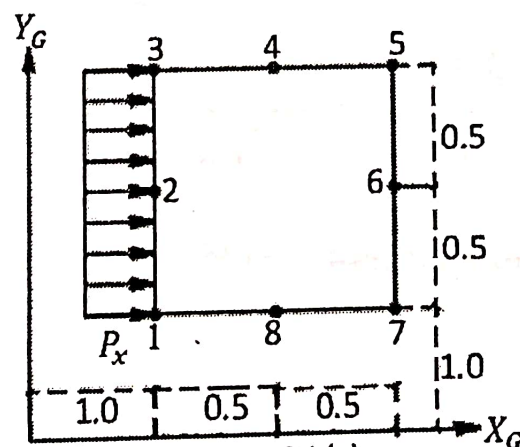


Figure Q4 (c)

[4]

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END TERM EXAMINATION          May 2024
M.Tech. (Structures) II Sem.
COURSE CODE: STE5202
COURSE TITLE: Durability of concrete structures
TIME: 3 Hours                 Max. Marks: 40

> Note: Attempt **any five** questions. All questions carry equal marks.

1   Describe how Portland cement is manufactured. Provide a sketch of various stages of manufacturing with a detailed discussion of various compounds of cement.          M8/CO1

2   Discuss various procedures or ways to improve durability of concrete structures. Describe some guidelines which have been prescribed by recent IS: 456-2000 with regard to durability of RCC structures.                      M8/CO2

3   Discuss why segregation of concrete is important to be avoided. Discuss in detail how the concrete can be made a cohesive mass, so that it does not occur. Discuss code guidelines also in this regard.
                                         M8/CO3

4   Discuss various factors which affect the quality of concrete in detail. Write a detailed note on how quality of concrete affects various features, which are important for durability of concrete.

5   Write short notes on **any two** of the following topics.     M8/CO4
    (a) Mix design of concrete
    (b) Specific gravity of cement
    (c) Use of admixtures in concrete.        M8/CO5

6   Discuss various methods of curing of concrete. Discuss their relative advantages and disadvantages in detail.        M8/CO6

II$^{nd}$ - SEMESTER
M.Tech. (Structural Engg.)
END SEMESTER EXAMINATION                    (May - 2024)
Course Code: STE5408      Course Title: Earthquake Resistant Design
of Structures
Time: 3:00 Hours                            Maximum Marks: 40

Note:   Answer **ALL** questions.
        Assume suitable missing data, if any.
        Use of IS1893 (Part 1):2016, IS13920:2016 and IS456:2000 are
        permitted.

Q.1  Answer **ALL** parts of the following:
   (a) What is an Earthquake and how does it measure?              [2][CO-1]
   (b) Write any four considerations for a building to make it with the maximum
       chance of survival.                                         [2][CO-1]
   (c) What are the properties of building required to make the adequate use of the
       Equivalent Lateral Force procedure?                         [2][CO-1]
   (d) What are the causes of joint failures in reinforced concrete buildings?
                                                                   [2][CO-1]

Q.2  Answer any **TWO** parts of the following:
   (a) In what way is the earthquake resistance of a structure affected by (i) non
       symmetry and (ii) elongated shape of buildings.             [4][CO-2]
   (b) Discuss how to increase period of vibration, energy dissipation capacity and
       ductility for a building in an earthquake prone area.       [4][CO-2]
   (c) What are the possible damages to RCC buildings in the earthquake prone
       region?                                                     [4][CO-2]

Q.3  Answer any **TWO** parts of the following:
   (a) What are the basic failure of slender and squat shear wall?  [4][CO-3]
   (b) Describe the any eight factors influencing the structural performance of shear
       walls.                                                      [4][CO-3]
   (c) Describe the behaviour of cantilever shear wall with the help of neat diagrams.
                                                                   [4][CO-3]

Q.4  Answer any **TWO** parts of the following:
   (a) How does Seismic Base Isolation develop? Describe the two approaches on
       which it is based.                                          [4][CO-4]
   (b) Discuss the different stages of Performance Based Seismic Design.
                                                                   [4][CO-4]
   (c) What are the steps carried out in the Pushover Analysis?     [4][CO-4]

**Q.5** Determine the moment of resistance of a rectangular cantilever shear wall for a 12 storey building with the following data:

Storey shear forces at different levels are given below:

| Storey No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Storey Shear (kN) | 5 | 10 | 30 | 80 | 140 | 200 | 360 | 500 | 700 | 850 | 950 | 900 |

Storey height = 3.2 m
Length of shear wall = 7.5 m
Seismic weight of building = $60 \times 10^3$ kN
Axial load on Shear wall = $3 \times 10^3$ kN,
Building is situated in Mumbai
Use M25 grade concrete and Fe415 steel

[8][CO-5]

OR

Plan of a single storey building having two shear walls in each direction is shown in Fig.1. It has some gravity columns that are not shown. All four walls are in M25 grade of concrete, 200 mm thick and 4 m long. Storey height is 4.5 m. Floor consists of cast in-situ reinforced concrete. Design shear force on the building is 100 kN in either direction. Determine design lateral forces on different shear walls using the torsion provisions of code IS1893 (part I): 2016.
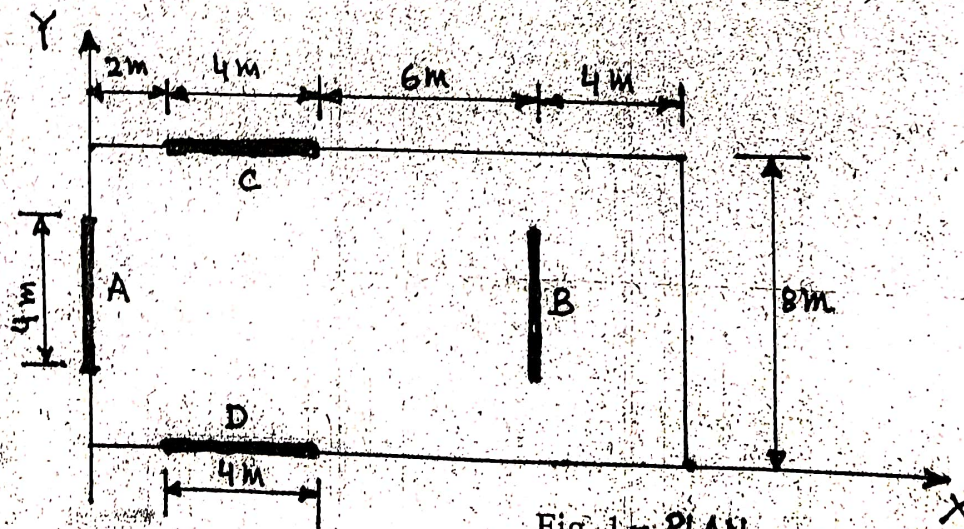
[8][CO-5]



Fig. 1 – PLAN

)2)

# END SEMESTER EXAMINATION

May-2024

**Course Code: SM 901**  **Course Title: Research Methodology and IPR**
**Time: 3:00 Hours**  **Max Marks: 50**

**Note:** There is a total of seven questions. Read all questions carefully.
Attempt **any 3 Questions from Section A** and **any 2 from Section B**
Assume suitable data, if any. Answer as precisely as possible.

## SECTION A

Q.1. How are measurement and scales related? Explain four types of scales of measurement with a single example having all of them.  [M-10] [CO-3]

Q.2. What do you mean by referencing style, in-text citation and bibliography? How can you apply software to assist in managing referencing style(s) in automated/semi-automated way?  [M-10] [CO-4]

Q.3. Identify a research topic of your choice. What type of data collection technique among survey, in-depth interview and observation will you apply with respect to this topic? Provide justification for the same.  [M-10] [CO-1, 2]

Q.4. What is Intellectual Property Right (IPR)? What type of IPR is applicable on your research? Justify.  [M-10] [CO-5]

## SECTION B

Q.5. [a] Suppose the following Table show frequency counts of types of transportation used by the publishing and the computer hardware industries. Apply Chi-square test of independence to determine whether type of industry is independent of transportation mode. Assume $\alpha = 0.5$. Given: tabulated values of Chi Square with 2 degrees of freedom = 5.991 and with 6 degrees of freedom= 12.592.

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## Industry X Transportation Table

|  | Air | Train | Truck |
|---|---|---|---|
| Publishing | 32 | 12 | 41 |
| Computer H/W | 5 | 6 | 24 |

[M-7] [CO-3]

[b] 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 $P(0<Z<1) = 0.3413$.

[M-3] [CO-3]

Q.6. Three groups of three guinea pigs each were injected, respectively, with 0.5 mg, 1.0 mg and 1.5 mg of a new tranquilizer, and the following are the number of minutes it took them to fall asleep:

| 0.5mg | 1.0mg | 1.5mg |
|---|---|---|
| 11 | 9 | 5 |
| 13 | 11 | 0 |
| 9 | 10 | 3 |

Use one way ANOVA to Test at the 5% level of significance whether the null hypothesis that the differences in the dosage have no effect on sleep can be rejected. Assume the populations are normal.

[Given F (2,6,.05) = 5.1433; F (6,2,.05) = 19.3295]

[M-10] [CO-3]

Q.7. Write short notes on **any two** the following: 5X2 =10 Marks [CO1]
[a] Type I and Type II errors in the context of Hypothesis Testing
[b] Significance of sampling and illustration of any probability based sampling method
[c] Point and Interval Estimation methods
[d] Central Limit Theorem with an illustrative example

II SEMESTER    Ph.D

# END TERM EXAMINATION                    May-2024

## COURSE CODE: SM 903  COURSE TITLE: Research and Publication Ethics

Time: 03:00 Hours                          Max. Marks: 50

> Note : All questions carry equal marks.
>         Make diagrams if required.

1. Differentiate between Basic and Applied Research.        [10][CO1]
2. Discuss Positivism. With the help of a Venn Diagram show truth and beliefs lead to knowledge creation.        [10][CO2]
3. Derive the difference between Consequentialism and Non-Consequentialism Theories of Moral Reasoning.        [10][CO3]
4. Explain Principles of Research Integrity. Show the steps in the research process and the moral dilemmas.        [10][CO4]
5. Write short notes on *any two*:
   (A)  Epistomology.
   (B)  Phenomenology.
   (C)  Citation Index.
   (D)  Scientific Misconduct [5,5][CO 1-4]

**SECOND SEMESTER**                                   **M.Tech (ECE)**

**END TERM EXAMINATION**                              **MAY-2024**

## VLS502: EMBEDDED SYSTEM DESIGN

**Time: 3 Hours**                                     **Max. Marks: 40**

| | |
|---|---|
| **Note:** | • Question 1 and 2 are *compulsory*. Attempt any *Four* from Q3 to Q7. |
| | • Marks are indicated against each question. |
| | • Assume suitable missing data, if any. |

Q1. a) Which architecture in digital signal processor reduces the execution time?     (1) [CO1-CO6]

a)Harvard b)CISC c)program storage d) von Neumann

(b)  What is the length of the PIC18 program counter? (1)
How many different program memory
locations can be addressed by the PIC18 MCU?

(c)  Write an instruction to perform: Subtract the file (1)
register at 0x30 and borrow from the WREG
register.

(d)  SPI follows a _____ communication protocol.     (1)
(a) Duplex (b) Full-duplex (c) one-way (d)Two-
way

(e)  What is the meaning of these ARM condition     (1)
codes? **a.** EQ and **b.** NE

(f)  Following is the instruction syntax format for     [1]
which of the operations.

```
 13              8  7  6                    0
┌──────────────┬────┬──────────────────┐
│   OPCODE     │ d  │   f (FILE #)      │
└──────────────┴────┴──────────────────┘
```
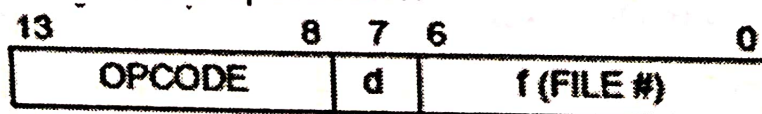
d = 0 for destination W
d = 1 for destination f
f = 7-bit file register address

a. Byte-oriented file register operations
b. Bit-oriented file register operations
c. Literal operations
d. Control operations

Q2. a) What is the significance of watchdog timer in (2) [CO1-CO6] Embedded System?

(b) What are the typical features of Digital Signal (2) Processors?

c) Explain the terms: (i) Barrel Shifter, and (ii) Circular (2) buffer

d) What is the difference between microcontroller and (2) SoC?

e) What is a bridge in context of buses? Explain its (2) role.

Q3. a) PRE Condition: (3) [CO2]
r0 = 0x00000000
r1 = 0x00090000
mem32[0x00009000] = 0x01010101
mem32[0x00009004] = 0x02020202

For given data, give updated value of r0 and r1 registers after executing
  (a)    LDR r0, [r1, #4]!
  (b)    LDR r0, [r1, #4]
  (c)    LDR r0, [r1], #4

b) What are load-store instructions used for in ARM (3) controller. Explain different types of load-store instructions with example of each.

Q4. a) Write a program to create a square wave of 50% duty (2) [CO1,3] cycle on bit 0 of Port C in PIC microcontroller.

b) Draw the architecture and explain the role of various (4) CPU functional units of 55x architecture of DSP processor.

Q5.(a) Draw a neat schematic to illustrate simple memory (3)[CO4] interface of 4 SRAMs and 4 ROMs with ARM processor.

b) Give the steps to read a super-cell (3,2) from 16x8 (3) DRAM chip.

Q6. (a) How do you ensure real-time constraints are met in (2) [CO5] DSP applications?

(b) Explain different classes of platform in SoC with their (4) characteristic features.

Q7. (a) Define Bus. Expand the terms PCI, I2C, SPI and (3) [CO6] AMBA in context of buses.

(b) What is meant by bus arbitration? What are the various (3) schemes of bus arbitration. Explain any one in detail.

Roll No._____

No. of pages 03

M.Tech

2nd SEMESTER

END TERM EXAMINATION

May-2024

COURSE CODE VLS504  COURSE TITLE Low Power VLSI Design

Max. Marks: 40

Time: 3:00 Hours

Note : Q. No. 1 is questions are COMPULSORY. Attempt any FOUR
question from remaining five,
All questions carry equal marks,
Assume suitable missing data, if any.

Q.1(a) A 180 nm standard cell process can have an average switching capacitance of 150 pF/mm2. You are synthesizing a chip composed of random logic with 0.2 as the average switching activity factor, where switching activity refers to the number of transitions per cycle. Estimate the power consumption of your chip if it has an area of 70 mm2 and runs at 450 MHz at VDD = 0.9 V.　　　　**[2] [CO1]**

(b) Considering static signal probabilities of the inputs A, B, C as $P_A = 0.5$ $P_B = 0.2$ and $P_C = 0$, compute the static probability of signal F for circuit of Fig. 1. Comment on the results.　　　**[2] [CO2]**
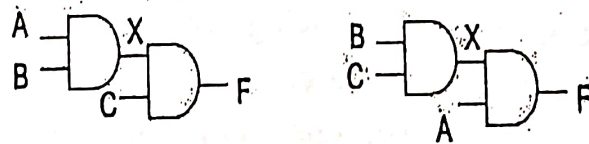


Fig. 1

(c) From experience, the standard deviation of the power samples measured from a circuit has been observed to have ±20% fluctuation from the mean. How many samples are required so that we are 99% confidence that the error of sample mean is within ±5%?  **[2] [CO2]**

(d) Which low power figure of merit is used for microprocessors?
　　　　**[2][CO1]**

**Q.2(a)** Optimize the circuit in Fig. 2 to obtain the least delay along the path from A to B when the electrical effort of the path is 4.5. **[4][CO3]**

**(b)** Discuss switching activity reduction techniques. Which one out of these will you prefer for N bit comparator? Explain your choice with neat schematic. **[4][CO4]**
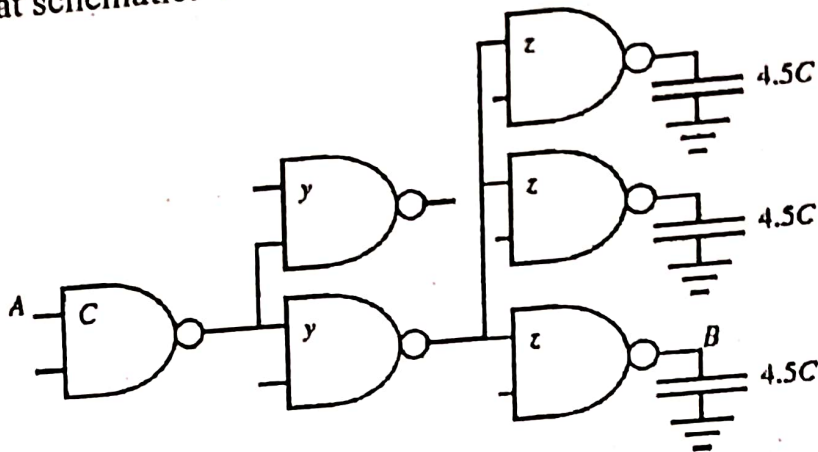


Fig. 2

**Q.3 (a)** Consider a dual-rail adiabatic logic gate realizing outputs AB+C and (AB+C)'. Assume that the load capacitance at each output of this gate is 200fF, $V_{c,max}$ = 2V, the effective ON resistance of each conducting transmission gate is 5kΩ, and the rising/falling transition time for the clocked power line is 100ns. (i) Show the schematic circuit diagram of this adiabatic gate. (ii) Calculate the energy consumption for the following scenario. When the clocked power line is low, the input changes from A=1 and B=C=0 to A=B=C=1; As the clocked power line ramps up, the output changes. Only account for energy dissipation due to transition at the output nodes and ignore all internal capacitances.**[Hint: You must first determine if one or both outputs change in order to do the correct calculation.]** **[4][CO4]**

**(b)** Describe zero and double clicking in clocked networks? Discuss set up and hold time constraints. **[4][CO4]**

Q.4 (a) Design the circuit for driver and receiver for low swing bus.

[4][CO4]

(b) What are different design options to reduce power consumption in SRAM? Describe any one methodology in detail in context of 6T SRAM cell. [4][CO4]

Q. 5 (a) Design 16-bit carry skip adder. Compute worst case delays of both adders and their suitability for high-speed operation. [4][CO5]

(b) Suggest changes in the array multiplier architecture to reduce worst case delay path. What would be the multiplier delay for suggested architecture? [4][CO5]

Q. 6 (a) Analyze the circuit given in Fig. 3 and identify its functionality. How is the circuit used for designing asynchronous circuit.

[4][CO6]

(b) A sequential system is given in Fig. 4. Compute minimum time period of the clock if $t_{setup} = 2ns$, $t_{hold} = 1ns$ $t_{comb} = 5ns$ and $t_{ctoq} = 10ns$. What will be the effect of positive clock skew ($t_{clk2} - t_{clk1} = 2ns$) negative clock skew ($t_{clk1} - t_{clk2} = 2ns$) on time period of the clock? [4][CO6]
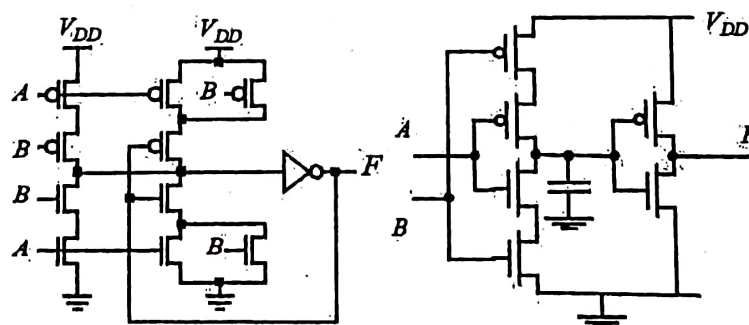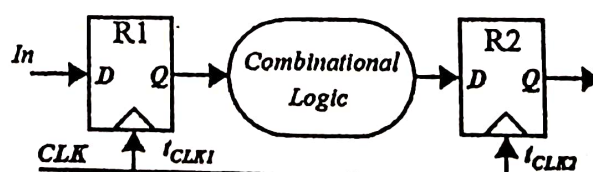


Fig. 3



Fig. 4

M. Tech. II Sem.

END TERM EXAMINATION          *May 2024*
COURSE: VLS 5202 ' CMOS Nano Neuromorphic
Circuits

*Time: 3 Hours*          *Max. Marks: 50*

Note: · All questions are compulsory. Assume missing data.

1. (a) How does the STDP learning rule work? Describe with expression and plot. Does STDP implement supervised or unsupervised learning?          [5][CO-1]

   (b) A pre-synaptic neuron fires at [0, 2, 4, 14, 15] ms. The post-synaptic neuron fires at [1, 5, 18, 20] ms. The synapse follows the STDP curve given in Fig. 1 and there is no other rule (than STDP) to update the weight, $w$, of the synapse. Plot the evolution of weight $w$ vs time for this synapse. Assume $w(t < 0) = 20$ units.          [5][CO-1,5]
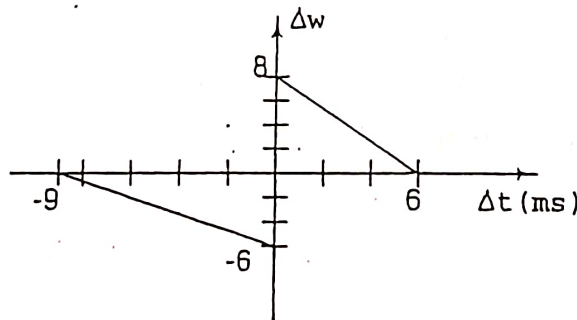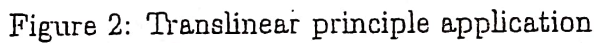


Figure 1: Simplified STDP curve for a synapse

2. Describe a simple circuit to implement STDP learning rule.

          [10][CO-5]

3. Consider the log-domain circuit given in Fig. 2. All MOSFETs are saturated and operate in sub-threshold regime.

(a) Identify a loop and apply translinear principle and derive the expression for $I_{syn}$. [5][CO-2]

(b) Based on the relationship of $I_{syn}$ with $I_o$, and $I_w$, analyse the working of this circuit. What does the circuit do? [5][CO-4]



Figure 2: Translinear principle application

4. Compare the axon-hillock circuit (Carver Mead neuron, 1989) and the voltage amplifier I&F neuron (van Schaik, 2001) in terms of working, flexibily in control of the neural dynamics (pulse width, frequency, firing threshold, refractory period etc.), complexity (number of components), area and energy consumption per spike. [10][CO-3]

5. Give the schematic and working of a switched-capacitor conductance based synapse. What decides the number of levels or values of weight that the synapse can take? [10][CO-4]

II-SEMESTER    134

**M.Tech. [VLSI]**

# END TERM EXAMINATION                    *May-2024*

## VLS-5406    CAD for VLSI Systems

*Time: 3:00 Hours*                                    Max. Marks:   40

Note : Attempt any four questions

Q1. (a) Explain partitioning and its need in terms of VLSI. Illustrate different classification of partioning algorithms and reasons for the same.        [5] [CO2]

(b) What are physical implications of design style in VLSI. Explain any four in detail.                                        [5] [CO1]

Q2. (a) What is floorplanning. Explain it with example. Differentiate between floorplanning and placement.                              [5] [CO2]

(b) What is a rectangular floorplan. What are the issues associated with the same and how are they rectified.                          [5] [CO2]

Q3. (a) What is Pin-Assignment. Explain the different techniques associated with the same.                                      [5] [CO3]

(b) What is placement. Illustrate with figures placement at different levels.                                            [5] [CO3]

Q4. (a)   What is Routing. Explain it need with example. Differentiate between Global Routing and detailed Routing.                        [5] [CO4]

(b) What is meant by MCM Technologies. Explain the design cycle for MCM Physical Design Cycle.                                [5] [CO4]

Q5. (a) Illustrate and elucidate the On-Chip clock generation and distribution in VLSI circuits.                                      [5] [CO5]

(b)   Explain   Latch-Up   and   its   different   prevention   techniques.                                          [5] [CO5]

2nd (Second) SEMESTER

## M.Tech.

# END TERM EXAMINATION
# May-2024

### VLS6401 : Mixed Signal Design

Time: 03:00 Hours

Max. Marks: 40

### Q.1

(a) Design a switched capacitor first-order circuit that has a low frequency gain of +10 and a -3 dB frequency of 1 kHz. Give the value of the capacitor ratios $\alpha 1$ and $\alpha 2$. Use a clock frequency of 100 kHz. [4][CO1]

(b) Design a switched capacitor summing amplifier that gives the output voltage during the $\phi_2$ phase period that is equal to $10v1 - 5v2$, where v1 and v2 are held constant during a $\phi_2 - \phi_1$ period and then resampled for the next period. [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]
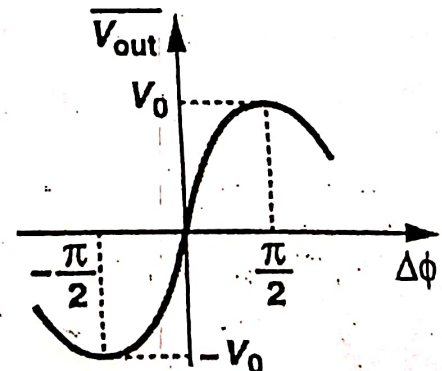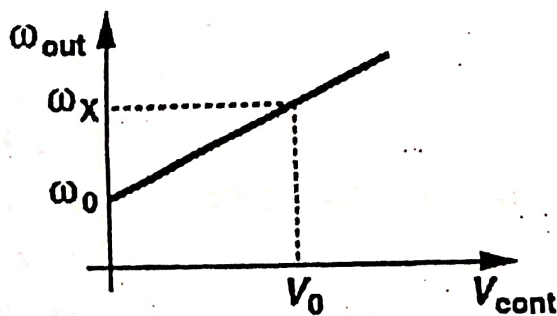


Fig. 1

(b) A cellular telephone incorporates a 900 MHz phase locked loop to generate the carrier frequencies. If $\omega_{LPF} = 2\pi \times (20\ kHz)$ 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 ?

[4][CO2]

Q.3

(a) Explain whether a master-slave D flip flop can operate as a phase detector or a frequency detector. Assume the flip flop provides differential outputs. [4][CO2]

(b) What is a basic charge-pump PLL? Explain your answer with suitable diagrams and equations. [4][CO3]

Q.4

(a) Consider a 12-bit DAC that uses charge scaling for the MSBs and voltage scaling for the LSBs. To minimize the capacitor element spread and the number of resistors, choose M = 5 and K = 7, where MSB sub-DAC has M bits and LSB sub-DAC has K bits with total DAC resolution of M+K bits. Find the tolerances necessary for the resistors and capacitors to give an INL and a DNL equal to or less than 2LSBs and 1LSB, respectively. [4][CO3]

(b) Explain the operation of serial charge-redistribution DAC with suitable diagrams. [4][CO3]

Q.5

(a) What is pipeline analog to digital converter (ADC)? Explain 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, find the digital output word and the analog equivalent voltage. [4][CO4]

## Q6.

(a) Two comparators are shown for an N-bit flash ADC in fig. 2. Comparators 1 and 2 have an offset voltage indicated as $V_{OS1}$ and $V_{OS2}$, respectively. A portion of the ideal transfer function of the converter is also shown in fig. 2. When do the comparator offsets cause a missing code? Express this condition in terms of $V_{OS1}$, $V_{OS2}$, N and $V_{REF}$.  [4][CO4]
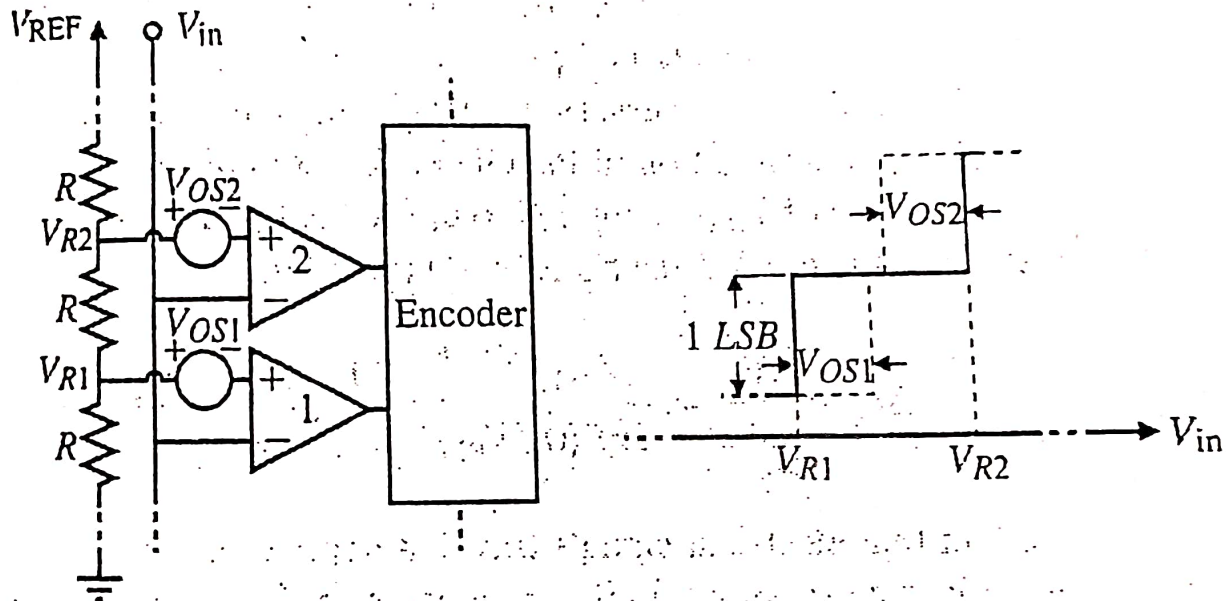


Fig. 2

(b) In continuation of the above question 6(a), assume all offsets are identical, express the magnitude of INL and DNL in terms of $V_{OS1}$ (=$V_{OS2}$), N and $V_{REF}$.

[4][CO4]