# QUESTION PAPERS FOR END TERM THEORY EXAMINATIONS

## May-2023


## M.Tech., MTPT, M.Sc., MBA, EMBA, M.Des.,

## 2nd, 4th & 6th SEMESTER

# INDEX

## M.TECH



## DESIGN



## M.Sc.



## MBA



## EMBA

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2nd SEMESTER

**M.Tech. ( VLS )**

**END TERM EXAMINATION** *May-2023*

**VLS502: EMBEDDED SYSTEM DESIGN**

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

**Note :** Assume suitable missing data, if any.

Q.1

a. Interpret the instruction ADD r0,r1,r1 LSL#1 [1][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][CO2]

c. Determine the status of C, DC and Z flags after the execution of the following instructions in PIC based systems

MOVLW 38H

ADDLW 2FH [1][CO2]

d. What is the effect on code density in ARM processor in T-mode of operation? Justify your answer [1][CO2]

Q.2

a. Draw, label and explain thumb architecture in ARM. [3.5][CO3]

b. Differentiate among various timers used in ARM processor. [3.5][CO2]

1-A

Q.3

a. Examine the various addressing modes of DSP Processor with examples. [3.5][CO4]

b. What is a Very long Instruction Word (VLIW) Processor? Draw its simple architecture. Compare it with clustered VLIW [3.5][CO4]

Q.4

a. Outline the concept of pipelining in PIC and ARM microcontrollers. [1.5][CO1]

b. Write an assembly language program to count odd numbers from a set of ten 8-bit numbers stored at successive memory locations starting from 0x30 H. [2.5][CO2]

Or

Write an assembly language program to find the maximum and minimum value among the list of ten 8-bit numbers. [2.5][CO2]

c. Differentiate between various timers used in PIC [2][CO3]

d. Draw the status register of the PIC microcontroller. [1][CO3]

Q5.

a. What are the various features of SOC and illustrate key approach for SOC design. Also explain the reconfigurable computing [3.5][CO3]

b. Draw a neat sketch for TI-OMAP and explain various components of it. [3.5][CO3]

Q.6

a. Explain the basic structure of SRAM Cell and illustrate the read operation with timing parameters [4][CO5]

b. What do you mean by paging? How are page faults serviced? How can we assign permissions for pages?. [3][CO5]

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2nd SEMESTER M.Tech

END TERM EXAMINATION May-2023

COURSE CODE VLS504 COURSE TITLE Low Power VLSI Design

Time: 3:00 Hours Max. Marks: 40

**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 64 bit off-chip bus operating at 1V and 1GHz is driving a capacitance of 25pF/bit. What is the power dissipation in operating the bus if half of the bus bits are having toggling rate of 0.25 and remaining bits are toggling at 0.5? **[2] [CO1]**

(b) Given discrete random signal, what will be maximum expected frequency? **[2] [CO2]**

(c) Devise power model for Cache memory based on component operation. **[2] [CO2]**

(d) Which low power figure of merit is used for batteries? **[2][CO4]**

Q.2(a) Consider the logic network of Fig. 1, which may represent the critical path of a more complex logic block. The output of the network is loaded with a capacitance which is 5 times larger than the input capacitance of the first gate. Compute logical and electrical effort of the circuit and also the values of a, b and c. **[4][CO3]**

(b) Considering phase delay ($d_p$) and skew constraint ($t_s^b$), determine the size of each buffer in clock tree T to minimize total power, $P_{tot}$. **[4][CO4]**

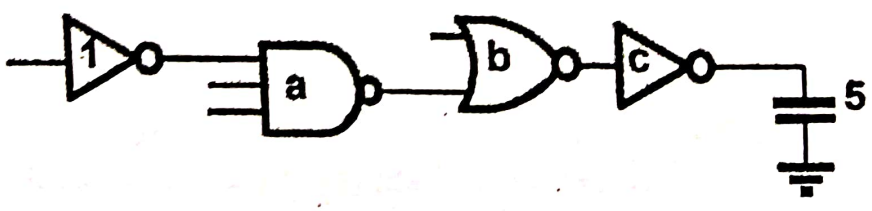


Fig. 1

Q.3 (a) Design an adiabatic 2-input AND/NAND gate. Calculate the energy consumption for the following scenario. When the clocked power line is low, the input changes from A=1 and B =0 to A=B =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. (Load capacitance at each output is 200fF, Vc,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.) **[4][CO4]**

(b) A designer has to keep the number of distinct gates in a cell library minimum so as to make selection faster in case of automated design. Analyze the number of distinct two input gates that you would prefer to keep in cell library. Clearly state the underlying principle.

**[4][CO4]**

Q.4 (a) Design the circuit for driver for charge recycling bus whose architecture is depicted in Fig. 2. Assuming 2n capacitors in charge recycling bus, comment on its power efficiency in comparison to conventional bus. **[4][CO4]**

(b) Explain the methodology to compute precomputation function. Design a precomputation architecture of n nit comparator. **[4][CO4]**

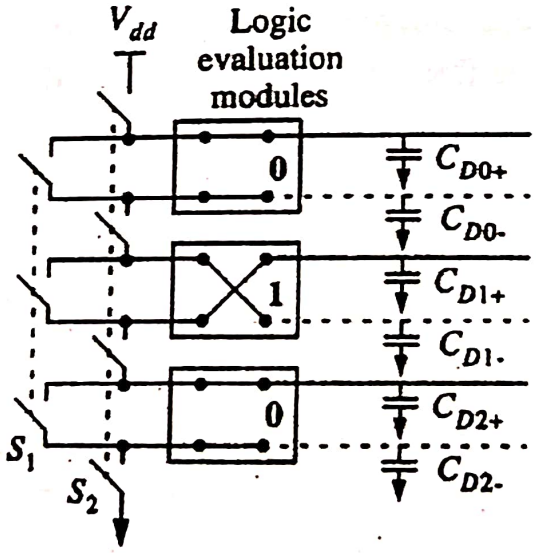


Fig. 2

Q. 5 (a) Design 16-bit linear carry select and square root carry select adders. Compute worst case delays of both adders and their suitability for high speed operation. [4][CO5]

(b) Explain the methodology adopted to reduce the critical path and number of adder cells in tree multipliers. [4][CO5]

Q. 6 (a) A self-timed architecture of 4-phase handshake protocol using Muller C-element is given in Fig. 3. Analyze the architecture and determine the necessary conditions on the Ack and Req signals. Examine the operation by plotting the timing behaviour of all signals of interest. [4][CO6]

(b) Differentiate Analyze the circuit of Fig. 4 and comment on its functionality. Also comment on its possible usage. [4][CO6]

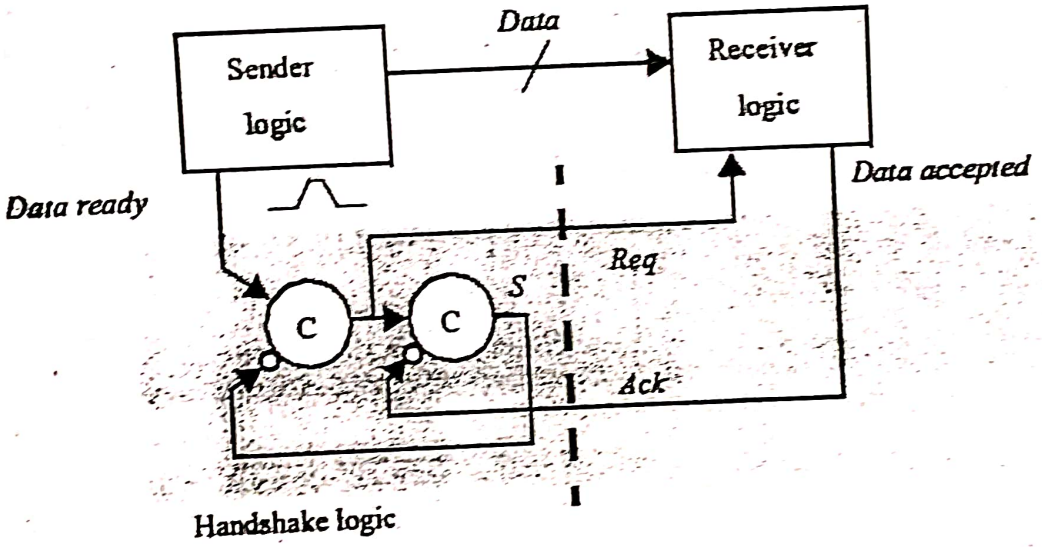


Fig.3

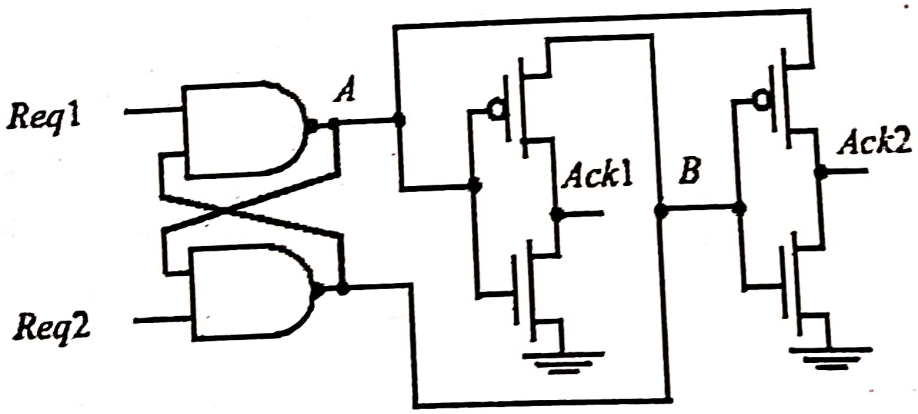


Fig.4

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# SECOND SEMESTER
## M. Tech. (VLSI)

**END TERM EXAMINATION** *May-2023*

**COURSE CODE: VLS 5208 Layout Design and Skills from Analog Perspective**

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

**Note:** · Attempt ***any five*** questions.
· Clearly specify any assumptions you make.

1. (a) Draw the layout of the source follower stage shown in Fig. 1a where the body effect of M1 has been removed by shorting source to the body terminal. Label each region clearly. **[5][CO2]**

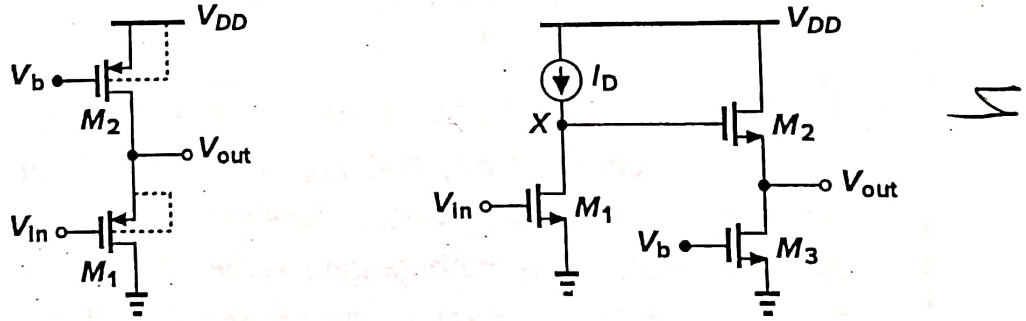


Figure 1

(b) Identify each stage in the amplifier shown in Fig. 1b. Derive the voltage gain of each stage and the overall voltage gain. Ignore the channel length modulation and body effect of M2. **[5][CO3]**

2. (a) Why is the second stage needed in Fig. 1b? What is the purpose of M3? **[2][CO3]**

   (b) In Fig. 1b, if $A_{v2}$ is the voltage gain of the second stage alone, design the second stage (i.e. find $(W/L)_2$, $(W/L)_3$, and $V_b$) for $A_{v2} \geq 0.99$ and $R_{out} \leq 10\ \Omega$. You may ignore channel length modulation (CLM) for bias current and $g_m$ calculations. Ignore the body effect and CLM of M2 for gain calculation. There is no constraint on power consumption but $V_{out,min} = 0.2$ V. Take $L_{min} = 1\ \mu m$, $\mu_n C_{ox} = 100\ \mu A/V^2$, $V_{Tn} = 0.7$ V, $\lambda_n = 0.1\ V^{-1}$ (for $L = 1\ \mu m$), $V_{DD} = 3$ V. Knowledge of gate voltage of M2 is not needed for this design. Find the power consumed by the second stage you designed. **[8][CO3]**

3. (a) For the circuit of Fig. 2a, calculate the small-signal voltage gain if $(W/L)_1 = 50\mu m/0.5\mu m$, $(W/L)_2 = 10\mu m/0.5\mu m$, and $I_{D1} = I_{D2} = 0.5\ mA$. $\mu_n C_{ox} = 100\ \mu A/V^2$, $\mu_p C_{ox} = 50\ \mu A/V^2$. **[5][CO3]**

   (b) In the circuit of Fig. 2b, assume that $(W/L)_1 = 50\mu m/0.5\mu m$, $(W/L)_2 = 50\mu m/2\mu m$, and $I_{D1} = I_{D2} = 0.5\ mA$ when both devices are in saturation. Recall that $\lambda \propto 1/L$. Calculate the small signal voltage gain value. Also calculate the maximum output voltage swing while both MOSFETs are saturated. $\mu_n C_{ox} = 100\ \mu A/V^2$, $\mu_p C_{ox} = 50\ \mu A/V^2$. Also, $\lambda_n = 0.1V^{-1}$ and $\lambda_p = 0.2V^{-1}$ for $L = L_{min} = 0.5\ \mu m$. **[5][CO3]**

4. (a) We want to increase the intrinsic gain of a device (Fig. 3(a)). We can do it by increasing $L$ by a factor of 4 (Fig. 3(b)).

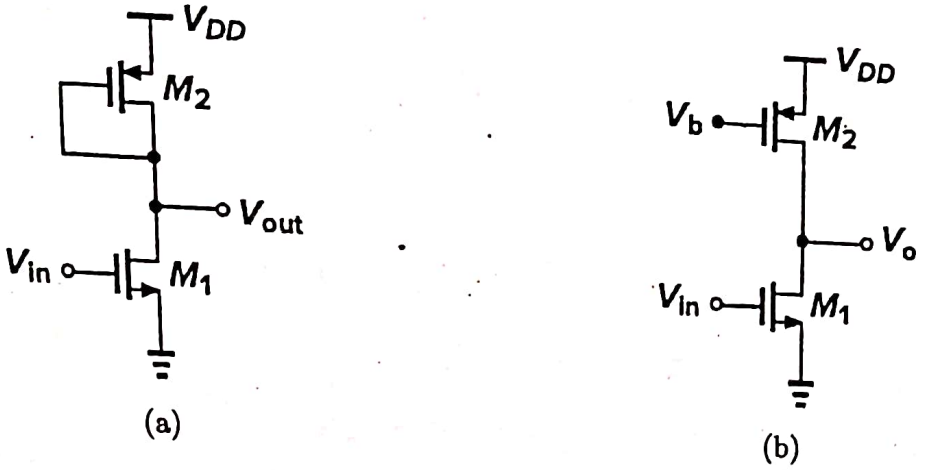


Figure 2

Alternatively, we can cascode it as shown in Fig. 3(c). Note that the bias current is to be kept same ($I_D$) in both cases. Also note that M2 and M1 in the second method (c) have same sizes. Compare the minimum output voltage in the two cases ((b) and (c)) so that the devices shown are saturated. Now compare the intrinsic gains (i.e. gain when the load is an ideal current source) of both methods. Overall, which is better? [5][CO3]

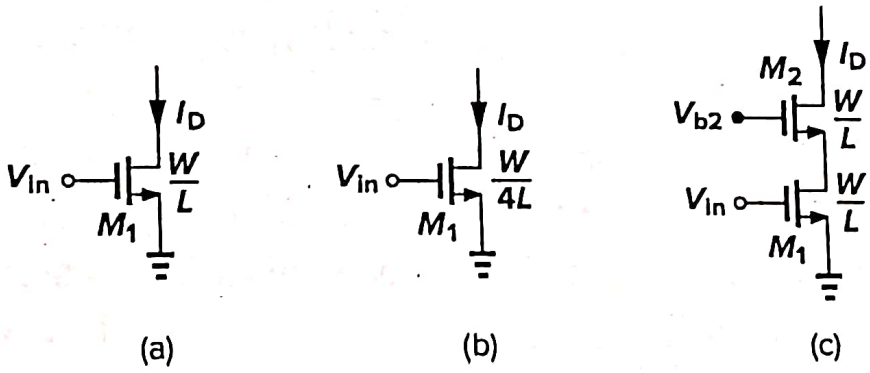


Figure 3

(b) Why do we need very high voltage gain for an op-amp? Or, what will go wrong if an op-amp does not have a very high voltage gain? [2][CO4]

(c) What are the main trade-offs if we try to increase the output

voltage swing of any amplifier. [3][CO3]

5. (a) Using the expressions for $r_o$ and $g_m$ and assuming $L$ to be constant, plot $g_m r_o$ of a saturated NMOS device versus $V_{GS}$ if (i) $I_D$ is constant, (ii) W is constant. [4][CO1,3]

   (b) Why is $g_m/I_D$ design methodology needed? Describe how it is used to design analog circuits. [6][CO1]

6. (a) Draw the schematic of a 9 transistor, differential input, differential output cascode op-amp stage. Find its output swing in terms of the overdrive voltages. Also find the Input Common Mode Range ($V_{in,CM:max} - V_{in,CM:min}$). [6][CO3]

   (b) Using the expressions for $r_o$ and $g_m$ and assuming $L$ to be constant, plot $g_m r_o$ of a saturated NMOS device versus $W/L$ if (i) $I_D$ is constant, (ii) $V_{GS}$ is constant. [4][CO1,3]

7. Draw the schematic of a high gain, high output voltage swing (use multiple stages) op-amp with single ended output that can drive a small load resistance without loosing gain. Also show the bias circuits to generate all bias voltages and currents (you may draw the bias circuits separately if page width is not sufficient, but use proper labels). [10][CO4]

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2nd SEMESTER **M.Tech. (VLSI Design & Embedded Systems)**

END TERM EXAMINATION *May-2023*

COURSE CODE: VLS5408 COURSE TITLE: CMOS RF Circuit Design

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

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

Q.1 Discuss gain compression and 1 dB compression point graphically and mathematically. [10][CO1]

Q.2Explain desensitization and blocking theoretically and mathematically. [10][CO2]

Q.3 Discuss cross modulation theoretically and mathematically. [10][CO3]

Q.4 What is intermodulation? Explain the two measures of intermodulation graphically and mathematically. [10][CO4]

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II-SEMESTER

**M.Tech.**

**END TERM EXAMINATION** *May-2023*

**COURSE CODE-VLS6301** **COURSE TITLE-SPEECH PROCESSING**

*Time: 03:00 Hours* *Max. Marks: 50*

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

Q.1 Define speech production mechanism with neat sketch diagram of different organs. [6][CO1]

Q.2 Explain speech signal processing applications in detail. [6][CO2]

Q.3 Formulate steps of Continuous Wavelet Transform (CWT) and define admissibility condition for CWT. [6][CO2]

Q.4 List speech feature extraction algorithms and design any one of them. [7][CO3]

Q.5 Design Dynamic Time Warping (DTW) algorithm and investigate by suitable example. [6][CO3]

Q.6 Design binary and multiclass classifications problems for speech signal using gaussian distribution. [6][CO4]

Q.7 Construct Hidden Markov Model (GMM) and explain different states of HMM using suitable example. [6][CO5]

Q.8 Assemble Automatic Speech Recognition (ASR) models. Define task-oriented application of automatic speech recognition. [7][CO4,CO5]

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*Total No. of Pages: 2*

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_____ SEMESTER

**M.Tech.[SPD]**

**END TERM EXAMINATION**

***May-2023***

**COURSE CODE: SPD502**

**COURSE TITLE: PAMI**

***Time: 3:00 Hours***

***Max. Marks: 40***

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

**Q1.** a) On the basis of following samples of observations, Table 1, find

i) Entropy (Outlook=Humidity)

ii) Information Gain (S, Humidity)

iii) Out of three types of branching, shown in Fig. 1, identify which is the correct branching operation. (Using Information Gain parameter).

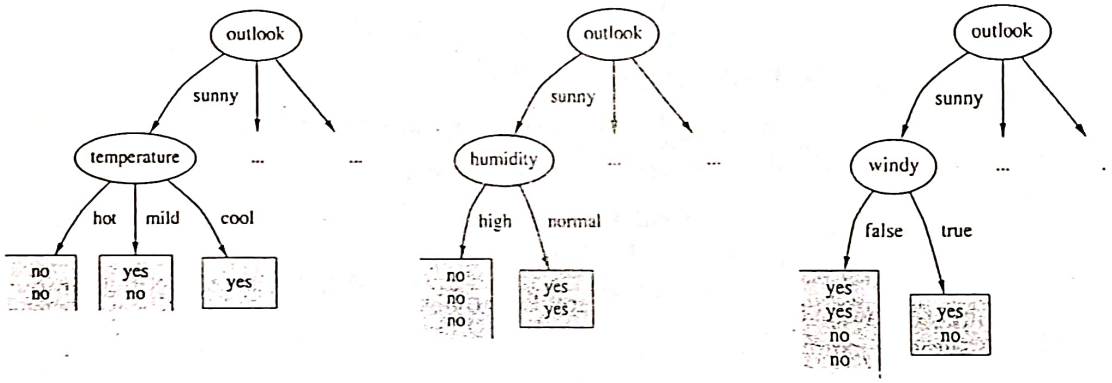


Fig. 1: Different combinations of root node branching to a) temperature attribute, b) humidity attribute c) windy attribute

Table 1

| Temperature | Outlook | Humidity | Windy | Play Golf |
|---|---|---|---|---|
| Hot | Sunny | High | False | No |
| Hot | Sunny | High | True | No |
| Hot | Overcast | High | false | Yes |
| Cool | Rain | Normal | False | Yes |
| Cool | Overcast | Normal | True | Yes |
| Mild | Sunny | High | false | No |
| Cool | Sunny | Normal | false | Yes |
| mild | Rain | Normal | false | Yes |
| Mild | Sunny | Normal | True | Yes |
| Mild | Overcast | High | True | Yes |
| Hot | Overcast | Normal | False | Yes |
| Mild | rain | High | True | No |
| Cool | rain | Normal | True | No |
| mild | rain | High | false | Yes |

**[5M] [CO-1]**

b) Explain SIFT key feature descriptor is defined. **[3M] [CO-4]**

c) What is the condition of SVM classifier to make true prediction. Explain it for both given set of true and false classification. **[2M] [CO-5]**

**Q2.** a) Consider artificial neurons have three inputs, the weights corresponding to these inputs have (1, -3, 2), the activation function is unit step. Determine the output for X1, X2, X3 input values, as shown in Table 2.

Table 2: Sample data

| S.No. | X1 | X2 | X3 |
|---|---|---|---|
| 1 | 1 | 0 | 0 |
| 2 | 0 | 1 | 1 |
| 3 | 1 | 0 | 1 |
| 4 | 1 | 1 | 1 |

**[3M] [CO-5]**

b) Compare bagging and boosting. **[3M] [CO-5]**

c) Explain backpropagation approach by defining all intermediatory activated signals and errors. **[4M] [CO-5]**

**Or**

For a given image $I = \begin{bmatrix} 45 & 34 & 54 & 20 & 30 & 12 \\ 2 & 2 & 2 & 2 & 2 & 2 \\ 33 & 20 & 34 & 10 & 70 & 20 \\ 1 & 1 & 1 & 1 & 1 & 1 \\ 45 & 34 & 54 & 30 & 10 & 10 \end{bmatrix}$, find the horizontal and vertical gradients of the image I using sobel kernel. **[4M] [CO-1] [CO-4]**

**Q3.** a) Write the steps of Adaboost algorithm, with appropriate mathematical explanation of each step. **[3M] [CO-2]**

b) If error rate (ε) of one weak classifier $h_1$ is 0.56, then find the weight of $h_1$ classifier utilised for adaboost classification. **[2M] [CO-2]**

c) In cross validation scheme, differentiate random sampling and stratified sampling with suitable example. **[3M] [CO-3]**

d) In uneven class distribution, which among Accuracy, Precision, Recall and F- measure evaluation parameters work better and why? **[2M] [CO-3]**

**Q4.** a) Define Adam optimiser using appropriate mathematical model. What are the key characteristics of RMSprop optimiser. **[5M] [CO-2] [CO-5]**

b) 'tanh' activation function nonlinearity is always preferred to 'sigmoid' activation nonlinearity. Justify your answer using appropriate mathematical definitions and plots. **[3M] [CO-2] [CO-5]**

c) Define vanishing gradient problem. **[2M] [CO-2] [CO-5]**

**Q5.** a) If an input vector $X = [1.25, 3, 1.5, -4.5]$to an activation function, has to be classified in four classes. Which activation function should be used between 'Logistic' or 'Softmax' function. Why? Justify the answer. **[5M] [CO-2] [CO-5]**

b) What is Dying ReLU Problem. How it is solved. **[5M] [CO-2] [CO-5]**

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2nd SEMESTER

**M.Tech. (SPD)**

**END TERM EXAMINATION** ***May-2023***

**COURSE CODE: SPD504 COURSE TITLE: EMBEDDED SYSTEM**

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

**Note :** Assume suitable missing data, if any.

Q.1 (a) Explain interrupt processing of PIC Microcontroller with the help of timing diagram. [Marks:3][CO#1]

Q.1 (b) Write an assembly language program to separate even numbers from a set of ten 8-bits numbers stored at successive memory location starting from 0x30 H. Store them at different locations. [Marks:3][CO#2]

Q.2 (a) Show the status of C and Z flag after the addition of [Marks:3][CO#2]

i) 0x0000009C and 0xFFFFFF64 in the following instruction.

Assume R1= 0x0000009C and R2= 0xFFFFFF64

ADDS R2, R1, R2

ii) 0x0000009C and 0xFFFFFF69 in the following instruction.

Assume R1= 0x0000009C and R2= 0xFFFFFF69

ADDS R2, R1, R2

Q.2 (b) Explain the functionality of different bits of CPSR Register in ARM processor. [Marks:3][CO#2]

Q.3 (a) Discuss the Modulo addressing and bit reversal addressing mode used in DSP processors with example. [Marks:3][CO#4]

Q.3 (b) Explain the architecture of TI C55x DSP processor with block diagram. [Marks:3][CO#4]

Q.4 (a) Draw the architecture of Clustered VLIW processor in detail. [Marks:3][CO#4]

Q.4 (b) State the contents of R2, R1 and memory location 0x30 after executing the following program. [Marks:3][CO#2]

```
MOV R2, #0x6
MOV R1, #0x4
ADD R2, R1, R2
ADD R2, R1, R2
MOV R5, #0x30
STRB R2, [R5]
```

Q.5 (a) What are various classes of Platform of SoC. Explain with the help of example. [Marks:3][CO#3]

Q.5 (b) Draw the hardware architecture of TI-OMAP and describe its operation. [Marks:4][CO#3]

Q.6 (a) Explain the DRAM cell? Also explain the organization of DRAM. [Marks:3][CO#5]

Q.6 (b) Explain the read and write operation timing diagram of SRAM along with SRAM read timing parameters. [Marks:3][CO#5]

Q.7 What is segmentation based memory management with Segment Descriptor Table (SDT). [Marks:3][CO#5]

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2nd SEMESTER

M.Tech

END TERM EXAMINATION May-2023

SPD5202 Research Methodology & Report Writing

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

**Note:** All questions are compulsory.
Marks are indicated against each question.
Assume suitable missing data, if any.

1. What do you mean by 'Sample Design'? What points should be taken into consideration by a researcher in developing a sample design for this research project. [5] [CO6]

2. Explain the possible contents in abstract, introduction, method, results, and discussion components of an empirical research paper for an international journal. [5] [CO2]

3. Describe the layout or format of a research report. Why is a 'review of literature' included in a research report? What is its purpose? Describe briefly the various elements included in a research report. [5] [CO4]

4. What is a hypothesis? Evaluate the characteristics of hypothesis. Formulate the Null hypothesis and alternative hypothesis with example. [5] [CO3]

5. Chandigarh is an upcoming cosmopolitan city in the north of India. It houses people from all over the country now-a-days and has people with varied culture and interests. With higher income at their disposal, the people of Chandigarh are now keeper than ever, to undertake various tours across the country. There are several Travel agencies and Tour/Travel operators in the city. Sharma Travels had started its business just few months ago and was excepting to double or treble its business in the coming festive season or the later holiday season. In this highly competitive business arena, Mr. Sharma has decided to conduct a survey to determine how much business Chandigarh has to offer and also wanted to know whether the residents are aware of Sharma Travels. He thought that this survey would also determine the effectiveness of his advertising strategies. Besides the above aspects, Mr.

. Sharma wants to gain additional knowledge on several facets such as peoples' travelling options, frequency of travel, their budgets, th satisfaction / dissatisfaction levels with their present travel agencies and other related characteristics. YOU as a researcher are required to desig detailed questionnaire to satisfy Mr. Sharma's queries on the above mentioned aspects besides other facts, such as demographics etc. Which y think might be of additional help to Mr. Sharma in his venture. [5] [CO2]

6. What are the advantages and disadvantages of using Latex over Micros Word for documentation? Create a short latex document which can output the title, a table of 3 rows and 4 columns, four figures in a row, conclusi and the references of a research paper in IEEE format? [5] [CO6]

7. Are you in agreement with the following statements? If so, give reasons: [5] [CO2]

(1) Validity is more critical to measurement than reliability.
(2) Stability and equivalence aspects of reliability essentially mean the same thing.

8. Enumerate the different methods of collecting data. Which one is the most suitable for conducting enquiry regarding family welfare programme in India? Explain its merits and demerits. [5] [CO3]

9. "It is never safe to take published statistics at their face value without knowing their meaning and limitations." Elucidate this statement by enumerating and explaining the various points which you would consider before using any published data. Illustrate your answer by examples wherever possible. [5] [CO5]

10. "Research design in exploratory studies must be flexible but in descriptive studies, it must minimize bias and maximize reliability." Discuss. [5] [CO4]

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II-SEMESTER

**M.Tech.**

**END TERM EXAMINATION** *May-2023*

**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.

Q.1 Define following terms [5][CO1,CO2]
(i) Non-stationary Signal
(ii) Phonatory System
(iii) Categorical Perception
(iv) Speech Signal Processing

Q.2 Explain Short Time Fourier Transform (STFT) and steps required for calculation of STFT. List name of five STFT window functions with mathematical expression. [5][CO2]

Q.3 Design Mel Frequency Cepstral Coefficients (MFCC) algorithm. [5][CO3]

Q.4 Formulate Perceptual Linear Prediction feature extraction algorithm. [5][CO3]

Q.5 Investigate the pattern matching with different distortion measures. [5][CO4]

Q.6 Assemble Automatic Speech Recognition (ASR) models with applications. How might computers do ASR? [5][CO4,CO5]

Q.7 Construct Gaussian Mixture Model (GMM) and Maximum Likelihood (ML) Estimation algorithms. [5][CO5]

Q.8 Demonstrate task specific voice control and dialog system in detail [5][CO5]

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2ND SEMESTER

M.TECH SIGNAL PROCESSING & DIGITAL DESIGN

ENDTERM EXAMINATION MAY 2023

COURSE CODE: SPD6203 MULTI-RATE SIGNAL PROCESSING

TIME: 3 Hours Max. Marks: 50

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

**Q1: [10 Marks][CO3]**

Consider the two-channel filter bank as shown in figure 1. If the input to the filter bank x[n] is {4, 4, 6, 8}. Filter coefficient of prototype filter is $h_0[n]=\left\{\frac{1}{2},\frac{1}{2}\right\}$.

Analyse time domain output at points 1 to 9.

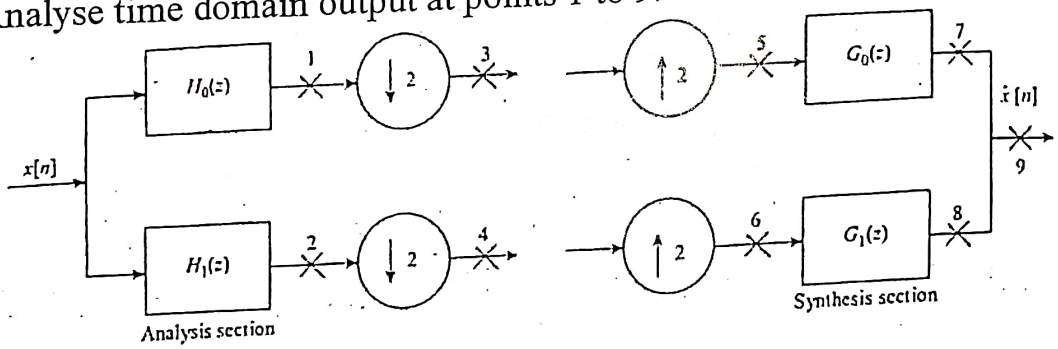


**Figure 1**

**Q2: [10 Marks][CO3]**

**a)** Evaluate the quadrature mirror filter bank along with the frequency response of low and high-pass quadrature mirror filter pair.

**b)** Analyse and synthesize the maximally decimated M-channel filter bank with frequency response.

**Q3: [10 Marks][CO4]**

**a)** Construct the process of converting a CD player digital signal sampled at 44.1 kHz to a professional audio workstation digital signal sampled at 52 kHz.

**b)** The four filters of two-channel quadrature mirror filter bank are given as $H_0(z)=4z^{-2}$, $H_1(z)=z^{-1}$, $G_0(z)=\frac{1}{4}z^{-1}$, $G_1(z)=z^{-2}$. Find whether this choice of filters results in perfect reconstruction system by computing the distortion and aliasing transfer function.

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**Q4: [10 Marks][CO5]**

Design the multi-rate operator expressions and properties for

**a)** Downsampling by factor of 'M'

**b)** Upsampling by factor of 'L'

**Q5: [10 Marks][CO6]**

Write the abstract on identifying the two latest trends with the need in the field of multi-rate signal processing.

Total no. of Pages: 3 Roll no.....

**SECOND SEMESTER**

**M.Tech**

**END TERM EXAMINATION** **May 2023**

**COURSE CODE: SWE 502** **COURSE TITLE: 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) What are the various constraints in cause effect graph. [3][CO3]

Q.2 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]. Create equivalence classes and generate test cases. [8][CO3]

Q.3 Consider the following program

```
# include<stdio.h>
# include<conio.h>
# include<math.h>
int main ()
{
    float a,b,c,r1,r2,d;
    printf ("enter the values of a b c");
```

```
scanf (" %f %f %f", &a, &b, &c);
d= (b*b) – (4*a*c);
if (d>0)
{
        r1 = -b+sqrt (d) / (2*a);
        r2 = -b-sqrt (d) / (2*a);
        printf ("The real roots = %f %f", r1, r2);
}
else if (d==0)
{
        r1 = -b/(2*a);
        r2 = -b/(2*a);
        printf ("roots are equal =%f %f", r1, r2);
}
else
        printf("Roots are imaginary");
return 0;
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.4 Consider the program given in Q.3. Generate test cases for all du paths, all uses paths and all definition paths. [8][CO5]

Q.5 Consider the program given in Q.3. Consider all variables and generate possible program slices. Design at least one test case from every slice. [8][CO5]

Q.6 Consider the program given in Q.3. 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.7 (a) What is Regression Testing. Explain the various steps of the regression testing process. [5][CO6]

(b) Differentiate between

(i) Alpha, Beta and Acceptance Testing

(ii) Testing, Quality assurance and Quality Control [3][CO2]

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Total no. of Pages: 2 Roll no.....

**II SEMESTER**

**M.Tech (SE)**

**ENDTERM EXAMINATION** ***May-2023***

**SWE 504 Empirical Software Engineering**

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

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

Q.1 Differentiate the following

a) Fabrication, Falsification and Plagiarism

b) Parametric and Nonparametric tests **[10]**

Q.2 Consider the table given below that represents the number of modules for 15 software systems. Conclude that whether the population from which sample is derived is on average different than the 12 modules. **[10]**

| Module No. | Module# | Module No. | Module# | Module No. | Module# |
|---|---|---|---|---|---|
| S1 | 10 | S6 | 35 | S11 | 24 |
| S2 | 15 | S7 | 26 | S12 | 23 |
| S3 | 24 | S8 | 29 | S13 | 14 |
| S4 | 29 | S9 | 19 | S14 | 12 |
| S5 | 16 | S10 | 18 | S15 | 5 |

Q.3 Identify the categories to which the following threats belong:

a) Genetic algorithms may produce different results each time they are applied for predicting defects.

b) Threat caused by not considering the effect of developer experience on the relationship between software metrics and fault proneness.

c) Severity level of defects may not be taken into account in a study with intent to predict defect proneness in a module.

d) Threat caused by only exploring systems developed using Java language.

e) Threat caused by using the same data for testing and training.
f) Threat caused by investigating a not publicly available data set.
g) Threat caused by exploring only open-source systems.
h) Threat caused by considering inappropriate level of significance.
i) Threat caused by incomplete or imprecise data sets.
j) If data consists of erroneous observations, outliers, or noise, and it lead to incorrect conclusions. **[10]**

Q.4 What are the different types of data that can be collected for empirical research? Based on what criteria can the researcher select the appropriate data analysis? **[10]**

Q.5 Write short note

a) K-fold and hold-out cross-validation methods
b) Mean Relative Error and Mean Absolute Relative Error **[10]**

Constant:

Critical Values of *t*-Distributions

| *Level of significance for one-tailed test* | 0.10 | 0.05 | 0.02 | 0.01 | 0.005 |
|---|---|---|---|---|---|
| *Level of significance for two-tailed test* | | | | | |
| *df* | 0.20 | 0.10 | 0.05 | 0.02 | 0.01 |
| 1 | 3.078 | 6.314 | 12.706 | 31.821 | 63.657 |
| 2 | 1.886 | 2.920 | 4.303 | 6.965 | 9.925 |
| 3 | 1.638 | 2.353 | 3.182 | 4.541 | 5.841 |
| ... | ... | ... | ... | ... | ... |
| 14 | 1.345 | 1.761 | 2.145 | 2.624 | 2.977 |
| 15 | 1.341 | 1.753 | 2.131 | 2.602 | 2.947 |
| ... | ... | ... | ... | ... | ... |
| 120 | 1.289 | 1.658 | 1.980 | 2.358 | 2.617 |
| ∞ | 1.282 | 1.645 | 1.960 | 2.326 | 2.576 |

*Total no. of Pages: 2* 21 *Roll no.....*

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

**END TERM EXAMINATION** *May-2023*

**SWE5204/ DSC5202 PREDICTIVE MODELLING**

***Time: 03:00Hours*** ***Max.Marks:50***

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

Q.1 Differentiate the following
a) Correlation and Covariance
b) Type I and Type II errors. **[5+5][CO 3&5]**

Q.2 What are the trade-offs between the different types of Classification Algorithms? How would do you choose the best one?? **[10][CO1]**

Q.3 An automobile tyre manufacturer claims that the average life of a particular grade of tyre is more than 20,000 km. A random sample of 16 tyres is having mean 22,000 km with a standard deviation of 5000 km.
Validate the claim of the manufacturer at 5%LoS. **[10][CO3]**

Q.4 a) What is Overfitting, and how can you avoid it?
b) Why and how to cross validate a model. **[5+5][CO4]**

Q.5 How do you handle imbalanced datasets when evaluating a model's performance? How do you evaluate the performance of a recommendation system trained with highly imbalanced dataset? **[6+4][CO5]**

Q.6 Write short note (Any Two) **[10][CO1 & CO2]**
a) PCA
b) Curse of Dimensionality
c) Statistical Modelling

Constant: 22

# t-test table

| cum. prob | $t_{.50}$ | $t_{.75}$ | $t_{.80}$ | $t_{.85}$ | $t_{.90}$ | $t_{.95}$ | $t_{.975}$ | $t_{.99}$ | $t_{.995}$ | $t_{.999}$ | $t_{.9995}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| one-tail | 0.50 | 0.25 | 0.20 | 0.15 | 0.10 | 0.05 | 0.025 | 0.01 | 0.005 | 0.001 | 0.0005 |
| two-tails | 1.00 | 0.50 | 0.40 | 0.30 | 0.20 | 0.10 | 0.05 | 0.02 | 0.01 | 0.002 | 0.001 |
| df | | | | | | | | | | | |
| 1 | 0.000 | 1.000 | 1.376 | 1.963 | 3.078 | 6.314 | 12.71 | 31.82 | 63.66 | 318.31 | 636.62 |
| 2 | 0.000 | 0.816 | 1.061 | 1.386 | 1.886 | 2.920 | 4.303 | 6.965 | 9.925 | 22.327 | 31.599 |
| 3 | 0.000 | 0.765 | 0.978 | 1.250 | 1.638 | 2.353 | 3.182 | 4.541 | 5.841 | 10.215 | 12.924 |
| 4 | 0.000 | 0.741 | 0.941 | 1.190 | 1.533 | 2.132 | 2.776 | 3.747 | 4.604 | 7.173 | 8.610 |
| 5 | 0.000 | 0.727 | 0.920 | 1.156 | 1.476 | 2.015 | 2.571 | 3.365 | 4.032 | 5.893 | 6.869 |
| 6 | 0.000 | 0.718 | 0.906 | 1.134 | 1.440 | 1.943 | 2.447 | 3.143 | 3.707 | 5.208 | 5.959 |
| 7 | 0.000 | 0.711 | 0.896 | 1.119 | 1.415 | 1.895 | 2.365 | 2.998 | 3.499 | 4.785 | 5.408 |
| 8 | 0.000 | 0.706 | 0.889 | 1.108 | 1.397 | 1.860 | 2.306 | 2.896 | 3.355 | 4.501 | 5.041 |
| 9 | 0.000 | 0.703 | 0.883 | 1.100 | 1.383 | 1.833 | 2.262 | 2.821 | 3.250 | 4.297 | 4.781 |
| 10 | 0.000 | 0.700 | 0.879 | 1.093 | 1.372 | 1.812 | 2.228 | 2.764 | 3.169 | 4.144 | 4.587 |
| 11 | 0.000 | 0.697 | 0.876 | 1.088 | 1.363 | 1.796 | 2.201 | 2.718 | 3.106 | 4.025 | 4.437 |
| 12 | 0.000 | 0.695 | 0.873 | 1.083 | 1.356 | 1.782 | 2.179 | 2.681 | 3.055 | 3.930 | 4.318 |
| 13 | 0.000 | 0.694 | 0.870 | 1.079 | 1.350 | 1.771 | 2.160 | 2.650 | 3.012 | 3.852 | 4.221 |
| 14 | 0.000 | 0.692 | 0.868 | 1.076 | 1.345 | 1.761 | 2.145 | 2.624 | 2.977 | 3.787 | 4.140 |
| 15 | 0.000 | 0.691 | 0.866 | 1.074 | 1.341 | 1.753 | 2.131 | 2.602 | 2.947 | 3.733 | 4.073 |
| 16 | 0.000 | 0.690 | 0.865 | 1.071 | 1.337 | 1.746 | 2.120 | 2.583 | 2.921 | 3.686 | 4.015 |
| 17 | 0.000 | 0.689 | 0.863 | 1.069 | 1.333 | 1.740 | 2.110 | 2.567 | 2.898 | 3.646 | 3.965 |
| 18 | 0.000 | 0.688 | 0.862 | 1.067 | 1.330 | 1.734 | 2.101 | 2.552 | 2.878 | 3.610 | 3.922 |
| 19 | 0.000 | 0.688 | 0.861 | 1.066 | 1.328 | 1.729 | 2.093 | 2.539 | 2.861 | 3.579 | 3.883 |
| 20 | 0.000 | 0.687 | 0.860 | 1.064 | 1.325 | 1.725 | 2.086 | 2.528 | 2.845 | 3.552 | 3.850 |
| 21 | 0.000 | 0.686 | 0.859 | 1.063 | 1.323 | 1.721 | 2.080 | 2.518 | 2.831 | 3.527 | 3.819 |
| 22 | 0.000 | 0.686 | 0.858 | 1.061 | 1.321 | 1.717 | 2.074 | 2.508 | 2.819 | 3.505 | 3.792 |
| 23 | 0.000 | 0.685 | 0.858 | 1.060 | 1.319 | 1.714 | 2.069 | 2.500 | 2.807 | 3.485 | 3.768 |
| 24 | 0.000 | 0.685 | 0.857 | 1.059 | 1.318 | 1.711 | 2.064 | 2.492 | 2.797 | 3.467 | 3.745 |
| 25 | 0.000 | 0.684 | 0.856 | 1.058 | 1.316 | 1.708 | 2.060 | 2.485 | 2.787 | 3.450 | 3.725 |
| 26 | 0.000 | 0.684 | 0.856 | 1.058 | 1.315 | 1.706 | 2.056 | 2.479 | 2.779 | 3.435 | 3.707 |
| 27 | 0.000 | 0.684 | 0.855 | 1.057 | 1.314 | 1.703 | 2.052 | 2.473 | 2.771 | 3.421 | 3.690 |
| 28 | 0.000 | 0.683 | 0.855 | 1.056 | 1.313 | 1.701 | 2.048 | 2.467 | 2.763 | 3.408 | 3.674 |
| 29 | 0.000 | 0.683 | 0.854 | 1.055 | 1.311 | 1.699 | 2.045 | 2.462 | 2.756 | 3.396 | 3.659 |
| 30 | 0.000 | 0.683 | 0.854 | 1.055 | 1.310 | 1.697 | 2.042 | 2.457 | 2.750 | 3.385 | 3.646 |
| 40 | 0.000 | 0.681 | 0.851 | 1.050 | 1.303 | 1.684 | 2.021 | 2.423 | 2.704 | 3.307 | 3.551 |
| 60 | 0.000 | 0.679 | 0.848 | 1.045 | 1.296 | 1.671 | 2.000 | 2.390 | 2.660 | 3.232 | 3.460 |
| 80 | 0.000 | 0.678 | 0.846 | 1.043 | 1.292 | 1.664 | 1.990 | 2.374 | 2.639 | 3.195 | 3.416 |
| 100 | 0.000 | 0.677 | 0.845 | 1.042 | 1.290 | 1.660 | 1.984 | 2.364 | 2.626 | 3.174 | 3.390 |
| 1000 | 0.000 | 0.675 | 0.842 | 1.037 | 1.282 | 1.646 | 1.962 | 2.330 | 2.581 | 3.098 | 3.300 |
| z | 0.000 | 0.674 | 0.842 | 1.036 | 1.282 | 1.645 | 1.960 | 2.326 | 2.576 | 3.090 | 3.291 |
| | 0% | 50% | 60% | 70% | 80% | 90% | 95% | 98% | 99% | 99.8% | 99.9% |
| | Confidence Level | | | | | | | | | | |

*Total No. of Pages 01*

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*Roll No. .....*

**FIFTH SEMESTER**

**M.Tech. (SWE/DSC)**

**END SEMESTER EXAMINATION** **MAY-2023**

**SWE 5406/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]** What do you mean by Well posted learning problems explain with example. (CO2)[5]

**[b]** Discuss dimensionality reduction Feature Selection approaches or methods. (CO5)[5]

2 **[a]** How supervised learning work? Explain with example and also write its application. (CO2)[5]

**[b]** Explain measures of spread in descriptive Statistics. (CO1)[5]

3 **[a]** Explain Bayes theorem with example. (CO3)[5]

**[b]** Discuss Margin of Error and Level of Confidence in Inferential Statistics. (CO3)[5]

4 **[a]** What is Agglomerative Hierarchical clustering algorithm steps and write different measure for the distance between two clusters. (CO4)[5]

**[b]** Discuss attribute selection methods in decision tree. (CO2)[5]

5 **[a]** Explain in detail working of Linear support vector machine. (CO4)[5]

**[b]** Explain the various activation functions used in artificial Neural Network. (CO5)[5]

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*Total no. of Pages: 02* *Roll No.....*

**2nd SEMESTER**

**M.Tech. (Structure Engineering)**

**END SEMESTER EXAMINATION** **May – 2023**

**STE-502 ADVANCED THEORY OF STRUCTURES**

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

**Note :**

- **Q. 3 is compulsory** and attempt **any three** from remaining questions.
- Assume suitable missing data, if any.

1. Find out equivalent joint load vector for a 6 m long member of grid frame on which the load is acting from one side, which consists of trapezoidal shape of width 0 at the ends and linearly increasing to 3m width at 2m from ends. This width for central region of 2m remains constant of 3m. Floor load may be taken as 30 kN/m$^2$. (9) (CO3)

2. Drive stiffness matrix for a curved member of 3 m radius, which subtends an angle of 45$^0$ at the centre. Cross-section of the member is 0.3 m wide and 0.5 m deep. Elastic modulus of the material is 25 kN/mm$^2$. The loading and structure are in the same plane. (9) (CO4)

3. 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 20 kN/mm$^2$. The yield strength of the material is 330 N/mm$^2$. All members have cross sectional area of 100 mm$^2$. The applied force P is 51.88 kN. All members are of 1000 mm length except AB. (13) (CO1)

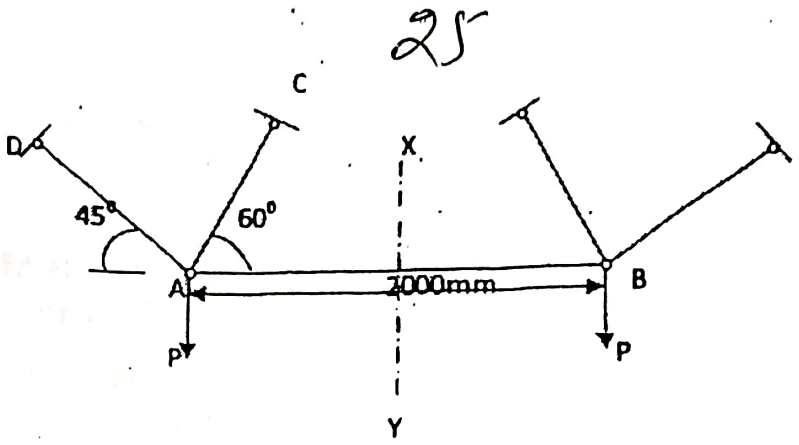


**Fig. 1**

4. Write down stiffness matrix in structural axis system for a space truss member. The member is having cross-sectional area, modulus of elasticity and length as 100 $mm^2$, 200 $kN/mm^2$ and 4.5 m respectively. The member is connecting joints X (2, 3, 4) and Y (7, 8, 9).

(9) (CO2)

5. Why do we use Sub-structure Technique of analysis? Explain the technique of analysis with the help of an example?

(9) (CO5)

Roll No._____

Total No. of Pages 02

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**M.Tech (Structural Engg.)**

**SECOND SEMESTER**
**END TERM EXAMINATION**

**(May - 2023)**

STE504 Finite Element Method of Structural Analysis

**Time: 3 hrs**

**Maximum Marks: 40**

**Note: Assume any missing data suitably.**

Q1 Using Rayleigh Ritz method, determine the expression for displacement and stress in a fixed bar subjected to axial force P as shown in Fig 1. Draw the displacement and stress variation diagram. 5 CO 1

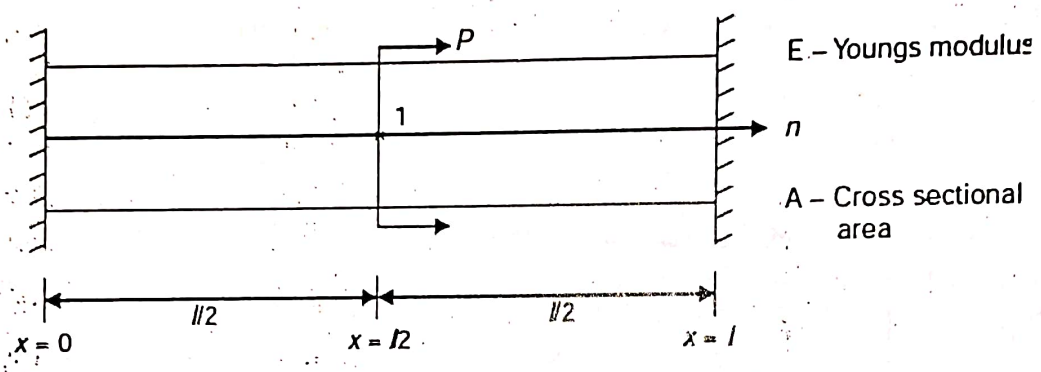


Fig 1

Q2 State and explain the principle of minimum potential energy with suitable example. 5 CO 1

Q3 In the element shown in Fig 2, P is the point (6,5). On this point the load components in x and y directions are 8kN and 12kN respectively. Determine its nodal equivalent forces using Isoparametric formulation. 6 CO 5

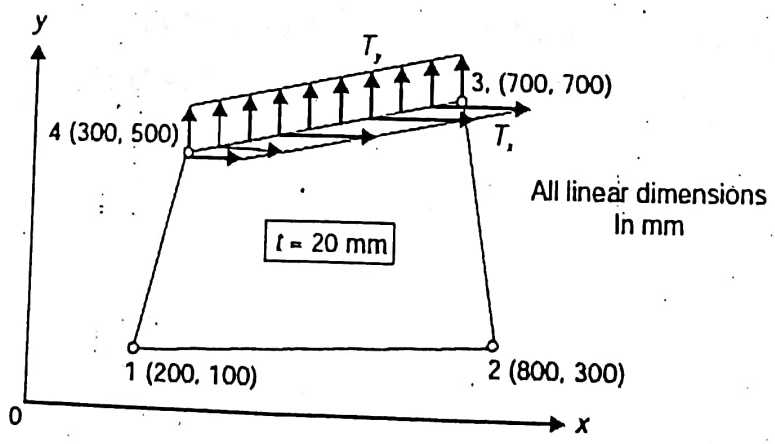


Fig 2

Q4 Discuss the various points to be considered while discretizing a structure for finite element analysis. 3 CO 3

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Q5 Determine the nodal displacement, element stresses and support reactions of the axially loaded bar as shown in Fig 3 by finite element approach. Take E = 200GPa and P = 30kN 6 CO 3

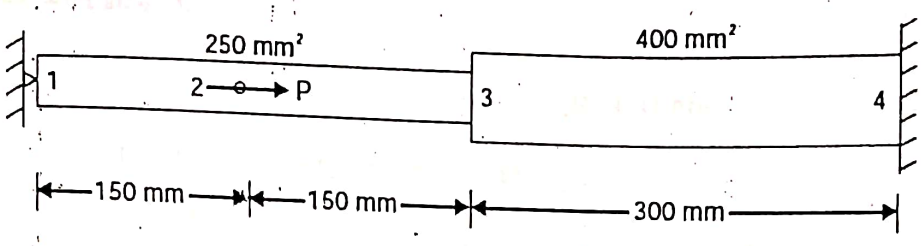


Fig 3

Q6 For the CST element as shown in Fig 4, assemble stiffness matrix taking E = 2X $10^5$N/mm$^2$, t = 20mm and poisons ratio = 0.25 6 CO 4

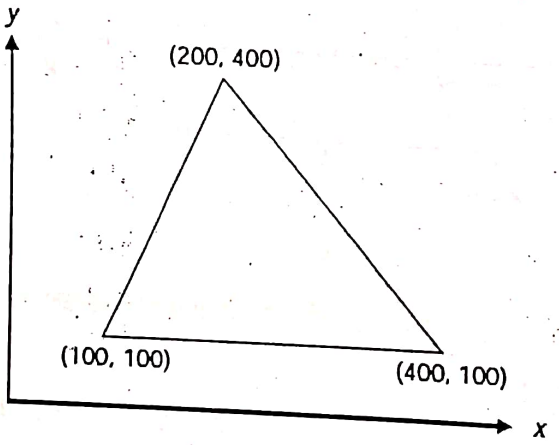


Fig 4

Q 7 Explain/Illustrate the following terms:( 3marks each) 9 CO 2

(i) Shape functions
(ii) Lagrange family of rectangular elements
(iii) Convergence requirement of shape function (any one)

II[nd] - SEMESTER
M.Tech. (Structural Engg.) 28
END SEMESTER EXAMINATION (May - 202
Course Code: STE5048 Course Title: Earthquake Resistant Desig of Structures
Time: 3:00 Hours Maximum Marks: 4

**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 are the principles of earthquake resistant design to preve the collapse of reinforced concrete buildings? [2][CO-
(b) What are the basic failure modes of cantilever shear wall? [2][CO-2
(c) What is the principle of Seismic Base Isolation and how does reduce the response to earthquake motion? [2][CO-4
(d) What are the objectives of strengthening procedures? [2][CO-3

Q.2 Answer any **TWO** parts of the following:
(a) Define the Focus and Epicentre of an Earthquake. An earthquak with moment magnitude ($M_w$) of 8.0 dyne-cm causes an averag strike slip displacement of 2.6 m. Determine the seismic moment of earthquake and the fault area that ruptured during th earthquake. [4][CO-1
(b) Describe any **four** Earthquake resistant design methods. [4][CO-1
(c) Explain the use of Response Reduction Factor in the earthquak resistant design of structures with the help of neat diagram.[4][CO-1

Q.3 Answer any **TWO** parts of the following:
(a) Describe the structural forms and positioning of shear walls with th help of neat diagrams. [4][CO-2]
(b) Discuss the various factors which influence the structura performance of shear wall. [4][CO-2]
(c) What are the steps carried out in the Pushover Analysis? [4][CO-2]

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-3]

Contd.....2

(b) Discuss the different stages of Performance Based Seismic Design. [4][CO

(c) Describe the Friction Pendulum System used in base isolation. [4][CO

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-4]

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**END TERM EXAMINATION MAY 2023**

**II SEM M.Tech. (Structures)** **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(a) Discuss stress strain relationship of HYSD reinforcement used in concrete. M4/CO1

(b) What do you understand by 'Rapid visual screening' of structures? Discuss the utility of the approach. M4/CO1

2(a) What are Alkali-aggregate reactions? Discuss in detail. M4/CO2

(b) Explain the utility of curing of concrete. M4/CO2

3(a) Discuss likely results of use of superplasticizers in concrete. M4/CO3

(b) Should visual observation be applied as a necessary step in the rehabilitation of important structures also? Discuss. M4/CO3

4(a) Briefly discuss a method to enhance fire resistance of an RCC column in an industrial building. M4/CO4

(b) What is 'Carbonation' of concrete? What are the factors responsible for it? M4/CO4

5(a) Write advantages of using 'Fibre reinforced concrete'. M4/CO5

(b) What is 'Rehabilitation' of structures. Describe the use of any one non-destructive method in this respect. M4/CO5

6 Write notes on any two of the following topics.

(a) Effect of shape of aggregates on concrete strength

(b) V-B test on concrete

(c) Environmental exposure conditions M8/CO6

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Total No. of Pages:02 Roll No.....

M.Tech./Ph.D. IISEMESTER **M.Tech. (Sruct.)**

**END SEMESTER EXAMINATION** ***April/May-2023***

## STE5308: Disaster Mitigation and Management

***Time: 3.00 Hours*** ***Max. Marks:50***

**Note:** Attempt Five questions. Question number ONE is compulsory.
All questions carry equal marks.
Assume suitable missing data, if any.

Q.1 Answer all the following questions [2x5=10]
(a) Define Disaster as per UNISDR 2016 [CO1]
(b) Define Flood. [CO2]
(c)Inundation Intensity Scale [CO3]
(d) Differentiate between Structural and Non-structural mitigation measures. [CO4]
(e) What is damage ratio. [CO5]

Q.2 (a) How hazard, risk, vulnerability are interconnected to each other? [CO1][2.5]
(b) Describe Floods Category & Alert Colour Codes [CO3] [2.5]
(c) Write notes on Cyclonic microzonation [CO4] [5]

Q.3(a) Define terms: Retrofitting and Recovery [CO1][2]
(b)Write short notes on institutional mechanism on Disaster Management in India [CO1][3]
(c) What is fragility curve and vulnerability curve? How do you obtain fragility curve for a component? [CO5][5]

P.T.O

Q.4 (a) What are the causes, mechanism of landslides. [CO4][4]

(b) What is Hazard, Risk, Vulnerability and Capacity Analysis (HRVCA).Explain in detail. [CO5][6]

Q.5 (a) Write meaning of Hazard resistant construction [CO3] [2.5]

(b) Differentiate Between Mitigation and Prevention. [CO1][2.5]

(c)Write briefly on guidelines for improving the cyclonic resistance of low-rise houses as per IS15498 :2004. [CO4][5]

Q.6 (a) Explain structural and non-structural approaches of controlling damages due to floods. [CO3][5]

(b)DOS and Don'ts in Buildings for safety against Earthquake. [CO4][5]

Total no. of Pages:02 33 Roll no.....

FIRST SEMESTER

Ph.D. (Course work)

**END TERM EXAMINATION May -2023**

**SM 901 RESEARCH METHODOLOGY AND IPR**

*Time: 03:00 Hours* *Max. Marks: 50*

**Note: Attempt all parts of a question together. Assume suitable missing data, if any.**

**Q1.** Answer the following:

i) What do you mean by Theoretical Framework? What is its importance?

ii) From the following situation answer the questions that follow:

A prevalent theory is that the diversity of the workforce (comprising people of different ethnic origins, races, and nationalities) contributes more to organizational effectiveness because each group brings its own special expertise and skills to the workplace. Further, this synergy can be exploited only if managers know how to harness the special talents of the diverse work group; otherwise, they will remain untapped. It is also believed that it is the Workforce Diversity which results in Creative Energy, which further leads results in Organisational Effectiveness.

a) **List** down the possible variables and indicate the type of variables.

b) **Draw** a theoretical framework using the variables identified [2+4+4 ][CO1]

**Q2. i)** What points we should keep in mind to write a good abstract of Ph.D. thesis? Explain.

**ii)** There has been a lot of studies done in the area of COVID 19 since the time it hit the world. Explain how the research designs in these studies have evolved on various aspects related to COVID. Take any three research designs to explain the same. [4+6][CO4, CO2]

**Q3.** Select correct option. Show calculations wherever needed.

Parts i to vi are of 1 mark each. Parts vii and viii are of 2 marks each.

i. If X is normally distributed with mean 100 and standard deviation 10, the value c such that P (X < c) = 0.5 is:
(a) 10 (b) 100 (c) 2 (d) Can't be found without Normal probability table/calculator

ii. If X follows Poisson Distribution, which of the following is true:
(a) Mean(X) > Variance(X) (b) Mean(X) = Variance(X) (c) Mean(X) < Variance (X) (d) None of these

iii. Which of the following is/are characteristic(s) of a good point estimator?
(a) Unbiasedness (b) Consistency (c) Sufficiency (d) All of these

iv. Given that Variance (X) = 5, then Variance (3X – 6) is: 34

v. The size of critical region and level of significance are same:
(a) TRUE (b) FALSE

vi. The Standard Normal Variable can take values between:
(a) -3 to 3 (b) -1 to 1 (c) - infinity to +infinity (d) None of these

vii. A large random sample of size 100 is drawn from a Population with mean 10 and variance 4. As per Central Limit Theorem, the sample mean will follow normal distribution with: mean =? and variance =?

viii. Suppose that 100 tires made by a certain manufacturer lasted on the average 22,0 miles. Suppose the population stand. Dev. is 1300 miles. The null hypothesis $\mu$ = 21,500 miles against the alternative hypothesis $\mu$ < 21,500 miles is to be tested the .01 level of significance. The calculated value of z statistic is ? [10][CO3]

**Q4.** Write short notes on any two of the following:

a. Explain the concept of Acceptance Region, Rejection Region and Critical Values in for the test statistic Z in the context of Hypothesis two tail Testing. Assume the Sampling Distribution as Normal and level of significance as 5%.
b. Explain any two sampling methods in brief
c. Steps of Hypothesis Testing
d. Advantages of sampling over census

[5 X 2 = 10] [CO3]

**OR**

A random sample of 3 randomly taken equal weight packages of each of the four different diet foods is analyzed for cholesterol contents. The data (in milligrams per package) is given in the following table. Can we infer at 5% significance level that four diet foods in differ in their cholesterol contents? Formulate null and alternate hypothesis suitably before performing the analysis. Assume conditions of normali of populations with similar variance (Use one way ANOVA; Given F(3,8, .05) = 4.07 and FF(8,3, .05) = 8.85.

[10] [CO3]

| Diet A | Diet B | Diet C | Diet D |
|---|---|---|---|
| 3.6 | 3.1 | 3.2 | 3.5 |
| 4.1 | 3.2 | 3.5 | 3.8 |
| 4.0 | 3.9 | 3.5 | 3.8 |

**Q.5 (i)** What is intellectual property? Mention the items that can be protected in intellectual property system. [5][CO5]

**(ii)** Differentiate between Copyright and Patents. [5][CO5]

Total no. of Pages:01 35 Roll no.....

SECOND SEMESTER Ph.D.

END TERM EXAMINATION May-2023

COURSE CODE SM903

COURSE TITLE RESEARCH AND PUBLICATION ETHICS

Time: 03:00 Hours Max. Marks: 50

Note : All questions carry equal marks.
Make diagram where required.

Q.1 Distinguish between basic and applied research along with existence value and use value. [10][CO1]

Q.2 Explain Consequentialism and Deontology. How do they help in developing standards for research conduct? [10][CO1]

Q.3 Discuss various aspects of Scientific Misconduct. [10][CO3]

Q.4 Discuss the role of the editor in ensuring research integrity and maintaining standards of publication. [10][CO4]

Q.5 (a) Explain copyright and plagiarism in detail.
(b) Write a note on Creative Commons. [10][CO5]

Total No. of Pages:2 36 Roll No.....

SECOND SEMESTER M.Tech. (PES)

END TERM EXAMINATION MAY-2023

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) (i) What are the characteristics for an ideal power device?

(ii) Describe the characteristics for an ideal power rectifier?

(iii) Describe the characteristics for an ideal power transistor?

(iv) Why are unipolar power device structures more attractive for applications than bipolar power devices?

[4+4=8M][CO1]

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) (a) Explain the parallel operation of thyristors.

(b) A 175 A thyristor is connected in parallel with a 225 A thyristor as shown in Fig. 2. The ON-state voltage drop across thyristors is 1.85 V and 1.75 V respectively. Determine the series resistance that must be connected in series with each thyristor when 400 A current is shared by two thyristors according to their rating.

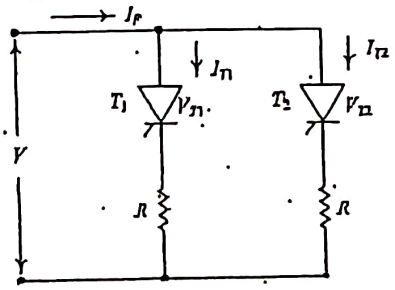


Fig.2

[4+4=8M][CO3]

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Q(4) (a) Explain the operation of power transistor as a switch and draw the V-I characteristics of a power transistor.

(b) A bipolar Power transistor as shown in Fig. 3 has $\beta = 30$ and the load resistance $R_C = 15\ W$. The dc supply voltage $V_{CC} = 200\ V$ and the input voltage to base is $V_B = 10\ V$. When $V_{CE(saturation)} = 1.2\ V$ and $V_{BE(saturation)} = 1.5\ V$, determine (a) the value of resistance $R_B$ so that transistor operates in saturation and (b) power loss in the transistor.

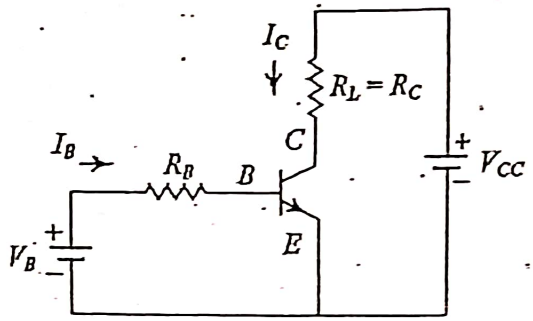


Fig.3 [4+4=8M][CO4]

Q(5) (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 ($cm^2/V\text{-}s$) | Depletion Width (cm) |
|---|---|---|---|
| 300 | $2.15 \times 10^{17}$ | 566 | $1.24 \times 10^{-4}$ |
| 600 | $8.55 \times 10^{16}$ | 720 | $2.78 \times 10^{-4}$ |

[4+4=8M][CO5]

Q(6) (a) Derive the expression for the optimum value of the effective relative permeability $\mu_{opt}$ for a the two winding inductor.

(b) Draw the Flow chart of Inductor design process.

[4+4=8M][CO5]

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Total no. of Pages: 03 Roll no.....

II SEMESTER

M.Tech.

**END TERM EXAMINATION** ***May-2023***

**PES 504 Controller Design for 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 of ideal boost converter. Derive the equations of inductor voltage, capacitor current and input current averaged over one switching period by performing small ripple approximation. [8] [CO1]

Q.3 A DC-DC converter has an input voltage of 30V and the output voltage of 60V. The absolute value of voltage across the inductor is 60V when the diode of the DC-DC converter is turned on. The load resistance is 10Ω. The inductance and capacitance values of the converter are 300μH and 600μF respectively.

| *Converter* | $G_{g0}$ | $G_{d0}$ | $\omega_0$ | $Q$ | $\omega_z$ |
|---|---|---|---|---|---|
| *buck* | $D$ | $\frac{V}{D}$ | $\frac{1}{\sqrt{LC}}$ | $R\sqrt{\frac{C}{L}}$ | $\infty$ |
| *boost* | $\frac{1}{D'}$ | $\frac{V}{D'}$ | $\frac{D'}{\sqrt{LC}}$ | $D'R\sqrt{\frac{C}{L}}$ | $\frac{D'^2R}{L}$ |
| *buck-boost* | $-\frac{D}{D'}$ | $\frac{V}{DD'^2}$ | $\frac{D'}{\sqrt{LC}}$ | $D'R\sqrt{\frac{C}{L}}$ | $\frac{D'^2R}{DL}$ |

Fig.1. Parameters of Transfer function

Answer the following with respect to the above information:

(a) Identify the DC-DC converter.

(b) Compute all the parameters of the line to output transfer function and control to output transfer function using the table in Fig.1.

(c) Draw the asymptotic bode magnitude plot of line to output transfer function by incorporating the values computed in (b).

(d) Draw the asymptotic bode phase plot of control to output transfer function by incorporating the values computed in (b).

[1+3+2+2] [CO2]

Q.4. The open loop gain transfer function *T(s)* of a DC voltage regulator shown in Fig. 2. is as follows:

$$T(s) = T_0 \frac{\left(1 + \frac{s}{\omega_z}\right)}{\left(1 + \frac{s}{Q\omega_{p1}} + \left(\frac{s}{\omega_{p1}}\right)^2\right)\left(1 + \frac{s}{\omega_{p2}}\right)}$$

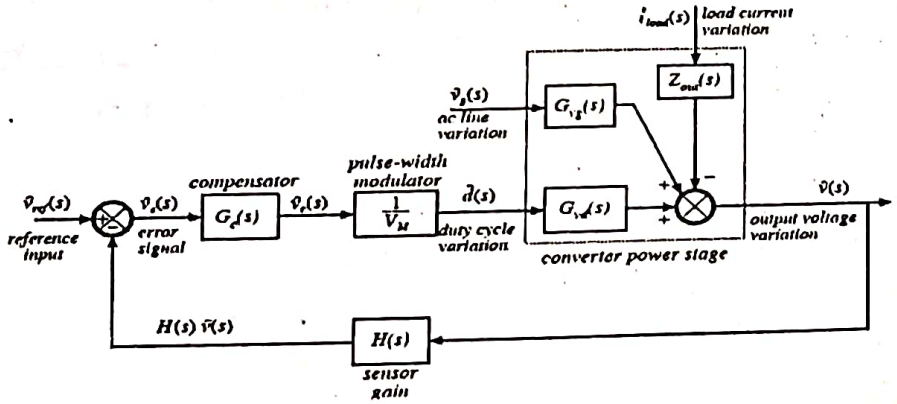


Fig. 2. Block Diagram of DC Voltage regulator

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) 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.

[1+3+4] [CO3]

Q.5 The bode plot of an uncompensated loop gain transfer function ($G_c(s)=1$), *T(s)* is as shown in Fig. 3.

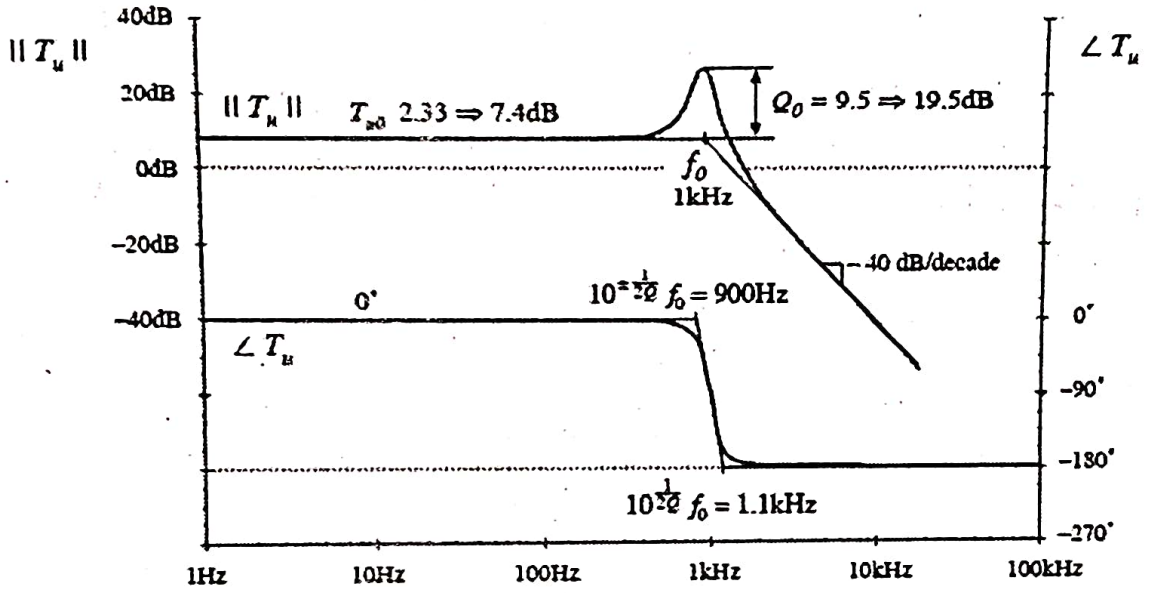


Fig. 3. Bode Plot of Uncompensated Systems

The above plot has a phase margin is $5^0$ and the gain crossover frequency is 1.8kHz. The existing gain at 4kHz is -16dB. Design a suitable compensator for increasing the phase margin to $35^0$ at a gain crossover frequency of 4kHz. [8] [CO4]

Q.6 (a) What is peak current mode control in a DC-DC Converter?

(b) Explain the stability problem in peak current mode control for duty ratio greater than 0.5. Mention a method to overcome the stability problem. [2+6] [CO5]

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*Total no. of Pages 02* *Roll no.....*

**2nd Semester Semester**
**M.TECH**
**END TERM EXAMINATION** **May-2023**
**PES 5206/C&I 5206 MACHINE LEARNING**

**Time: 3.00 Hours** **Max Marks: 50**

**Note: All the questions are compulsory.**

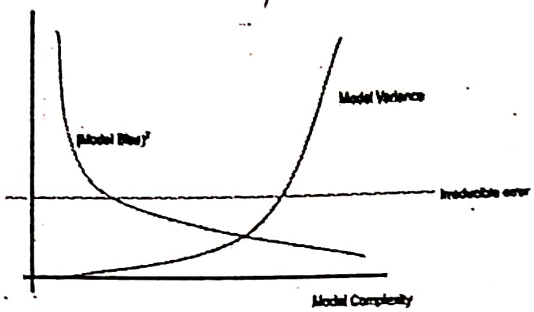
1. A. Write short notes on Gradient Descent Algorithm? Explain with a pseudo code? **[5] [CO5]**
   B. Run the Gradient Descent algorithm on the error function $f(x, y) = 5 + x^2 + y^2 + 5xy$ with a starting guess $x^{(0)} = 1$, $y^{(0)} = 2$ and using step size of 0.1. Output the next two guesses $(x^{(1)}, y^{(1)})$, and $(x^{(2)}, y^{(2)})$. **[5] [CO5]**

2. A. The average marks obtained in an examination is 74 and the standard deviation is 7. If 12.5% of the class are given A+ grade (Highest grade) and the marks obtained follow the normal distribution, them what is the lowest possible marks obtained in A+ grade? Refer **Table** **[5] [CO1]**
   B. An examination paper has 100 multiple choice questions of 4 marks each, with each question having four choices. Each incorrect answer fetches -1 marks. What is the total expected marks obtained by a student? **[2.5] [CO1]**

   C. Calculate the inverse of the given 2×2 matrix
   $$\begin{bmatrix} 3+2i & i \\ -i & 3-2i \end{bmatrix}$$ **[2.5] [CO1]**

3. We have the following data (in increasing order) for the attribute *age*: **13, 15, 16, 16, 19, 20, 20, 21, 22, 22, 25, 25, 25, 25, 30, 33, 33, 35, 35, 35, 35, 36, 40, 45, 46, 52, 70.** Using the following data for *age*: **[10] [CO3]**
   i) Use min- max normalization to transform the value **35** for *age* onto the range [0.0,1.0].
   ii) Use z-score normalization to transform the value **35** for *age*.

4. 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]

5. A. Explain the Loss function used in the machine learning algorithms. Also explain in detail about the Regression and Classification based Loss functions?

[5] [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?

[5] [CO2]

**Reference**: You may refer the following table (**Table 1**) for **Question 2(A).**

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]**

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*Total no. of Pages: 02* *Roll no*_____

**SECOND SEMESTER**

**M.Tech. (Power Electronics & Systems)**

**END TERM EXAMINATION** *May-2023*

**PES-5312 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) Double-edge symmetrical modulation,
(b) Phase opposition disposition modulation,
(c) Triplen carrier ratios,
(d) Direct modulation,
(e) Diode clamped multilevel inverter.

Q.2 Comment on the following: **[5×2=10] [CO3]**

(a) Weighted THD normalized to the base frequency for *l-l* switched output voltage of a single-phase inverter with double-edge naturally/regular sampled and symmetrical/asymmetrical modulation.
(b) Naturally sampled sine-triangle modulation for three-phase voltage source inverter.

Q.3 Derive the mathematical relation for three-level naturally sampled sine-triangle PWM for single-phase *l-l* 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 *l-l* inverter output voltage.
(c) Comment on the magnitude of even ($2m$) carrier groups harmonic and odd sideband harmonics in *l-l* inverter output voltage.

Q.4 What is third harmonic reference injection? Derive and compare the rms values of fundamental output pole voltage of three-phase inverter, which is modulated with square wave fundamental frequency modulation, sinusoidal pulse-width modulation (SPWM) and SPWM with third harmonic reference injection. **[10] [CO2, CO4]**

Q.5 A three-phase two-level inverter with $V_{dc} = 600V$, star connected load with impedance of 8+j6Ω at $f_o = 50Hz$. The inverter is operated under space vector modulation (SVM) with the switching frequency of 3.6 kHz. **[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)

| $v_a^*$ | $v_b^*$ | $v_c^*$ |
|---|---|---|
| 188.4V | 20V | -208.4 |

(ii)

| $v_a^*$ | $v_b^*$ | $v_c^*$ |
|---|---|---|
| 138.2 | -188.8 | 50.6 |

(c) Calculate the corresponding SVM time weights ($T_1$, $T_2$, $T_0$) for the magnitude of instantaneous voltages (given in Q.5 (b) part (i) under shaded region).

Total Number of Pages 2 Roll No.....

**M.Tech Power Electronics & Systems** *2nd SEMESTER*

END SEMESTER EXAMINATION *(May-2023)*

***PES-5408 Grid Connected Converters & Systems***

***Time: 3 Hours*** ***Maximum Marks:40***

**Note: Assume suitable missing data, if any.**
**Q1, 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 operation for the single phase non-isolated grid connected PV inverter.

(ii) In case of islanded condition, the highest capacity inverter is tasked for Master, in a Master-slave configuration of the microgrid.

(iii) Islanding detection based on PLL scheme need to employ a fast & a slow PLL.

(iv) Instantaneous power theory based grid synchronization works well only under ideal conditions of voltages at PCC.

(v) 2nd order generalised integrator based PLL offer parallel operational capabilities as that with Adaptive filter based PLL with easy implementation.

(vi) DC bus voltage of grid connected inverters is always kept higher than the maximum grid voltage (line-line).

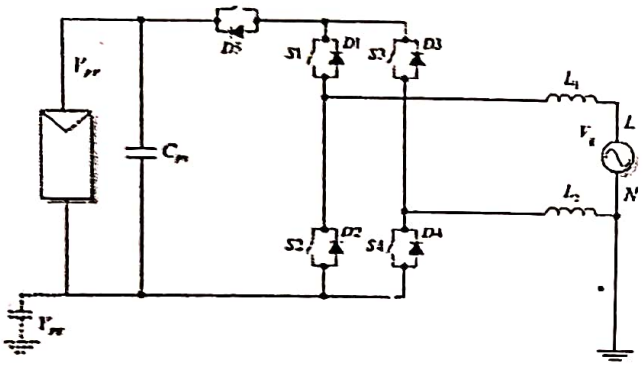
(vii) Current controlled Voltage Source Inverter(VSI) offer fast & flexible control and grid coupling, vis-à-vis voltage controlled VSI.

(viii) LCL filters for GCI offer better filtering as compared to L or LC filters **1x8**

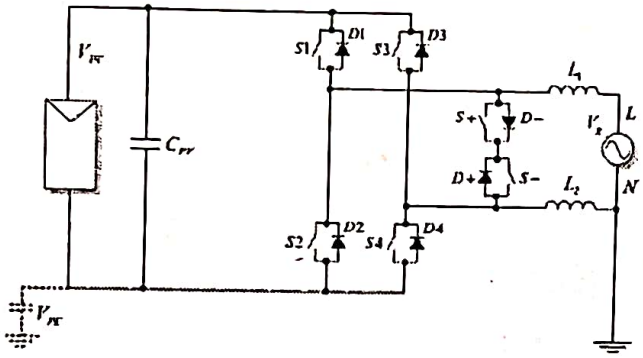
**2** [a] The operational observations and the grid connected single phase PV inverter architecture type is placed in a matrix format. Fill the corresponding squares in the matrix with '✓' where a match between the PV inverter and observation is established otherwise place 'x'. **4**

| OBSERVATIONS ⇨ / INVERTER & MODULATION ⇩ | Low leakage current & Low EMI | High leakage current & High EMI | High switching ripple @ switching frequency | Lower switching ripple @ 2x switching frequency | High filtering requirement | Zero output voltage state | High core losses in filter | Lower reactive power exchange during free wheeling |
|---|---|---|---|---|---|---|---|---|
| Full Bridge with Bipolar Modulation | | | | | | | | |
| Full Bridge with Unipolar Modulation | | | | | | | | |
| Full Bridge with Hybrid Modulation | | | | | | | | |
| SMA H5 | | | | | | | | |

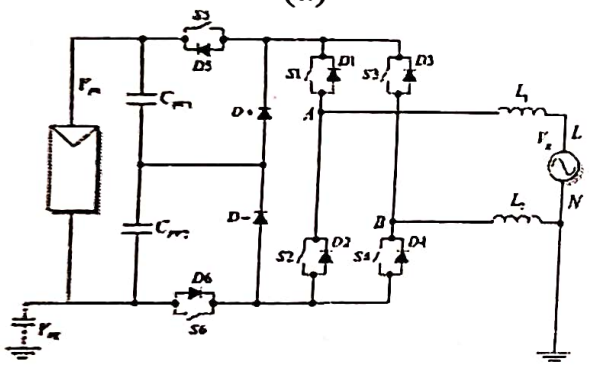
[b] Identify the single phase grid connected PV inverter topologies (write their names). 2



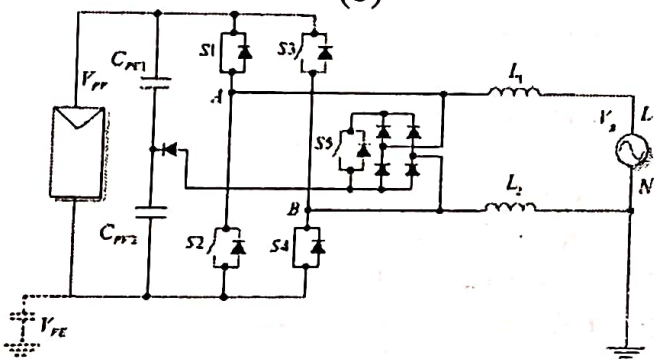
(a)



(b)



(c)



(d)

[c] Identify the constraints for the Non-Detection zones for islanding detection for the grid connected inverters. 2

3 [a] The three phase grid side inverter has the rms phase voltage of 220V and rated line current of 10A(rms). The PWM switching frequency of the inverter is 10kHz and the DC bus voltage is 600V. Design the LCL filter which mandates following constraints.

i) *the peak value of the ripple current through inverter side inductor ($i_{L1}$) < 30% 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% of the rated current.*

iii) *grid side inductor and capacitor of the LCL filter provide the same reactive power.* 4

[b] Given a single phase voltage source inverter with hybrid modulation. The top switches are switched with fundamental frequency of 50Hz and the bottom two are switched with unipolar SPWM with switching frequency of $f_s$. Derive the inductor current ripple for the LC filter in terms of DC bus voltage. 4

4 [a] Derive the transfer function of second order adaptive filter from fundamentals. Use it to realize first the Generalized Integrator and later describe how it can be used to realize quadratic signal generator(QSG). 4

[b] Draw the Basic Structure of PLL. Explain through diagrams how forward power transformation can realize PLL, and reverse Park transformation can realize QSG. 4

5 [a] Explain briefly the Instantaneous Reactive Power Theory and Synchronous Reference Frame (SRF) theory. Compare their relative merits and demerits. Use these for extraction of fundamental current component for operation of Grid Supportive Inverter(GSI) to supply only requisite real power requirements. Use block diagrams to explain the control of GSI using SRF theory. 6

[b] Discuss briefly the frequency drift techniques for islanding detection of Grid connected inverters. 2

6 [a] Explain the difference between the Grid forming and Grid Supportive inverters. Support your answer with suitable modulation scheme and switching operation. Briefly discuss their roles and requirements in Master-Slave operation of the microgrid 6

[b] State the salient features of H5 and H6 PV inverters in bullet points, and tabulate their comparison of merits/demerits. 2

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**PhD Course Work [PHYSICS]**

END SEMESTER EXAMINATION **(May, 2023)**

**NST-502** **ANALYTICAL TECHNIQUES**

Time: 3:00 Hours Max. Marks: 40

Note: Answer Any **FIVE** questions. **Question No. 1** is Compulsory. Assume suitable missing data, if any

**1: Answer all the questions.** **[2 x 5]**

**[a].** What are Miller indices? Draw plane (120) plane in a cubic crystal structure. (CO1)

**[b].** Distinguish between characteristic and continuous radiations of X-rays, which type of X-rays is used for material characterizations. (CO1)

**[c].** Using relation of X-ray intensity vs absorption coefficient, determine the transmission factor of 1 mm lead screen for $MoK_\alpha$ and $CrK_\alpha$ radiations, with mass absorption coefficient values, 141 $cm^2/gm$ and 585 $cm^2/gm$, respectively, for these targets and density of lead is 11.34 $gm/cm^3$. (CO1)

**[d].** Drawing a pattern of X-ray peak Intensity vs diffraction angle. Write all the information extracted from peak width. (CO2)

**[e].** What is the difference between IR and FTIR? Why KBr material is used as binder for sample preparation in FTIR? (CO3)

**2[a].** Define 'multiplicity' and 'structure factor'. Assuming proper fractional atomic positions of 'face centered cubic' cell, find out the structure factor in mixed and unmixed state of intensity. (CO1) **[3]**

**[b].** Explain the basic principle and instrumentation of X-ray Photo Electron Spectroscopy. Write the different characteristics studied/ analyzed by XPS. (CO3)**[3]**

**3[a].** Discuss working and principle of FTIR. Consider a FTIR pattern of any compound and show finger print and characteristic regions in it and explain. Write the wavenumbers of C-O, C-C and C=O stretches. (CO3) [3]

**[b].** Discuss the working and principle of Fluorescence microscope. How it is better than bright field microscope? (CO4) [3]

**4[a].** Discuss about secondary electron (SE), backscattered electron (BSE) and X-rays ejection and their applications in material characterization for a scanning electron microscope (SEM). (CO4) [3]

**[b].** Explain briefly: (i) Magnetic force microscopy(MFM) (CO4) **[1.5]**
(ii) Atomic absorption spectroscopy (AAS) (CO3) **[1.5]**

**5[a].** Discuss about contact and non contact mode of Atomic force microscope (AFM). Using force – distance curve, explain the cantilever and tip interaction with the specimen to measure adhesion force using AFM. (CO4) [4]

**[b].** Define Peizo sensitivity in AFM, if a cantilever travels a distance of 40 nm during adhesion force measurement for a deflection of 5 V signal, calculate the sensitivity of peizo crystal. (CO2) [2]

**6[a].** Explain the principle, working and application of thermal gravimetric technique (TGA). Write any example for multiple transition with weight losses and signify the transition process. (CO5) [4]

**[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) [2]

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*Roll No...*

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

**Ph.D.**
**May-2023**

## NST504: Design and Synthesis of Nanostructures

*Time: 3:00 Hours*

*Max. Marks: 40*

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

Q1. Briefly compare the nanoparticle synthesis methods, namely physical, chemical, and biological, and discuss the advantages and disadvantages of these processes. [7]

Q2. How sol-gel process is different from the colloidal method? Explain the xerogel, aerogel and cryogel processes. Also, describe the point of zero charge and zeta potential. [7]

Q3. Briefly discuss the Laser ablation method of production of nanoparticles. Which is the common laser used for the process and why? [6]

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

Q5. Write short notes on any **Two** of the following. [5×2=10]

(a) Bottom-up and Top-down approaches
(b) Chemical vapour and physical vapour deposition methods
(c) Ball milling method
(d) Sputtering method
(e) Electrospinning method

Total no. of Pages: 01 49 Roll No.....

2nd Semester

M.Tech

End Term Examination May-2023

ISY502 High Performance Computing System

Time:3 Hours Max marks : 40

Note: All questions are compulsory.

Q.1 Design a computing cluster from Single Board Computer heterogeneous computers for Internet of Things applications [8][CO1,4]

OR

Design a cloud architecture for the Internet of Things applications. [8][CO1,4]

Q.2 Explain Process Migration with desirable features and major activities of good process migration. [8][CO2,3]

Q.3 Describe Processor Thrashing and Load Balancing Approaches and issues in designing load-balancing algorithms. [8][CO3,]

Q.4 What are Parallel Interface Libraries? Differentiate between Parallel Virtual Machine(PVM) and Message Passing Interface(MPI). [8][CO 5]

Q.5 Explain the following: [4*2=8][CO1,2,3,4]

a. Service model-based cloud.
b. Deployment model based cloud
c. Graphics Processing Unit
d. CISC

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*Total No. of Pages* 2

Roll No.....

**SECOND SEMESTER**
**M.TECH. [ ISY]**

**END TERM EXAMINATION** **(May- 2023)**

**ISY504 COMPUTER NETWORK AND APPLICATIONS**

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

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

Q.1[a] Define the terms static, adaptive and hierarchical routing. How does Link state routing overcome the shortcomings of Distance Vector Routing?

[b] Compare open as closed loop congestion by giving one technique for each . **(4+4=8)(CO3)**

Q.2[a] The Internet uses OSPF and the interior routing protocol. Justify the given statement.

[b] Why does the IPv6 header have fewer fields than IPv4? Or does it **(4+4=8)(CO3)**

Q.3[a] Explain the mechanism of sending and receiving e-mails(with attachments) and associated protocols SMTP, POP amd IMAP.

[b] FTP uses TCP and not UDP, Justify. **(6+2=8)(CO4)**

Q.4[a] Compare the UDP and TCP protocols through their header formats.

[b] What issues would be caused if a TCP/IP network using the Nagel's Algorithm stopped using it? **(6+2=8)(CO4)**

Q.5[a] Explain in detail how sliding window protocol is used for transport layer flow, why does it differ from flow control at layer 2 ?

[b] What is the significance of pseudo header and concept of "Port" at the transport layer? **(6+2=8)(CO4)**

Q.6[a] What is the Network ID, subnet mask , broadcast address, First Usable IP and Last Usable IP on the subnet that a node 192.186.1.15/27 belongs to? If the given block was to be divided among four subnets determine the First and Last Usable IP of each subnet. **(CO3)**

[b] Show using the above network as example advantage or disadvantage of CIDR over Classful addressing **(4+4=8)(CO5)**

Q.7 Write Short notes on :

a] HTTP

b] DNS

**(4+4=8)(CO5)**

********END********

*Total No. of Pages: 02* *Roll No.*_____

**SECOND SEMESTER** **M.Tech. (ISY)/Ph.D.**

**MID SEMESTER EXAMINATION** **MAY-2023**

# ISY-5410 MACHINE LEARNING AND APPLICATIONS

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

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

**Question No. 1** **[2x4=8]**

**[a]** What is need of optimization in Machine Learning? And what is exploding gradient issue. [CO1]

**[b]** Consider two AI based Speaker Systems (A, B), where A speaks truth in 70% of cases, B in 50% of cases. Find the probability that they will speak the same thing while describing a certain event? [CO2]

**[c]** Differentiate between Hierarchical and Partitional Clustering [CO4]

**[d]** What are the steps involved in a typical Reinforcement Learning algorithm? [CO5]

**Question No. 2** **[4x2=8]**

**[a]** Consider a training dataset as given in below Table, classify whether a given car *{Red, Domestic, SUV}* will be stolen or not using Naïve Bayes. [CO3]

| Example No. | Color | Type | Origin | Stolen? |
|---|---|---|---|---|
| 1 | Red | Sports | Domestic | Yes |
| 2 | Red | Sports | Domestic | No |
| 3 | Red | Sports | Domestic | Yes |
| 4 | Yellow | Sports | Domestic | No |
| 5 | Yellow | Sports | Imported | Yes |
| 6 | Yellow | SUV | Imported | No |
| 7 | Yellow | SUV | Imported | Yes |
| 8 | Yellow | SUV | Domestic | No |
| 9 | Red | SUV | Imported | No |
| 10 | Red | Sports | Imported | Yes |

**[b]** Suppose you are given the following positively labelled data points: {(3, 1), (3, -1), (6, 1), (6, -1)} and the following negatively labelled data points: {(1, 0), (0, 1), (0, -1), (-1, 0)}. Find the equation of the separating hyperplane that accurately discriminates the two classes using Support Vector Machine. [CO3]

**Question No. 3** **[4x2=8]**

**[a]** A coin is flipped 100 times, given that there were 40 tails, find the maximum likelihood estimate for the probability $p$ of tail on a single toss using Log Likelihood, and consider $p$ as a binomial probability. [CO2]

**[b]** In a Gradient Descent optimization, what is the requirement of the error function? And if an error function is denoted as $f(x) = x^4 - 2x^3 - 1$, then determine the point which may create a problem for optimization in Gradient Descent. [CO2]

**Question No. 4** **[4x2=8]**

**[a]** What is over fitting in training and testing of data? And discuss how it can be resolved?

**[b]** The sea bass and salmon fishes are categorized based on length and weight as given in below Table. Predict an unknown sample of weight 5 and length 6 using linear regression model.

| S.No. | Weight | Length | Class |
|---|---|---|---|
| 1 | 3 | 5 | Sea Bass |
| 2 | 7 | 8 | Salmon |
| 3 | 12 | 5 | Sea bass |
| 4 | 16 | 9 | Salmon |
| 5 | 20 | 8 | Sea bass |
| 6 | 5 | 6 | ? |

**Question No. 5** **[4x2=8]**

**[a]** Define Agglomerative Hierarchical clustering. The table below is an example of a distance matrix. Obtain single linkage and complete linkage dendrogram for the above distance matrix using the concept of "Agglomerative Hierarchical Clustering". [CO4]

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

**[b]** Four points A (1, 1), B (2, 1), C (4, 3) and D (5, 4) are lying on a 2-dimensional X-Y plane. Group them into 2 clusters by calculating Euclidean distance using a K-means clustering algorithm. Show all the intermediate centroids and clusters in each iteration. [CO4]

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**2nd SEMESTER**
**M.Tech./Ph.D (IEM)**

**END SEMESTER EXAMINATION** **(May–2023)**

**IEM-502 Operations Research**

*Time: 3:00Hours* *Maximum Marks: 40*

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

1. Given the following LPP [CO#5]

Maximize: $z = -x_1 + 2x_2 - x_3$

Subject to: $3x_1 + x_2 - x_3 \le 10;\quad -x_1 + 4x_2 + x_3 \ge 6;$

$x_2 + x_3 \le 4;\ x_1, x_2, x_3 \ge 0.$

and its optimal solution is given in the following table:

| | $C_j$ (for maxima) | -1 | 2 | -1 | 0 | 0 | 0 | -M | |
|---|---|---|---|---|---|---|---|---|---|
| $C_B$ | Basis | $x_1$ | $x_2$ | $x_3$ | $s_1$ | $s_2$ | $s_3$ | $A_2$ | B |
| 0 | $s_1$ | 3 | 0 | -2 | 1 | 0 | -1 | 0 | 6 |
| 2 | $x_2$ | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 4 |
| 0 | $s_2$ | 1 | 0 | 3 | 0 | 1 | 4 | -1 | 10 |
| | $z_j$ | 0 | 2 | 2 | 0 | 0 | 2 | 0 | 8 |
| | $C_j$-$z_j$ | -1 | 0 | -3 | 0 | 0 | -2 | -M | |

[a] Find the range of $b_3$ consistent with optimal feasible solution and also obtain the new optimal solution for $b_3$=12. (7)

[b] Find the range of $c_2$ consistent with optimal feasible solution and also find the new optimal solution for $c_2$=4. (3)

2. [a] Suppose that all car owners fill up when their tanks are exactly half full. At the present time, an average of 7.5 customers per hour arrive at a single-pump gas station. It takes an average of 4 minutes to service a car. Assume that inter-arrival times and service times are both exponential. (i) For the present situation, compute average number of customers present in the queuing system (L) and average time a customer spends in the system (W). (ii) Suppose that a gas shortage

occurs and panic buying takes place. To model this phenomenon, suppose that all car owners now purchase gas when their tanks are exactly three-quarters full. Since each car owner is now putting less gas into the tank during each visit to the station, we assume that the average service time has been reduced to 3 1 3 minutes. How has panic buying affected L and W? (5) [CO#3]

[b] What is goal programming? Write the steps of GP model formulation. (5)[CO#1]

3. Solve the following IPP problem using Gomory algorithm. (10) [CO#4]

Maximize: $Z = 2x_1 + 10x_2 + x_3$

Subject to: $5x_1 + 2x_2 + x_3 \le 15$; $2x_1 + x_2 + 7x_3 \le 20$; $x_1 + 3x_2 + 2x_3 \le 25$;

All variables non-negative and integral.

Use following LPP optimal solution to proceed for IPP optimal solution:

| | $C_j$ | 2 | 10 | 1 | 0 | 0 | 0 | |
|---|---|---|---|---|---|---|---|---|
| $C_B$ | Basis | $x_1$ | $x_2$ | $x_3$ | $s_1$ | $s_2$ | $s_3$ | B |
| 10 | $x_2$ | 5/2 | 1 | 1/2 | 1/2 | 0 | 0 | 15/2 |
| 0 | $s_2$ | -1/2 | 0 | 13/2 | -1/2 | 1 | 0 | 25/2 |
| 0 | $s_3$ | -13/2 | 0 | 1/2 | -3/2 | 0 | 1 | 5/2 |
| | $Z_j$ | 25 | 10 | 5 | 5 | 0 | 0 | 75 |
| | $C_j$-$Z_j$ | -23 | 0 | -4 | -5 | 0 | 0 | |

4[a] Certain fixed number of homogeneous units needs to be delivered from city 1 to city 7. The number of alternative routes is possible to reach city 7 by passing through five more cities denoted as city 2 to city 6. Distance between cities in miles of all possible routes is given. Find the shortest path by applying Dijkstra's algorithm after drawing the network flow diagram. (5)[CO#4]

| Cities | 1-2 | 1-3 | 2-3 | 2-4 | 2-5 | 3-4 | 3-5 | 3-7 | 4-6 | 5-6 | 6-7 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Distance (Miles) | 5 | 6 | 6 | 9 | 4 | 8 | 2 | 25 | 15 | 12 | 12 |

[b] Explain the procedure of Prim's algorithm for solving minimum spanning tree problems. (5) [CO#2]

5[a] What are various elements of a queuing system? Explain Kendall's notation for representing queing models. (5) [CO#1]

[b] What is the travelling salesman problem? How its solution does is different from the solution of the assignment problem? (5) [CO#1]

6. Write shot notes on **any two** of the following topics (2X5) [CO#2]

[a] Duality theory; [b] Kruskal's algorithm; [c] Branch and bound algorithm.

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SS

2nd SEMESTER

Course: M.TECH (IEM)

# Delhi Technological University

## END SEMESTER EXAMINATION MAY-2023

### IEM-504, Supply Chain Management

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)** Discuss the characteristics of different types of supplier relationships.

**(b)** An auto manufacturer sources both office supplies and subsystems such as seats. What, if any, difference in sourcing strategy would you recommend for the two types of products?

**[5×2=10][CO1]**

**2(a)** Identify the push/pull boundary and two processes each in the push and pull phases.

**(b)** Why do you think assembly in the consumer electronics industry is performed by third parties, whereas assembly in the auto industry is almost never outsourced?

**[5×2=10][CO2]**

**3(a)** The flow of information has become more and more important in supply chain management. Describe the key impacts of information on supply chain performance in terms of responsiveness and efficiency with reference to the logistics industry.

**(b)** Do you expect aggregation of inventory at one location to be more effective when a company such as Dell sells computers or when a company such as Amazon sells books? Explain by considering transportation and inventory costs.

**[5×2=10][CO3]**

**4(a)** For a manufacturer that sells to many retailers, why does a quantity flexibility contract result in less information distortion than a buyback contract?

**(b)** What are some scenarios in which postponing product differentiation across all products may not be profitable? How can tailored postponement help in such situations?

**[5×2=10][CO4]**

**5(a)** Write a note on close-loop supply chain OR Circular economy and its components.

**(b)** What are some benefits to improved sustainability of a supply chain?

**[5×2=10][CO5]**

**6(a)** How do the location and size of warehouses affect the performance of a firm such as Amazon? What factors should Amazon take into account when deciding where and how big its warehouses should be?

**(b)** Write short notes on Agile Supply Chain and the factors influencing the agility of a supply chain. **[5×2=10][CO6]**

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Total No. of pages 2 Roll No.....

THIRD SEMESTER M. TECH(IEM)

**END SEMESTER EXAMINATION MAY 2023**

**IEM 5210 Contemporary Issues in Industrial Engineering and Management**

**Time 3 Hours Max. Marks: 100**

| Note: | Assume suitable missing data, if any<br>Answer ALL QUESTIONS |
|---|---|

1. ''Many innovations on technology-based approaches are well-suited to the enhancement of Supply Chain Management.'' Explain the information and technology applications for SCM. (Marks 10) (CO#1,2)

*(or)*

Discuss the scope of latest Technology in Operations Management (Marks 10) (CO#1,2)

2. Write explanatory notes on (Marks 10) (CO# 2)

(a) Management by Participation (b) Management by objectives

*(or)*

Discuss Herzberg's two factor theory of Motivation and discuss the managerial implications. (Marks 10) (CO#2)

*Case study: I*

*Approximately 40 million customers visit Starbucks each week. Customers will pay a higher price for a cup of coffee, compared with that in local establishments; because Starbucks delivers consistent product and service quality to give customers a "Starbucks Experience" that is inimitable in the industry. The ability to set a new benchmark in product quality and customer service has been the cornerstone of its business. Starbucks's excellent global reputation developed from management belief in human capital and in treating employees as the company's greatest asset. Jim Donald, CEO and president of Starbucks, believes that human resources should attend every strategic discussion concerning the company. By aligning human resources management and delivering word-class customer service to customers. Employees at Starbucks are expected to cooperate and work together to meet the demands of their customers. Starbucks attracts and retained the best and the brightest in the industry due to the high level of satisfaction that employees receive while on the job. To increase employee's passion to deliver high level of customer service. Starbucks offers a multitude of training options to employees so they may become coffee masters. Starbucks has created a competitive advantage by creating a workforce that is very knowledgeable and passionate about what it does.*

Questions

3. Do you believe that Starbucks's corporate culture has given the organization a competitive in the industry? Explain (Marks 10) (CO#4)
4. What makes Starbucks more desirable to work than other coffee shops? Would you prefer to work at Starbucks? Why or not? Discuss. (Marks 10) (CO#3,4)

*Case study: II*

*Workers and management at Whirlpool Appliance's Benton Harbor plant in Michigan have set an example of how to achieve productivity gains, which has benefited not only the company and its stockholders, but also Whirlpool customers, and the workers themselves. Things weren't always rosy at the plant. Productivity and quality weren't good. Neither were labor-management relations. Workers hid defective parts so management wouldn't find them, and when machines broke down, workers would simply sit down until sooner or later someone came to fix it. All that changed in the late 1980s. Faced with the possibility that the plant would be shut down, management and labor worked together to find a way to keep the plant open. The way was to increase productivity-producing more without using more resources. Interestingly, the improvement in productivity didn't come by spending money on fancy machines. Rather, it was accomplished by placing more emphasis on quality. That was a shift from the old way, which emphasized volume, often at the expense of quality. To motivate workers, the company agreed to gain sharing, a plan that rewarded workers by increasing their pay for productivity increases. The company overhauled the manufacturing process, and taught its workers how to improve quality. As quality improved, productivity went up because more of the output was good, and costs went down because of fewer defective parts that had to be scrapped or reworked. Costs of inventory also decreased, because fewer spare parts were needed to replace defective output, both at the factory and for warranty repairs. And workers have been able to see the connection between their efforts to improve quality and productivity. Not only was Whirlpool able to use the productivity gains to increase workers' pay, it was also able to hold that lid on price increases and to funnel some of the savings into research.*

Questions (Marks 10) (CO#5)

5. What were the two key things that Whirlpool management did to achieve productivity gains? How are productivity and quality related?

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Roll no.....

II SEMESTER

M.Tech.

END TERM EXAMINATION

*MAY-2023*

IEM-5304 INTERNATIONAL LOGISTICS AND WAREHOUSE MANAGEMENT

*Time: 3:00 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 key drivers of globalization and how have they impacted international trade? [5] [CO1]

Q.1 b) What are the risks and challenges associated with outsourcing, and how can companies mitigate these risks? [5] [CO1]

Q.2 a) What role does technology play in managing transportation in the supply chain, and how can it be used to enhance visibility and coordination? [5] [CO2]

Q.2 b) What are the environmental considerations that companies need to take into account when outsourcing logistics functions to a 3PL or 4PL provider, and how can they reduce their carbon footprint? [5] [CO2]

Q.3 a) Explain the best practices for material handling in the warehouse, and how can companies minimize the risk of damage or loss during transportation and storage? [5] [CO3]

Q.3 b) How can companies design and optimize their warehouse layout to maximize space utilization, reduce inventory costs, and improve operational efficiency? [5] [CO3]

Q.4 a) Explain the various key factors that companies need to consider when redesigning their supply chain, and how can they balance the trade-offs between cost, speed, and flexibility? [5] [CO4]

Q.4 b) What are the emerging trends and innovations in risk management, including the use of artificial intelligence and machine learning to enhance risk assessment and management? [5] [CO4]

Q.5 a) How can companies leverage technology and data analytics to optimize their reverse logistics operations, including visibility, efficiency, and cost-effectiveness? [5] [CO5]

Q.5 b) What are the emerging trends and innovations in reverse logistics, including the use of blockchain technology and other advanced solutions to improve visibility and efficiency? [5] [CO5]

Q.6 a) How can businesses measure the effectiveness of their transport security strategies, and explain the various key performance indicators (KPIs) that they should track? [5] [CO2]

Q.6 b) Discuss how would you set up a collaboration mechanism for the enterprises in a supply chain? [5] [CO1]

Q.7 Write the short notes on

a) Role of scale of logistics [5] [CO5]

b) Characteristics of the remanufacturing environment in reverse logistics [5] [CO5]

Total No. of Pages: 03 Roll No.....

2nd Sem

M.Tech

END SEMESTER EXAMINATION May-2023

IEM 5404: Industry 4.0 and Smart Manufacturing

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

**Note: 1. QUESTION NUMBER 1 IS COMPULSORY.**
Attempt and FOUR from remaining questions; assume missing data if any.
2. Substantiate your answers with illustration and examples.

1 A five decades old company is engaged in the business of packing material for food items (manufacturing of packing material, food processing machinery and maintenance of machinery). It has a presence in more than 50 countries. Discuss the following issues for this company in context with implementing Industry 4.0 and Smart Manufacturing: [CO5][8]

(a) The three digital capabilities the company should aim for.
(b) Soft and hard elements in justifying the digitization project
(c) Blueprint of smart and connected factory
(d) Mobile and virtual access solutions

**OR**

A world leader beauty products company (large and complex) is rethinking its vision under Industry 4.0 environment as the world is on the cusp of a digital future full of possibilities. Discuss:

(a) How digitalization will affect its products and consumer expectations.

(b) What are the various dimensions of complexities for such type of business and company.

(c) How Industry 4.0 will leverage the supply chain management to improve efficiency and user experience.

2a What is Industry 4.0? Discuss the design principles of Industry 4.0. [CO1][4]

2b What are drivers and enablers of the Industry 4.0? Briefly discuss the challenges for a light engineering works in implementing Internet of Things (IOT) [CO2][4]

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3 Justify the following statements: [CO2][8]

a) Industry 4.0 helps in reducing machine downtime.
b) Industry 4.0 leads to improved efficiency and productivity.
c) Industry 4.0 leads to zero defects manufacturing.
d) Industry 4.0 leads to development of products that interact with the consumer

4 Discuss the various dimension of Smart Manufacturing at the level of (a) Device, (b) Supervisory Control and Data Acquisition (SCADA), (c) Manufacturing Operations Management Level (MOM) and (d) Enterprise Level. [CO2,CO5][8]

Also develop an integrated framework of Smart Manufacturing.

5a What do you understand by Robot, Autonomous Robot, Autonomous Mobile Robot and Cobot. [CO1][4]

5b Discuss the applications of Autonomous Robots in an Automobile Welding Shop. Also briefly outline the physical layer, network layer and application layer of the Autonomous Robot. [CO2,CO3][4]

6 What is the difference between Augmented Reality (AR) and Virtual Reality (VR)? How these technologies can be used in (a) onsite maintenance of plants and equipment (b) Military. [CO3,CO5][8]

Briefly discuss the features of the AR/VR App to be developed by an IT company for the elevator industry to aid in maintenance and repair.

7 Write Brief notes on [CO1,CO5][8]

(a) Big Data
(b) 3D Printing
(c) Future of Works and Skills for Workers in the Industry 4.0 Era
(d) Industry 4.0 and Sustainability

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*Total No. of Pages:01* *Roll No. .....*

**2nd SEMESTER**

**M.Tech**

**End Term Examination** **May-2023**

**IT5310 Applied Cryptography**

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

**Note:** Answer **all** questions

Assume suitable missing data, if any.

Q.1 Explain the AES algorithm with a neat diagram and explain the steps. (8) [CO 1]

Q.2 Explain the Diffie Hellman key exchange. Use it to exchange key between A and B (8) [CO 2]

Consider q=353, α= 3 ( 3 is primitive root of 353)

Q.3 Give a brief of RSA algorithm. Choosing the two primes as p=3 and q=11. generate the set of public and private keys using RSA. (8) [CO 2]

OR

Explain the idea of Elliptic curve cryptography. How it is different from other asymmetric key algorithms? What are its vulnerability and strengths? (8) [CO 2]

Q.4 What are the criteria that a function must fulfill to be eligible for a hash function? Explain how the message digest is created in Secure Hash Algorithm 1 (SHA 1). (7) [CO 3]

Q.5 What is the difference between message authentication and entity authentication? Explain with a suitable example. What are the different witnesses by which a claimant must identify herself to the verifier? (7) [CO3]

Q.6 What is the need to design a new protocol called X.509 even though the certification authority has solved the problem of public key fraud? Give a detailed description of all the fields in the X.509 certificate. (6) [CO4]

Q.7 State some applications of key establishment protocols. (6) [CO4]

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*Total no. of Pages:3* *Roll no .....*

**Ph. D Coursework**

**END TERM EXAMINATION** ***May-2023***

**HU- 703 Econometrics**

***Time: 03:00 Hours*** ***Max. Marks: 60***

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

Q.1 We may be concerned that the bivariate model is inappropriate. Consider the extended multivariate regression;

$\ln\_wage_i = \alpha + \beta tenure_i + \gamma_1 BlueCollar_i + \gamma_2 WhiteCollar_i + \dot{\varepsilon}_i$

where BlueCollar and WhiteCollar are mutually exclusive dummy variables equal to one if the individual's occupation is classified as blue collar and white collar, respectively. The estimation output from this regression is included below.

```
. gen WhiteCollar = (occupation == 1)

. gen Managerial = (occupation == 2)

. gen BlueCollar = (occupation == 3)

. reg ln_wage tenure BlueCollar WhiteCollar
```

| Source | SS | df | MS | Number of obs | = | 2,231 |
|---|---|---|---|---|---|---|
| | | | | F(3, 2227) | = | 127.78 |
| Model | 107.530402 | 3 | 35.8434674 | Prob > F | = | 0.0000 |
| Residual | 624.686666 | 2,227 | .280505912 | R-squared | = | 0.1469 |
| | | | | Adj R-squared | = | 0.1457 |
| Total | 732.217068 | 2,230 | .328348461 | Root MSE | = | .52963 |

| ln_wage | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| tenure | .0299802 | .0020387 | 14.71 | 0.000 | .0259822 | .0339782 |
| BlueCollar | -.1886312 | .0260202 | -7.25 | 0.000 | -.2396575 | -.1376048 |
| WhiteCollar | -.3471735 | .0288962 | -12.01 | 0.000 | -.4038399 | -.2905072 |
| _cons | 1.852852 | .0225853 | 82.04 | 0.000 | 1.808561 | 1.897142 |

a. Give an interpretation of the estimate on tenure.
b. Calculate a 90 percent confidence interval for β. Give an interpretation of this interval.
c. Test the hypothesis H0: $\beta = 0.05$ on the 5 percent-level. [5+5+5]

Q.2

a. Why do we use Durbin-Watson d Test? Write a short note on this.
b. What is the difference between ordinary least square estimators and generalized least square estimators?
c. Explain the Koyck approach to Distributed-Lag Model. [5+5+5]

Q.3 Suppose that the number of traffic accidents (N) is a function of the number of cars on the road (C) and the average speed of cars on the road (S). The true population relationship between accidents, cars and average speed is given by:

$N = 1000 + 50C + 25S + \varepsilon$

where ε is a random error that meets all of our standard assumptions. The number of cars on the road is negatively correlated with average speed due to the increased congestion associated with additional cars. The true population relationship between the number of cars and average speed is given by:

$S = 80 - 4C + \nu$

where ν is a random error that meets all of our standard assumptions.

a. If you ran a regression with N as the dependent variable and C and S as the independent variables, what would the expected value of the estimated slope coefficient for C be? Assume that you include a constant term in your regression.
b. If you ran a regression with N as the dependent variable and C as the only independent variable, what would the expected value of the estimated slope coefficient for C be? Assume that you include a constant term in your regression.
c. Suppose that you ran a regression with average speed as the dependent variable and number of cars on the road as the independent variable but you forced the intercept to be zero (in other words, you do not include a constant term). Will the expected value of the estimated slope coefficient be greater than, equal to or less than the true population value of the slope coefficient? Include a written explanation and a scatter plot showing speed as a function

of number of cars to illustrate your answer. Assume that we always observe positive numbers of cars and positive average speeds. [5+5+5]

Q.4 Suppose that we are interested in the relationship between hours of weekly exercise and resting heart rate. The more a person exercises on average, the lower his or her resting heart rate is. For individuals who don't exercise at all, males have a lower resting heart rate on average than females. The decrease in resting heart rate from an additional hour of exercise per week is bigger for males than females.

a. Write down the regression model you would use to estimate the relationship between resting heart rate, gender and weekly exercise. Resting heart rate should be your dependent variable. Provide clear definitions of all variables you include in your model.

b. Based on the information given above, what are the expected signs for each of your coefficients in the regression model you specified in part (a)?

c. Suppose people tend to make random mistakes when measuring their heart rate. What effects will this have on the estimation results when you run the regression model specified in part (a)? [5+5+5]

Q.5

a. What are the theoretical and practical consequences of multicollinearity?

b. Consider that in the true model, $\alpha = 0$, but that you included the constant term in the regression. How would you expect this to affect your estimates? [10+5]

Q.6 What do you understand by Heteroscedasticity? Discuss two methods to detect it. [5+10]

Total no. of Pages: 01 67 Roll no.....

FIRST SEMESTER

**Ph.D Course Work**

**END TERM EXAMINATION** **May-2023**

## HU-708 Gender and Technology

*Time: 03:00 Hours* *Max. Marks: 50*

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

Q.1 What do you mean by Gender? Discuss relevance of gender in development of New Technology. [CO#1and 3]

Q.2 How significant is discussion on class in understanding contemporary use of technology? Discuss. [CO# 3]

Q.3 Discuss economic theories on Women. [CO# 2]

Q.4 How has technological change affected the ideas of gender? Discuss. [CO#2]

Q.5 Examines how technology offers possibilities for new social relations and how to evaluate them at work place? [ CO#2 and 3]

Q.6 Discuss concept of Gender Budgeting and its relevance. [CO#1and2]

Q.7 Discuss significance of Gender in Marketing. [CO#2]

Total Number of pages 2 68 Roll No. .....

II- SEMESTER M.Tech.(Env. Engg.)

END-TERM EXAMINATION MAY-2023

**ENE502 Water Engineering Design.**

Duration: 3:00 Hours Maximum Marks: 40

**Note: All questions are compulsory.** Marks CO

**Assume suitable missing data, if any.**

Q1 Design the approximate dimensions of a set of rapid gravity filters for treating water required for a population of 70,000 ; the rate of supply being 180 litres per day per person. The filters are rated to work 6000 litres per hour per sq m. Assume whatever data are necessary, and not given. 5

Q2 Chlorine usage in the treatment of 30,000 cubic metre per day is 15 kg/day. The residual after 10 min. contact is 0.20 mg/l. Calculate the dosage in milligrams per litre and chlorine demand of the water. 4

Q3 Prove that the area and overflow rates rather than the detention period govern the design of a settling tank. 5

Q4 Explain any one of the following terms:- 4
(i) Water Softening.
(ii) Clariflocculation

Q5 What is an intake structure? Enumerate the various types of intakes and discuss in detail with diagram any one of them. 5

Q6 A rectangular sedimentation basin is to handle 15 million litres/day of raw water. A detention basin of width to length ration of 1/3 is proposed to trap all particles larger than 0.04mm in size. Assuming a relative density of 2.85 and 20°c as the average temperature, compute the basin dimensions. If the depth of the tank is 3.0 m, calculate the detention time. 5

Q7 Design a river intake with respect to (i) number & size of the opening in the intake well; (ii) size, shape & height of the intake well; (iii) the gravity pipe for raw water connecting the intake well and jack well. The data supplied is :- 6

R.L. of river bed = 115m
R. L. of lowest water level = 118m
R. L. of high flood level = 127m
R. L. Of normal water level = 122m
Population = 95,000
Average water demand = 250l/head/d.

OR

Q7 Design a coagulation cum sedimentation tank with continuous flow for a population of 55,000 persons with a daily per capita water demand of 130 litres. Make necessary assumptions where needed. Sketch the coagulation cum sedimentation tank with dimensions.

Q8 The analysis of a hard water shows the following compositions: 6

| | | |
|---|---|---|
| Free carbon dioxide | = | 4 mg/l |
| Alkalinity | = | 70 mg/l |
| Non-carbonate hardness | = | 94 mg/l |
| Total magnesium | = | 17 mg/l |

Assume that it is possible to remove all but 32 mg/l of carbonate hardness with lime, and that the treated water is to have a total hardness of 83 mg/l. Determine the amount of hydrated lime and soda required for treatment per million litre of raw water.

Total no. of Pages:01 72 Roll no.....

SECOND SEMESTER M.Tech

**END TERM EXAMINATION** ***May-2023***

**EN5306 GREEN TECHNOLOGY & SUSTAINABILITY**

***Time: 03:00 Hours*** ***Max. Marks: 50***

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

Q.1 (a) Define sustainable development. Why is it important and what are the challenges in the field of sustainable development? Explain.
(b) Green technology includes different aspects of technologies that reduce the impact of humanity on the environment and establish new ways of sustainable development. Comment. [10][CO1]

Q.2 (a) What is the latest breakthrough in fusion technology? What are the implications of this breakthrough in the field of green technology?
(b) What are biofuels? What are the uses of algal biofuels and why is algae a favourite candidate for this purpose? Discuss. [10][CO4]

Q.3 (a) How green innovation is beneficial to the ecosystem? What are the challenges associated with green innovations? Explain.
(b) Discuss the various renewable energy resources and point out the major problems associated with their demand and supply. [10][CO4]

Q.4 (a) Discuss the emerging green technologies for wastewater treatment and the challenges associated with it.
(b) Explain the greener approach towards reduction of pollution for paper and pulp industry. [10][CO2]

Q5. (a) Enlist the principles of Green Chemistry. Explain any three in detail.
(b) Explain the green initiatives being adopted in order to design a residential complex as a self-sustainable unit. [10][CO1, CO2]

Q.6 Write short notes on
(a) Ecological restoration
(b) Green product management
(c) Bioremediation
(d) Greening the Indian transport sector [10][CO3]

Total No. of Page 1 Roll No. .....

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END TERM EXAMINATION

MAY 2023

ENE 5202 Environmental Policy and Law

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

**Note: Attempt any FIVE questions. All questions carry equal marks.**

1. Before enforcing any policy in a state, what are the different stages that need to be considered by the implementing authorities. (10) [CO 3]
2. Write short notes on any two of the followings: (10) [CO 2]
   (i) Economic perspective with reference to policy making constraints
   (ii) Nairobi Declaration
   (iii) Direct regulation as a policy instrument
3. In your opinion which criterion is the most important for choosing policy instrument in the context of your country along with a detailed discussion about all the policy instruments? (10) [CO 4]
4. (a) Critically analyse the priority activities of Agenda 21 in context of the capital city of India (5) [CO 4]
   (b) Significant contribution of the Stockholm conference on the Human Environment (5) [CO 1]
5. (a) How and what penalties will you decide under different sections violating the provisions in the EPA Act? (5) [CO 3]
   (b) Highlight the importance of Sec. 19.1 & 24.5 in Air Act along with the drawback of this act. (5) [CO 1]
6. (a) Mention the year against the following environmental regulations: (5) [CO 1]
   (i) All India Elephant Preservation Act
   (ii) Earth Summit
   (iii) Forest (Conservation) Rules
   (iv) Batteries (M&H) Rules
   (v) The National Environment Tribunal Act
   (b) Discuss the importance of Section 16 A with reference to CPCB under water act. (5) [CO 2]

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SECOND SEMESTER M.TECH. (ENE)

END-TERM EXAMINATION MAY– 2023

ENE-504 SOLID WASTE MANAGEMENT

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

[redacted]

1. Discuss the configuration and significance of following landfill components
   a) Double-liner system 4[CO3]
   b) Top Cover 4[CO3]

2. a) A community of 20000 people generates MSW at a rate of 0.5 kg p person per day. The compacted unit weight of MSW in the collection truck is 500 kg/m$^3$. If the capacity of collection truck is 15m$^3$, how many truckloads of MSW, on average, will be unloaded at the landfill each year? 8[CO2]

3. a) Briefly discuss the challenges associated with composting of organic was in India. 4[CO1]
   b) Discuss the working of a thermal WTE plant in detail. 4[CO1]

4. Estimate the landfill area required to handle 15 year's MSW for a town of 100000 people. The per capita waste generation is 0.65Kg/day; landfi density is 500Kg/m$^3$, with FIVE three metre lifts. Assume that 20% of the cell volume is soil used for cover, and additional 4.0 hectare land is requir for other operations. 8[CO4]

5. Write short notes on
   a) Reduction at Source 4[CO2]
   b) Integrated solid waste management 4[CO2]

6. MSW 'as delivered' has 65.1% of paper, food waste, yard trimmings, wo and other decomposable matter. The moisture content of this waste is 35%. The elemental analysis of decomposable has following mass percentages:

| Element | C | H | O | N | Other | Total |
|---|---|---|---|---|---|---|
| Dry Mass (%) | 45.2 | 6.0 | 43.7 | 0.43 | 4.67 | 10 |

Find the chemical formula for the C, H, O, N portion of decomposable. Also find out the percentage of methane generated, per kilogram of waste. 8[CO5]

Total no. of Pages 02

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Roll no.....

II[nd] SEMESTER

M.Tech.

**END TERM EXAMINATION** ***May-2023***

**ENE5402 GLOBAL WARMING AND CLIMATE CHANGE**

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

**Note :** All questions are compulsory.

Assume suitable missing data, if any.

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

   [b] Assume that you are an Environmental Engineer working in the city of Gurgaon and your responsibility is to manage the Municipal Solid Waste (MSW) in the city which is just being dumped to the nearby non-engineered landfill site. Suggest projects you may put up in order to better manage the MSW and which can also earn carbon credits for the Municipal Corporation. 5 [CO5]

2. [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]Explain how stratospheric Ozone remains in dynamic equilibrium of chemical processes of formation and destruction? [5][CO1]

3. [a] A 0.27 $km^2$ 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] Owing to the population increase in India, there is an increase demand on the production of food grains. Also, the climate change is posing a threat to the food security. What measures **have been taken** / **should be taken** by the Indian Government to tackle this problem? 5 [CO

4. [a] What are the various catalytic reactions that goes on in the atmosphere in relation to Ozone? Briefly explain. 5 [CO
[b] What is IPCC? What was the objective of setting up IPCC? 5 [CO3]

5. [a]Explain the term "Adaptation" and "Mitigation" with reference to climate change. 2 [CO

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

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

[d]Differentiate between feedback mechanism and radiative forcing. 2[CO1]

[e]List out the adaptation and mitigation strategies adopted by India in order to address climate change. 2[CO4]

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*Total No. of Pages: 5* *Roll No.....*

**2nd SEMESTER**

**M.Tech DSC-II (Deptt. of SE)**

**END TERM EXAMINATION** **May-2023**

**DSC502 -DATA PREPARATION AND ANALYSIS**

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

**Note:** Assume suitable missing data, if any.
Simple calculators are allowed.
Do all the parts of a question together.

Q1. a) A Co. X has developed a new bulb whose design specifications call for a light output of 960 lumens compared to an earlier model that produced only 750 lumens. The company's data indicate that standard deviation of light output for this type of bulb is 18.4 lumens. From a sample of 20 new bulbs the testing committee found an average light of output of 954 lumens per bulb. At a 5% significance level, can the company conclude that its new bulb is producing the specified 960 lumens output. [6 marks]

b) An IT company estimated last year that 35% of potential software buyers were planning to wait to purchase their new opening system until an upgrade has been received. After an advertising campaign the company surveyed 3000 people and found 950 who were still skeptical and wanted to wait. At 5% significance level can the company conclude that the proportion of skeptical people had decreased. [4 marks]

Q2 a) Consider a study in which a sample of 15 people has been observed while using toothpastes A, B, C respectively. Let us assume that 5 of the participants have been randomly assigned to each of the treatments and the study has provided the following data:

No. of cavities during the study period

| Observations | A | B | C |
|---|---|---|---|
| | 19 | 20 | 18 |
| | 15 | 25 | 12 |
| | 22 | 22 | 16 |
| | 17 | 19 | 17 |
| | 19 | 23 | 15 |
| Total | 92 | 109 | 78 |

(i) Is there any significant difference in the mean value of cavities by using the three toothpastes? Test at $\alpha = 0.05$. [6 marks]

(ii) Compute r-squared. [1 mark]

b) What are the assumptions of OLS? [3 marks]

Q3 a) Regression equations of two variables X and Y are as follows: $8X-10Y = 64$; $40X-18Y = 320$. Find

(i) Regression coefficients

(ii) Coefficient of correlation between X and Y

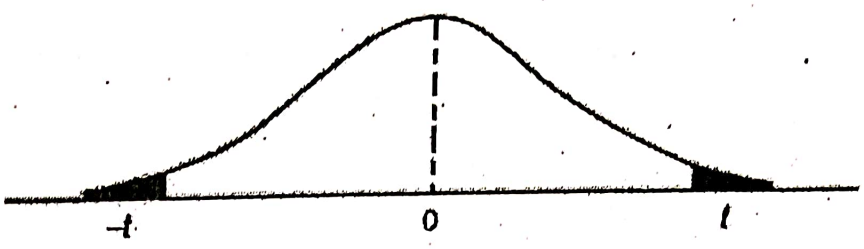
(iii) If variance of $X = 4$, find variance of Y. [6 marks]

b) Explain the properties of a good estimator. [4 marks]

Q4. Answer the following (answer the questions in sequence)

a) What is standard normal distribution? [1 mark]
b) What is standard estimate of error? [1 mark]
c) What are Dependent samples? [1 mark]
d) Difference between parametric and non-parametric test? [1 mark]
e) How do you handle the outliers in the data? If there are too many outliers in the data, which will be the most representative average value – Mean, Median, Mode, Geometric Mean, Harmonic Mean? [2 marks]
f) What is Central Limit theorem? What is its significance? [2 marks]
g) Explain the difference between estimator, estimate and estimation using example. [2 marks]

# Tables attached below: t, z, F

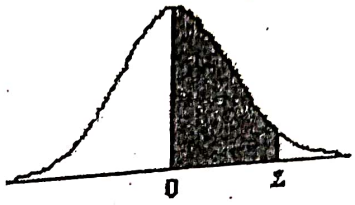



| Degrees of freedom | 0.80 | 0.60 | 0.40 | 0.20 | 0.10 | 0.05 | 0.02 | 0.0 |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.325 | 0.727 | 1.376 | 3.078 | 6.314 | 12.706 | 31.821 | 63.66 |
| 2 | 0.289 | 0.617 | 1.061 | 1.886 | 2.920 | 4.303 | 6.965 | 9.92 |
| 3 | 0.277 | 0.584 | 0.978 | 1.638 | 2.353 | 3.182 | 4.451 | 5.84 |
| 4 | 0.271 | 0.569 | 0.941 | 1.533 | 2.132 | 2.776 | 3.747 | 4.60 |
| 5 | 0.267 | 0.559 | 0.920 | 1.476 | 2.015 | 2.571 | 3.365 | 4.03 |
| 6 | 0.265 | 0.553 | 0.906 | 1.440 | 1.943 | 2.447 | 3.143 | 3.70 |
| 7 | 0.263 | 0.549 | 0.896 | 1.415 | 1.895 | 2.365 | 2.998 | 3.49 |
| 8 | 0.262 | 0.546 | 0.889 | 1.397 | 1.860 | 2.306 | 2.896 | 3.35 |
| 9 | 0.261 | 0.543 | 0.883 | 1.383 | 1.833 | 2.262 | 2.821 | 3.25 |
| 10 | 0.260 | 0.542 | 0.879 | 1.372 | 1.812 | 2.228 | 2.764 | 3.16 |
| 11 | 0.260 | 0.540 | 0.876 | 1.363 | 1.796 | 2.201 | 2.718 | 3.10 |
| 12 | 0.259 | 0.539 | 0.873 | 1.356 | 1.782 | 2.179 | 2.681 | 3.05 |
| 13 | 0.259 | 0.538 | 0.870 | 1.350 | 1.771 | 2.160 | 2.650 | 3.01 |
| 14 | 0.258 | 0.537 | 0.868 | 1.345 | 1.761 | 2.145 | 2.624 | 2.97 |
| 15 | 0.258 | 0.536 | 0.866 | 1.341 | 1.753 | 2.131 | 2.602 | 2.94 |
| 16 | 0.258 | 0.535 | 0.865 | 1.337 | 1.746 | 2.120 | 2.583 | 2.92 |
| 17 | 0.257 | 0.534 | 0.863 | 1.333 | 1.740 | 2.110 | 2.567 | 2.89 |
| 18 | 0.257 | 0.534 | 0.862 | 1.330 | 1.734 | 2.101 | 2.552 | 2.87 |
| 19 | 0.257 | 0.533 | 0.861 | 1.328 | 1.729 | 2.093 | 2.539 | 2.86 |
| 20 | 0.257 | 0.533 | 0.860 | 1.325 | 1.725 | 2.086 | 2.528 | 2.84 |
| 21 | 0.257 | 0.532 | 0.859 | 1.323 | 1.721 | 2.080 | 2.518 | 2.83 |
| 22 | 0.256 | 0.532 | 0.858 | 1.321 | 1.717 | 2.074 | 2.508 | 2.81 |
| 23 | 0.256 | 0.532 | 0.858 | 1.319 | 1.714 | 2.069 | 2.500 | 2.80 |
| 24 | 0.256 | 0.531 | 0.857 | 1.318 | 1.711 | 2.064 | 2.492 | 2.79 |
| 25 | 0.256 | 0.531 | 0.856 | 1.316 | 1.708 | 2.060 | 2.485 | 2.78 |
| 26 | 0.256 | 0.531 | 0.856 | 1.315 | 1.706 | 2.056 | 2.479 | 2.77 |
| 27 | 0.256 | 0.531 | 0.855 | 1.314 | 1.703 | 2.052 | 2.473 | 2.77 |
| 28 | 0.256 | 0.530 | 0.855 | 1.313 | 1.701 | 2.048 | 2.467 | 2.76 |
| 29 | 0.256 | 0.530 | 0.854 | 1.311 | 1.699 | 2.045 | 2.462 | 2.75 |
| 30 | 0.256 | 0.530 | 0.854 | 1.310 | 1.697 | 2.042 | 2.457 | 2.75 |
| 40 | 0.255 | 0.529 | 0.851 | 1.303 | 1.684 | 2.021 | 2.423 | 2.70 |
| 60 | 0.254 | 0.527 | 0.848 | 1.296 | 1.671 | 2.000 | 2.390 | 2.66 |
| 120 | 0.254 | 0.526 | 0.845 | 1.289 | 1.658 | 1.980 | 2.358 | 2.61 |
| ∞ | 0.253 | 0.524 | 0.842 | 1.282 | 1.645 | 1.960 | 2.326 | 2.57 |

# Z table

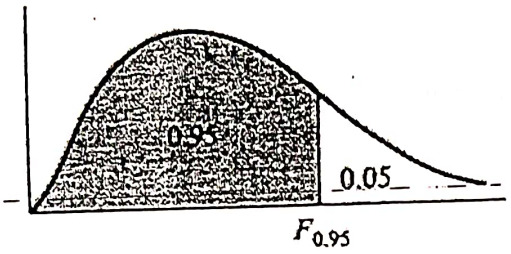
## Normal Curve Areas

The entries in the body of the table correspond to the area shaded under the normal curve.




| z | 0.00 | 0.01 | 0.02 | 0.03 | 0.04 | 0.05 | 0.06 | 0.07 | 0.08 | 0.09 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 0.0000 | 0.0040 | 0.0080 | 0.0120 | 0.0160 | 0.0199 | 0.0239 | 0.0279 | 0.0319 | 0.0359 |
| 0.1 | 0.0398 | 0.0438 | 0.0478 | 0.0517 | 0.0557 | 0.0596 | 0.0636 | 0.0675 | 0.0714 | 0.0753 |
| 0.2 | 0.0793 | 0.0832 | 0.0871 | 0.0910 | 0.0948 | 0.0987 | 0.1026 | 0.1064 | 0.1103 | 0.1141 |
| 0.3 | 0.1179 | 0.1217 | 0.1255 | 0.1293 | 0.1331 | 0.1368 | 0.1406 | 0.1443 | 0.1480 | 0.1517 |
| 0.4 | 0.1554 | 0.1591 | 0.1628 | 0.1664 | 0.1700 | 0.1736 | 0.1772 | 0.1808 | 0.1844 | 0.1879 |
| 0.5 | 0.1915 | 0.1950 | 0.1985 | 0.2019 | 0.2054 | 0.2088 | 0.2123 | 0.2157 | 0.2190 | 0.2224 |
| 0.6 | 0.2257 | 0.2291 | 0.2324 | 0.2357 | 0.2389 | 0.2422 | 0.2454 | 0.2486 | 0.2517 | 0.2549 |
| 0.7 | 0.2580 | 0.2611 | 0.2642 | 0.2673 | 0.2703 | 0.2734 | 0.2764 | 0.2794 | 0.2823 | 0.2852 |
| 0.8 | 0.2881 | 0.2910 | 0.2939 | 0.2967 | 0.2995 | 0.3023 | 0.3051 | 0.3078 | 0.3106 | 0.3133 |
| 0.9 | 0.3159 | 0.3186 | 0.3212 | 0.3238 | 0.3264 | 0.3289 | 0.3315 | 0.3340 | 0.3365 | 0.3389 |
| 1.0 | 0.3413 | 0.3438 | 0.3461 | 0.3485 | 0.3508 | 0.3531 | 0.3554 | 0.3577 | 0.3599 | 0.3621 |
| 1.1 | 0.3643 | 0.3665 | 0.3686 | 0.3708 | 0.3729 | 0.3749 | 0.3770 | 0.3790 | 0.3810 | 0.3830 |
| 1.2 | 0.3849 | 0.3869 | 0.3888 | 0.3907 | 0.3925 | 0.3944 | 0.3962 | 0.3980 | 0.3997 | 0.4015 |
| 1.3 | 0.4032 | 0.4049 | 0.4066 | 0.4082 | 0.4099 | 0.4115 | 0.4131 | 0.4147 | 0.4162 | 0.4177 |
| 1.4 | 0.4192 | 0.4207 | 0.4222 | 0.4236 | 0.4251 | 0.4265 | 0.4279 | 0.4292 | 0.4306 | 0.4319 |
| 1.5 | 0.4332 | 0.4345 | 0.4357 | 0.4370 | 0.4382 | 0.4394 | 0.4406 | 0.4418 | 0.4429 | 0.4441 |
| 1.6 | 0.4452 | 0.4463 | 0.4474 | 0.4484 | 0.4495 | 0.4505 | 0.4515 | 0.4525 | 0.4535 | 0.4545 |
| 1.7 | 0.4554 | 0.4564 | 0.4573 | 0.4582 | 0.4591 | 0.4599 | 0.4608 | 0.4616 | 0.4625 | 0.4633 |
| 1.8 | 0.4641 | 0.4649 | 0.4656 | 0.4664 | 0.4671 | 0.4678 | 0.4686 | 0.4693 | 0.4699 | 0.4706 |
| 1.9 | 0.4713 | 0.4719 | 0.4726 | 0.4732 | 0.4738 | 0.4744 | 0.4750 | 0.4756 | 0.4761 | 0.4767 |
| 2.0 | 0.4772 | 0.4778 | 0.4783 | 0.4788 | 0.4793 | 0.4798 | 0.4803 | 0.4808 | 0.4812 | 0.4817 |
| 2.1 | 0.4821 | 0.4826 | 0.4830 | 0.4834 | 0.4838 | 0.4842 | 0.4846 | 0.4850 | 0.4854 | 0.4857 |
| 2.2 | 0.4861 | 0.4864 | 0.4868 | 0.4871 | 0.4875 | 0.4878 | 0.4881 | 0.4884 | 0.4887 | 0.4890 |
| 2.3 | 0.4893 | 0.4896 | 0.4898 | 0.4901 | 0.4904 | 0.4906 | 0.4909 | 0.4911 | 0.4913 | 0.4916 |
| 2.4 | 0.4918 | 0.4920 | 0.4922 | 0.4925 | 0.4927 | 0.4929 | 0.4931 | 0.4932 | 0.4934 | 0.4936 |
| 2.5 | 0.4938 | 0.4940 | 0.4941 | 0.4943 | 0.4945 | 0.4946 | 0.4948 | 0.4949 | 0.4951 | 0.4952 |
| 2.6 | 0.4953 | 0.4955 | 0.4956 | 0.4957 | 0.4959 | 0.4960 | 0.4961 | 0.4962 | 0.4963 | 0.4964 |
| 2.7 | 0.4965 | 0.4966 | 0.4967 | 0.4968 | 0.4969 | 0.4970 | 0.4971 | 0.4972 | 0.4973 | 0.4974 |
| 2.8 | 0.4974 | 0.4975 | 0.4976 | 0.4977 | 0.4977 | 0.4978 | 0.4979 | 0.4979 | 0.4980 | 0.4981 |
| 2.9 | 0.4981 | 0.4982 | 0.4982 | 0.4983 | 0.4984 | 0.4984 | 0.4985 | 0.4985 | 0.4986 | 0.4986 |
| 3.0 | 0.4987 | 0.4987 | 0.4987 | 0.4988 | 0.4988 | 0.4989 | 0.4989 | 0.4989 | 0.4990 | 0.4990 |
| 3.1 | 0.4990 | 0.4991 | 0.4991 | 0.4991 | 0.4992 | 0.4992 | 0.4992 | 0.4992 | 0.4993 | 0.4993 |
| 3.2 | 0.4993 | 0.4993 | 0.4994 | 0.4994 | 0.4994 | 0.4994 | 0.4994 | 0.4995 | 0.4995 | 0.4995 |
| 3.3 | 0.4995 | 0.4995 | 0.4995 | 0.4996 | 0.4996 | 0.4996 | 0.4996 | 0.4996 | 0.4996 | 0.4997 |
| 3.4 | 0.4997 | 0.4997 | 0.4997 | 0.4997 | 0.4997 | 0.4997 | 0.4997 | 0.4997 | 0.4997 | 0.4998 |
| 3.5 | 0.4998 | 0.4998 | 0.4998 | 0.4998 | 0.4998 | 0.4998 | 0.4998 | 0.4998 | 0.4998 | 0.4998 |
| 3.6 | 0.4998 | 0.4998 | 0.4999 | 0.4999 | 0.4999 | 0.4999 | 0.4999 | 0.4999 | 0.4999 | 0.4999 |
| 3.7 | 0.4999 | 0.4999 | 0.4999 | 0.4999 | 0.4999 | 0.4999 | 0.4999 | 0.4999 | 0.4999 | 0.4999 |
| 3.8 | 0.4999 | 0.4999 | 0.4999 | 0.4999 | 0.4999 | 0.4999 | 0.4999 | 0.4999 | 0.4999 | 0.4999 |
| 3.9 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 |

# Values of F for F Distributions with 0.05 of the Area in the Right




$\nu_1$ degrees of freedom in numerator

$\nu_2$ degrees of freedom in denominator

**tail**

| $\nu_2$ \ $\nu_1$ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 12 | 15 | 20 | 24 | 30 | 40 | 60 | 120 | $\infty$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 161 | 200 | 216 | 225 | 230 | 234 | 237 | 239 | 241 | 242 | 244 | 246 | 248 | 249 | 250 | 251 | 252 | 253 | 254 |
| 2 | 18.5 | 19.0 | 19.2 | 19.2 | 19.3 | 19.3 | 19.4 | 19.4 | 19.4 | 19.4 | 19.4 | 19.4 | 19.4 | 19.5 | 19.5 | 19.5 | 19.5 | 19.5 | 19.5 |
| 3 | 10.1 | 9.55 | 9.28 | 9.12 | 9.01 | 8.94 | 8.89 | 8.85 | 8.81 | 8.79 | 8.74 | 8.70 | 8.66 | 8.64 | 8.62 | 8.59 | 8.57 | 8.55 | 8.53 |
| 4 | 7.71 | 6.94 | 6.59 | 6.39 | 6.26 | 6.16 | 6.09 | 6.04 | 6.00 | 5.96 | 5.91 | 5.86 | 5.80 | 5.77 | 5.75 | 5.72 | 5.69 | 5.66 | 5.63 |
| 5 | 6.61 | 5.79 | 5.41 | 5.19 | 5.05 | 4.95 | 4.88 | 4.82 | 4.77 | 4.74 | 4.68 | 4.62 | 4.56 | 4.53 | 4.50 | 4.46 | 4.43 | 4.40 | 4.37 |
| 6 | 5.99 | 5.14 | 4.76 | 4.53 | 4.39 | 4.28 | 4.21 | 4.15 | 4.10 | 4.06 | 4.00 | 3.94 | 3.87 | 3.84 | 3.81 | 3.77 | 3.74 | 3.70 | 3.67 |
| 7 | 5.59 | 4.74 | 4.35 | 4.12 | 3.97 | 3.87 | 3.79 | 3.73 | 3.68 | 3.64 | 3.57 | 3.51 | 3.44 | 3.41 | 3.38 | 3.34 | 3.30 | 3.27 | 3.23 |
| 8 | 5.32 | 4.46 | 4.07 | 3.84 | 3.69 | 3.58 | 3.50 | 3.44 | 3.39 | 3.35 | 3.28 | 3.22 | 3.15 | 3.12 | 3.08 | 3.04 | 3.01 | 2.97 | 2.93 |
| 9 | 5.12 | 4.26 | 3.86 | 3.63 | 3.48 | 3.37 | 3.29 | 3.23 | 3.18 | 3.14 | 3.07 | 3.01 | 2.94 | 2.90 | 2.86 | 2.83 | 2.79 | 2.75 | 2.71 |
| 10 | 4.96 | 4.10 | 3.71 | 3.48 | 3.33 | 3.22 | 3.14 | 3.07 | 3.02 | 2.98 | 2.91 | 2.85 | 2.77 | 2.74 | 2.70 | 2.66 | 2.62 | 2.58 | 2.54 |
| 11 | 4.84 | 3.98 | 3.59 | 3.36 | 3.20 | 3.09 | 3.01 | 2.95 | 2.90 | 2.85 | 2.79 | 2.72 | 2.65 | 2.61 | 2.57 | 2.53 | 2.49 | 2.45 | 2.40 |
| 12 | 4.75 | 3.89 | 3.49 | 3.26 | 3.11 | 3.00 | 2.91 | 2.85 | 2.80 | 2.75 | 2.69 | 2.62 | 2.54 | 2.51 | 2.47 | 2.43 | 2.38 | 2.34 | 2.30 |
| 13 | 4.67 | 3.81 | 3.41 | 3.18 | 3.03 | 2.92 | 2.83 | 2.77 | 2.71 | 2.67 | 2.60 | 2.53 | 2.46 | 2.42 | 2.38 | 2.34 | 2.30 | 2.25 | 2.21 |
| 14 | 4.60 | 3.74 | 3.34 | 3.11 | 2.96 | 2.85 | 2.76 | 2.70 | 2.65 | 2.60 | 2.53 | 2.46 | 2.39 | 2.35 | 2.31 | 2.27 | 2.22 | 2.18 | 2.13 |
| 15 | 4.54 | 3.68 | 3.29 | 3.06 | 2.90 | 2.79 | 2.71 | 2.64 | 2.59 | 2.54 | 2.48 | 2.40 | 2.33 | 2.29 | 2.25 | 2.20 | 2.16 | 2.11 | 2.07 |
| 16 | 4.49 | 3.63 | 3.24 | 3.01 | 2.85 | 2.74 | 2.66 | 2.59 | 2.54 | 2.49 | 2.42 | 2.35 | 2.28 | 2.24 | 2.19 | 2.15 | 2.11 | 2.06 | 2.01 |
| 17 | 4.45 | 3.59 | 3.20 | 2.96 | 2.81 | 2.70 | 2.61 | 2.55 | 2.49 | 2.45 | 2.38 | 2.31 | 2.23 | 2.19 | 2.15 | 2.10 | 2.06 | 2.01 | 1.96 |
| 18 | 4.41 | 3.55 | 3.16 | 2.93 | 2.77 | 2.66 | 2.58 | 2.51 | 2.46 | 2.41 | 2.34 | 2.27 | 2.19 | 2.15 | 2.11 | 2.06 | 2.02 | 1.97 | 1.92 |
| 19 | 4.38 | 3.52 | 3.13 | 2.90 | 2.74 | 2.63 | 2.54 | 2.48 | 2.42 | 2.38 | 2.31 | 2.23 | 2.16 | 2.11 | 2.07 | 2.03 | 1.98 | 1.93 | 1.88 |
| 20 | 4.35 | 3.49 | 3.10 | 2.87 | 2.71 | 2.60 | 2.51 | 2.45 | 2.39 | 2.35 | 2.28 | 2.20 | 2.12 | 2.08 | 2.04 | 1.99 | 1.95 | 1.90 | 1.84 |
| 21 | 4.32 | 3.47 | 3.07 | 2.84 | 2.68 | 2.57 | 2.49 | 2.42 | 2.37 | 2.32 | 2.25 | 2.18 | 2.10 | 2.05 | 2.01 | 1.96 | 1.92 | 1.87 | 1.81 |
| 22 | 4.30 | 3.44 | 3.05 | 2.82 | 2.66 | 2.55 | 2.46 | 2.40 | 2.34 | 2.30 | 2.23 | 2.15 | 2.07 | 2.03 | 1.98 | 1.94 | 1.89 | 1.84 | 1.78 |
| 23 | 4.28 | 3.42 | 3.03 | 2.80 | 2.64 | 2.53 | 2.44 | 2.37 | 2.32 | 2.27 | 2.20 | 2.13 | 2.05 | 2.01 | 1.96 | 1.91 | 1.86 | 1.81 | 1.76 |
| 24 | 4.26 | 3.40 | 3.01 | 2.78 | 2.62 | 2.51 | 2.42 | 2.36 | 2.30 | 2.25 | 2.18 | 2.11 | 2.03 | 1.98 | 1.94 | 1.89 | 1.84 | 1.79 | 1.73 |
| 25 | 4.24 | 3.39 | 2.99 | 2.76 | 2.60 | 2.49 | 2.40 | 2.34 | 2.28 | 2.24 | 2.16 | 2.09 | 2.01 | 1.96 | 1.92 | 1.87 | 1.82 | 1.77 | 1.71 |
| 26 | 4.23 | 3.37 | 2.98 | 2.74 | 2.59 | 2.47 | 2.39 | 2.32 | 2.27 | 2.22 | 2.15 | 2.07 | 1.99 | 1.95 | 1.90 | 1.85 | 1.80 | 1.75 | 1.69 |
| 27 | 4.21 | 3.35 | 2.96 | 2.73 | 2.57 | 2.46 | 2.37 | 2.31 | 2.25 | 2.20 | 2.13 | 2.06 | 1.97 | 1.93 | 1.88 | 1.84 | 1.79 | 1.73 | 1.67 |
| 28 | 4.20 | 3.34 | 2.95 | 2.71 | 2.56 | 2.45 | 2.36 | 2.29 | 2.24 | 2.19 | 2.12 | 2.04 | 1.96 | 1.91 | 1.87 | 1.82 | 1.77 | 1.71 | 1.65 |
| 29 | 4.18 | 3.33 | 2.93 | 2.70 | 2.55 | 2.43 | 2.35 | 2.28 | 2.22 | 2.18 | 2.10 | 2.03 | 1.94 | 1.90 | 1.85 | 1.81 | 1.75 | 1.70 | 1.64 |
| 30 | 4.17 | 3.32 | 2.92 | 2.69 | 2.53 | 2.42 | 2.33 | 2.27 | 2.21 | 2.16 | 2.09 | 2.01 | 1.93 | 1.89 | 1.84 | 1.79 | 1.74 | 1.68 | 1.62 |
| 40 | 4.08 | 3.23 | 2.84 | 2.61 | 2.45 | 2.34 | 2.25 | 2.18 | 2.12 | 2.08 | 2.00 | 1.92 | 1.84 | 1.79 | 1.74 | 1.69 | 1.64 | 1.58 | 1.51 |
| 60 | 4.00 | 3.15 | 2.76 | 2.53 | 2.37 | 2.25 | 2.17 | 2.10 | 2.04 | 1.99 | 1.92 | 1.84 | 1.75 | 1.70 | 1.65 | 1.59 | 1.53 | 1.47 | 1.39 |
| 120 | 3.92 | 3.07 | 2.68 | 2.45 | 2.29 | 2.18 | 2.09 | 2.02 | 1.96 | 1.91 | 1.83 | 1.75 | 1.66 | 1.61 | 1.55 | 1.50 | 1.43 | 1.35 | 1.25 |
| $\infty$ | 3.84 | 3.00 | 2.60 | 2.37 | 2.21 | 2.10 | 2.01 | 1.94 | 1.88 | 1.83 | 1.75 | 1.67 | 1.57 | 1.52 | 1.46 | 1.39 | 1.32 | 1.22 | 1.00 |

**END**

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*Total no. of Pages: 01* *Roll no.....*

**2nd SEMESTER**

**M.Tech.**

**END TERM EXAMINATION** *May-2023*

**DSC 5406 Deep Learning**

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

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

Q.1 What is deep learning? Explain applications of deep learning along with the deep learning model that is best used for that application. [8][CO1]

Q.2 Explain YOLO algorithm with the help of an example. Explain advantages and disadvantages of YOLO algorithm. [8][CO4]

Q.3 Differentiate between Batch Gradient Descent, Stochastic Gradient Descent and Mini batch gradient Descent. Explain significance of pooling operation in CNN. [8][CO3]

Q.4 Briefly explain KNN. How do you choose optimal k in KNN? Does KNN suffer from the curse of dimensionality? If yes then explain why. [8][CO2]

Q.5 [a] Describe in detail following performance metrics:

[i] Accuracy
[ii] Misclassification Rate
[iii] Sensitivity
[iv] Specificity
[v] Precision
[vi] F-Score

[b] Describe Dissimilarity Matrix with an example. Describe dissimilarity measure for:

[i] Nominal Attributes
[ii] Ordinal Attributes

[6+2][CO2]

Q.6[a] Differentiate between GRU and LSTM.

[b] Define RNN. Explain functioning of RNN with the help of one example. [4+4][CO5]

Q.7 Explain Back Propagation with its algorithm. Why we need Back Propagation? [8][CO3]

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*Total No. of Pages 02* *Roll No. .....*

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

**END SEM EXAMINATION** May- *2023*

## C&I 502 INTELLIGENT CONTROL

*Time:3:00 Hours* *Max. Marks :100*

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

Q1[a]: [a] Explain Fuzzy P, Fuzzy PI, Fuzzy PD and Fuzzy PD+I controller. [CO2] [10+10]

[b] Explain the soft computing and hard computing terms. Give some examples of hard and soft computing. [CO1]

Q2[a] Define 1-norm, 2-norm and ∞-norm of signals, vectors and matrices. Define local Lipschitz property also. [CO1] [10+10]

[b] What are the induced 1-norm, 2-norm and ∞-norm of the vector X and matrix A. [CO1]

$$X=\begin{bmatrix}-9\\5\\6\end{bmatrix}$$

A= [2 1 -4; 3 7 2; 5 8 3]

Q3 Derive the equations of inverted pendulum system. Explain how the fuzzy logic controller can be implemented on inverted pendulum system using fuzzy logic toolbox. Give detail steps and diagrams. [CO3] [20]

Q4 [a] Explain the multilayer feedforward neural network. Explain with examples using mathematical calculations. [CO4] [10+10]

[b] Explain the recurrent neural network, Jordan, Elman networks, combined Jordan and Elman network. Draw the neat diagrams? [CO4]

Q5 Explain the Rule list used in fuzzy logic toolbox. Take a washing machine example and derive the rule list. Take two inputs Grease and Dirt and one output. Use three triangle linguistic variables for inputs and output. Draw all graphs of inputs and output neatly. Assume universe of discourse for inputs and output. Prepare rule base table. Write complete MATLAB program for washing machine. [CO3] [20]

Q6 [a] Explain Pre-processing, Fuzzification, Fuzzy Rule Base, Fuzzy Inference Engine, Defuzzification and post processing in Fuzzy logic controller. [CO2] [10+10]

[b] Discuss the term Intelligence and also Johnson and Picton's model with the help of neat diagram. [CO1]

Q7 [a] A fuzzy logic controller has inputs as error and change in error. Universe of discourse for error and change in error are from -5 to 5 and -2 to 2 respectively. Universe of discourse for output is from -10 to 10. All the membership functions are triangular. Linguistic variables for inputs and output are NB, Z and PB. Rule base is shown in table-1. 10+10 [CO2]

Table-1: Rule Base

| Error | Change in error | Output |
|---|---|---|
| NB | NB | NB |
| Z | NB | NB |
| PB | NB | Z |
| NB | Z | NB |
| Z | Z | Z |
| PB | Z | PB |
| NB | PB | Z |
| Z | PB | PB |
| PB | PB | PB |

Use Centre of area method to calculate crisp control signals u(t) when the error E(t) and rate of change of error CE(t) have the following values.

$$E(t)=1.5,\ CE(t) = 1.5$$

[b] Derive the mathematical modeling of separately excited DC motor. Describe the implementation of fuzzy control on it. Draw neat diagrams. [C02]

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Total No. of Pages 2

Roll No. .....

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

SECOND SEMESTER

**End Term Examination (May 6,2023)**

**C&I-504 PROCESS CONTROL**

Time: 3 Hours

Maximum Marks: 40

**Note: Question No. 1 is compulsory.** Answer **ANY four *questions*** from remaining.
Write your Roll number on question paper.
Assume suitable missing data, if any.

1 Answer the following questions in brief.

[a] Sketch an approximate unit step response of the following first order process with and without time delay element.

$G_p(s) = 6e^{-4s} / (9s + 1)$

[b] What is difference between split range control and selective control?

[c] What is the condition for effective operation of cascade control strategy in process Control?

[d] If the transfer function of a liquid level process is h(s)/q(s)= 0.75/2500s+1, Assuming an empty tank i.e. h(0)=0, find the level h after 2000 sec if the inflow valve is suddenly opened to allow a flow rate of 0.8 m3/sec

[e] Write input and out relation of a Proportional Derivative and Proportional Integral controller and state the effect of variations in derivative time and integral time on process dynamics.

[f] In a Jacketed Stirred Tank heater, identify the input and output variables.

[g] Give one example of multi variable process and identify input and out variables.

[h] What are the values of pressure for fully closed and fully open position of a fail open valve?

**(1x8)**

2. [a] Draw a schematic and also a block diagram for a pneumatic PD controller and explain its operation to control the pressure. Derive transfer function of the controller pc(s)/e(s). Define all notations used in deriving transfer function.

**(4)**

[b] Consider the process described by the following transfer function

$g(s) = 1/s^3+4s^2+s-6$

Use the Routh method to find the range of PI controller parameters ($K_c$,$\tau_I$) for which the *closed-loop* system is stable.

**(4)**

3. [a] What is the ratio control? Give few applications of ratio control. Explain with help of neat Process Instrumentation diagram and block diagram different approaches for implementing ratio control. Why indirect ratio control is preferred over direct ratio control?

**(4)**

[b] Consider the following first order plus time delay process

$$G(s) = \frac{100e^{-s}}{100s+1}$$

For a unit step change in the set point determine closed loop step response of this process using P only control based on Ziegler Nichols closed loop oscillations method. Sketch the time response behavior.

**(4)**

4. A storage tank is fed by an input flow rate Fi(t), and a steady rate of liquid (constant density) withdrawal is maintained by the constant speed pump at the tank outlet with flow rate F0. The tank's cross-sectional area is 2.5 $m^2$. The incoming flow rate fluctuates around its nominal

steady-state value in a sinusoidal fashion with a maximum deviation of 10 $m^3$/hr, and the frequency of the sinusoidal fluctuation is denoted by ω.

a. Derive from first principles the mathematical model for the change in height of liquid level in the tank.

b. If there is a steady state, what is Fi(t)?

c. Derive the time response of the liquid level in the tank (as a deviation from the steady state) as a function of time and frequency of the input flow rate. **(8)**

**5.** Consider the block diagram shown in Figure 1 that shows the combination of a cascade control with a feed forward controller designed to counteract the disturbance $d_1$. For this block diagram:

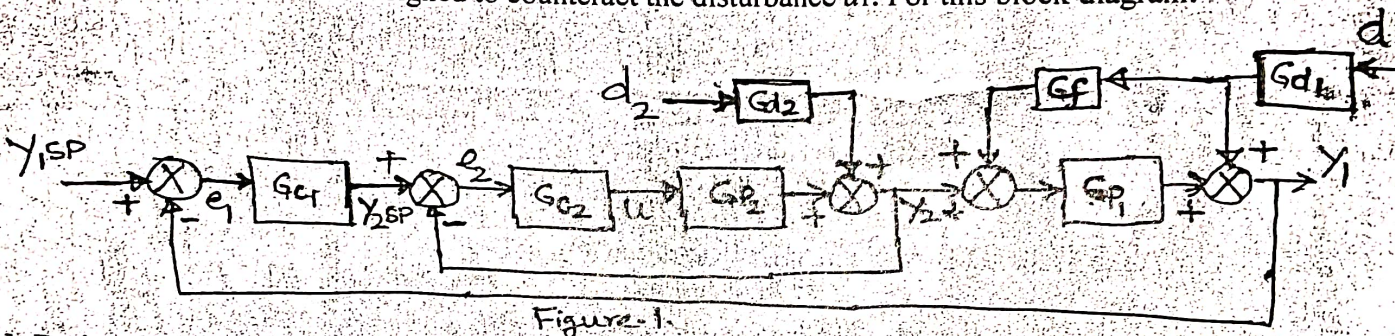



Figure-1.

[a]. Derive the closed-loop relation between $y_2(s)$ and $y_{2sp}$ and $d_2$. Represent the transfer functions in this relation as $g_1$ and $g_2$, i.e. $y_2(s) = g_1 y_{2sp} + g_2 d_2$. Similarly derive the closed-loop relation between $y_1(s)$ and $y_{1sp}$ and $d_1$.

[b]. Consider $g_{p2} = 1/(1+s)$ and $g_{c2} = K_2 = 1$. Then derive an expression for $y_2/y_{2sp}$. **(8)**

**6.** Consider a second-order system that has a single zero:

$G(s) = K(\tau_a s+1) /(\tau_1 s+1)(\tau_2 s+1)$ If $\tau_1 > \tau_2$, and for a unit step input:

[a]. Determine under what condition(s) will the output y(t) show an extremum (maximum or minimum).

[b]. Determine when inverse response can occur. **(8)**

**7.** Draw a neat internal layout of programmable logic controller and explain its classifications on the basis of number and types of inputs and outputs and other factors. What is the function of timer in PLC and what are their different types? **(8)**

No. of Pages:03 Roll No.....

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

**End Semester Examination** **May-2023**

**C&I5306 ANALOG FILTER DESIGN**

**Time: 03 Hours** **Maximum Marks: 50**

**Note:** Question No. 1 is compulsory
Answer any **Four** questions from the remaining 6 questions
All parts of must be attempted at same place.
Assume suitable value for missing data (if any) by giving suitable reasons.

1 [a] The pass band and stop band frequency are same for [CO1]
(i) Elliptic LPF
(ii) Chebishev LPF
(iii) Butterworth LPF
(iv) Brick wall LPF

[b] For a maximally flat LPF the pass band frequency $\omega_p$ and the 3-db frequency are related by ..... [CO4]

[c] Write down the transfer function of a third order all pass filter [CO1]

[d] The Miller's integrator is a non-inverting integrator (True/False) [C03]

[e] Give a passive realization of the following bilinear transfer function [CO1]

$$\frac{1(sCR-1)}{2(sCR+1)}$$

[f] The cutoff frequency, pole quality factor and gain(s) in a KHN filter are independently controllable (True/False) [CO3]

[g] The Tow-Thomas filter is a third order filter (True/false) [C03]

[h] In a Sallen and Key filter the maximum value of gain achievable, when the frequency setting resistors and capacitors have identical values and pole quality factor =0.5 is given by..... [CO2]

[j] The maximum value of the pole quality factor for real axis poles in a second order filter is equal to ..... [CO1]

[k] Draw the op-amp based circuit of a frequency dependent negative resistor. [CO3]

**[1X10]**

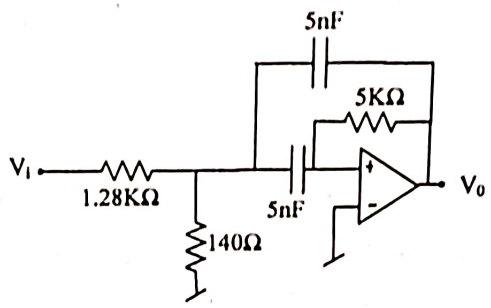
2[a] List out all the reasons due to which the following transfer function can't be realized [CO1][04]

$$\frac{3s^6 + 2s^2 - 0.8s + 1}{s^5 + 2.5s^4 - 1.2s^2 + (1 + 3.9l)s + 0.6}$$

[b] The normalized components of an active filter were computed to be $R_1 = 1.243$, $R_2 = R_3 = 1.677$, $R_4 = 6.888$ and $C_1 = C_2 = 0.765$; the amplifier gain is required to be $K = 1.93$. The normalizing frequency is $f_0 = 360$kHz. Choose the impedance levels such that the filter can be built with $C = 0.05$nF capacitors. Determine the remaining elements of the circuit including the final gain of the amplifier.

[CO1] **[06]**

3 Determine the center frequency, gain at the center frequency and the bandwidth of the bandpass filter circuit shown below. [CO2][**10**]

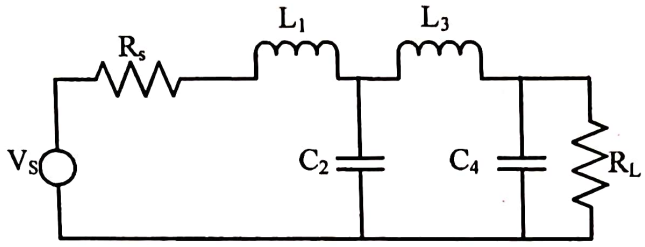



4 It is required to design a filter with the following specifications: $\alpha_{max} = 0.5$dB, $\alpha_{min} = 15$dB, $\omega_p = 1000$r/s, $\omega_s = 2000$r/s. The filter must have maximally flat magnitude response. Determine the order of the filter and give an RC active realization of the same. [CO4][**10**]

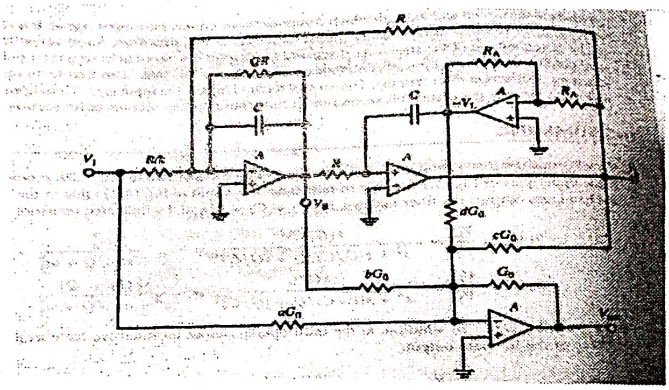
5[a] Find a maximally flat approximation for the highpass filter characterized by the following specifications: $\alpha_{min} = 15$dB, $\alpha_{max} = 3$dB, $f_p = 1000$ Hz, $f_s = 500$Hz. [CO4][**05**]

[b] Find the maximally flat approximation for the following bandpass specifications: $\alpha_{max} = 3$dB, $\alpha_{min} = 20$dB, $f_p = 1500$Hz-1000Hz, $f_{s1} = 0$-275Hz, $f_{s2} = 2000$Hz-$\infty$. [CO4][**05**]

6 Write down the equations necessary for operational simulation of the ladder given below and therefrom develop a leapfrog structure. Also give an op-amp RC realization of the same. [CO5][**10**]




7 Determine the transfer function $\frac{v_{out}}{v_1}$ for the circuit shown below. You may directly use the result(s) from some previously known prototype circuits. [CO3][**10**]



## APPENDIX

The following table contains the co-efficients of the Butterworth polynomial corresponding to the Butterworth transfer function of an all pole filter having the -3dB frequency of 1.

Denominator coefficients for polynomials of the form $S_n + a_{n-1}s^{n-1} + a_{n-2}s^{n-2} + \ldots\ldots\ldots + a_1 s + a_0$

| n | $a_0$ | $a_1$ | $a_2$ | $a_3$ | $a_4$ | $a_5$ | $a_6$ | $a_7$ | $a_8$ | $a_9$ |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | | | | | | | | | |
| 2 | 1 | 1.414 | | | | | | | | |
| 3 | 1 | 2.000 | 2.000 | | | | | | | |
| 4 | 1 | 2.613 | 3.414 | 2.613 | | | | | | |
| 5 | 1 | 3.236 | 5.236 | 5.236 | 3.236 | | | | | |
| 6 | 1 | 3.864 | 7.464 | 9.142 | 7.464 | 3.864 | | | | |
| 7 | 1 | 4.494 | 10.098 | 14.592 | 14.592 | 10.098 | 4.494 | | | |
| 8 | 1 | 5.126 | 13.137 | 21.846 | 25.688 | 21.846 | 13.137 | 5.126 | | |
| 9 | 1 | 5.759 | 16.582 | 31.163 | 41.986 | 41.986 | 31.163 | 16.582 | 5.759 | |
| 10 | 1 | 6.392 | 20.432 | 42.802 | 64.882 | 74.233 | 64.882 | 42.802 | 20.432 | 6.392 |

Total no. of Pages:03 Roll no.....

Second SEMESTER M.Tech. [C&I]

END TERM EXAMINATION May-2023

CODE: C&I-5402 COURSE TITLE: Intelligent Instrumentation

Time: 03:00 Hours Max. Marks: 40

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

**Q.1 (a)** What are the different approaches by which interference can be compensated, explain each. **[4][CO1]**

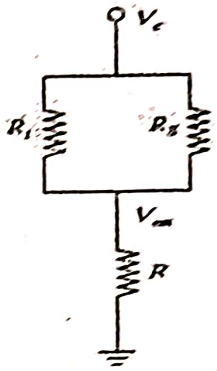
**(b)** A metallic strain gauge of resistance 120Ω and gauge factor 2.0, $\alpha=5\times10^{-3}$ Ω/Ω/°C, $\beta=1\times10^{-3}$ m/m/°C is bonded to a beam, which is subjected to a strain of 200μ and a temperature variation of 10°C. Determine the gauge factor and change in resistance due to α and β, also determine the temperature interfering output voltages for a power supply voltage of 12.0 V in the Wheatstone bridge circuit. **[4][CO1]**

**Q.2** In the tea industry, the drying of the fermented tea is carried out in drying machines. The extent of drying level of the tea is determined by the heat transfer mechanism of the dryer. Rough Set Theory was applied to develop rules to ascertain which variable mostly correlates the level of drying and their ranges. Following Table shows conditions that were summarized after taking readings of inlet air temperature (°C), feed rate of tea (number of trays/15 min), and dryer outlet temperature (°C) at Chinnamara Tea Estate, India. Determine the coefficients of Strength, Certainity factor and Coverage factor for each decision of the table shown. **[8][CO2]**

Tea Dryer Data

| Cases | Inlet Temperature Range (°C) | Feed Rate Range (Trays/15 min) | Outlet Temperature Range (°C) | Drying Status | Nos. of Reading |
|---|---|---|---|---|---|
| 1 | 85–90 | 3–5 | 65–70 | Normal | 20 |
| 2 | 90–100 | 5–10 | 65–70 | Normal | 25 |
| 3 | 100–115 | 3–5 | 65–70 | Normal | 14 |
| 4 | 100–115 | 3–5 | 65–70 | Over | 12 |
| 5 | 90–100 | 3–5 | 60–65 | Over | 22 |
| 6 | 85–90 | 10–15 | 70–80 | Under | 21 |
| 7 | 85–90 | 5–10 | 65–70 | Under | 25 |

**Q.3 (a)** The temperature compensating bridge shown in Figure below has a temperature sensitivity of 8 mV/°C and produces an output voltage of 100 mV (full scale)/volt bridge excitation. The bridge excitation $V_{ex}$ is 6.0 V when the circuit excitation is 8 V. The temperature compensation is accomplished by the PTC sensor with resistance at 25°C is 2.5 kΩ and the temperature coefficient of resistance is given by $\alpha_T = \frac{\alpha_{25}}{(1+\alpha_{25}\,\Delta T)}$ where $\alpha_{25}$ is the 0.077 Ω/°C and ΔT is the change in temperature of the sensor (K).




Take bridge resistance as 5.6 kΩ.

Determine

1. The shunting resistance $R_s$
2. The required and actual excitation voltages at 27°C.

**[4][CO2]**

**(b)** Determine the magnitude of the complex number 5+j10 by CORDIC computation. **[4][CO2]**

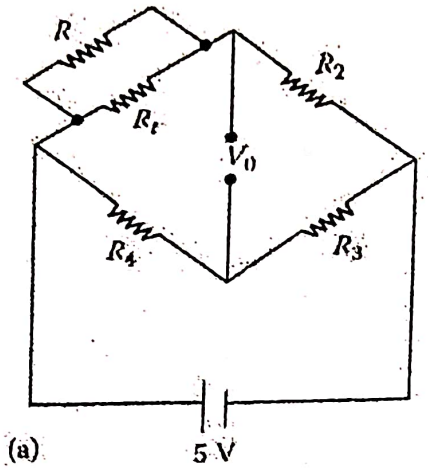
**Q.4 (a)** The signal frequency of the rotational sensor is measured by a microcontroller by reference frequency method using a clock of 10 MHz. Determine the minimum number of input cycle that can be used to measure the frequency with a 12-bit resolution if the sensor produces a signal of frequency 1–5 kHz. **[4][CO2]**

**(b)** List basic modules of IEEE 1451 standard and explain about STIM in detail.

**[4][CO4]**

**Q.5 (a)** A thermistor with $R_0$=5 kΩ at 25°C and β=3000 K is linearized over a temperature range of −20°C to 100°C by shunting with a resistor of optimal value R as shown in figure below. The parallel combination ($R_t$||R) is connected to branch-1 of an unbalanced Wheatstone bridge with a supply voltage of 5.0 V. The resistors of the other three branches are made equal to ($R_0$||R). The output voltage of the bridge is the linearized response of the thermistor.

Analyze the performance of the linearization methods using three equidistant temperature points: −20°C, 40°C and 100°C. **[4][CO3]**



(a)

**(b)** A 12-bit counter–type nonlinear ADC is configured with an EPROM where data for five different characteristic equations are stored. Determine the EPROM address format and EPROM size. **[4][CO3]**

**Q.6 (a)** Kindly show how is the sensitivity and per unit sensitivity of positive coefficient resistive sensor is affected by shunting with a constant resistance. **[4][CO3]**

**(b)** Explain working of Nonlinear Successive Approximation ADC. **[4][CO3]**

**Q.7** Write short note on:

**(a)** Types of learning in Neural Network. **[4][CO2]**

**(b)** What is loading effect and how it can be reduced in case of voltage output and in case of current output **[4][CO1]**

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Roll No.....

Total No. of Pages: 2

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. (a) What are different models of Distributed system.
(b) What are the design principles that should be followed for designing DS with better performance and fault tolerating quality?
(c) What are the issues in designing reliable DS.?

[2, 3,3]

Q.2 (a) Differentiate remote procedure call from conventional procedure call with help of an example. Also explain in detail parameter passing and stub generation.

(b) Describe the following in context of communication
(i) Message oriented transient communication techniques,
(ii) Message oriented persistent communication techniques.
(iii) Two level naming of process.
(iv) Role of binding agent in server binding.

[4,4]

Q.3 (a) Explain the steps of DOS for memory reference for distributed shared memory(DSM).
(b) Name different consistency models in Distributed Shared Memory and explain any three.
(C)Explain the protocol for data locating in replicated migrating blocks (centralized approach) including the block table contents.

[2,3,3]

Q.4 (a) Write the Lamport algorithm for implementing logical clock explaining its step with suitable example. What are its drawback? Explain a model for clock synchronization that overcomes these drawbacks.

(b) Explain the steps of token passing approach for entering in to critical section [CS] with the help of an example: Five processes (P1, P2, P3, P4, P5) are grouped in ring, Process P2 is in CS and P1, P4 are waiting to enter CS. Also estimate the waiting time for these processes to enter CS. What happens when token is lost?

[4,4]

Q.5 (a) Explain the method used for determining following factors to design Load Balancing algorithm
(i) Load estimation of a node
(ii) Process transfer policy ( double threshold)
(iii) Location Policy(Bidding)
(iv) State information exchange policy

(b) What are different activities that are performed for pre-emptive process migration? Discuss mechanism for address transfer and message forwarding.

[4, 4]

Q.6 (a) What are the different methods to create server initiated replicas? Give a protocol explaining steps with suitable examples.

(b) Discuss the different ways to propagate updated contents to relevant replica server?

(c) Describe the purpose and working of Quorum protocol with suitable examples.

Q.7 Write short notes on any two from followings: [2, 3,3]
(i) Case study of RPC
(ii) Cache Coherence.
(iii) File Sharing semantics with case study of DCE
(iv) Multicast or group communication.

[4, 4]

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Total No. of Pages 2
II -SEMESTER
END SEMESTER EXAMINATION

Roll No.....
M.Tech.(CSE)
May- 2023

CSE-504 ADVANCED COMPUTER NETWORKS

Time: 3:00 Hours

Max. Marks: 40

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

**Q.No. 1**

A. Explain modelling and measurement in context of computer networks and also discuss network coding techniques with example. [4][CO#2]

B. What is the need of overlay network? Explain Resilient Overlay Networks (RON) with conceptual design. [4][CO#4]

**Q.No. 2**

A. Why RSVP is used in networking? Does RSVP reservation protocol allow retaining the reserved path by the host for later use? Explain. [4][CO#2]

B. What is session initiation protocol (SIP)? How it works in VoIP protocol? And also explain difference between SIP and VoIP. [4][CO#2]

**Q.No.3**

A. What are the various network traffic modelling ? Explain Markov and Embedded Markov Models and Poisson Distribution Model. [4][CO#2]

B. What are the different issues in 4G mobile networks? How it is different from other emerging networks type? Explain in detail. [4][CO#3]

**Q.No. 4**

A. What are the different types of TCP for congestion control? Compare TCP Tahoe with TCP Reno and How TCP vegas is different from TCP Tahoe/Reno? [4][CO#1]

B. Explain following with suitable example [4][CO#2]
   i. VoIP
   ii. MAC Protocol

**Q.No. 5**

A. Explain Multi cast flow and congestion control and also explain working of Adhoc on demand distance vector (AODV) routing protocol with suitable example. [4][CO#3]

B. What is the difference between Slow Start Algorithm and Congestion Avoidance Algorithm? Explain the working of both algorithms with suitable example. [4][CO#1]

**Q.No.6**

A. What is the role of Traffic Policing and Traffic Shaping in computer networks? What are the types of scheduling to improve quality of service (QoS)?. [4][CO#1]

B. What is web caching? Explain its working with suitable example. [4][CO#4]

**Q.No.7 Explain challenges and issues in the following**

i. Online Social Networks(OSN) and P2P [4][CO#5]
ii. Wireless Sensor Networks - Cross layer sensor data dissemination [4][CO#5]

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*Total No. of Pages 2* *Roll No. .....*

**SECOND SEMESTER** **M.Tech. (CSE)**

**END SEMESTER EXAMINATION** *(May-2023)*

**CSE5214 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 impact the design and layout of multimedia applications? [CO1]

b) Describe a modern computer system's architecture and explain its key components' function. [CO1]

c) In what ways does the Quality of Service (QoS) architecture play a crucial role in upholding the dependable and efficient dissemination of multimedia content, while concurrently ensuring the maintenance of its quality? [CO5]

d) Justify, what you mean by securing multimedia applications? [CO1]

e) What are the various obstacles that may arise while attempting to guarantee accessibility in multimedia applications, and what strategies can be employed to overcome these impediments? [CO6] [2+2+2+2+2=10]

Q2. a) Explain the concepts of sampling and quantization in the context of audio and speech data. [CO2](4)

b) Describe the techniques used for low-bit rate speech compression, and explain how they are used to reduce the size of speech data. [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) Explain the digital model of speech production, and describe how it is used in speech analysis and synthesis using examples. [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)** How does the choice of colour model affect the quality and accuracy of an image or video and explain how they are used to represent colour? [CO4](4)

**b)** Describe the different image compression techniques and file formats used in multimedia applications. [CO4](3)

**c)** When integrating multimedia content into web applications, what are some strategies that can be used to ensure optimal loading times and playback performance for users with different internet speeds and devices? [CO5,6](3)

**Q5.a)** Explain the concept of non-linear storytelling in multimedia and hypermedia communication. How can this approach be used to engage and motivate audiences, and what are some examples of successful applications of this technique? [CO4,5](4)

**b)** What are some of the ethical and legal considerations that should be taken into account when creating and distributing multimedia and hypermedia content? How can these considerations be addressed to ensure the responsibility and ethical use of these technologies? [CO5](3)

**c)** What key data models and standards are used in multimedia and hypermedia communication, and how do they facilitate interoperability between different systems and applications? [CO6] (3)

**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)** Explain the concept of interactivity in hypermedia communication, and how it can be used to enhance user engagement and learning outcomes. [CO4](3)

**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? [CO5](3)

**Q7.** Write a short note on:

**a)** Multimedia Distributed Processing Model. [CO1](2)

**b)** Multimedia Security. [CO2](2)

**c)**Image Acquisition and representation. [CO3](2)

**d)** Image Compression and File Formats. CO3](2)

**e)** 2D Graphics. [CO 4](2)

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*Total no. of Pages: 02* 95 *Roll no.....*

**End Term Examination** **May-2023**

**Second Semester** **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.

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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) Generate cipher text for the plain text "Security is important" using Rail Fence technique.

e) Distinguish between a substitution and transposition cipher.

Q2. a) Alice and Bob want to establish a secret key using the Diffie-Hellman key exchange protocol. Assuming the values as n=11, g=5, x=2 and y=3, find the values of A, B and the secret key. **[2][CO3]**

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

(c) How is SHTTP different from SSL? **[2][CO4]**

(d) 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) When is a Demilitarized Zone required? How is it implemented? Discuss the related challenges. **[6][CO5]**

(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) Spoofing
c) Vernam Cipher
d) Feistel cipher
e) WAP

**END**

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Total No. of Pages 2

Roll No.....

II-SEMESTER
END SEMESTER EXAMINATION

M.Tech.(CSE)
May- 2023

CSE-5402 WIRELESS AND MOBILE COMMUNICATION

Time: 3:00 Hours

Max. Marks: 40

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

*Q.No. 1*

A) What is Hidden node problem? How hidden and exposed node problem can be avoided? And also explain the MAC frame format of IEEE 802.11. [4][CO#2]

B) Show the various subsystems of the Cellular system architecture. Differentiate between BSC and MSC. Explain the working of Mobile call termination and Mobile call origination in a cellular system. [4][CO#1]

*Q.No. 2*

A) If a particular cellular system has a total bandwidth of 66 MHz and if the telephone system uses two 50 KHz simplex channels to provide full duplex voice and control channels, Compute the number of channels per cell if N=7 and N=12. If 1 MHz of the allocated spectrum is dedicated to control channels, determine an equitable distribution of control channels and voice channels in each cell for each of the two systems.
(N is number of cells per cluster) [4][CO#3]

B) What is Mobile IP? Explain Packet flow in mobile IP, if two nodes communicate and both are in foreign networks. What additional routes do packets take if reverse tunnelling is required? [4][CO#4]

*Q.No. 3*

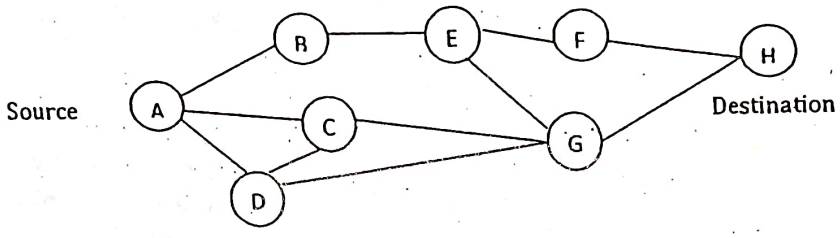
A) What is difference between care of address (CoA) and co-located CoA? Describe the registration of a visiting Mobile node (MN) on handover. [4][CO#4]

B) How frequency reuse Distance $D = \sqrt{(3N)} \times R$ is calculated? Explain. Given the minimum distance between two cochannels D=81 meters, and Radius of a cell R =3 meters, find the reuse factor of the network. [4][CO#3]

*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. [4][CO#2]

B) Draw a flow chart for route maintenance in TORA and explain the route creation and route maintenance by using TORA assuming that at time t link fails between node G and node H. For following network. [4][CO#5]




*Q.No. 5*

A) What is WAP? Discuss the components of the wireless application protocol (WAP) architecture. [4][CO#4]

B) Explain the Dynamic Source Routing (DSR) protocol with example and differentiate it with ad-hoc on demand distance vector routing (AODV). [4][CO#5]

*Q.No. 6*

A) What are the Data management issues in mobile computing? How Data Management is done in Mobile Computing? Explain. [4][CO#5]

B) What kind of problems may arise if TCP is implemented over wireless Networks? Explain and also discuss different approaches for TCP improvement. [4][CO#4]

*Q.No. 7 Write short notes on the following (Answer <u>All</u> parts)* ***4X 2=08***

a) CSMA/CA with RTS/CTS [CO#2]

b) PLCP in FHSS and DSSS mode. [CO#3]

c) Authentication & access in GSM. [CO#1]

d) Power management in DCF mode. [CO#5]

*Total no of Pages: 02* 99 *Roll No:* _____

**2nd SEMESTER**

**M.Tech. [Bioinformatics]**

**END TERM EXAMINATION** **MAY-2023**

**BIO-502 Advances in Bioinformatics**

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

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

Q.1 a) Design a research study to investigate the genetic variation of a particular trait in a population.

b) Compare and contrast the impact of point mutations and chromosomal abnormalities on genetic variation.

[4+4][CO# BIO-502.1]

Q.2 Analyze the strengths and limitations of using predictive tools in biological sequence analysis and characterization and suggest alternative approaches or complementary methods to enhance accuracy and reliability.

[8][CO# BIO-502.2]

Q.3 Evaluate the impact of genotype and phenotype mapping on biomedical research and healthcare, discussing both the benefits and potential ethical considerations, and identify areas where further research is needed.

[8][CO# BIO-502.3]

99-A

Q.4 Use genotype and phenotype mapping to investigate a specific genetic disorder, such as cystic fibrosis or Huntington's disease, and describe how mapping techniques can be used to identify the specific genetic variants responsible for the disease phenotype. Additionally, suggest potential strategies for managing and treating inherited diseases based on an understanding of genotype and phenotype mapping, such as gene therapy or targeted drug development.

[8][CO# BIO-502.3]

Q.5 a) Describe the main types of machine learning algorithms, including supervised, unsupervised, and reinforcement learning, and give an example of how each is used in real-world applications.

b) Briefly discuss the importance of data preprocessing and feature engineering in machine learning and how these techniques can improve the accuracy and reliability of a model.

[4+4][CO# BIO-502.4]

Q.6 Design a pharmacogenomics study to investigate the genetic basis of drug response in a specific population, and describe the experimental design, sample collection and analysis methods, and expected outcomes.

[8][CO# BIO-502.5]

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Total no. of Pages: 02 Roll no.....

SECOND SEMESTER

**M.Tech./Ph.D**

**END TERM EXAMINATION** ***May-2023***

***BIO 504 High throughput Structural Biology***

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

**Note:** Please provide suitable diagram/flowchart, wherever applicable.
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. [4][CO# BIO504.4]

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

**Q.2** a) Describe structural biology and its need. How structural biology has played a key role in understanding of biomolecules? Comment upon its historical development and progression. [4][CO# BIO504.1]

b) What is circular dichroism (CD) spectroscopy? Describe the working principle of CD. List its applications. [4][CO# BIO504.3]

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

**Q.3** a) What are various constituents of DNA? Explain various structural forms of DNA. Differentiate these forms A-DNA, B-DNA, and Z-DNA. [4][CO# Bio504.1]

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

c) What is mass spectroscopy? Describe its working principle, components and their functions, design and construct. [4][CO# BIO504.3]

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

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

**Q.5** a) Optical density of a 500 bp long 1 ml DNA solution was found to be 0.052. 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]. [2.5] [CO#BIO504.4]

b) Define surface plasmon resonance and its components, working, and applications. [2.5][CO#BIO504.3]

**or**

Write working principle, design and construct, components and their function, and list their biological applications.

a) SEM, b) XRD [5] [CO#BIO504.3]

Total No. of pages 2 102 Roll No.....

II SEMESTER M.TECH. (Bioinformatics)
END SEMESTER EXAMINATION (May 2023)

BIO5308 Immunoinformatics
Max.Marks: 50 Time: 3 Hours

**Note:** Part A is compulsory. (20 marks)
Part B: Attempt any 6 questions (30 marks)
Assume suitable missing data, if any.

PART A (Compulsory section)

1. Write short notes on the following : (3x4=12 marks) CO#3, 5
   a. QSAR
   b. SVM and its applications
   c. HLA haplotype classification

2. Explain how diversity in antigen binding site of antibody is generated? How is membrane-bound IgM generated and what role does it play in B cell receptor constitution? Explain the molecular mechanism of antigen mediated class switching.(8 marks) CO#1,2

PART B
(Attempt any 6 questions, each carries equal marks)

3. Describe how Tap deficiency may result in higher frequency of cross presentation of antigens by MHC? What are haptens and what are the considerations for development of suitable carriers? CO#1,4

4. Describe how B cell and T cell epitope prediction mechanism differs from MHC epitope prediction? Discuss any 2 epitope

prediction tools in details with special focus on their advantages and shortcomings. **CO#1,5**

5. Describe the possible causes and therapy of autoimmune disorders: Explain how pernicious anaemia and haemolytic anaemia differ at the level of molecular targeting. **CO#2**

6. What is chronic graft rejection? Differentiate between Type II and Type IV hypersensitivity. Describe the properties of cytokines and how do they impact the immune system? **CO#2,5**

7. Differentiate between classical and alternative complement fixation pathways. How are subunit or recombinant vaccines different from heat inactivated vaccines like in the case of Polio? **CO#2,5**

8. Give a comparative account of how ITAM phosphorylation is a key event in both B and T cell signalling (draw suitable schematic diagrams). Explain the role of CTLA 4 and CD28 in T cell activity regulation. What are T dependent and T independent antigens? **CO#4**

9. Computational epitope design and vaccine prediction can be useful in decreasing the experimental time. Discuss with a case study. What are artificial neural networks and how are they beneficial in vaccinology? **CO#4,5**

Total No. of Pages 2 Roll no.....

IInd SEMESTER

M.Tech.

**END TERM EXAMINATION** ***May-2023***

**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 Certain gene expression is extremely poor for transfection. In order to avoid such situation 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?

**[08][CO1]**

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

**[08][CO2]**

Q.3 With the help of given arbitrary sequence (i) prepare atleast two sets of primers and load EcoRI, BamHI, XhoI, HindIII, XbaI, SmaI in the primers together with Tm of each primer:

5'CTCAGACTAGCATGGACCGAGCAGCAACAATTCACGAT-
TAACTTAGCCGATTGCTAATACTAGCTTACGTTACGACATGAAC
TAATACGCCGGATCGATCGACTAACATTC3'. 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][CO3]**

Q.4 Draw neat gene architecture and describe the role of TBP, TFBE, TATA and CAAT boxes. How cis-acting elements are important for eukaryotic gene expression? How would you validate the TFBE using an antibody? What is coding sequence and describe the importance of 3' UTR?

**[08][CO4]**

Q.5 Explain any two of the following DNA-protein interaction techniques.

i. Yeast-two-hyridization (Y2H)

ii. Shotgun sequencing

iii. DNaseI foot printing assay

iv. Fluorescence resonance energy transfer (FRET)

**[08][CO4]**

Q.6 Explain the protocol of RNA extraction with composition and function of buffers. Explain the role of Northern hybridisation with different steps.

**[08][CO4]**

Q.7 What are the tools of recombinant DNA technology? Explain the working protocol and application of recombinant DNA technology with an appropriate diagram. Briefly discuss the role of recombinant DNA technology in human health and disease.

**[08][CO2]**

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*Total No. of Pages:3* *Roll No.....*

**M.Tech.(AI) 2ndSemester**

**END SEMESTER EXAMINATION** **(May – 2023)**

AI502 Machine Learning

**Paper Code** **Title of the subject**

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

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

**Q1.** (a) Explain the relationship between following concepts:

i. Inductive Learning and prediction
ii. Deductive learning and classification
iii. Reinforcement Learning and intelligent agent

(b) Explain the data characterization such as Central Tendency and Data dispersion. How do you identify noise and outliers in given data? **[3,5]**

**Q2.** (a) Draw the flow chart for dimensional reduction using Principle Component Analysis, explaining all steps with the help of an example.

(b) What are the various factors which are evaluated to compare different classification techniques

(c) Accuracy evaluation of model using .632 bootstrap. **[4,2,2]**

**Q3** (a) Consider the data below as training samples for car theft. Attributes are Colour, Type, Origin, and class label, Stolen which can be either Yes or No. Construct decision tree based on above data using ID3 algorithm and derive the rules. Predict the class label for SUV car that is yellow in colour and is imported.

| Example No | Colour | Type | Origin | Stolen |
|---|---|---|---|---|
| 1 | Red | Sports | Domestic | Yes |
| 2 | Red | Sports | Domestic | No |
| 3 | Red | Sports | Domestic | Yes |
| 4 | Yellow | Sports | Domestic | No |
| 5 | Yellow | Sports | Imported | Yes |
| 6 | Yellow | SUV | Imported | No |
| 7 | Yellow | SUV | Imported | Yes |
| 8 | Yellow | SUV | Domestic | No |
| 9 | Red | SUV | Imported | No |
| 10 | Red | Sports | Imported | Yes |

(b) State intelligent classification techniques; Explain any one in detail.

[5,3]

Q4 (a) The following table contains the attributes Name, Gender, Trait-1, Trait-2, Trait-3 and Trait-4 where name is an object-id , gender is a symmetric attribute and the remaining trait attributes are asymmetric.

| Name | Gender | Trait-1 | Trait-2 | Trait-3 | Trait-4 |
|---|---|---|---|---|---|
| Kevan | M | N | P | P | N |
| Caroline | F | N | P | P | N |
| Erik | M | P | N | N | P |

For asymmetric attribute values, let the value of P be set to 1 and value of N be set to 0.

(i) Show the contingency matrix for each pair .

(ii) Compute the simple matching coefficient for each pair.

(iii) Compute the Jaccard coefficient for each pair.

(b) Suppose that the data mining task is to cluster the following eight points with (x, y) into two clusters

A1(2,6); A2(3,4); A3(3,8); A4(4,7); A5(6,2);A6(6; 4); A7(7,3); A8(7,4); A9(7,6); A10(8,5)

The distance function is Manhattan distance. Suppose initially we assign A2, and A8 as the centre of each cluster, respectively. Use the k-means algorithm to show only

i) The two clusters and the cluster centres after the first round of execution.

ii) Apply k Medoid to reform clusters.

[4,4]

Q5. (a) The following sample data table contains variable of mixed type. Calculate dissimilarity matrix and find the most similar object

| Object_id | Test-I (categorical) | Test-II (ordinal) | Test-3 (ratio-scaled) |
|---|---|---|---|
| 1 | Code-A | high | 445 |
| 2 | Code-B | low | 22 |
| 3 | Code-C | medium | 164 |
| 4 | Code-A | high | 1,210 |

**(b)** Explain the steps for the Agglomerative Hierarchical Clustering to construct dendogram Tree where input to agglomerative algorithms is the set X given below:

x1 (0,0) ; x2 (1,1) x3(3,1); x4(2,4); x5(6,3); x6(6,6); x7(5,2); x8(3,5); x9(0,2); x10(2,1).

**[4,4]**

**Q6** **(a)** Calculate various evaluation metrics for classification such as precision, Recall, F-measure, accuracy, error, sensitivity and specificity for following confusion matrix:

| Actual class/ Predicted class | Cancer=yes | Cancer =no | Total |
|---|---|---|---|
| Cancer=yes | 90 | 210 | 300 |
| Cancer =no | 140 | 9560 | 9700 |
| | 230 | 9770 | 10000 |

(b) For given set of 100 tuples, write down steps of k cross validation. How do you calculate accuracy. How accuracy is improved in stratified cross validation.

(c) What is class imbalance problem in two class classifications. What are the methods to solve it

[4,2,2]

Q7. Write short notes on( any two)

(a) Bagging & boosting

(b) Linear and Non Linear regression

(c) Random Forest and Tree pruning

(d) Sequential covering algorithm for rule extraction and their quality measure

[4,4]

*Total No. of Pages: 4*

*Roll No. .....*

**SECOND SEMESTER**

**M. Tech. (AI)**

# END SEMESTER EXAMINATION *May-2023*

## AI504 ARTIFICIAL NEURAL NETWORKS

***Time: 3:00 Hours***

***Max. Marks: 40***

**Note:** Answer ***ALL*** questions.
Assume suitable missing data, if any.
CO# is course outcome related to question

**1[a]** Consider perceptron with two input features is used to classify items as good (1) and faulty (0). Given dataset (1, 2, 1), (-1, 1, -1), (0, -1, 1), (2, 2, -1). The triplet ($x_1$, $x_2$, $y$) in the dataset represents features ($x_1$, $x_2$) and class ($y$). The perceptron's weight vector is initialized to [0.1, 0.2], and the bias term is initialized to 0. The learning rate is set to 0.1. Perform two iterations of perceptron training using the training data above. Show the updated weight vector and bias term after each iteration (each sample). Use the sign function as the activation function.

**[4] [CO1, CO2]**

**[b]** The sigmoid function is used as activation function in logistic regression. It makes mean squared error based cost function unsuitable for gradient decent, explain why? Give an alternate cost function, prove that it is suitable for gradient decent algorithm. **[4][CO2]**

**2.** Attempt any two

**[a]** Consider the neural network (shown in Fig.1) to predict the binary output y based on two input features $x_1$ and $x_2$ using the given dataset ($x_1$, $x_2$, $y$): (1, 2, 0) (1, 1, 0) (4, 3, 1) (5, 4, 1).

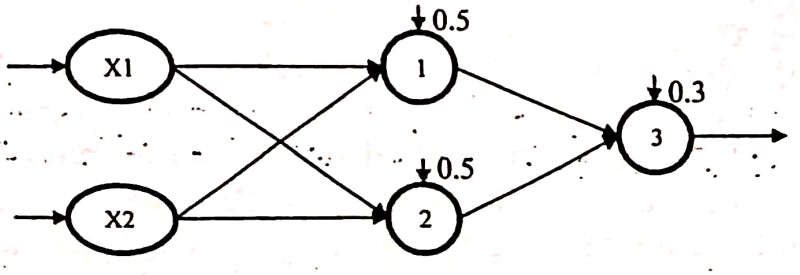


Fig. 1

Assume ReLU activation for the hidden layer, and sigmoid activation for the output layer. Initialize the weights of the hidden layer to be $W^{[1]}$ = [[0.1, -0.2], [0.3, -0.4]] and the bias to be b1 = [0.5, 0.5]. Initialize the weights of the output layer to be $W^{[2]}$ = [[0.2], [-0.1]] and the bias to be b2 = [0.3]. Find predicted output by the neural network. **[4] [CO2]**

**[b]** Assume that you are working on a project to develop a spam filter for emails using a perceptron. The perceptron takes as input a bag-of-words representation of the email's text, where each element of the input vector corresponds to the count of a particular word in the email. We are given a dataset of 1000 emails, half of which are spam and half of which are not spam, and we randomly split the dataset into a training set of 800 emails and a validation set of 200 emails. We initialize the perceptron's weight vector and bias term to all zeros, and set the learning rate to 0.1.

(*i*) Suppose the perceptron achieves an accuracy of 90% on the validation set. Does this mean that the perceptron is a good spam filter? Explain your reasoning.

(*ii*) Now, suppose the given dataset 90% spam email and 10% as not spam. Does 98% accuracy on the validation set indicate a good spam filter? Explain your reasoning. **[2+2][CO2, CO3]**

**[c]** In above spam classifier design, suppose we decide to experiment with different learning rates to see if we can improve the perceptron's performance. We try learning rates of 0.01, 0.1, and 1.0. For each learning rate, we train the perceptron using the training set and evaluate its performance on the validation set. We find the following results:

| Learning rate | 0.01 | 0.1 | 1.0 |
|---|---|---|---|
| Accuracy on validation set | 92% | 95% | 89% |

Based on these results, which learning rate should we use for the perceptron and why? **[4][CO2, CO3]**

**3.** Attempt any two

**[a]** Consider training of the neural network shown in Fig.1. Let the cost function is binary cross-entropy. Perform one iteration of backpropagation using the first data point to update the weights and biases. Use a learning rate of 0.1. Calculate the updated weights and biases of the output layer after one iteration of backpropagation.

**[4] [CO2]**

[b] Derive the expression for weight updation (backpropagation) of the weight $w_{11}$ *i.e.* the weight between input $x_1$ and neuron 1 of the hidden layer. Show each step clearly with computation graph. **[4] [CO2]**

[c] Consider a neural network with three output nodes, and the output values from the last layer before the softmax activation are [2.5, 1.0, 0.7]. Calculate the softmax values for each output node. What is the index of the node with the highest softmax value? What is the interpretation of the softmax values? **[4] [CO2]**

**4.** Attempt any two

[a] Suppose you are working on a classification problem with a dataset consisting of 10,000 samples. You have trained three models with the following accuracy values:

Model A: training accuracy = 85%, validation accuracy = 80%
Model B: training accuracy = 90%, validation accuracy = 85%
Model C: training accuracy = 95%, validation accuracy = 80%

(*i*) Which model(s) suffer from high bias and which model(s) suffer from high variance?

(*ii*) What are the possible reasons for the observed bias and variance in each model? **[4] [CO1, CO2]**

[b] Explain the trade-off between bias and variance in machine learning and how it can be managed. How would you go about choosing the best model for above (in part [a]) particular classification problem?

Now, suppose you have access to more data and can double the size of the dataset to 20,000 samples. How do you think this would affect the bias and variance of the models? How would you use this additional data to improve the performance of the models? **[2+2] [CO1, CO2]**

[c] An artificial neural network is designed for binary classification of a disease. The performance is evaluated on 2000 patients. The confusion matrix for the classification results is as follows:

| | Predicted Positives | Predicted Negatives |
|---|---|---|
| Actual Positives | 300 | 100 |
| Actual Negatives | 400 | 1200 |

Calculate the accuracy, recall, precision, and F1 score of the model for the positive class. Discuss the importance of each measure, if the disease is highly contagious. **[4] [CO2, CO3]**

5. A convolutional neural network (CNN) has the following architecture: *Input layer:* 32x32x3 image; *Convolutional layer*: with 64 filters, each with size 5x5, using stride 1 and no padding; *Max pooling layer* with size 2x2; *Convolutional layer* with 128 filters, each with size 3x3, using stride 2 and no padding; *Max pooling layer* with size 2x2; *Convolutional layer* with 256 filters, each with size 3x3, using stride 1 and full padding; *Max pooling layer* with size 2x2; *Fully connected layer* with 512 neurons; *Output layer* with 10 neurons.

**[a]** Find the size feature maps before fully connected layer. Show the calculation for each step. **[4] [CO2, CO3]**

**[b]** Compute the number of learnable parameters in each layer of the above CNN architecture. **[4] [CO2, CO3]**

**---Best of Luck---**

Total No. of Pages: 02

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SECOND SEMESTER

**M. Tech. (AI)**

## END SEMESTER EXAMINATION May-2023

## AI5202 HEURISTIC METHODS

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

Note: Answer *ALL* questions.
Assume suitable missing data, if any.
CO# is course outcome related to question

1. Give the algorithm for Ant Colony Optimization. Find the shortest distance between four cities using Ant Colony Optimization. Perform the operation for two iterations. The distance between cities is as given below:

[0 10 12 11 10 0 13 15 12 13 0 9 11 15 9 0]

Consider the following values for the parameters:
The influencing parameter $\infty$=1, $\beta$=2, Rate of pheromone evaporation 0.5, Number of ants=3

**[3+7][CO2, CO3]**

2. Find the optimal value of a, b, c and d using Genetic Algorithm which satisfies the expression a+2b+3c+4d=30. The model uses following parameters:

**[a]** Crossover rate of 0.7, swapping two genes from second position of both the chromosomes.

**[b]** Mutation rate is 0.1 happening at $i^{th}$ position of the $i^{th}$ chromosome in $i^{th}$ iteration.

**[c]** Use Roulette wheel method for parent selection method.

**[d]** Perform the generational genetic algorithm for two iterations.

**[10] [CO2, CO3]**

3. Attempt *any ONE* of the followings

**[a]** Consider a Course Scheduling System(CSS) for scheduling courses in a college. The purpose of CSS is to provide schedule of day and time, place (class room), the instructor and course name for conducting classes with no conflict in timings, class room, course or instructor. Perform the following operation with regard to the given requirement

(i) How can we represent the possible candidate solutions?
(ii) Identify hard constraints and soft constraints of the solution.
(iii) Which heuristic or meta-heuristic do you propose and why?

**[2+4+4][CO1, CO3]**

**[b]** Consider the function $f(x) = 3x^4 - 4x^3 - 12x^2 + 5x + 10$ defined on the interval [-1, 3]. Use particle swarm optimization (PSO) to find the minimum of f(x)

with 10 particles and a maximum of 100 iterations. The inertia weight w is set to 0.9, the cognitive weight c1 is set to 1.5, and the social weight c2 is set to 1.5. The initial position of each particle is generated randomly in the search space [-1, 3], and the velocity is initialized to zero. Use the following equation to update the position and velocity of each particle:

$$v_i(t+1) = wv_i(t) + c1r1*(p_i - x_i) + c2r2(p_g - x_i)$$
$$x_i(t+1) = x_i(t) + v_i(t+1)$$

where $v_i(t)$ and $x_i(t)$ are the velocity and position of particle i at iteration t, $p_i$ is the best position found by particle i so far, $p_g$ is the best position found by the entire swarm, and r1 and r2 are random numbers between 0 and 1.

**[10][CO2]**

**4.** What is Scatter Search? Explain how Scatter Search can be applied for any one of the applications given below:

**[a]** N-Queens problem
**[b]** Travelling Salesman Problem
**[c]** Course Timetabling Problem **[10] [CO1, CO2]**

**5.** Attempt *any TWO* of the followings

**[a]** How does Tabu search overcome the drawbacks inherent in Hill Climbing Algorithm? **[5] [CO2,CO3]**

**[b]** Use the simple Hill Climbing algorithm to solve the following problem: Owners of a car rental company have determined that if they charge customers p rupees per day to rent a car, where $50 \leq p \leq 200$, the number of cars n they rent per day can be modeled by the linear function $n(p)=1000-5p$ . If they charge Rs.50 per day or less, they will rent all their cars. If they charge Rs. 200 per day or more, they will not rent any cars. Assuming the owners plan to charge customers between Rs. 50 per day and Rs. 200 per day to rent a car, how much should they charge to maximize their revenue? **[5] [CO3]**

**[c]** Consider a function f(x) defined on the interval [m, n]. The function has multiple local minima and maxima. Use global and local search algorithms to find the global minimum of f(x) on [m, n]. Assume that the function is continuous and differentiable on the entire interval [m, n]. You may use any global search algorithm such as simulated annealing or genetic algorithms, and any local search algorithm such as gradient descent or Newton's method. Provide a detailed explanation of the algorithms used, and their convergence properties. Prove that the algorithm finds the global minimum with high probability. **[5][CO1, CO2]**

**—Best of Luck—**

Total no. of Pages:2 111 Roll no.....

II SEMESTER

M.Tech

END TERM EXAMINATION May-2023

AI5304 Pattern Recognition

Time: 03:00 Hours Max. Marks: 40

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

Q.1 Differentiate between the following: [4x2=8][CO2]

a) Information Gain and Gini Index

b) Precision and Recall

c) Covariance and Correlation

d) Dimensionality Reduction and Data Reduction

Q.2 a) What is the significance of Entropy? Explain mathematically its computation and analysis. [4][CO1]

b) Explain any non-hierarchical clustering in detail with an example of your choice. [4][CO3]

Q.3 a) Using data in the given table, find the accuracy. [2][CO4]

| | | Predicted class | |
|---|---|---|---|
| | | Class 1 | Class 2 |
| **Actual class** | Class 1 | 350 | 90 |
| | Class 2 | 30 | 900 |

b) What information can be interpreted about the data from its Eigen vectors and Eigen values? Identify the Eigen vectors for the following 3x3 matrix:
Row1 [10, -1, -8]; Row 2 [-1, -2, 0]; Row 3 [0, 5, -2].

[6][CO4]

Q.4 The output of a classifier is described in the below table. Generate the confusion matrix and evaluate the classifier based on Specificity, Sensitivity, False Positive Rate and False Negative Rate. [8][CO3]

| Item# | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Predicted class** | A | A | A | B | A | B | B | B | A | B |
| **Actual class** | B | A | B | B | B | B | A | A | A | A |

Q.5 a) Explain any 4 Activation functions used in a Neural Network based model. [4][CO1]

b) Three companies A, B and C supply 25%, 35% and 40% of the notebooks to a school. Past information suggests that 5%, 4% and 2% of the notebooks produced by these companies are defective. If a notebook was found to be defective, what is the probability that the notebook was supplied by A? [4][CO4]

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**Second Semester**
**M. TECH (AI)**
**END TERM EAMINATION** **MAY-2023**

**AI5402 Natural Language Processing**

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

**Note: Answer all questions. Write pseudo codes for all algorithms asked. Assume suitable missing data, if any. Note [CO#] refers to a particular course outcome.**

**Answer all questions**

Q1. (a) Describe the steps of Hidden Markov Model for POS Tagging with a suitable example. [7M] [CO3]

(b) Differentiate between Rule based POS Tagging and Statistical POS Tagging. [3M] [CO3]

Q2. (a) Consider the following Document Id, along with keywords and final class label where first six documents are training sample and last document is a test sample.

| | Doc Id | Keyword | Label |
|---|---|---|---|
| **Training** | 1 | Worship, Cheerful, Delight, Delight, Cheerful | Pass |
| | 2 | Cheerful, Worship, Kick, Delightful, Cheerful | Pass |
| | 3 | Worship, Move, Cheerful, Good | Pass |
| | 4 | Cheerful, Worship, Pain, Kick, Pain | Fail |
| | 5 | Pain, Pain, Worship, Kick | Fail |
| | 6 | Worship, Happy, Cheerful, Worship, Pain | Pass |
| **Test** | 7 | Worship, Pain, Cheerful, Worship, Kick | ? |

Using the notion of Naïve Bayes Classification method, identify test sample document (Doc Id 7) will be classified as Pass, or Fail? Write all mathematical steps. [7M] [CO3]

(b) Differentiate between Support Vector and K-NN classifier in the context of text classification? [3M] [CO3]

Q2. (a) Distinguish between Text summarization and Topic Modelling? [3M] [CO5]

(b) What do you mean by Latent Dirichlet Allocation (LDA) for performing topic modelling. Write all steps involved in LDA. [7M] [CO5]

Q3. (a) Compute the minimum edit distance using dynamic programming approach between two strings S1=INTENSION, and S2=EXECUTION. Assume the cost of an insertion and deletion operation as 1 unit each and cost of a substitution operation as 2 units. Write the suitable recurrence relation for the same and show all calculation steps. [8M] [CO2]

(b) Write in general four challenges for performing sentiment analysis in low resource language like Hindi. [2M] [CO5]

Q4(a) Distinguish between extractive and abstractive text summarization [2M] [CO5]

(b) Define NER (Named Entity Recognition) and design one statistical method of your choice for performing NER with suitable example? [6M] [CO4]

(c) Consider input alphabet $\sum=\{a,b\}$ write regular expression for all the stings over 'a' and 'b' which denotes

(i) odd number of 'a's

(ii) three consecutive a's and two consecutive b's [2M] [CO1]

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# Ph. D. (Course Work)

May, 2023

## *AM-503 D, Quantum Calculus*

Time: 3 Hours Max. Marks: 100

*Note: Attempt **any five** questions and all the questions are carry equal marks.*

(1) (a) Define $q$ and $h$ derivative of arbitrary function $f(x)$.

(b) Find the values of

$$(i)\ D_q f(x) \quad (ii)\ D_q\ [f(x).g(x)] \quad (iii)\ D_q\left[\frac{f(x)}{g(x)}\right].$$

(2) (a) State and prove Fundamental theorem of $q$-calculus.

(b) For any number $\alpha$, show that

$$D_q\left(\frac{1}{(1-x)_q^{\alpha}}\right) = \frac{[\alpha]}{(1-x)_q^{\alpha+1}}$$

(3) (a) If $yx = qxy$ where $q$ is a number commuting with both $x$ and $y$ the

$$(x+y)^n = \sum_{j=0}^{n} \begin{bmatrix} n \\ j \end{bmatrix} x^j y^{n-j}$$

(b) Prove that

$$\begin{bmatrix} n \\ j \end{bmatrix} = \begin{bmatrix} n-1 \\ j-1 \end{bmatrix} + q^j \begin{bmatrix} n-1 \\ j \end{bmatrix}$$

(4) (a) Define *Gauss's Binomial* formula and prove that

$$(x+y)_q^{\infty} = \sum_{j=0}^{n} q^{j\frac{(j-1)}{2}} \frac{x^j}{(1-q)(1-q^2)\ldots(1-q^j)}.$$

(b) Define *Heine's binomial* formula and prove that

$$\frac{1}{(x+y)_q^{\infty}} = \sum_{j=0}^{n} \frac{x^j}{(1-q)(1-q^2)\dots(1-q^j)}.$$

(5) (a) Define *Jackson integral* formula of arbitrary function $f(x)$ and prove that

$$\int \frac{1}{x} d_q x = \frac{(q-1)}{\log q} \log x$$

(b) Write condition for *Jackson integral* to be $f(x) = 1/x$ exist. why $f(x) = 1/x$ fail for *Jackson* formula.

(6) (a) If $F(x)$ is an antiderivative of $f(x)$ and $F(x)$ is continuous at $x = 0$ then show that

$$\int_a^b f(x) d_q x = F(b) - F(a), \qquad 0 \le a < b \le \infty.$$

(b) Define the $q$–Gamma and $q$–Beta functions.

(7) (a) Derive the *q Bernstein polynomial* and find its values for $1, t,$ *and* $t^2$.

(b) Derive the *q Szász-Mirakyan operators* and find its values for $1, t,$ *and* $t^2$.

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**PhD [AM]**

**SECOND SEMESTER** 117

May 2023

END EXAMINATION

***AM-504B, Advanced Mathematical Methods***

Time: 3.0 Hours

Max. Marks: 100

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

1. Solve the followings difference equations:
   (i) $a_{n+3} + a_{n+2} - a_{n+1} - a_n = 0.$
   (ii) $a_{n+2} - 5a_{n+1} + 4a_n = 0$ where $a_0 = 0, a_1 = 1.$
2. Find a particular solution to the second-order in-homogeneous difference equation (By variation of parameters).
$$(n+2)a_{n+2} + a_{n+1} - (n-1)a_n = 1.$$
3. Discuss perturbation theory and find the roots of the equation
$$x^3 - 4.001x + 0.002 = 0.$$
4. Find the local behavior of the solution to the Airy equation $y'' = xy$ near $x = 0.$
5. Find behavior of $\int_0^x t^{-1/2} e^{-t} dt$ as $x \to +\infty.$
6. Define the asymptotic expansion of modified Bessel function $K_0(x) = \int_1^\infty (s^2 - 1)^{-1/2} e^{xs} ds$ using Watson's lemma.
7. Define Pade approximation and discuss Convergence of Pade approximants for $e^z$.

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8. Determine asymptotic expansion of a Fourier integral

$$I(x) = \int_0^1 \frac{e^{ixt}}{1+t} dt$$

as $x \to +\infty$

9. Define Asymptotic series and hence solve

$$x^2 y''(x) + (1+3x)y'(x) + y(x) = 0.$$

10. Discuss the behaviour near irregular singular point. Can we apply Frobenius method on $x^3 y'' = y(x)$ ? If yes then solve, otherwise discuss. Also find the controlling factor of the equation.

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