

Total No. of Printed Pages:2

T.E - (Electronics & TC / Electronics & Comm) (Sem-VI)(Revised Course 2019-2020)  
EXAMINATION JULY 2023  
Motor Control and Applications

[Time: 03:00 Hours]

[Max. Marks: 100]

**Instructions:**i) Answer any two questions with any two from Part A, any two from Part B and any one from Part C.  
ii) Assume suitable data if necessary.

PART A

- Q.1 a. With neat figure explain the different parts of an electric drive. 10  
b. With their respective speed torque characteristics and wiring diagrams, differentiate between series and shunt connected DC motors. 10
- Q.2 a. With neat figure, explain the working of a Ward-Leonard speed control system. What are its advantages and disadvantages? 10  
b. Explain Power control or motoring control operation of a Chopper drive with neat diagrams. How can the circuit be modified for 2 Quadrant operation? 10
- Q.3 a. A DC shunt motor takes no load armature current of 2.5A and runs at 2000rpm. Its armature resistance is  $0.5\Omega$ . Calculate its speed when taking an armature current of 50A. At this current armature reaction reduces the field by 3%. 6  
b. With neat diagrams, explain the working of a Dual converter drive in both its modes. 12  
c. What is the purpose of free-wheeling diode in phase-controlled drives? 2

PART B

- Q.4 a. With neat diagram explain the working of the 3-phase induction motor. 5  
b. Explain the speed control of 3 phase induction motor using Pole changing techniques. 15
- Q.5 a. Explain the working of a Hybrid stepper motor with neat diagrams. 6  
b. Explain rotor slip power speed control. What are the disadvantages? How the disadvantages can be overcome? 8  
c. With neat figure explain the starting method for Slip ring induction motor. 6
- Q.6 a. With neat diagrams explain the working and the need for a Static Scherbius Drive. 8  
b. Describe the operation of variable reluctance stepper motor. What is microstepping? 6  
c. Explain Stator Voltage Speed control methods for 3 phase induction motors. What are its disadvantages? 6

PART C

- Q.7 a. With a neat diagram explain the construction of a DC motor. What is the purpose of the commutator? What would happen if commutator was not there? 10
- b. How can you achieve speed control above rated speed for Shunt DC motor? Explain with neat applicable diagrams. 6
- c. What is 4 quadrant operation? 4
- Q.8 a. What are the factors that affect the choice of an electric drive? Explain. 8
- b. With neat figure explain the parts and working of a typical thyristor converter-controlled DC motor drive system. 12

Total No. of Printed Pages:2

T.E - (Electronics & TC / Electronics & Comm) (Sem-VI)(Revised Course 2019-2020)

EXAMINATION JULY 2023

Biomedical Electronics and Instrumentation

[Time: 03:00 Hours]

[Max. Marks: 100]

- Instructions:**
1. Assume suitable data wherever necessary.
  2. Answer any **two** questions from PART-A.
  3. Answer any **two** questions from PART-B.
  4. Answer any **one** question from PART-C.
  5. All symbols, abbreviations and notations have their usual meaning.

**PART A**

- Q.1
- a) What are the common bioelectric potentials? Explain any two in detail with suitable diagrams. List their amplitudes and frequencies. 6
  - b) What are the problems involved in using plate electrodes as a body surface electrode? Explain how these problems are eliminated in the modern body surface electrodes with the help of construction details. 7
  - c) Explain Ground- Fault circuit interrupter circuit. 7
- Q.2
- a) With the help of a neat block diagram explain the ECG monitoring system. Also explain some artifacts associated with the ECG recording. 7
  - b) What is the need for a cardiac pacemaker? With the help of a neat block diagram, explain the working of an external pacemaker. 7
  - c) With the help of a block diagram, explain the working of an automatic blood pressure meter. 6
- Q.3
- a) What is the need for defibrillation? With the help of a diagram explain the working of a direct current defibrillator. 7
  - b) Design the cardiology department of a small hospital to include facilities for intensive-care monitoring and diagnosis. Specify all the equipment and instrumentation. 7
  - c) Explain gross shock and micro-current shock hazard. Which shock hazard is more harmful? Explain why. 6

## PART B

- Q.4 a) With a neat diagram explain the instrumentation required for measuring the mechanics of breathing. 7
- b) Explain how endoscopy can be used to view internal organs of the body. 6
- c) Explain in detail the working of a Microwave Diathermy unit. 7
- Q.5 a) With the help of a block diagram, explain the working of a MRI machine. 7
- b) Explain the basic principle involved in computed tomography to examine internal structures of the body. Also state the merits and demerits of CT. 7
- c) Explain the different display modes of ultrasound imaging 6
- Q.6 a) Explain how Single Positron Emission Computed Tomography is used as an imaging modality for medical applications. Also explain its safety precautions. 8
- b) Write notes on: 12
- i. Laser Therapy
- ii. DICOM

## PART C

- Q.7 a) Define absolute and relative refractory period and all or none law with respect to cell biopotential. Hence explain action and resting potential with the help of waveform. 7
- b) What do you understand by the term "Reference electrode"? Which is the most commonly used reference electrode in biopotential measurements? Explain its construction. Why is hydrogen electrode seldom used as a reference electrode? 7
- c) Explain the effects of electric current on human body. 6
- Q.8 a) How are X-rays produced? List their properties and explain the application of X-rays in medicine. 7
- b) What is physiotherapy? How can ultrasound be used in physiotherapy? Explain the Ultrasonic Therapy unit in detail. 7
- c) Explain the basic concept of how telemedicine can be used in medicine. Also elaborate on the essential parameters for telemedicine. 6

Total No. of Printed Pages:03

**T.E - (Electronics & TC / Electronics & Comm Engg) (Sem-VI) (Revised Course 2019-2020)**  
**EXAMINATION JUNE 2023**  
**Control System Engineering**

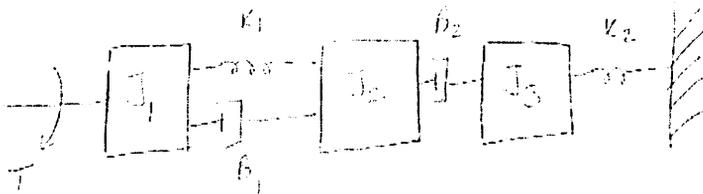
[Time: 03:00 Hours]

[Max. Marks:100]

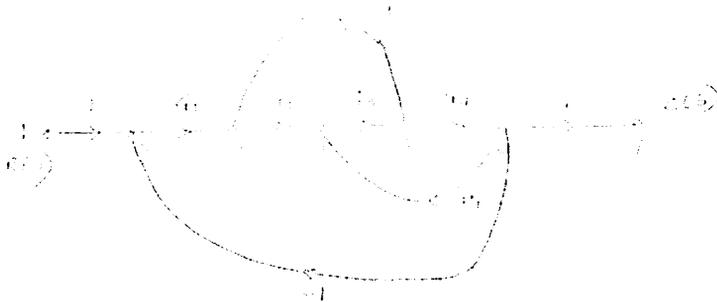
- Instructions:**
- 1) Answer **any five** questions, selecting **two** questions from Part- **A**, **two** questions from Part - **B** and **one** question from Part - **C**.
  - 2) **Assume** suitable data if necessary.
  - 3) Draw figures and sketches **wherever** necessary.

**PART-A**

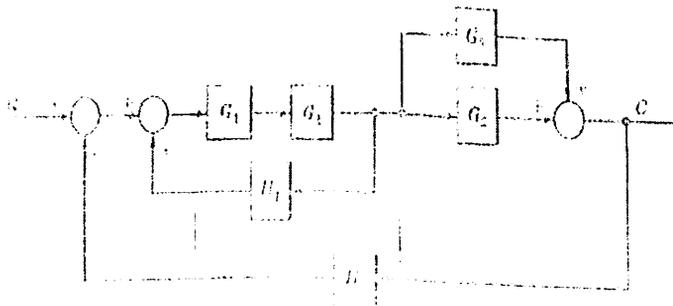
- Q1** a) For the mechanical system shown write differential equation and obtain transfer function **07** function.



- b) Using the Mason's gain formula obtain the overall transfer function whose signal flow graph is given below. **06**



- c) Using block diagram reduction method determine the closed loop transfer function **07**  $C(s)/R(s)$ .



- Q2** a) Derive the expression for time response of second order system for unit step input 07  
when the system is underdamped.
- b) Construct Routh array and determine the stability of the system whose 07  
characteristic equation is given by  $s^6 + s^5 + 3s^4 + 3s^3 + 3s^2 + 2s + 1 = 0$ .
- c) Obtain the response of unity feedback system whose open loop transfer function 06  
is  $G(s) = \frac{4}{s(s+5)}$  for unit step input.
- Q3** a) A unity feedback system has open loop transfer function: 04  
 $G(s) = \frac{25(s+4)}{s(s+0.5)(s+2)}$  Determine the steady state error for unit ramp input.
- b) Explain the effect of adding poles and zeroes to root locus? 06
- c) A unity feedback control system with OLTF is given by  $G(s) = \frac{k}{(s+1)(s+2)}$  10  
 $H(s)=1$ . Sketch root locus.

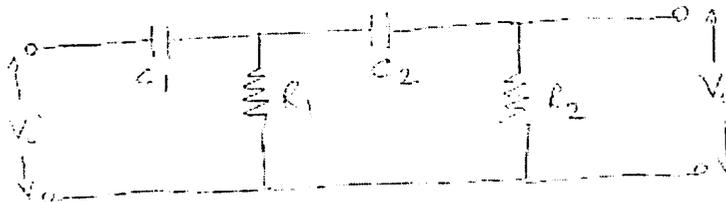
## PART B

- Q4** a) Derive the transfer function corresponding to following state models: 10  
i)  $x(t) = \begin{bmatrix} 0 & 1 \\ -3 & -2 \end{bmatrix} x(t) + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u(t); y(t) = [1 \ 0]x(t)$   
ii)  $x(t) = \begin{bmatrix} -2 & 1 \\ -3 & 0 \end{bmatrix} x(t) + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t); y(t) = [1 \ 0]x(t)$
- b) Sketch the Nyquist plot for a system with open loop transfer function: 10  
$$G(s)H(s) = \frac{s+2}{(s+1)(s-1)}$$
- Q5** a) The open loop transfer function of a unity feedback system is given by 10  
 $G(s) = \frac{1}{s^2(1+2s)(1+s)}$ . Sketch the polar plot and determine GM and PM.
- b) Draw the bode plot for the transfer function given below and determine gain 10  
margin and phase margin.  $G(s) = \frac{10}{s(1+0.4s)(1+0.1s)}$
- Q6** a) Explain the principle of Lag compensator. Derive the transfer function and show 08  
location of poles and zeroes.
- b) The open loop transfer of unity feedback system is given by  $G(s) = \frac{k}{s(s+4)(s+80)}$  12  
Design a lag compensator so that phase margin is  $33^\circ$  and velocity error constant  
 $K_v | 30 \text{sec}^{-1}$ .

## PART-C

- Q7 a) Consider a unity feedback system with OLTF  $G(S) = \frac{K}{s(s+1)(s+5)}$  10
- Design a lead compensator so that
- i) Phase Margin is  $\geq 20^\circ$
  - ii) Velocity error constant  $K_v \geq 50$ .
- b) Write a short note on PI control action. 05
- c) Explain the following: 05
- i) Peak time
  - ii) Peak overshoot
  - iii) Settling time

- Q8 a) Obtain transfer function of the following electrical system shown below: 08



- b) State and explain differences between two approaches to the analysis & design of Control system: The transfer function approach and State variable approach. 06
- c) Explain Proportional Derivative controller with diagram and transfer function. 06

Total No. of Printed Pages: 2

T.E - (Electronics & TC / Electronics & Comm) (Sem-VI)(Revised Course 2019-2020)

EXAMINATION JULY 2023

Mobile Communication

[Time: 03:00 Hours]

[Max. Marks: 100]

- Instructions:**
1. Answer Any Five Questions By Selecting Two Questions From Part - A, Two Questions From Part -B And One Question From Part -C.
  2. Assume suitable data if necessary.

**PART A**

- Q.1
- a) Explain the forced handoff? Also list the advantages of delayed handoff? 7
  - b) Explain how the co-channel interference can be reduced by means of a notch in the tilted antenna pattern. 8
  - c) Explain the frequency reuse in cellular system. 5
- Q.2
- a) For a Two-Ray model derive the expression for the received power at a distance 'd' from transmitter and show that  $P_r = P_t G_t G_r h^2 / d^4$ . 8
  - b) Derive an expression for the Doppler shift. When does the maximum handoff occur? 6
  - c) Explain the sweep frequency measurement technique of channel sounding. 6
- Q.3
- a) Derive an expression for the impulse response of a multipath channel. 8
  - b) For a Rayleigh fading signal. Find a) number of zero level crossings and b) the average fade duration for threshold levels  $\rho=0.1$  and  $\rho=1$  when the Doppler frequency is given as 20Hz. 5
  - c) Explain why a hexagon has been chosen to represent a cell in cellular layouts. 3
  - d) Define the Brewster Angle. Calculate the Brewster angle  $\theta_B$  for a wave impinging on poor ground, having a permittivity of  $\epsilon_r=15$  at the frequency of 100 MHz. 4

**PART B**

- Q.4
- a) With the help of a neat block diagram, explain the RAKE receiver. 6
  - b) Draw and explain the structure of time slot in a GSM system. 6
  - c) Explain how PN sequences are generated of length 7. Discuss the properties of PN sequences. 8
- Q.5
- a) Distinguish between linear and non-linear equalizers. 6
  - b) Explain the polarization diversity in mobile communication systems. 7
  - c) Explain the different control channels in GSM. 7

- Q.6
- a) Explain how mean square error between the desired equalizer output and actual equalizer is minimized using least mean square algorithm. 8
  - b) A single tone jammer is applied to a DS-SS system. Derive an expression to show that the effective jamming power depends on processing gain and normalized power of the interfering signal. 8
  - c) Discuss the necessity of power control in CDMA system. 4

**PART C**

- Q.7
- a) Discuss the frequency and channel specifications of IS-95. 6
  - b) With the help of suitable mathematical expressions, explain Rayleigh and Rician fading. 6
  - c) With the help of a block diagram, explain the reverse channel block of CDMA system. 8
- Q.8
- a) With the help of a block diagram, explain the architecture of a GSM system. 8
  - b) Calculate the path loss due to diffraction if the transmitter power is 12 W, gain of the transmitting antenna is 12 db, gain of the receiving antenna is 5 db, loss factor 1 db at 900 MHz frequency. The heights of transmitting antenna, receiving antenna, the obstacle are 55 m, 4.5 m and 420 m respectively. The obstacle is separated from the transmitter by 3.5 km and from receiver by 2.5 km. 8
  - c) The Signal to Interference ratio needed for acceptable operation is 15 dB. If the path loss exponent is 4, compute the minimum value of the cluster size for the cellular communication system. 4

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T.E - (Electronics & TC / Electronics & Comm) (Sem-VI)(Revised Course 2019-2020)

EXAMINATION JUNE 2023

Wireless Sensor Networks

[Time: 3:00 Hours]

[Max. Marks:100]

- Instructions:**
- 1) Assume suitable data wherever necessary.
  - 2) Figure to right indicate maximum marks.
  - 3) Answer any 5 questions with any 2 from part A, any 2 from part B and any 1 from part C.

**PART-A**

- Q1 a) Write a short note on any two of wireless sensor network application. **12**
- I. Structural health monitoring
  - II. Traffic control
  - III. Healthcare
- b) Explain with block diagram data acquisition and actuation. **08**
- Q2 a) With neat diagram explain the protocol stack for wireless sensor network. **07**
- b) Explain the processor subsystem in wireless sensor node. **06**
- c) Which shortcoming of SMAC does the T-MAC address? Explain briefly TMAC ability to adapt to traffic density. **07**
- Q3 a) Explain the functional and nonfunctional aspects of operating system in wireless sensor node. **12**
- b) Explain the Low-Energy Adaptive Clustering Hierarchy contention free MAC protocols. **08**

**PART-B**

- Q4 a) Explain briefly the commonly used routing metrics. 08
- b) How does the SPIN family of protocols address the three challenges faced by flooding? Explain briefly SPIN PP and Spin BC routing protocol. 12
- Q5 a) Why is time synchronization needed in a WSN? Give at least two examples. 06
- b) Give three reasons why dynamic power management is a crucial concern in wireless sensor networks. 07
- c) What is a man-in-the-middle attack? Can you imagine a concrete WSN scenario where such an attack could be catastrophic? 07
- Q6 a) Explain the six different types of time stamps that characterize the communication in FTSP. 06
- b) What is the difference between local and global power management strategies? Give an example how a global power management can be realized at the link layer. 07
- c) What is routing? List and explain the various categories of routing protocols. 07

**PART-C**

- Q7 a) Explain the challenges and constraints that impact the design of wireless sensor networks. 08
- b) Write a short note on any two of the following. 12
- i. Tiny OS
  - ii. SOS
  - iii. Contiki
- Q8 a) Explain the difference between external and internal time synchronization and name at least one concrete example for each type of synchronization. 08
- b) What is the main drawback of dynamic power management strategies that are based on a synchronous sleeping? 08
- c) Explain why the depth of the synchronization tree in centralized LTS should be small. 04

Total No. of Printed Pages: 2

T.E - (Electronics & TC / Electronics & Comm) (Sem-VI)(Revised Course 2019-2020)

EXAMINATION JUNE 2023

Radar System Engineering

[Time: 3:00 Hours]

[Max. Marks:100]

- Instructions:**
1. Answer any five questions with Two from PART-A, Two from PART-B and One from PART-C
  2. Assume suitable data whenever necessary.

**Part –A**

Answer any Two questions from the following:

- Q1
- a) With the help of a block diagram explain the working of Pulse radar. 6
  - b) Applying the radar parameters, derive the radar signal power equation. Hence obtain the expression for Maximum Radar Range. 8
  - c) Explain the methods of integration of Radar pulses. 6
- Q2
- a) Explain the Doppler Effect. Hence derive the expression for Doppler frequency shift. 7
  - b) With the help of a block diagram explain the working of Continuous Wave Doppler radar. 6
- Diagram, explain the working of single Delay Line 7

Total No. of Printed Pages: 2

T.E - (Electronics & TC / Electronics & Comm) (Sem-VI)(Revised Course 2019-2020)

EXAMINATION JUNE 2023

Radar System Engineering

[Time: 3:00 Hours]

[Max. Marks:100]

- Instructions:**
1. Answer any five questions with Two from PART-A, Two from PART-B and One from PART-C
  2. Assume suitable data whenever necessary.

**Part –A**

**Answer any Two questions from the following:**

- Q1
- a) With the help of a block diagram explain the working of Pulse radar. 6
  - b) Applying the radar parameters, derive the radar signal power equation. Hence obtain the expression for Maximum Radar Range. 8
  - c) Explain the methods of integration of Radar pulses. 6
- Q2
- a) Explain the Doppler Effect. Hence derive the expression for Doppler frequency shift. 7
  - b) With the help of a block diagram explain the working of Continuous Wave Doppler radar. 6
  - c) With the help of a neat diagram, explain the working of single Delay Line Canceller. 7
- Q3
- a) Explain the Radar cross sections of complex targets using Swerling Target Models. 8
  - b) Use the Radar range to determine the required transmitter power for the Radar if  $S_{\min} = 10^{-13}$  Watts. Gain=33.0103 dB, wavelength=0.23m, PRF=524 and target cross-section is 2sq.m. 6
  - c) What is blind speed? Explain how staggered PRF helps in eliminating blind speed. What are the limitations of this method? 6

**Part –B**

**Answer any Two questions from the following:**

- Q4 a) Explain using diagram the Sequential Lobbing method of Radar Tracking. 6
- b) With the help of neat diagram explain Conical scanning method. 8
- c) Explain the method of Low angle Tracking. 6
- Q5 a) Explain with the help of neat diagram Amplitude Comparison Monopulse Radar Tracking method. 10
- b) Explain how tracking in range is achieved using split range gate. 6
- c) Write a short note on Pulse compression Radar. 4
- Q6 a) Explain Radomes and Rotodomes. 6
- b) Explain with the help of neat diagram the working of Secondary Surveillance Radar. 8
- c) Explain with the help of neat diagram Phase Comparison Monopulse Radar Tracking method. 6

**Part-C**

**Answer any One questions from the following:**

- Q7 a) With the help of neat waveforms and block diagram explain the operation of FM-CW Radar. 8
- b) With the help a neat block diagram, explain the working of Non-Coherent MTI Radar system. 6
- c) Explain any Three Applications of radar 6
- Q8 a) Give the advantages and disadvantages of using Continuous wave radar. Hence Explain any One application of CW Radar. 8
- b) With the help a neat block diagram and waveforms, explain the working of MTI Radar system. 8
- c) Explain the types of Radar System Losses. 4

Total No. of Printed Pages: 2

T.E - (Electronics & TC / Electronics & Comm) (Sem-VI)(Revised Course 2019-2020)

EXAMINATION JULY 2023

Cyber Law and IPR

[Time: 3 Hours]

[Max. Marks:100]

- Instructions:**
1. Assume suitable data **only** if necessary
  2. Answer any **two** questions from PART-A
  3. Answer any **two** questions from PART-B
  4. Answer any **one** question from PART-C
  5. All symbols, abbreviations and notations have their usual meaning

**PART A**

- Q1 a) Power of arrest without warrant from a public place under section 80 of the Information Technology Act, 2000, is a tragedy and a comedy. Justify. 06  
b) What is hacking? How are hackers classified? In terms of motivation, explain the four types of hacking. 07  
c) Define and explain exclusion clauses in contracts. How are exclusion clauses abused? 07
- Q2 a) Explain the UDRP process of appointing an administrative panel. 08  
b) Write a note on copyright term and respect for foreign works. 06  
c) Explain any six functions that the controller of certifying authorities needs to perform. 06
- Q3 a) Explain in detail cyber fraud and cyber cheating. 08  
b) List any five strategies adopted in India to reduce software piracy. 05  
c) Explain in detail the battle between freedom and control on the internet. 07

**PART B**

- Q4 a) Write a short note on 2x5=10  
iii) Trade Secrets  
iv) Protection of New Plant Variety  
b) Explain in detail the WIPO Copyright Treaty. 10
- Q5 a) Elaborate on the term patents? Explain in detail the objective behind Patent Law. 08  
b) Explain in detail the aspects of the license agreement. 06  
c) Can stamps, labels, tokens, cards, be considered an article for the purpose of registration of Design? Justify. 06
- Q6 a) Explain Semiconductor Chip Protection Act, in detail. 06  
b) Explain in detail the rights of patentees. 06  
c) Write a note on trademark infringement and remedies. 08

**PART C**

- |    |    |   |    |
|----|----|---|----|
| Q7 | a] | Explain territorial jurisdiction with an example.   | 07 |
|    | b] | List and explain the main functions performed by a signature.   | 05 |
|    | c] | Differentiate between shrink wrap and click wrap contracts. What care must be taken while formulating click wrap contracts? | 08 |
| Q8 | a] | Explain in detail transfer of patent rights in the form of assignment.  | 08 |
|    | b] | Explain the procedure for registration of domain names.   | 06 |
|    | c] | Explain the UK Data Protection Act.   | 06 |

Total No. of Printed Pages: 03

**T.E - (Electronics & TC / Electronics & Comm) (Sem-VI)(Revised Course 2019-2020)**  
**EXAMINATION JUNE 2023**  
**Artificial Neural Networks**

[Time: 3:00 Hours]

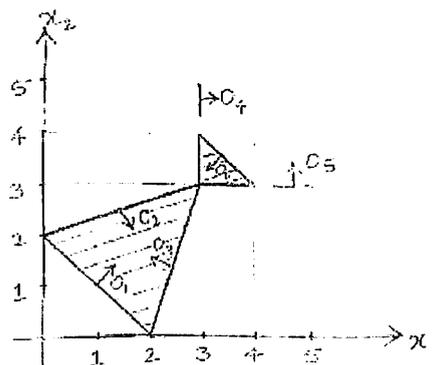
[Max. Marks:100]

**Instructions:**

- 1) Assume suitable data wherever necessary.
- 2) Answer any 5 questions, taking two questions from PART A, two questions from PART B and one question from PART C.

**PART A**

- Q1
- a. Distinguish between Supervised and Unsupervised Learning. 4
  - b. Show that for bipolar sigmoidal activation function  $f'(net) = \frac{1}{2}(1 - O_k^2)$  where  $O_k$  = output of the  $k^{th}$  output neuron 8
  - c. How is the Artificial Neuron Model derived from the Biological Neuron? 8  
Realize the following functions using artificial neuron model:
    - i. 2-input AND Gate with bias
    - ii.  $Y = ab + bc + \bar{a}\bar{c}$
- Q2
- a. Explain the general network learning algorithm. What are the disadvantages of network pruning algorithm? 6
  - b. Explain the following w.r.t neural networks: 6
    - i. Generalizability
    - ii. Momentum
  - c. Design a neural network classifier for the following data. 8



Shaded area belongs to class I. Rest of the pattern space belongs to class II

- Q3 a. Apply Neural Tree Algorithm to solve corner isolation problem. 6
- b. Train the network using the following data using Hebbian Learning rule for one epoch. Assume unipolar continuous neuron characteristics. 6
- $$X_1 = \begin{bmatrix} 1 \\ -2 \end{bmatrix} \quad X_2 = \begin{bmatrix} 0 \\ 1 \end{bmatrix} \quad X_3 = \begin{bmatrix} 2 \\ 3 \end{bmatrix}$$
- Initial weights are:  $W^0 = \begin{bmatrix} 1 \\ -1 \end{bmatrix}; C = 1$
- c. The prototype points are given as 8
- $X_1=[5,2]$   $X_2=[6,2]$   $X_3=[4,3]$   $X_4=[5,5]$  \_\_\_\_\_ Class I
- $X_5=[0,0]$   $X_6=[-2,-1]$   $X_7=[-2,4]$   $X_8=[-4,0]$  \_\_\_\_\_ Class II
- i. Are they linearly separable?
- ii. Find cluster centroid for each class and design the classifier.

**PART B**

- Q4 a. What is meant by clustering? Explain the Simple Competitive Learning Algorithm. 7
- b. Apply LVQ on the following data to perform one epoch of training. Assume learning constant  $C=0.5$  8
- $X_1 = [1.1 \quad 1.7 \quad 1.8] - - - -$  Class I
- $X_2 = [0 \quad 0 \quad 0] - - - -$  Class ii
- $X_2 = [0 \quad 0.5 \quad 1.5] - - - -$  Class II
- Assume initial weight matrix as:  $W = \begin{bmatrix} 1 & 1 & 1 \\ 0.1 & 0.1 & 0.9 \\ 0.2 & 0.7 & 0.3 \end{bmatrix} \begin{matrix} \text{Class II} \\ \text{Class II} \\ \text{Class I} \end{matrix}$

- c. Explain the working of Auto-Encoders. 5
- Q5 a. Explain one application of neural network. 10
- b. Design Bidirectional Associative memory for following input-output pairs: 6
- $(1,1,-1,-1) \rightarrow (1,1)$
- $(1,1,1,1) \rightarrow (1,-1)$
- $(-1,-1,1,1) \rightarrow (-1,1)$
- Test the response of the network for pattern (1, 1, 1, 1)

- c. Differentiate between Discrete Hopfield network and Continuous Hopfield Network. 4
- Q6 a. Illustrate the working of a simple Hamming Network. 5
- b. Explain the working principle of Brain-State-in-Box (BSB) Network. Given the training set as  $(1,1,1)$ ,  $(-1, -1,1)$ ,  $(1, -1, -1)$ , determine the network response for  $(-0.5,0.7, -0.2)$  10
- c. Briefly explain the layers of a Convolutional Neural Network. 5

## PART C

- Q7 a. Explain winner-take-all learning rule. 5
- b. Design MAXNET and determine its response if node inputs are  $(0.7,0.3,0.2)$  8
- c. For a four node Hopfield network, that stores the input patterns:  $(1, 1, 1, 1)$  and  $(-1,-1,-1,1)$ , Determine network response for  $(1, 1, 1,-1)$ ,  $(1, 0,-1,-1)$ . 7
- Q8 a. Cluster the following samples using ART for one epoch. Assume vigilance parameter = 0.8  
 $X1 = (1,1,0,0,0,0,1)$   $X2 = (1,1,0,1,1,1,0)$   $X3 = (0,0,1,1,1,1,0)$   $X4 = (1,1,1,1,0,0,0)$ . 10
- b. Derive weight update equations in case of Error Back Propagation Algorithm. 10

Total No. of Printed Pages: 2

T.E - (Electronics & TC / Electronics & Comm) (Sem-VI)(Revised Course 2019-2020)

EXAMINATION JUNE 2023

VLSI Technology and Design

[Time: 3:00 Hours]

[Max. Marks:100]

- Instructions:** 1) Attempt **TWO** full questions from part A, **TWO** full questions from part B and **ONE** full question from part C.  
2) All symbols carry their usual meaning.  
3) Assume suitable data if necessary.  
4) Figures to the **right** indicates **marks**.

**PART A**

- Q1 a. Explain parasitic capacitances associated with a MOSFET. [6M]  
b. Explain Channel length modulation. Hence derive the drain current equation of a MOSFET. [8M]  
c. Explain the following terms with reference to n- channel MOSFET [6M]  
i. Accumulation region.  
ii. Inversion region.
- Q2 a. Draw the VTC curve of a CMOS inverter. Derive the expression for  $V_{IL}$  of a CMOS inverter. [8M]  
b. Write a SPICE code to plot the output of the following Boolean expression. [8M]  
$$F = \overline{(AB + CD)}$$
  
Take inputs A, B, C and D as pulse waveforms. Assume default level 1 parameters and  $V_{DD}=3.3V$ .  
c. Explain the terms Fan in and Fan out of a CMOS circuits. [4M]
- Q3 a. For a CMOS inverter the rise and fall time are 6 ns and 3 ns. If a 4 input NAND gate is fabricated using NMOS and PMOS identical to those used in the inverter then determine the rise and fall time of 4-input NAND gate. [6M]  
b. Write a SPICE code for CMOS NOR gate with square pulses as digital input. Plot for input and output. Assume  $V_{DD} = 3.3V$ . Use default level 1 parameters. [8M]  
c. Describe the method of measurement of Gamma ( $\gamma$ ) of a MOSFET. [6M]

PART B

- Q4 a. Implement the following using CMOS LOGIC. [8M]  
 i.  $F = ((AB + C)D) + E$   
 ii.  $X = \overline{A(BC + D) + EF}$
- b. Explain photolithography process. [6M]  
 c. Write VHDL program to implement JK Flip-flop. [6M]
- Q5 a. For the logic function  $F = \overline{(XY) + (RS)}$  [10M]  
 i. Draw the schematic using CMOS logic  
 ii. Draw the Euler diagram and Identify the Euler path  
 iii. Draw the optimized stick diagram using Euler path. [10M]
- b. With a neat diagram explain ion implantation process. Give its advantages and disadvantages.
- Q6 a. Draw and explain the circuit for D-latch using transmission gates. [6M]  
 b. Write VHDL Program for 4 bit shift register (SIPO). [6M]  
 c. Explain the oxidation process. Describe the role of Silicon dioxide in Fabrication process. [8M]

PART C

- Q7 a. Explain Silicon on insulator process. Give its advantages. [6M]  
 b. An enhancement type NMOS is biased with  $V_G = 4.0V$ ,  $V_D = 2V$ ,  $V_{SB} = 0V$ . Assume  $W = 400nm$ ,  $L = 40nm$ ,  $\mu_n C_{ox} = 25 \mu A/v^2$  and  $V_{T0} = 1V$ . [8M]  
 i. Determine region of operation. Also find its drain current.  
 ii. Calculate new value of  $I_D$  if  $V_D$  is increased to 5V. Mention its region of operation  
 c. Write a VHDL program for 4:1 MUX using if statement. [6M]
- Q8 a. Draw the optimized layout for OR gate using MOSIS design rules (Scalable LAMBDA rules). [10M]  
 b. Write VHDL program to implement following using data flow modeling. [10M]  
 i.  $F = AB + CD + AC$   
 ii. 2:4 decoder.

Total No. of Printed Pages: 3

**T.E - (Electronics & TC / Electronics & Comm Engg) (Sem-VI)(Revised Course 2019-2020)**  
**EXAMINATION JANUARY 2023**  
**5)Wireless Sensor Networks**

[Time:3:00 Hours]

[Max. Marks:100]

- Instructions:** 1) Assume suitable data wherever necessary.  
2) Figure to right indicate maximum marks.  
3) Answer any two questions each from Part A, Part-B and any one question from Part-C.

**PART A**

Answer any two questions from the following:

- |    |  |    |
|----|--|----|
| Q1 | A. Explain the Pattern MAC contention based MAC protocol.                              | 8  |
|    | B. Explain the Power aware multi-access with signalling contention based MAC protocol. | 8  |
|    | C. Explain single hop versus multi hop communication in wireless sensor network.       | 4  |
| Q2 | A. With neat diagram explain the protocol stack for wireless sensor network.           | 8  |
|    | B. Explain the communication interface of wireless sensor node.                        | 8  |
|    | C. Compare traditional network versus wireless sensor network.                         | 4  |
| Q3 | A. Write a short note on any two of wireless sensor network applications.              | 12 |
|    | B. Explain briefly characteristics of MAC protocols in sensor networks.                | 8  |

**PART B**

- |    |   |   |
|----|---|---|
| Q4 | A. Sketch the classification structure of routing protocols & provide the brief information about the same.   | 6 |
|    | B. With neat diagrams, discuss flooding & its challenges in detail. Is directed diffusion technique based on flooding? Justify.   | 8 |
|    | C. With neat diagrams, explain rumor routing.   | 6 |
| Q5 | A. Give reasons why dynamic power management is a crucial concern in WSN.   | 4 |
|    | B. What is the difference between local and global power management strategies? Give an example how a global power management can be realized at the link layer. How can a local power management strategy achieve efficient power consumption in a wireless sensor node? | 4 |

- C. With respect to ranging techniques in WSN, discuss 12
- i. Time of Arrival
  - ii. Time Difference of Arrival
  - iii. Angle of Arrival
  - iv. Received Signal Strength
- Q6 A. Describe the CIA security model. Which service(s) described in this 8  
model do you think are essential for the following scenarios? Justify your answers.
- a) A WSN that allows emergency response teams to avoid risky and dangerous areas and activities.
  - b) A WSN that collects biometric information collected at an airport.
  - c) A WSN that measures air pollution in a city for a research study.
  - d) A WSN that alerts a city of an impending earthquake.
- B. The task of local power management is to figure out how power is consumed by the 8  
different subsystems of a wireless sensor node. Discuss this with respect to the:
- i. Processor Subsystem
  - ii. Communication Subsystem
  - iii. Power Subsystem
  - iv. Battery & DC-DC Converter
- C. Discuss the SPIN - EC Protocol for routing. 4

**PART C**

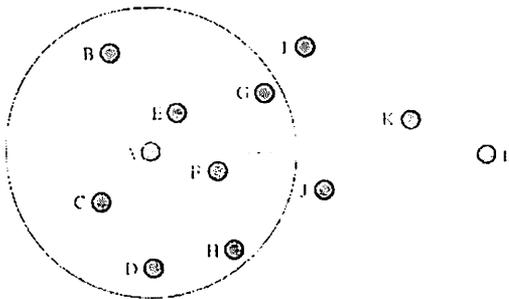
Answer any one question from the following:

- Q7 A. The choice of operating system depends on what factors? Discus briefly. 12
- B. List and discuss various classification of MAC protocols. 8
- Q8 A. What is a denial-of-service attack? Explain the following attacks: 8
- i. Jamming attack
  - ii. Exhaustion attack
  - iii. Tampering attack

While "typical" computers are in homes, offices, labs, etc., wireless sensor

nodes are often placed in places that are publicly open and accessible. What kind of attacks could an adversary initiate by accessing a single sensor node in a large-scale WSN?

- B. Explain the concepts of symmetric and asymmetric keys. A shift cipher as a simple example of a cryptographic technique. Is this cipher a symmetric or an asymmetric key cryptography technique? What are the problems with such a simple cipher? 6
- C. Consider the topology in figure below. Node A wishes to forward a packet toward destination L via one of its neighbors (its communication range is indicated with the circle). Define the following forwarding strategies and give proper justification to mention which neighbor will A choose while using:
- Greedy forwarding
  - Nearest with forwarding progress
  - Most forwarding progress within radius
  - Compass routing



Total No. of Printed Pages: 4

T.E. (Electronics & TC / Electronics & Comm Engg) Semester-VI (Revised Course 2019-20)

EXAMINATION JANUARY 2023

Artificial Neural Networks

[Time: Three Hours]

[Max. Marks:100]

Instructions:

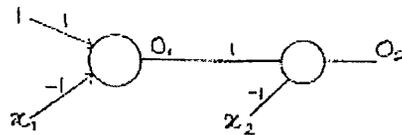
- 1) Assume suitable data wherever necessary.
- 2) Answer any five full questions taking two questions from PART-A, two questions from PART-B and one question from PART-C.

Part-A

- Q1
- a) With neat, labelled sketches, discuss the structural and consequent functional correspondence between a biological neuron and an artificial neuron model. 4
  - b) Design a neural network using McCulloch-Pitts Neuron Model to realise the following logic operations: 4
    - i) 3-input NAND Gate
    - ii) Memory Cell
  - c) Perform two training steps using Delta Learning Rule for  $\lambda = 1$  and  $c=0.25$  using the following training set: 4

$$\text{Training set} = \left\{ \left( X_1 = \begin{bmatrix} -1 \\ 1 \\ -1 \end{bmatrix}, d_1 = 1 \right), \left( X_2 = \begin{bmatrix} -2 \\ 1 \\ -1 \end{bmatrix}, d_2 = -1 \right) \right\}$$

- d) The feed forward network shown below implements partitioning of the  $x_1x_2$  plane. If both neurons use binary bipolar activation function, plot the region in the plane where  $O_2 = +1$ . 8



- Q2
- a) Derive the equations for updation of weights in case of Error Back-Propagation Algorithm. 8
  - b) Training the weight adjustment of 3 class classifier using three Discrete Bipolar Perceptron Network has been completed in 3 steps with augmented pattern component of -1 and  $\eta = 0.5$ . 6

Step 1: Presentation of  $Y_1$  resulted in adjustment of all weights initiated as

$$W_1^1 = W_2^1 = W_3^1 = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

Step 2: Presentation of  $Y_2$  resulted in adjustment of weight  $W_3^2$  only.

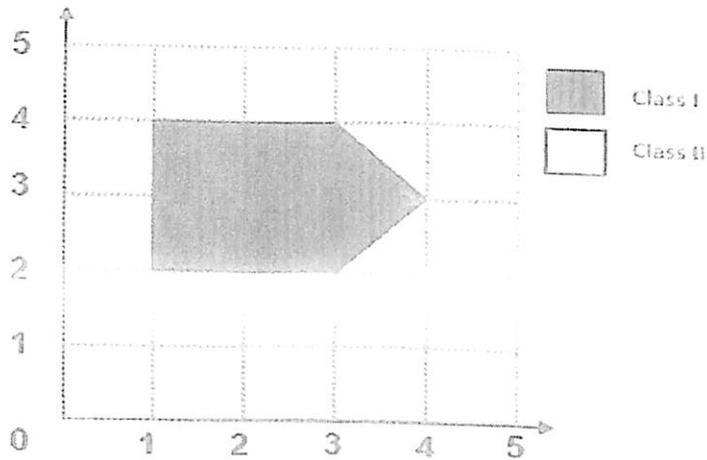
Step 3: Presentation of  $Y_3$  resulted in adjustment of  $W_2^3$  only.

Final weights are:  $W_1^4 = \begin{bmatrix} 1 \\ 3 \\ -1 \end{bmatrix}$ ,  $W_2^4 = \begin{bmatrix} 5 \\ -1 \\ 2 \end{bmatrix}$ ,  $W_3^4 = \begin{bmatrix} 1 \\ -1 \\ 2 \end{bmatrix}$

Find the patterns  $X_1, X_2$ , and  $X_3$  used for training.

- c) With the help of neat contour diagram of an error surface, illustrate how the addition of a momentum term in the weight update equation of Error Back-Propagation Algorithm helps in global convergence of the algorithm. 6

- Q3 a) Design a discrete bipolar perceptron classifier network to achieve the classification of the planar pattern illustrated in the figure given below. The shaded disjoint area in the figure belongs to Class I and the rest of the pattern space belongs to Class II. 6



- b) With a neat labelled plot of an error surface, describe the working principle of Quick-Prop Algorithm. What are its limitations? 6

- c) Define Linear Separability and Linear Non-Separability with respect to Artificial Neural Networks. 4

- d) What are Network Pruning Algorithms? 4

**Part -B**

- Q4 a) Illustrate the working of simple Hamming Network. 5

- b) Design a MAXNET and determine for the input (0.9, 0.8, 1, 0.85) 5

- c) Cluster the following points using Simple Competitive Learning. Use  $\eta = 0.5$ . 10  
 $X_1 = [0, 1, 0], X_2 = [1, 1, 0.5], X_3 = [0.2, 0.2, 0.2], X_4 = [0.4, 0.4, 0.4], X_5 = [0.4, 0.5, 0.6],$   
 $X_6 = [0, 0, 0]$ . Assume the initial matrix as follows:

$$W^T = \begin{bmatrix} 0.4 & 0.7 & 0.5 \\ 0.9 & 0.5 & 0.3 \\ 0.6 & 0.8 & 0.7 \end{bmatrix}$$

- Q5 a) Describe the types of associations in Artificial Networks with the help of examples. 5  
 b) Write a short note on Recurrent Neural Networks. 5  
 c) Design a Bidirectional Associative Memory for the following data: 10
- |            |   |          |
|------------|---|----------|
| (Input)    | : | (output) |
| (1,1,1,-1) | : | (1,1).   |
| (1,1,-1,1) | : | (1,-1).  |
| (1,-1,1,1) | : | (-1,1)   |
| (-1,1,1,1) | : | (-1,-1)  |
- Determine the response for (1,-1,-1,1)

- Q6 a) Explain the working of the LVQ Algorithm. 6  
 b) Design a BSB network to store the patterns (1, 1, 1), (-1, -1, -1), (-1, -1, 1). Determine the network response for corrupted input pattern (0.5, 0.6, -0.7). 4  
 c) Describe the construction and working of a Convolutional Neural Network. What is the purpose of pooling in a CNN? 4  
 d) Formulate and describe the expression for the Lyapunov Function (Energy Function) for Discrete Hopfield Networks. 6

**Part -C**

- Q7 a) Perform an appropriate pattern to image space mapping to solve the XNOR problem. 7  
 b) Explain the working of a Polynomial Network. 6  
 c) The prototype points are given as follows: 7
- |   |       |          |
|---|-------|----------|
| $X_1 = (5,1), X_2 = (7,3), X_3 = (3,2), X_4 = (5,4)$      | ----- | class I  |
| $X_5 = (0,0), X_6 = (-1, -3), X_7 = (-2,3), X_8 = (-3,0)$ | ----- | class II |
- i) Find if these points are linearly separable.  
 ii) Find the cluster centroid for each class and design the classifier.  
 iii) Draw the classifier obtained.

- Q8 a) Classify the following samples using Self Organizing Feature Maps Algorithm for ONE iteration. Assume learning constant = 0.6, topological distance as 1 and a linear network 8

topology as C-A-B.

$$X_1 = (1.3, 1.9, 2), X_2 = (0.3, 0.4, 0.2), X_3 = (0.3, 0.8, 1.2), X_4 = (1.3, 1.1, 0.3)$$

$$W^T = \begin{bmatrix} 1.3 & 1.1 & 1.5 \\ 0.2 & 0.3 & 0.4 \\ 0.5 & 0.6 & 0.7 \end{bmatrix} \begin{matrix} -A \\ -B \\ -C \end{matrix}$$

- b) How can the Lyapunov Function (Energy Function) be minimised for Discrete Hopfield Networks? 8
- c) Explain any one application of neural networks in detail. 4

Total No. of Printed Pages: 2

**T.E (Electronics & TC / Electronics & Comm Engg) Semester-VI (Revised Course 2019-20)**  
**EXAMINATION JANUARY 2023**  
**Radar System Engineering**

[Time: Three Hours]

[Max. Marks: 100]

- Instructions:** (1) Attempt five questions, any two questions each from Part-A and part-B, and one from Part-C  
(2) Assume suitable data wherever necessary.

**Part-A**

- Q1** (a) Derive fundamental radar range equation governed by minimum receivable echo power  $S_{min}$ . Describe the effect of pulse repetition frequency on the estimated unambiguous range of radar. **(8 Marks)**
- (b) Compute the maximum detectable range of a radar system specified below: Operating wavelength = 3.2 cm, Peak pulse transmitted power = 500 KW, Minimum detectable power = 0.1pW, Capture area of the antenna =  $5m^2$  and a Radar cross-sectional area of the target  $5m^2$ ,  $G=1000$ . **(4 Marks)**
- (c) Justify the requirement of integration of radar pulses to improve target detection process. **(4 Marks)**
- (d) Explain the factors, which govern pulse width of a radar. A shipboard radar has 0.9 $\mu$ sec transmitted pulse width. Two boats in the same direction are separated by 150 meters. Will the radar detect two boats as two targets? Justify your answer. **(4 Marks)**
- Q2** (a) The average time between false alarms is specified as 30 minutes and the receiver bandwidth 0.4 MHz Compute  
i) The probability of false alarm and  
ii) The threshold to noise power ratio ( $V_T^2 / \psi_o$ )  
Estimate the average time between false alarms if the threshold is increased by 0.3dB. **(8 Marks)**
- (b) Describe chief characteristics of the radar echo from target when its radar cross section is in the (a) Rayleigh region (b) resonance region (c) Optical region. **(6 Marks)**
- (c) Establish a relation between Doppler frequency shift and radial velocity of a moving target. A 8GHz Police radar measures a Doppler frequency of 1788Hz from a car approaching the stationary police vehicle in an 80 km/hour speed limit zone. Is the car dose exceeding the speed limit? Justify your answer. **(6 Marks)**
- Q3** (a) What is a delay line canceller? Illustrate the concept of blind speeds based on the frequency response of a single delay line canceller. Suggest methods to reduce the effect of blind speeds for unambiguous detection of a moving target. **(8 Marks)**
- (b) A Radar measures an apparent range of 7nmi when the prf is 4000Hz, but it measures an apparent range of about 18.6nmi when the prf is 3500Hz. What is the true range in nmi? **(6 Marks)**

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- (c) Distinguish between MTI and Pulse Doppler Radars. Discuss the factors limiting the performance of an MTI system. (6 Marks)

**Part-B**

- Q4** (a) With the help of necessary diagrams, explain the working of an amplitude comparison mono pulse tracking radar in azimuth or elevation (one angle co-ordinate only). (8 Marks)
- (b) Why is amplitude comparison mono pulse more likely to be preferred over the conical scan tracker or lobe-switching tracker? (6 Marks)
- (c) Distinguish between amplitude comparison mono pulse and phase comparison mono pulse. (6 Marks)
- Q5** (a) Explain the principles of Early-late gate range tracking with neat sketches. (5 Marks)
- (b) Why does tracking radar have a poor accuracy at low elevation angles? Summarize the two methods that may be used to avoid poor tracking at low altitude. (8 Marks)
- (c) Draw and explain the block diagram of Conical-scan tracking radar. (7 Marks)
- Q6** (a) Explain the working of a bistatic radar. What are its applications? Distinguish between Monostatic and bistatic Radars. (9 Marks)
- (b) Discuss the need for pulse compression. Explain the principle of phase coding for pulse compression in radar. (8 Marks)
- (c) What are rotodomes? How is it different from/ similar to radomes? (3 Marks)

**Part-C**

- Q7** (a) Discuss any four applications of Radar. (6 Marks)
- (b) With the help of neat diagrams, explain the working principle of FM- CW radar. (8 Marks)
- (c) What are Non-coherent MTI radars? List out the advantages of Non-coherent MTI radars. (6 Marks)
- Q8** (a) Explain working of FM pulse compression radar. (5 Marks)
- (b) Writ short notes on **any three**
- i) Secondary Surveillance Radar
  - ii) Synthetic Aperture Radar(SAR)
  - iii) Radomes
  - iv) Radar Displays
- (3x5 Marks)