BE / ETRX / SEM-VII (CBSGS) / Embedded System Design

(3 Hours)                          (Total Marks : 80)

N.B. Question no. 1 is compulsory.
　　　 All questions carry same weightage/marks.
　　　 Attemt any other 3 from remaining 5 questions. Attempt total 4 questions
　　　 Assume suitable date whereever necessary.

Q1.a. What are' the challenges while meeting low power consumption, performance, low-cost requirement for an embeded system. Explain how they affect other? (5)
　　b. What kind of communication an embedded system may need? Describe any two types (5)
　　c. Why C programing is popular for embedded programing? Describe related features. (5)
　　d. Cortex-A8, R4, M3 are suitable for certain class of applications, justify how? (5)

Q2.a. What features of cortx-M3 makes it suitable for low-power, RTOS based applications. (10)
　　b. What is CAN protocol? Describe topology and Frame formats with significance of fields. (10)

Q3.a. What is need of debug and trace facility? How cortex-M3 supports it? (10)
　　b. For low power design which microcontroller architecture will you use? Why? What is typical design strategy for achieving low-power consumption. (10)

Q4. Heart is having a natural pulse generator which is responsible to rythmically beating of heart. Malfunctioning of that leads to arythmic heart beating. Design a pacemaker (pulse generator) which generates electrical pulses to trigger heart, if it senses irregular(or low) heart rate. This pacemaker is typically inplanted inside body near chest. Assume appropriate design challenge and design an embedded system (pacemaker) which can sense and trigger (if required) heart to bring heart back to normal rythmic beating. For this design develop
　　a. Functional model /FSM which describes functioning of system
　　b. Hardware block diagram which describes typical hardware building blocks
　　c. Software architecture which describe typical functions/drivers/tasks required in program d. piscuss special design challenges for this design and suggest solutions/approach
　　e. Suggest list of components with justification. (20)

Q5.a. What is Real time operating system's role, function in an embeded system? Describe various uCOS-II c-functions which are used to implements RTOS functions/role. (10)
　　b. What is shared data? How it is handled in RTOS? What are priorty inversion problems? How priority inversion problem can be addressed/solved? (10)

Q6. Write short notes on any four.
　　a. Task scheduling policies (any three) and its impact on average waiting, turn-around time
　　b. Compare FPGA/CPLD based embedded system against Microcontroller based
　　c. Testing methodologies, tools and need.
　　d. Wireless embedded communication.
　　e. Inter process communication in RTOS (20)

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**Q.P. Code : 728402**

( 3 Hours )                                  [Total Marks : 80

N.B.    1)    Question No. 1 is compulsory

2)    Solve any three questions from the remaining questions

3)    Assume suitable data  if necessary

1.    Solve any four of the following. (5 marks each)                                    (20)

(a)    Explain various charges in the gate oxide after fabrication of MOSFET.

(b)    What is Trench Isolation? Explain its use in VLSI technology.

(c)    Classify crystal structure with respect to resistivity and periodicity of atoms.

(d)    Enlist the steps for obtaining Silicon from Sand.

(e)    Explain Molecular Beam Epitaxy.

2.    (a)    Define Range, Projected Range and straggle with respect to Ion        (10)
Implantation. Also explain the damage produced due to light ion and heavy
ion with neat diagram.

(b)    Describe APCVD process with neat diagram. Why wafers are lying horizontal    (10)
in this process. Enlist drawbacks of this process.

3.    (a)    List out common Unit processes in IC Fabrication. What is the difference    (10)
between N-well and P-well process? Draw final cross-sectional view of
CMOS inverter fabrication using N-well process with appropriate labels?

(b)    Draw layout of CMOS inverter along with its circuit diagram.  Mention    (10)
clearly all dimensions as per lambda rules. Explain buried and butting
contact.

4.    (a)    Explain Steps of Lithography with suitable diagrams. Also classify    (10)
Lithography techniques.

(b)    What is SOI technology? Enlist methods for fabrication of SOI. Explain any    (10)
one of it.

5.    (a)    Describe with the help of a neat diagram Hayness-Schokley experiment for    (10)
measurement of Drift Mobility of n-type semiconductor.

(b)    Compare evaporation and sputtering methods for metal deposition. Which    (10)
methods are commonly used for deposition of Silicon, $SiO_2$ and metals?

6.    Write short notes on any four of the following. (5 marks each)                    (20)

(a)    Parametric test and functionality test for IC testing

(b)    Electric package reliability.

(c)    Silicon Crystal defects

(d)    Multiagte device Structures

(e)    MESFET fabrication process

(3 Hours) [ Total Marks : 80

N.B.: (1) Question No. 1 is **compulsory**.
    (2) Answer any **three** questions from remaining five questions.
    (3) Assume suitable **data** where ever **necessary**.

1. Solve any **four** questions :—     20
    (a) Differentiate between Plugging and generating mode in AC Motor.
    (b) With the help of diagram explain principle of working of induction heating.
    (c) For a single phase full converter with inductive load, if the source inductance Ls is considered find the average output voltage and reduction in the average output voltage due to overlap if $\alpha$ = 30 deg. and $\mu$=2 deg. with supply voltage of 230 volts.
    (d) The speed of 10 HP separately excited DC motor is controlled by single phase full converter. The rated armature current is 30 A. Ra = 0.5 ohm. The ac supply voltage is 260 volts. The motor voltage constant is 0.182V/rpm. While in motoring action with back emf of 192 volts the polarity of it is reversed for regenerative action. Calculate firing angle to keep the motor current at its rated value.
    (e) Explain battery charging circuit in detail.

2. (a) Explain stator voltage control technique for three phase induction motor. Draw torque-slip characteristics.   10
    (b) Explain three phase fully controlled bridge converter with source inductance. Draw waveforms.   10

3. (a) Draw and explain average model and state space model for buck DC-DC converter in detail.   10
    (b) What is the need of SVM. Explain SV sequence and SV switching in detail in space vector modulation.   10

4. (a) Explain continuous mode fly-back converter in continuous mode. Derive the relation for load voltage   10
    (b) A 3 phase 4 pole induction motor is operated from 415V / 50 Hz supply. Stator voltage control technique is to be applied to vary the speed. The motor is driving a load torque of 100 N-m. Find out the following if motor speed is 100 rad/sec. i)Slip ii)$P_{ag}$ iii) $P_{slip}$ iv) $P_{mech}$ v) The efficiency of rotor circuit.   10

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5. (a) Draw and explain semi converter drive for separately excited DC motor. **10**
   Draw torque-speed characteristics.
   (b) State and explain different characteristics of battery. **5**
   (c) A UPS driving 600 W load which has a power factor of 0.8. The efficiency **5**
   of the inverter is 80 percent. The battery voltage is 24 volts dc. Assume
   that there is a separate charger for the battery. Determine the followings.
   i) KVA rating of the inverter ii) Wattage of the rectifier.

6. Write short notes on the following :— **20**
   (a) On line and off-line UPS
   (b) Controllers in DC-DC converters
   (c) Torque-slip/speed characteristics of induction motor with operating
   regions with different value of slip.

Q.P. Code : 728602

(3 hours) [Total marks: 80]

N.B: (1) Answer any four questions out of six questions
(2) Question No:1 is compulsory
(3) Assume suitable data if necessary

1. Answer any four questions briefly: (20)
    a) Explain PPP header format.
    b) Compare TCP and UDP.
    c) List the categories of UTP cables. How is noise interference minimized in twisted pair cables?
    d) Distinguish between OSPF and BGP.
    e) What is sub netting? List advantages and disadvantages of the same.

2. a) List and explain different ARQ techniques. Specify the maximum window size for each with justification. (10)
   b) What is piggybacking? Give an example of Piggybacked frame (10)
      Sketch the appropriate HDLC frames for the following scenario involving Primary station 'A' and two Secondary stations B and C:
        i.   Primary station A wishes to establish a Normal Response mode link with Secondary stations B and C.
        ii.  Both the stations B and C send positive acknowledgements to A.
        iii. Station A sends a polling command to B and B sends 4 data frames. The third frame is lost during transmission.
        iv.  Assuming Selective repeat ARQ, station A sends negative acknowledgement to station B.
        v.   Station B resends the frame and A sends positive acknowledgement.
        vi.  Station A now polls station C and station C responds with ready response. A sends three data frames to C and C sends positive acknowledgement to indicate the receipt of error free data frames.

3. a) Differentiate between IPv4 and IPv6. (10)
      Determine the class and network address for the following IP addresses (Assuming subnetting is not being used and use default mask)
      i) 84.42.58.11 ii) 195.38.14.13 iii) 144.62.12.9
   b) What is meant by 'blocking' in circuit switching networks? Bring out the advantages of multi stage space division switching over single stage switching. (04)
   c) Sketch three stage space division switch for N=15, n=5 and k=2 (06)
      What is the condition required to make it non blocking?
      For the same specifications, sketch three stage TST switch using TSI modules.

**[TURN OVER]**

4. a) Draw OSI reference model and explain function of each layer. Name the layers (10)
   responsible for: i) end to end reliability ii) link to link reliability.

   b) Define the utilization or efficiency of the line and derive the expression for (10)
   stop and wait flow control. Calculate the maximum link utilization for the following cases:
   i)   Stop and wait flow control
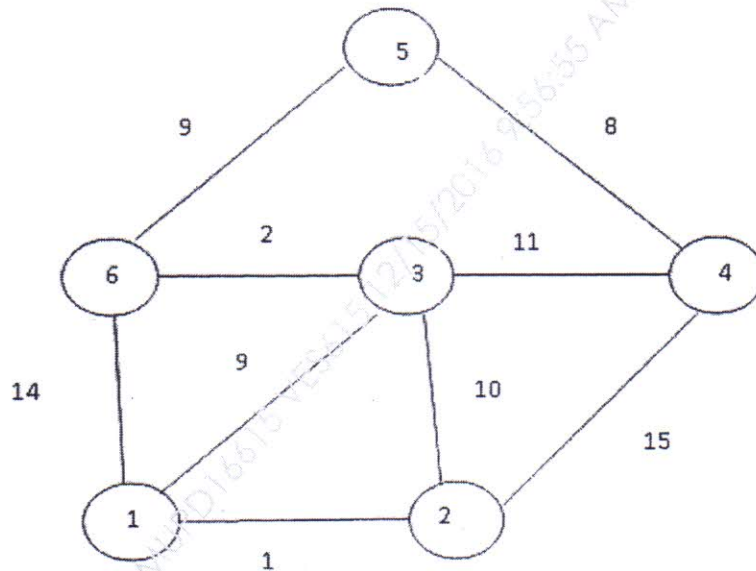   ii)  Sliding window flow control with window sizes of 4 and 7
   Link specifications:
   Frame length= 1000 bits/frame
   Velocity of propagation = $2 \times 10^8$ m/sec
   Link distance= 20km
   Data rate= 20 Mbps

5. a) Apply Dijkstra's and Bellman Ford algorithm to the given network and find the least (10)
   cost path between source node 1 to all other nodes:



   b) Draw and explain TCP header format with the help of a neat diagram. (10)

6. Write short note on: ( Any TWO) (20)
   a) Congestion control techniques
   b) ADSL
   c) TCP connection establishment and release
   d) CSMA/CD

QP Code :728701

(3 Hours) [ Total Marks : 80

N.B. : (1) Question **No. 1** is compulsory.
   (2) Attempt **any three** questions from remaining.
   (3) **All** questions carry **equal** marks.
   (4) Assume suitable data wherever necessary.

1. Answer **any four** of the following:
  (a) Justify the statement "Quality of picture depends on the no: of pixels 5
    and the no: of gray levels representing the pictures".
  (b) Explain RGB color model to represent a digital image. 5
  (c) Can two different images have the same histogram? Justify your 5
    answer.
  (d) Define Chain codes in 4-connectivity and 8-connectivity. 5
  (e) Compare arithmetic coding and Huffinan coding. 5

2. (a) Apply the following Image Enhancement techniques for the given 3 bits 10
  per pixel image segment.

$$1 = \begin{bmatrix} 2 & 1 & 2 & 1 & 0 \\ 7 & 1 & 4 & 3 & 2 \\ 2 & 4 & 1 & 3 & 7 \\ 1 & 3 & 4 & 6 & 3 \\ 1 & 4 & 1 & 3 & 4 \end{bmatrix}$$

  (i) Digital Negative
  (ii) Bit plane Slicing
  (iii) Thresholding with T = 5

 (b) Perform histogram equalization and plot the histograms before and after 10
  equalization.

| Gray level | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| No:of pixels | 128 | 75 | 280 | 416 | 635 | 1058 | 820 | 684 |

[TURN OVER]

3. (a) Given the 7x7 Image segment, perform dilation using the structuring element shown:      **10**

Structuring element:

| 1 | 0 |
|---|---|
| 0 | 1 |

| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|---|---|---|---|---|---|---|
| 0 | 1 | 0 | 1 | 0 | 1 | 0 |
| 0 | 1 | 0 | 1 | 0 | 1 | 0 |
| 0 | 1 | 0 | 1 | 0 | 1 | 0 |
| 0 | 1 | 1 | 1 | 1 | 1 | 0 |
| 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 0 | 0 | 0 |

(b) Explain image segmentation based on similarity with the help of examples.      **10**

4 (a) A source emits 6 symbols with the following probabilities. Construct the Huffman code and calculate the average code word length and coding efficiency.      **10**

| Symbol | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| Probability | 0.2 | 0.3 | 0.06 | 0.15 | 0.04 | 0.25 |

(b) Explain with block diagram the transform based coding.      **10**

5. (a) Check whether the DFT matrix is unitary or not and calculate the 2D-DFT of the given image segment using matrix multiplication method.      **10**

$$f(x,y) = \begin{matrix} 0 & 0 & 1 & 1 \\ 1 & 2 & 0 & 0 \\ 1 & 0 & 1 & 1 \\ 2 & 0 & 2 & 0 \end{matrix}$$

(b) Explain various image enhancement techniques in frequency domain.      **10**

6. Write short notes on **any three** of the following :-      **20**
   - (a) Hit or Miss Transformation
   - (b) Discrete Wavelet Transform
   - (c) Thresholding techniques
   - (d) Image file formats

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**QP Code : 728801**

( 3 Hours)          [ Total Marks : 80

N.B. : (1) Question no. **1** is **compulsory**
      (2) Solve any three from the remaining five questions
      (3) Assume suitable data if necessary.
      (4) **Figures** to the **right indicate** full **marks.**

1. Attempt **any four** from the following questions     20
    (a) Draw a simple artificial neuron and discuss the calculation of the output. State any two characteristics of an artificial neural network.
    (b) Indicate the differences between excitatory and inhibitory weighted interconnections.
    (c) Compare and contrast BAM and Hopfield networks.
    (d) Explain fuzzification and defuzzification process.
    (e) Explain the difference between supervised and unsupervised learning.

2. (a) Draw the model of Adaline network. Explain the training algorithm used here.     10
    (b) What are linearly separable and nonseparable pattern classes? Discuss how perceptrons can be used to classify each of them.     10

3. (a) What are the two types of discrete Hopfield nets? Draw the architecture of discrete Hopfield net. State the testing algorithm used in discrete Hopfield Network.     10
    (b) Draw a simple neural network with a single neuron, four input points and one output point. Apply Hebbian rule to this network with binary activation function and obtain the updated weight vector. The initial weight vector is $W^1 = [1 \ -1 \ 0 \ 0.5]^t$ and the training set consists of three inputs, $X_1 = [1 \ -2 \ 1.5 \ 0]^t$ ; $X_2 = [1 \ -0.5 \ -2 \ -1.5]^t$ ; $X_3 = [0 \ 1 \ -1 \ 1.5]^t$ Assume learning constant as 1.     10

4. (a) What are LVQs? Explain LVQ1 algorithm in detail.     10

    (b) With a neat architecture, explain the training algorithm of Kohonen self-organizing feature maps.     10

5. (a) Three fuzzy sets are defined as:     10

$$A = \left\{ \frac{0.1}{30} + \frac{0.2}{60} + \frac{0.3}{90} + \frac{0.4}{120} \right\}$$

**[TURN OVER]**

$$B = \left\{ \frac{1}{1} + \frac{0.2}{2} + \frac{0.5}{3} + \frac{0.7}{4} + \frac{0.3}{5} + \frac{0}{6} \right\}$$

$$C = \left\{ \frac{0.33}{100} + \frac{0.65}{200} + \frac{0.92}{300} + \frac{0.21}{400} \right\}$$

Find the following:
(a)   $R = A \times B$
(b)   $S = B \times C$
(c)   $T = R \circ S$ using max-min composition
(d)   $T = R \circ S$ using max-product composition

(b)   Explain any four defuzzification methods with suitable diagrams.

10

6.  Write short notes on **any four**:
    (a) Types of activation functions                    20
    (b) Properties of neural networks
    (c) Boltzmann Machine
    (d) Rate of learning
    (e) ANFIS

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