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21EC33

Third Semester B.E./B.Tech. Degree Examination, June/July 2025
Basic Signal Processing

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Define vector subspaces and explain the four fundamental subspaces. **(06 Marks)**

b. Determine whether the vectors $V_1 = (1, 2, 3)$, $V_2 = (3, 1, 7)$ and $V_3 = (2, 5, 8)$ are linearly dependent or linearly independent. **(08 Marks)**

c. Explain linear transformation in detail. **(06 Marks)**

OR

2 a. Determine whether or not each of the following forms a basis $x_1 = (2, 2, 1)$, $x_2 = (1, 3, 7)$ and $x_3 = (1, 2, 2)$ in R^3. **(08 Marks)**

b. If $U = \begin{bmatrix} 1 \\ 2 \\ 2 \end{bmatrix}$; $V = \begin{bmatrix} 2 \\ -2 \\ 1 \end{bmatrix}$; $W = \begin{bmatrix} 2 \\ 1 \\ -2 \end{bmatrix}$

Then show that U, V, W are pair-wire orthogonal vectors. Find the lengths of u, v, w and find orthonormal vectors U_1, V_1, W_1 from vectors U, V, W. **(12 Marks)**

Module-2

3 a. If $A = \begin{bmatrix} 4 & 6 & 6 \\ 1 & 3 & 2 \\ -1 & -5 & -2 \end{bmatrix}$, find eigen values and eigen vectors for matrix A. **(08 Marks)**

b. Diagonalize the matrix : $A = \begin{bmatrix} 1 & 2 \\ 0 & 3 \end{bmatrix}$. Find an invertible matrix P and a diagonal matrix D such that $A = PDP^{-1}$ and hence find A^3. **(12 Marks)**

OR

4 a. What is the positive definite matrix? Mention the methods of testing positive definiteness. **(04 Marks)**

b. Test to see if A^TA is positive definite : $A = \begin{bmatrix} 1 & 1 \\ 1 & 2 \\ 2 & 1 \end{bmatrix}$. **(04 Marks)**

c. Factorize the matrix A into $A = U\Sigma V^T$ using SVD.

$A = \begin{bmatrix} 2 & 3 \\ 0 & 2 \end{bmatrix}$. **(12 Marks)**

Module-3

5 a. Define signals and system with examples. **(05 Marks)**

b. Explain elementary discrete signals :
i) Exponential ii) Sinusoidal iii) Step iv) Impulse functions. **(05 Marks)**

c. The discrete-time signals x(n) and y(n) are shown in Fig.Q5(c)(i) and Fig.Q5(c)(ii) respectively sketch the signal z(n) = x(2n) y(n – 4). **(10 Marks)**

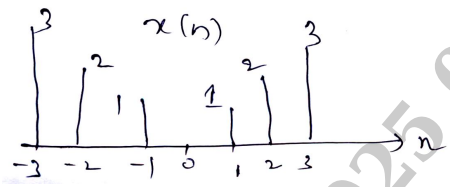

Fig.Q5(c)(i)

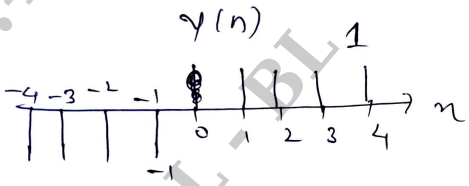

Fig.Q5(c)(ii)

OR

6 a. State and explain the properties :
i) Linearity ii) Time invariance iii) Memory iv) Causality. **(08 Marks)**

b. For the following system, determine whether the system is :
i) Linear ii) Time-invariance iii) Memoryless iv) Causal v) Stable
$T\{x(n)\} = x(-n)$. **(12 Marks)**

Module-4

7 a. Evaluate the discrete – time convolution sum given below : $y(n) = u(n) * u(n-3)$. **(08 Marks)**

b. Consider a input x(n) and a unit impulse response h(n) given by :
$x(n) = \alpha^n u(n) : 0 < \alpha < 1$
$h(n) = u(n)$
Evaluate and plot the output signal y(n). **(12 Marks)**

OR

8 a. Obtain the unit-step response for LTI system. **(06 Marks)**

b. Determine a discrete-time LTI system characterized by impulse response :
$h(n) = \left(\frac{1}{2}\right)^n u(n)$ is : i) Stable ii) Causal iii) Memory. **(06 Marks)**

c. Find the step response for the LTI system represented by the impulse response :
$h(n) = \left(\frac{1}{2}\right)^n u(n)$. **(08 Marks)**

Module-5

9 a. Explain briefly the RoC and its important properties. **(06 Marks)**

b. State and prove shifting and scaling properties of Z-transform. **(06 Marks)**

c. Find the Z-transform of the signal using properties :
$x(n) = \left(\frac{1}{2}\right)^n u(n) * \left(\frac{1}{3}\right)^n u(n)$. **(08 Marks)**

OR

10 a. Find the inverse Z-transform of the following using partial fraction expansion method.
$$X(z) = \frac{1 + 2z^{-1} + z^{-2}}{1 - \frac{3}{2}z^{-1} + \frac{1}{2}z^{-2}} \quad \text{RoC } |z| > 1.$$ **(08 Marks)**

b. A system has impulse response $h(n) = \left(\frac{1}{2}\right)^n u(n)$. Determine the input to the system if the output is given by $y(n) = \frac{1}{3}u(n) + \frac{2}{3}(-\frac{1}{2})^n u(n)$. **(08 Marks)**

c. Define causality and stability of the Z-transform. **(04 Marks)**

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21EC42

Fourth Semester B.E./B.Tech. Degree Examination, June/July 2025
Digital Signal Processing

Time: 3 hrs. Max. Marks: 100

Note : ***Answer any FIVE full questions, choosing ONE full question from each module.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Find the 16 point DFT of a signal

$$x(n) = \begin{cases} \frac{1}{2} & n \le 0 \\ 1 & 1 \le n \le 15 \end{cases}$$ **(08 Marks)**

b. With neat diagram, explain frequency domain sampling and reconstruction of discrete time signals. **(08 Marks)**

c. The first fiver values of an 8 point DFT of real valued sequence are (4, 1-j1 , 0 , 1+j2, 0}. Find the remaining values of the DFT. **(04 Marks)**

OR

2 a. Determine 8 point DFT of x(n) = [1,1,1,1,0,0,0,0]. **(10 Marks)**

b. Determine 4 point circular convolution between $x_1(n)$ = [1,2,2,1] and $x_2(n)$ = [1,1] using DFT and IDFT method. **(10 Marks)**

Module-2

3 a. State and prove Parseval's theorem in DFT. **(06 Marks)**

b. Using overlap save method, compute y(n) of a FIR filter with impulse response h(n) = [3, 2, 1] to an input x(n) = [2, 1, -1, –2, -3, 5, 6, –1, 2, 0, 2, 1]. Use only 8-point circular convolution. **(08 Marks)**

c. For the sequences $x_1(n) = \cos\left(\frac{2\pi n}{N}\right)$ and $x_2(n) = \sin\left(\frac{2\pi n}{N}\right)$, $0 \le n \le N-1$, determine N point circular correlation of $x_1(n)$ and $x_2(n)$. **(06 Marks)**

OR

4 a. Using over lap add method, compute y(n) of a FIR filter with impulse response h(n) = [1,2,1] to an input sequence x(n) = [1, 2 , 3, 3, 2, 1, –1, –2 , –3 , 5, 6, -1, 2 , 1], use only 6-point circular convolution. **(10 Marks)**

b. Find the DFT of a sequence x(n) = [1, 2, 3, 4, 4, 3, 2, 1] using radix 2 DIT – FFT algorithm. **(10 Marks)**

Module-3

5 a. Design a FIR filter with a desired frequency response

$$H_d(e^{jw}) = \begin{cases} e^{-j3w}; & \frac{-3\pi}{4} \le w \le \frac{3\pi}{4} \\ 0; & \frac{3\pi}{4} < |w| < \pi \end{cases}$$

. Also obtain the frequency response. **(10 Marks)**

b. A FIR filter is given by difference equation

$y(n) = x(n) + \frac{2}{5}x(n-1) + \frac{3}{4}x(n-2) + \frac{1}{3}x(n-3)$. Draw the corresponding direct Form – I and lattice structure. **(10 Marks)**

OR

6 a. Given $H(z) = (1 + 0.6z^{-1})^5$. Realize in direct form and cascade of first and second order sections. **(10 Marks)**

b. Determine filter coefficients h(n) of a FIR filter with a desired frequency response.

$$H_d(w) = \begin{cases} e^{-2w} & -\pi/4 \le w \le \pi/4 \\ 0 & \pi/4 \le |w| \le \pi \end{cases}$$ use Hamming window. **(10 Marks)**

Module-4

7 a. Derive the expression for the order of Butterworth filter. **(06 Marks)**

b. The system function of the analog filter is given as $H_a(S) = \frac{S+0.1}{(S+0.1)^2+16}$. Obtain the system function of the digital filter using bilinear transformation. Assume T = 2 seconds. **(06 Marks)**

c. Design a digital Butterworth filter with a maximum pass band attenuation 3.01 dB at pass band edge frequency 500Hz and stop band attenuation of 15 dB at stop band edge frequency 750 Hz. Sampling rate of 2 KHz. **(08 Marks)**

OR

8 a. A system is specified by its transfer function

$$H(z) = \frac{(z-1)(z-2)(z+1)z}{\left[z-\left(\frac{1}{2}+j\frac{1}{2}\right)\right]\left[z-\left(\frac{1}{2}-j\frac{1}{2}\right)\right]\left[z-j\frac{1}{4}\right]\left[z+j\frac{1}{4}\right]}$$ realize the system in the direct form - I and direct form – II. **(10 Marks)**

b. A Butterworth low pass filter has to meet the following specifications :

i) Pass band ripple and edge frequency of 1dB, 100 π rad/sec.

ii) Stop band attenuation and edge frequency of 35 dB, 1000 π rad/sec respectively at the sampling rate of 2000 samples/sec. Applying BLT technique, determine H(z). **(10 Marks)**

Module-5

9 a. With a neat diagram, explain the Harvard architecture used in DS processors. **(07 Marks)**

b. Explain dedicated MAC computation in DSP processor with a block diagram. **(05 Marks)**

c. Convert the following decimal numbers into the floating point representation :

i) 0.640492×2^{-2} ii) -0.638454×2^5.

Use 4 bits to represent exponent and 12 – bits for mantissa. **(08 Marks)**

OR

10 a. With a neat diagram, explain basic architecture of TMS320C54X family digital signal processors. **(10 Marks)**

b. Describe the IEEE single precision floating point format used in DSP processors. **(05 Marks)**

c. Find the signed Q – 15 representation for the decimal number 0.560123. **(05 Marks)**

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21EC43

Fourth Semester B.E./B.Tech. Degree Examination, June/July 2025
Circuits and Controls

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Briefly explain the types of sources in electric circuit. **(05 Marks)**

b. Use mesh analysis to determine mesh currents in the circuit shown in Fig.Q.1(b).

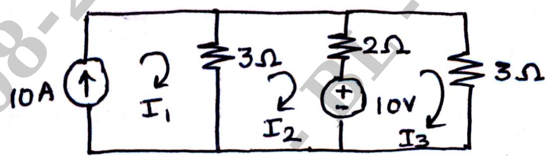

Fig.Q.1(b)

(10 Marks)

c. Use Norton's theorem to determine current through branch 'b-e' in the circuit shown in Fig.Q.1(c).

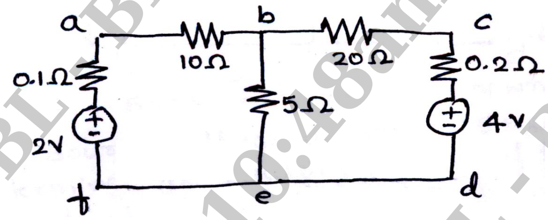

Fig.Q.1(c)

(05 Marks)

OR

2 a. State and explain Thevenin's theorem. **(10 Marks)**

b. What should be the value of pure resistive load to be connected across the terminals a and b in the network shown in the Fig.Q.2(b), so that the maximum power is transferred to the load? What is the maximum power?

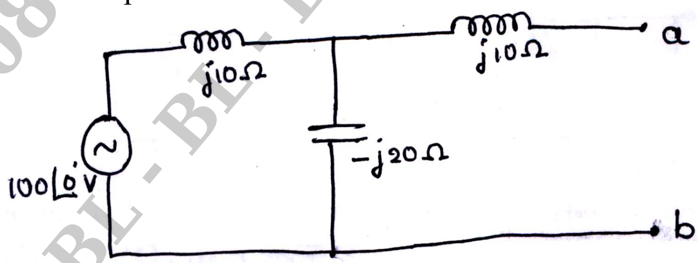

Fig.Q.2(b)

(10 Marks)

Module-2

3 a. For the network of Fig.Q.3(a), determine z-parameters

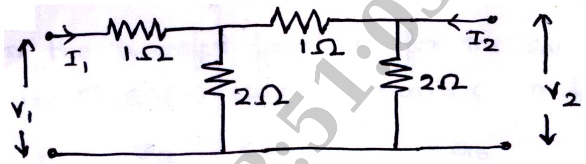

Fig.Q.3(a)

(08 Marks)

b. Obtain Laplace transform of i) Unit step function ii) Unit impulse function. **(04 Marks)**

c. State and prove initial and final value theorems. **(08 Marks)**

OR

4 a. Find the h-parameters of the network shown in Fig.Q.4(a).

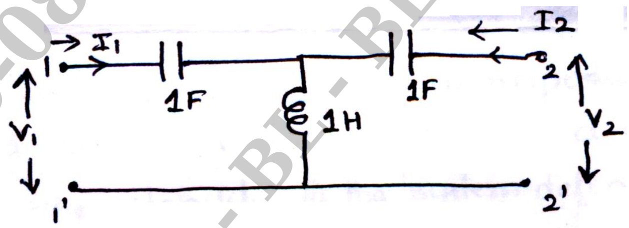

Fig.Q.4(a)

(10 Marks)

b. In the series RL circuit shown in the Fig.Q.4(b), the source voltage is v(t) = 50 sin250t V. Determine the resulting current if the switch is closed at t = 0.

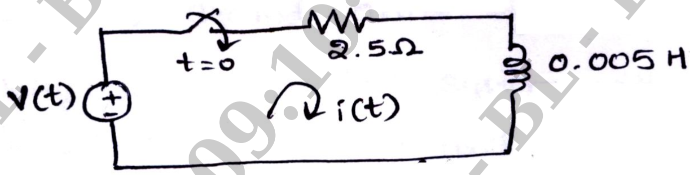

Fig.Q.4(b)

(10 Marks)

Module-3

5 a. Compare closed loop and open loop control systems. Give one example for each. **(06 Marks)**

b. Find the transfer function $\frac{V_o(S)}{V_i(S)}$ for the system shown in Fig.Q.5(b) with buffer amplifier of gain K.

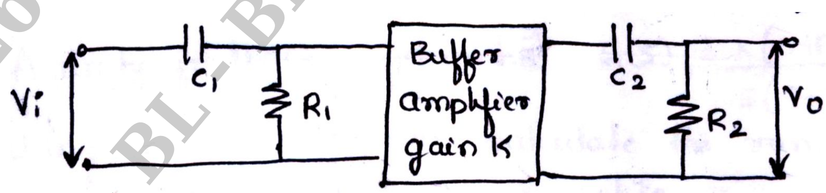

Fig.Q.5(b)

(06 Marks)

c. Draw a block diagram for the electric circuit shown in Fig.Q.5(c) and evaluate the transfer function $\frac{E_o(S)}{E_i(S)}$.

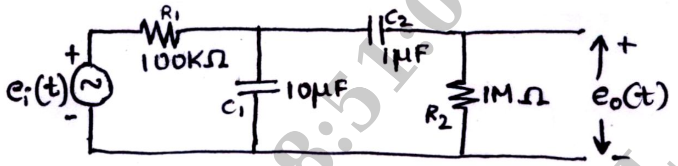

Fig.Q.5(c)

(08 Marks)

OR

6 a. What are the effects of negative feedback in control system? **(05 Marks)**

b. Obtain the transfer function for the signal flow graph shown in Fig.Q.6(b) using Mason's gain formula.

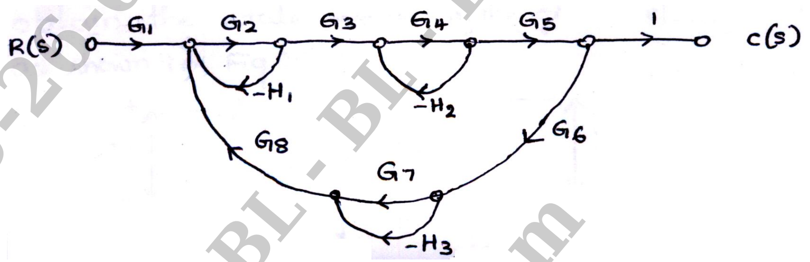

Fig.Q.6(b)

(10 Marks)

c. Illustrate force to current analogy. **(05 Marks)**

Module-4

7 a. Derive an expression for time response of an under damped second order system for a unit step input. **(08 Marks)**

b. Check the stability of the system defined by the equation $s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$ using R-H criterion. **(06 Marks)**

c. Derive an expression for rise time (t_r) of an underdamped second order system. **(06 Marks)**

OR

8 a. For a unity feedback control system with $G(S) = \frac{64}{S(S+9.6)}$, write the output response to a unit step input. Determine :

i) The response at t = 0.1 sec.

ii) Maximum value of the response and time at which it occurs.

iii) Settling time. **(08 Marks)**

b. Explain Routh-Hurwitz criterion for stability of the system and mention its limitations. **(04 Marks)**

c. A unity feedback system has $G(S) = \frac{K(S+13)}{S(S+3)(S+7)}$. Using Routh's criterion calculate the range of K for which the system is i) Stable ii) has its closed loop poles more negative than – 1. **(08 Marks)**

Module-5

9 a. Sketch the complete root locus of the system having $G(S)H(S) = \dfrac{K}{S(S+1)(S+2)(S+3)}$ **(10 Marks)**

b. Write short note on lead lag compensator. **(04 Marks)**

c. Obtain the state model of the given electrical system as shown in Fig.Q.9(c). **(06 Marks)**

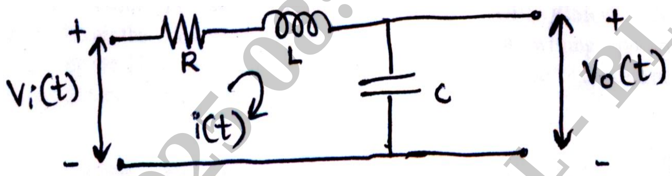

Fig.Q.9(c)

OR

10 a. A unity feedback control system has $G(S) = \dfrac{80}{S(S+2)(S+20)}$. Draw the Bode plot. Determine GM, PM, Wgc and Wpc and also comment on the stability. **(10 Marks)**

b. A linear time invariant system is characterized by the homogeneous state equation:

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

Obtain the solution of homogeneous equation by assuming the initial state vector $X_0 = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$. **(06 Marks)**

c. Explain any four rules for construction of root loci. **(04 Marks)**

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21EC51

Fifth Semester B.E./B.Tech. Degree Examination, June/July 2025
Digital Communication

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Explain generation and detection of BPSK with necessary figures and equations. **(08 Marks)**

b. An FSK system transmits binary data at a rate of 10^6 bits/sec. Assuming channel noise is AWG with zero mean and power spectral density 2×10^{-20} watts/Hz. Determine the average probability of error. Assume coherent detection and amplitude of received sinusoidal signal for both symbol 1 and 0 to be 1.2 microvolt. (Take erf (3) = 0.99998). **(06 Marks)**

c. With Geometric representation and expressions, explain 16-QAM. **(06 Marks)**

OR

2 a. Draw the block diagram of QPSK Transmitter and receiver and explain the operation. **(08 Marks)**

b. A binary data stream 0010010011 needs to be transmitted using DPSK technique. Prove that the detected sequence remains invariant with the choice of initial bit. **(08 Marks)**

c. In a digital communication system, the bit rate is 1 Mbps and carrier frequency of transmission is 100 MHz. Find the symbol rate of transmission and bandwidth requirement of the channel in 16-ary PSK system. **(04 Marks)**

Module-2

3 a. Explain the Geometric representation of set of M energy signals as linear combinations of N-orthonormal basis functions for N = 2 and M = 3 with necessary figures and expressions. **(10 Marks)**

b. Two functions $S_1(t)$ and $S_2(t)$ are given in Fig Q3(b) for an interval $0 \le t \le T$ seconds. Using Gram –Schmidt procedure, express these functions in terms of orthonormal functions. Also sketch $\phi_1(t)$ and $\phi_2(t)$

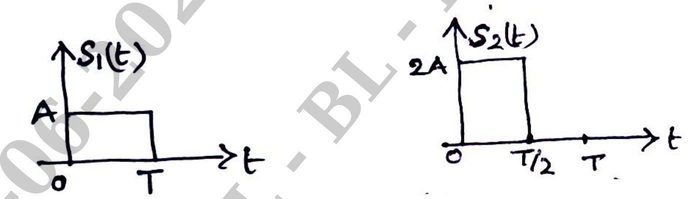

Fig Q3(b) **(10 Marks)**

OR

4 a. Discuss conversion of the continuous AWGN channel into a vector channel. **(10 Marks)**

b. What is correlative coding? Explain Duobinary signaling scheme with necessary figures. **(10 Marks)**

Module-3

5 a. With a neat block diagram, explain the model of spread spectrum Digital communication system. **(08 Marks)**

b. Define processing gain, probability of error and anti-jamming characteristics (ie Jamming Margin) of DS-SS system. **(06 Marks)**

c. Write short notes on Psendonoise sequence. **(06 Marks)**

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

OR

6 a. Explain the working of FH/MFSK transmitter and receiver with neat block diagram. **(08 Marks)**

b. Explain CDMA based on IS-95, Forward link. **(06 Marks)**

c. In a direct sequence, spread-spectrum modulation, it is required to have a jamming margin greater than 26dB. The ratio $\frac{E_b}{No}$ is set at 10. Determine the minimum processing gain and the minimum number of stages required to generate the maximum length sequence. **(06 Marks)**

Module-4

7 a. Define self information, average information, information rate and coding efficiency. **(04 Marks)**

b. Refer the state diagram of the Markov source shown in Fig Q7(b). Find : i) probabilities of the state ii) Entropy of each state iii) Entropy of the source.

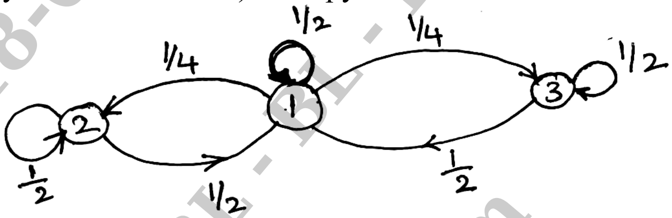

Fig Q7(b) **(10 Marks)**

c. For four symbols S_1, S_2, S_3 and S_4 having probabilities of occurrence given by 0.1, 0.2, 0.3 and 0.4. Construct a code using Shannon- Fane encoding algorithm and find the efficiency of coding. **(06 Marks)**

OR

8 a. A discrete memoryless source has an alphabet x = {x_1, x_2, x_3, x_4}. It is known that $P(x_1) = 0.4$, $P(x_2) = 0.3$, $P(x_3) = 0.2$ and $P(x_1) = 0.1$. Find H(x) and show that $I(x_1, x_2, x_3, x_4) > H(x)$ **(04 Marks)**

b. A source produces six symbols x_1, x_2, x_3, x_4, x_5 and x_6 with probabilities 0.3, 0.25, 0.20, 0.12, 0.08, 0.05. Construct Binary Huffman code. Find efficiency of coding and draw decision tree. **(10 Marks)**

c. Explain in brief, the methods of controlling errors, types of errors and types of codes. **(06 Marks)**

Module-5

9 a. Consider a linear block code with n = 6 and k = 3. The check bits of this code are derived using the discrete relations given below : Take D = [0 0 1]

$C_4 = d_1 \oplus d_2$

$C_5 = d_1 \oplus d_2 \oplus d_3$

$C_6 = d_2 \oplus d_3$

i) Find Generator matrix, G

ii) Find all the code-words of the linear block code

iii) Find the error detecting and error correcting capabilities of the code. **(08 Marks)**

b. Consider a single error correcting code (Hamming code) for a message block of size equal to 11. How many check bits are required? Find a parity check matrix for this code. **(08 Marks)**

c. Draw the syndrome calculator circuit for a (7,4) single error correcting code. **(04 Marks)**

OR

10 a. Refer the code rate r = $\frac{1}{2}$ and constraint length k = 3 convolution encoder shown in Fig Q10(a) below. Find C for the message m = {1, 1, 0, 1} using Time domain approach and transform domain approach.

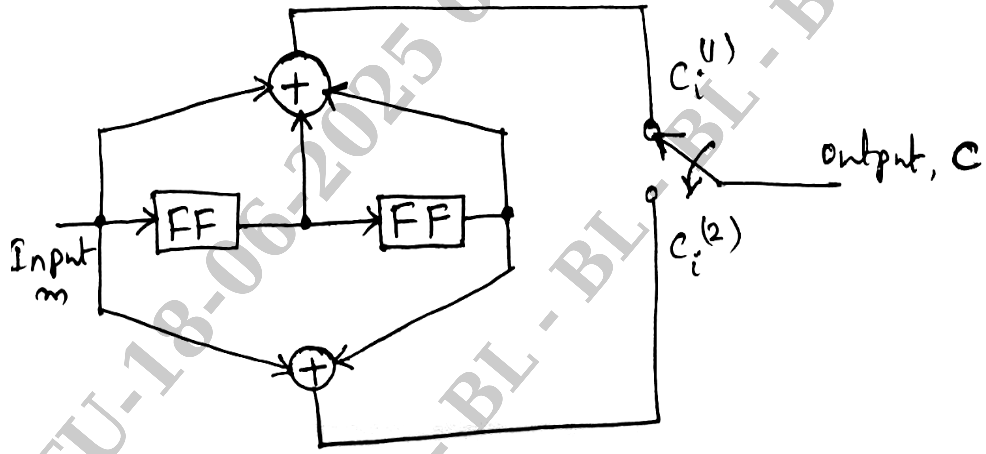

Fig Q10(a) **(10 Marks)**

b. For the convolution encoder shown in Fig Q10(b), draw the state diagram, tree diagram and find d_{free}.

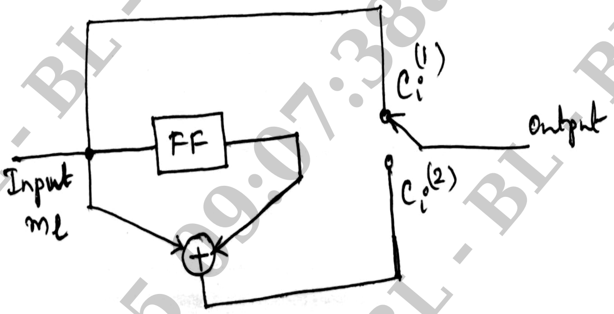

Fig Q10(b) **(10 Marks)**

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21EC52

Fifth Semester B.E./B.Tech. Degree Examination, June/July 2025
Computer Organization and ARM Microcontrollers

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Explain the performance of a processor
i) Processor clock ii) Basic performance equation iii) Clock rate. **(06 Marks)**
b. Discuss the 8-bit parallel port input interface circuit with a neat diagram. **(08 Marks)**
c. Explain the PCI bus in brief for read operation along with the timing diagram. **(06 Marks)**

OR

2 a. Describe the various addressing modes give one example for each mode. **(10 Marks)**
b. With respect to handling interrupts from multiple devices, explain
i) interrupt priority ii) daisy chain method. **(10 Marks)**

Module-2

3 a. Explain in detail the synchronous DRAM structure with a neat diagram. **(10 Marks)**
b. Describe the hardwired computer with an example. **(10 Marks)**

OR

4 a. Explain with a neat diagram fetching a word from memory and storing a word in memory. **(10 Marks)**
b. Explain the single bus organization of the data path inside a processor with a neat diagram. **(10 Marks)**

Module-3

5 a. Explain an ARM based embedded device with a neat diagram and also discuss the AMBA bus protocols. **(10 Marks)**
b. What is CPSR? Explain the banked registers in detail. **(10 Marks)**

OR

6 a. Explain the ARM core dataflow model with a neat diagram and also discuss the ARM registers. **(10 Marks)**
b. Explain the conditional code flag in ARM processor. **(05 Marks)**
c. Differentiate between Von Neumann architecture and Harvard architecture. **(05 Marks)**

Module-4

7 a. What is Barrel shifter? Explain all the Barrel shifter instructions with an example for each instruction. **(10 Marks)**
b. Explain the following instructions with syntax and give an example for each
i) LDM ii) STMIA iii) ADR iv) BIC v) SWI. **(10 Marks)**

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

OR

8 a. Explain the program status register instructions in detail. Give one example for each instruction. **(05 Marks)**

b. Illustrate the pre-indexing and post indexing instruction of ARM. **(05 Marks)**

c. Explain the following instruction with syntax give a example for each
i) MLA ii) BL iii) LDRB iv) STRH v) SWP. **(10 Marks)**

Module-5

9 a. Explain the three C looping structures in detail. **(10 Marks)**

b. Explain the basic C data types in detail. **(05 Marks)**

c. Write an ALP to find the sum of first 10 integer numbers. **(05 Marks)**

OR

10 a. What are the issues that encounter when porting C code to the ARM code. **(05 Marks)**

b. Write an ALP to find the largest number in an array of 32 numbers. **(05 Marks)**

c. Write a note on :
i) Pointer Aliasing
ii) Bit Fields. **(10 Marks)**

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21EC54

Fifth Semester B.E./B.Tech. Degree Examination, June/July 2025
Electromagnetic Waves

Time: 3 hrs. Max. Marks: 100

Note : ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. What do you mean by scalar and vector fields? Show the difference between two. **(06 Marks)**

b. Given three points in Cartesian coordinate system as A(3, -2, 1) , B(-3 , -3 , 5) , C(2, 6, -4). Find : i) The vector from A to C
ii) The unit vector from B to A
iii) The distance from B to C
iv) The vector from A to the midpoint of the straight line joining B to C. **(08 Marks)**

c. State Coulomb's law of force between any two point charges and also in vector form. **(06 Marks)**

OR

2 a. A charge Q_2 = 12 inc is located in free space at P_2 (-0.03 , 0.01 , 0.04)m. Find the force on Q_2 due to Q_1 where $Q_1 = 110\mu C$ at P_1(0.03 , 0.08 , -0.02)m. **(06 Marks)**

b. A volume charge density is expressed as $\rho_v = 10z^2 \times \sin \pi y$. Find the total charge inside the volume $(-1 \le x \le 2)$, $(0 \le y \le 1)$, $(3 \le z \le 3.6)$. **(06 Marks)**

c. Derive the expression for electric field intensity due to infinite line charge. **(08 Marks)**

Module-2

3 a. State and prove the Gauss's law. **(06 Marks)**

b. Consider a coaxial cable with inner radius 'a' and outer radius 'b'. Derive the expression for flux density ($\overline{D}$) for the region a < r < b using Gauss's law. **(08 Marks)**

c. The flux density $\overline{D} = r/3\ \bar{a}_r$ nc/m^2 is in the free space :
i) Fine $\overline{E}$ at r = 0.2m
ii) Find the electric flux leaving the sphere of r = 0.2m.
iii) Find the total charge within the sphere of r = 03.m. **(06 Marks)**

OR

4 a. Derive Maxwell first equation as applied to the electro statics, using Gauss's law. State the divergence theorem using Maxwell's first equation. **(06 Marks)**

b. Evaluate the both sides of divergence theorem for the field $\overline{D} = 2xy\ \bar{a}_x + x^2\ \bar{a}_y$ c/m^2 and rectangular parallel piped formed by the planes x = 0 and x = 1 , y = 0 and y = 2 and z = 0 and z = 3. **(08 Marks)**

c. Derive the expression for the work done in moving a point charge in an electric field. **(06 Marks)**

Module-3

5 a. Determine whether or not the following potential fields satisfy the Laplace's equation :
i) $V = x^2 - y^2 + z^2$ ii) $V = r \cos \phi + z$ iii) $V = r \cos + \theta + \phi$. **(06 Marks)**

b. Using the Laplace's equation, derive an expression for capacitance per unit length of a coaxial cable using the following boundary conditions. $V = V_0$ at $r = a$ and $V = 0$ at $r = b$, $b > a$. **(08 Marks)**

c. State and explain Biot – Savart law applicable to magnetic field. **(06 Marks)**

OR

6 a. Derive the expression for a curl , applying Ampere's circuital law to an incremental surface element. **(08 Marks)**

b. State and prove the Stoke's theorem. **(06 Marks)**

c. What is scalar magnetic potential? Explain Laplace equations for scalar magnetic potential. **(06 Marks)**

Module-4

7 a. Define and explain the terms magnetic flux and magnetic flux density. Obtain the magnetic flux using magnetic flux density in coaxial cable. **(08 Marks)**

b. In certain region, the magnetic flux density in a magnetic material with $\chi_m = 6$ is given and $\overline{B} = 0.005y^2\ \bar{a}_x$ T. At y = 0.4m , find the magnitude of : i) $\overline{J}$ ii) $\overline{J}_b$ iii) $\overline{J}_T$. **(06 Marks)**

c. Discuss the boundary conditions for magnetic field based on the normal component of the $\overline{B}$ and $\overline{H}$. **(06 Marks)**

OR

8 a. Derive an expression for the magnetic force between differential current elements. **(06 Marks)**

b. A conductor of length 2.5m in z = 0 and x = 0 carries a current of 12A in $-\bar{a}_y$ direction. Calculate the uniform flux in the region , if the force on the conductor is 12×10^{-2} N in the direction specified by $\left[\frac{-\bar{a}_x + \bar{a}_z}{\sqrt{2}}\right]$. **(08 Marks)**

c. State and explain Faraday's law of electromagnetic induction in integral and point form. **(06 Marks)**

Module-5

9 a. Write the Maxwell's equations in the integral form and explain the physical significance. **(06 Marks)**

b. Two parallel conducting plates of area 0.05m^2 are separated by 2mm of lossy, dielectric for which $\varepsilon_r = 8.3$ and $\sigma = 8 \times 10^{-4}$ S/m. given an applied voltage $V = 10 \sin 10^7 t$ V. Find total r.m.s current. **(08 Marks)**

c. Do the fields $E = E_m \sin x \sin t\ \bar{a}_y$ and $\overline{H} = \frac{E_m}{\mu o} \cos x \cos t\ \bar{a}_z$ satisfy the Maxwell's equations. **(06 Marks)**

OR

10 a. Write short notes on Retarded potential. **(06 Marks)**

b. Given $E = E_o z^2 e^{-t}\ \bar{a}_x$ in free space, determine if there exist a magnetic field such that both Faraday's law and Ampere's circuital law are satisfied simultaneously. **(08 Marks)**

c. Discuss the propagation of uniform plane wave in good conductor. **(06 Marks)**

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21EC51

Fifth Semester B.E./B.Tech. Degree Examination, June/July 2025
Digital Communication

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Explain generation and detection of BPSK with necessary figures and equations. **(08 Marks)**

b. An FSK system transmits binary data at a rate of 10^6 bits/sec. Assuming channel noise is AWG with zero mean and power spectral density 2×10^{-20} watts/Hz. Determine the average probability of error. Assume coherent detection and amplitude of received sinusoidal signal for both symbol 1 and 0 to be 1.2 microvolt. (Take erf (3) = 0.99998). **(06 Marks)**

c. With Geometric representation and expressions, explain 16-QAM. **(06 Marks)**

OR

2 a. Draw the block diagram of QPSK Transmitter and receiver and explain the operation. **(08 Marks)**

b. A binary data stream 0010010011 needs to be transmitted using DPSK technique. Prove that the detected sequence remains invariant with the choice of initial bit. **(08 Marks)**

c. In a digital communication system, the bit rate is 1 Mbps and carrier frequency of transmission is 100 MHz. Find the symbol rate of transmission and bandwidth requirement of the channel in 16-ary PSK system. **(04 Marks)**

Module-2

3 a. Explain the Geometric representation of set of M energy signals as linear combinations of N-orthonormal basis functions for N = 2 and M = 3 with necessary figures and expressions. **(10 Marks)**

b. Two functions $S_1(t)$ and $S_2(t)$ are given in Fig Q3(b) for an interval $0 \le t \le T$ seconds. Using Gram –Schmidt procedure, express these functions in terms of orthonormal functions. Also sketch $\phi_1(t)$ and $\phi_2(t)$

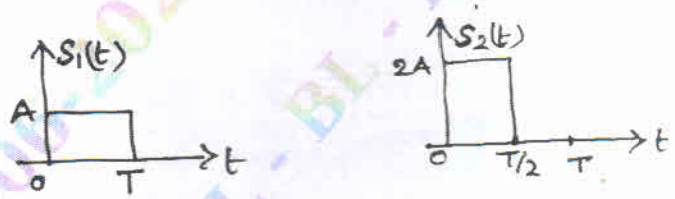

Fig Q3(b) **(10 Marks)**

OR

4 a. Discuss conversion of the continuous AWGN channel into a vector channel. **(10 Marks)**

b. What is correlative coding? Explain Duobinary signaling scheme with necessary figures. **(10 Marks)**

Module-3

5 a. With a neat block diagram, explain the model of spread spectrum Digital communication system. **(08 Marks)**

b. Define processing gain, probability of error and anti-jamming characteristics (ie Jamming Margin) of DS-SS system. **(06 Marks)**

c. Write short notes on Psendonoise sequence. **(06 Marks)**

OR

6 a. Explain the working of FH/MFSK transmitter and receiver with neat block diagram. **(08 Marks)**

b. Explain CDMA based on IS-95, Forward link. **(06 Marks)**

c. In a direct sequence, spread-spectrum modulation, it is required to have a jamming margin greater than 26dB. The ratio $\frac{E_b}{No}$ is set at 10. Determine the minimum processing gain and the minimum number of stages required to generate the maximum length sequence. **(06 Marks)**

Module-4

7 a. Define self information, average information, information rate and coding efficiency. **(04 Marks)**

b. Refer the state diagram of the Markov source shown in Fig Q7(b). Find : i) probabilities of the state ii) Entropy of each state iii) Entropy of the source.

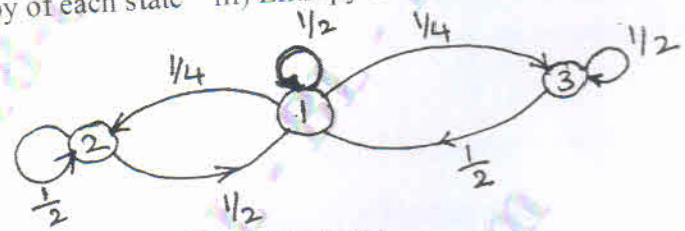

Fig Q7(b) **(10 Marks)**

c. For four symbols S_1, S_2, S_3 and S_4 having probabilities of occurrence given by 0.1, 0.2, 0.3 and 0.4. Construct a code using Shannon- Fane encoding algorithm and find the efficiency of coding. **(06 Marks)**

OR

8 a. A discrete memoryless source has an alphabet $x = \{x_1, x_2, x_3, x_4\}$. It is known that $P(x_1) = 0.4$, $P(x_2) = 0.3$, $P(x_3) = 0.2$ and $P(x_1) = 0.1$. Find $H(x)$ and show that $I(x_1, x_2, x_3, x_4) > H(x)$ **(04 Marks)**

b. A source produces six symbols x_1, x_2, x_3, x_4, x_5 and x_6 with probabilities 0.3, 0.25, 0.20, 0.12, 0.08, 0.05. Construct Binary Huffman code. Find efficiency of coding and draw decision tree. **(10 Marks)**

c. Explain in brief, the methods of controlling errors, types of errors and types of codes. **(06 Marks)**

Module-5

9 a. Consider a linear block code with n = 6 and k = 3. The check bits of this code are derived using the discrete relations given below : Take D = [0 0 1]

$C_4 = d_1 \oplus d_2$

$C_5 = d_1 \oplus d_2 \oplus d_3$

$C_6 = d_2 \oplus d_3$

i) Find Generator matrix, G

ii) Find all the code-words of the linear block code

iii) Find the error detecting and error correcting capabilities of the code. **(08 Marks)**

b. Consider a single error correcting code (Hamming code) for a message block of size equal to 11. How many check bits are required? Find a parity check matrix for this code. **(08 Marks)**

c. Draw the syndrome calculator circuit for a (7,4) single error correcting code. **(04 Marks)**

OR

10 a. Refer the code rate r = $\frac{1}{2}$ and constraint length k = 3 convolution encoder shown in Fig Q10(a) below. Find C for the message m = {1, 1, 0, 1} using Time domain approach and transform domain approach.

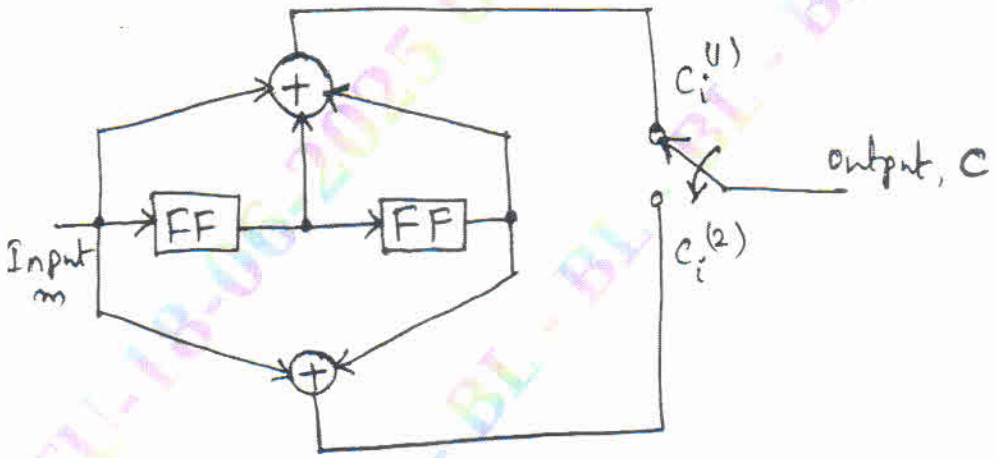

Fig Q10(a) **(10 Marks)**

b. For the convolution encoder shown in Fig Q10(b), draw the state diagram, tree diagram and find d_{free}.

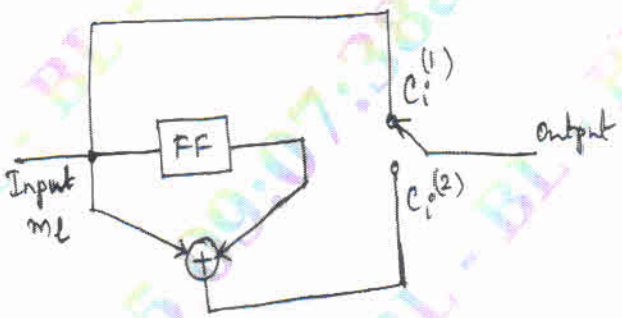

Fig Q10(b) **(10 Marks)**

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21EC52

Fifth Semester B.E./B.Tech. Degree Examination, June/July 2025
Computer Organization and ARM Microcontrollers

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Explain the performance of a processor
i) Processor clock ii) Basic performance equation iii) Clock rate. **(06 Marks)**

b. Discuss the 8-bit parallel port input interface circuit with a neat diagram. **(08 Marks)**

c. Explain the PCI bus in brief for read operation along with the timing diagram. **(06 Marks)**

OR

2 a. Describe the various addressing modes give one example for each mode. **(10 Marks)**

b. With respect to handling interrupts from multiple devices, explain
i) interrupt priority ii) daisy chain method. **(10 Marks)**

Module-2

3 a. Explain in detail the synchronous DRAM structure with a neat diagram. **(10 Marks)**

b. Describe the hardwired computer with an example. **(10 Marks)**

OR

4 a. Explain with a neat diagram fetching a word from memory and storing a word in memory. **(10 Marks)**

b. Explain the single bus organization of the data path inside a processor with a neat diagram. **(10 Marks)**

Module-3

5 a. Explain an ARM based embedded device with a neat diagram and also discuss the AMBA bus protocols. **(10 Marks)**

b. What is CPSR? Explain the banked registers in detail. **(10 Marks)**

OR

6 a. Explain the ARM core dataflow model with a neat diagram and also discuss the ARM registers. **(10 Marks)**

b. Explain the conditional code flag in ARM processor. **(05 Marks)**

c. Differentiate between Von Neumann architecture and Harvard architecture. **(05 Marks)**

Module-4

7 a. What is Barrel shifter? Explain all the Barrel shifter instructions with an example for each instruction. **(10 Marks)**

b. Explain the following instructions with syntax and give an example for each
i) LDM ii) STMIA iii) ADR iv) BIC v) SWI. **(10 Marks)**

OR

8 a. Explain the program status register instructions in detail. Give one example for each instruction. **(05 Marks)**

b. Illustrate the pre-indexing and post indexing instruction of ARM. **(05 Marks)**

c. Explain the following instruction with syntax give a example for each
i) MLA ii) BL iii) LDRB iv) STRH v) SWP. **(10 Marks)**

Module-5

9 a. Explain the three C looping structures in detail. **(10 Marks)**

b. Explain the basic C data types in detail. **(05 Marks)**

c. Write an ALP to find the sum of first 10 integer numbers. **(05 Marks)**

OR

10 a. What are the issues that encounter when porting C code to the ARM code. **(05 Marks)**

b. Write an ALP to find the largest number in an array of 32 numbers. **(05 Marks)**

c. Write a note on :
i) Pointer Aliasing
ii) Bit Fields. **(10 Marks)**

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21EC53

Fifth Semester B.E./B.Tech. Degree Examination, June/July 2025
Computer Communication Networks

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Explain the concept of packet switched and circuit switched network. **(10 Marks)**

b. What is physical topology? With illustration explain the various types of physical topology. **(10 Marks)**

OR

2 a. Explain the concept of encapsulation and decapsulation in protocol layering in the internet. **(08 Marks)**

b. With necessary illustration explain the different data flow techniques used for communication between two devices. **(06 Marks)**

c. Describe the LAN and WAN with neat sketches. **(06 Marks)**

Module-2

3 a. Describe the process of framing, flow control and error control in the Data Link Control (DLC) services. **(10 Marks)**

b. Explain the two kinds of services defined by the IEEE 802.11 wireless LAN standard. **(10 Marks)**

OR

4 a. Explain the working of CSMA method used in MAC sublayer with a sketch of the space/time model of collision. **(10 Marks)**

b. With a suitable example network scenario. Explain the formation of a VLAN. What characteristics of VLAN are used for grouping workstations into a VLAN? **(10 Marks)**

Module-3

5 a. Explain the datagram approach and virtual circuit approach in forwarding the packets in the network layer with a neat sketch. **(10 Marks)**

b. With necessary illustration explain the concept of link state routing. **(10 Marks)**

OR

6 a. Write a note on the following services of the network layer.
i) Packetization
ii) Routing and forwarding
iii) Error control
iv) Flow control
v) Congestion control. **(10 Marks)**

b. Outline the three phases involved in data transfer in a connection oriented service. **(10 Marks)**

Module-4

7 a. Discuss the various services offered by TCP with neat illustration. **(10 Marks)**

b. Explain the working of Go-Back-N protocol. **(10 Marks)**

OR

8 a. Explain the features of TCP with suitable examples. **(10 Marks)**

b. Explain the working of the selective repeat protocol. **(10 Marks)**

Module-5

9 a. What is the use of File Transfer Protocol (FTP)? Explain control connection and data connection in FTP. **(10 Marks)**

b. Explain with example, the working of HTTP. **(10 Marks)**

OR

10 a. With suitable example explain the three phases of E-mail message transfer. **(10 Marks)**

b. What is meant by resolution in DNS system? Explain with neat diagrams, the two resolution processes used to resolve the domain names and addresses. **(10 Marks)**

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21EC54

Fifth Semester B.E./B.Tech. Degree Examination, June/July 2025
Electromagnetic Waves

Time: 3 hrs. Max. Marks: 100

Note : *Answer any FIVE full questions, choosing ONE full question from each module.*

Module-1

1 a. What do you mean by scalar and vector fields? Show the difference between two. **(06 Marks)**

b. Given three points in Cartesian coordinate system as A(3, -2, 1) , B(-3 , -3 , 5) , C(2, 6, -4).
Find : i) The vector from A to C
ii) The unit vector from B to A
iii) The distance from B to C
iv) The vector from A to the midpoint of the straight line joining B to C. **(08 Marks)**

c. State Coulomb's law of force between any two point charges and also in vector form. **(06 Marks)**

OR

2 a. A charge $Q_2 = 12$ inc is located in free space at P_2 (-0.03 , 0.01 , 0.04)m. Find the force on Q_2 due to Q_1 where $Q_1 = 110\mu C$ at P_1(0.03 , 0.08 , -0.02)m. **(06 Marks)**

b. A volume charge density is expressed as $\rho_v = 10z^2 \times \sin \pi y$. Find the total charge inside the volume $(-1 \le x \le 2)$, $(0 \le y \le 1)$, $(3 \le z \le 3.6)$. **(06 Marks)**

c. Derive the expression for electric field intensity due to infinite line charge. **(08 Marks)**

Module-2

3 a. State and prove the Gauss's law. **(06 Marks)**

b. Consider a coaxial cable with inner radius 'a' and outer radius 'b'. Derive the expression for flux density ($\overline{D}$) for the region $a < r < b$ using Gauss's law. **(08 Marks)**

c. The flux density $\overline{D} = r/3\ \overline{a}_r$ nc/m^2 is in the free space :
i) Fine $\overline{E}$ at r = 0.2m
ii) Find the electric flux leaving the sphere of r = 0.2m.
iii) Find the total charge within the sphere of r = 03.m. **(06 Marks)**

OR

4 a. Derive Maxwell first equation as applied to the electro statics, using Gauss's law. State the divergence theorem using Maxwell's first equation. **(06 Marks)**

b. Evaluate the both sides of divergence theorem for the field $\overline{D} = 2xy\ \overline{a}_x + x^2\ \overline{a}_y$ c/m^2 and rectangular parallel piped formed by the planes x = 0 and x = 1 , y = 0 and y = 2 and z = 0 and z = 3. **(08 Marks)**

c. Derive the expression for the work done in moving a point charge in an electric field. **(06 Marks)**

Module-3

5 a. Determine whether or not the following potential fields satisfy the Laplace's equation :
i) $V = x^2 - y^2 + z^2$ ii) $V = r\cos\phi + z$ iii) $V = r\cos + \theta + \phi$. **(06 Marks)**

b. Using the Laplace's equation, derive an expression for capacitance per unit length of a coaxial cable using the following boundary conditions. $V = V_0$ at $r = a$ and $V = 0$ at $r = b$, $b > a$. **(08 Marks)**

c. State and explain Biot – Savart law applicable to magnetic field. **(06 Marks)**

OR

6 a. Derive the expression for a curl , applying Ampere's circuital law to an incremental surface element. **(08 Marks)**

b. State and prove the Stoke's theorem. **(06 Marks)**

c. What is scalar magnetic potential? Explain Laplace equations for scalar magnetic potential. **(06 Marks)**

Module-4

7 a. Define and explain the terms magnetic flux and magnetic flux density. Obtain the magnetic flux using magnetic flux density in coaxial cable. **(08 Marks)**

b. In certain region, the magnetic flux density in a magnetic material with $\chi_m = 6$ is given and $\bar{B} = 0.005y^2\ \bar{a}_x$ T. At $y = 0.4$m , find the magnitude of : i) $\bar{J}$ ii) $\bar{J}_b$ iii) $\bar{J}_T$. **(06 Marks)**

c. Discuss the boundary conditions for magnetic field based on the normal component of the $\bar{B}$ and $\bar{H}$. **(06 Marks)**

OR

8 a. Derive an expression for the magnetic force between differential current elements. **(06 Marks)**

b. A conductor of length 2.5m in $z = 0$ and $x = 0$ carries a current of 12A in $-\bar{a}_y$ direction. Calculate the uniform flux in the region , if the force on the conductor is 12×10^{-2} N in the direction specified by $\left[\frac{-\bar{a}_x + \bar{a}_z}{\sqrt{2}}\right]$. **(08 Marks)**

c. State and explain Faraday's law of electromagnetic induction in integral and point form. **(06 Marks)**

Module-5

9 a. Write the Maxwell's equations in the integral form and explain the physical significance. **(06 Marks)**

b. Two parallel conducting plates of area $0.05m^2$ are separated by 2mm of lossy, dielectric for which $\varepsilon_r = 8.3$ and $\sigma = 8 \times 10^{-4}$ S/m. given an applied voltage $V = 10 \sin 10^7 t$ V. Find total r.m.s current. **(08 Marks)**

c. Do the fields $E = E_m \sin x \sin t\ \bar{a}_y$ and $\bar{H} = \frac{E_m}{\mu o} \cos x \cos t\ \bar{a}_z$ satisfy the Maxwell's equations. **(06 Marks)**

OR

10 a. Write short notes on Retarded potential. **(06 Marks)**

b. Given $E = E_0 z^2 e^{-t}\ \bar{a}_x$ in free space, determine if there exist a magnetic field such that both Faraday's law and Ampere's circuital law are satisfied simultaneously. **(08 Marks)**

c. Discuss the propagation of uniform plane wave in good conductor. **(06 Marks)**

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21EC62

Sixth Semester B.E./B.Tech. Degree Examination, June/July 2025
Microwave Theory and Antennas

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Explain the operating principle of 9 Gunn-decode with neat energy band diagram and I-V-Characteristics. **(08 Marks)**

b. A Telephone Line has R = 6 Ω/km, L = 2.2 mH/km, C = 0.005 mF/km and G = 0.05 m mho/km. Determine Z_0, α, β at 1 KHz frequency and also find phase – velocity V_p (m=milli). **(08 Marks)**

c. What are standing waves? Obtain expressions for VSWR interms of reflection coefficient(P). **(04 Marks)**

OR

2 a. Derive the transmission line equations in voltage and current forms. **(08 Marks)**

b. A 50 Ω lossless line connects a matched signal of 100 KHz to a load of 100 Ω. The load power is 100 mW. Calculate :

i) Voltage reflection coefficient (P)
ii) VSWR of the load
iii) Position of first V_{min} and V_{max}
iv) Imp at $V_{min\ and}\ V_{max}$ and value of $V_{min\ and}\ V_{max}$. **(08 Marks)**

c. Explain briefly single stub impedance matching technique. **(04 Marks)**

Module-2

3 a. Derive the S-matrix representation of a multiport network. **(08 Marks)**

b. What is circulator? Explain the operating principle of 4 port circulator. **(06 Marks)**

c. What is attenuators? Explain its different types briefly. **(06 Marks)**

OR

4 a. Derive the S-matrix for Magic –T. **(08 Marks)**

b. What are waveguide Tees? Explain briefly each type. **(08 Marks)**

c. Write a note on Faraday's rotation Isolator. **(04 Marks)**

Module-3

5 a. Explain the construction of micro-strip line. **(05 Marks)**

b. Discuss the different types of losses occurs in micro-strip lines. **(05 Marks)**

c. A micro-strip line composed of zero – thickness copper conductors on a substrate having E_r = 8.4, tan δ = 0.0005 and thickness 2.4 mm. If the line width is 1 mm and operated at 10 GHz, calculate :

i) Characteristics impedance Z_0
ii) Attenuation due to conductor loss and dielectric loss. **(10 Marks)**

OR

6 a. Define following parameters with respect to antenna.
   i) Radiation pattern
   ii) Radiation intensity
   iii) Beam Area (ΩA). **(08 Marks)**

   b. Explain the radio-communication link and derive Friis transmission formula. **(06 Marks)**

   c. An antenna has normalized field pattern given by $E_n = \cos^3\theta$; where θ is polar angle in spherical co-ordinates and it varies from 0 to π. Find the HPBW and directivity. **(06 Marks)**

Module-4

7 a. Derive an expression for radiation resistance of a short-dipole antenna. **(08 Marks)**

   b. Explain and derive the array of two isotropic point sources of same amplitudes and phase. **(08 Marks)**

   c. Explain the principle of pattern multiplication. **(04 Marks)**

OR

8 a. Explain with neat diagram linear array of n-isotropic point sources of equal amplitude and spacing. **(10 Marks)**

   b. Write a note on short dipole antenna. **(05 Marks)**

   c. Write short notes on Thin linear antenna. **(05 Marks)**

Module-5

9 a. Derive an expression for radiation resistance of a small-loop antenna. **(10 Marks)**

   b. Explain the rectangular horn antenna and its basic types. **(10 Marks)**

OR

10 a. Explain the operational modes of a Helicast antenna. **(10 Marks)**

   b. Explain Yagi-Uda array with the help of neat diagram. **(10 Marks)**

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21EC63

Sixth Semester B.E./B.Tech. Degree Examination, June/July 2025
VLSI Design and Testing

Time: 3 hrs. Max. Marks: 100

Note : ***Answer any FIVE full questions, choosing ONE full question from each module.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. 2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Describe the working of n – type MOSFET with neat diagrams. Derive the equations for drain current. **(10 Marks)**

b. Realize the CMOS gate for the following function :

$Y = \overline{(A + B)C + DE}$. **(03 Marks)**

c. Implement 2 : 1 multiplexes using transmission gate and explain its operation with necessary timing diagram. **(07 Marks)**

OR

2 a. Explain the operation of CMOS inverter with help of transfer characteristics. Explain various region of operation. **(07 Marks)**

b. With necessary circuit diagram operation of tristate inverter, and realize 2 : 1 multiplexer with tristate inverter. **(10 Marks)**

c. Realize 3 i/p NOR gate using CMOS logic. **(03 Marks)**

Module-2

3 a. Explain the steps fabrication of CMOS n – well process with neat sketches. **(10 Marks)**

b. What is λ – based design rules? Write design rules for following layers :

i) Polysilicon ii) Metal iii) n_+ & P_+ diffusion iv) N well. **(06 Marks)**

c. Draw the layout diagram for 2 input NAND Gate. **(04 Marks)**

OR

4 a. Define term "Logical effort". Describe the estimation of logic effort by using example. **(06 Marks)**

b. Estimate parasitic delay of 2 input NAND gate with PMOS width of 2 NMOS width of 2. **(04 Marks)**

c. Draw stick diagram for 3 input NAND gate and estimate the number of tracks and dimensions. **(10 Marks)**

Module-3

5 a. Write the classification of semiconductor memories and explain typical memory organization of RAM memory with neat diagram. **(10 Marks)**

b. Explain operation of full CMOS SRAM cell with necessary topology. **(10 Marks)**

OR

6 a. Differentiate between DRAM and SRAM. **(04 Marks)**

b. Explain the operation of 4 × 4 NOR based ROM array with necessary circuit diagram. **(06 Marks)**

c. Write short notes on :

i) Flash memory cell ii) Ferro electric RAM. **(10 Marks)**

Module-4

7 a. Describe the different types of bridging faults with example. **(06 Marks)**

b. Describe temporary faults in VLSI. **(04 Marks)**

c. For the logic model shown below in Fig. Q7(c), find the Boolean difference with respect to X_2. **(10 Marks)**

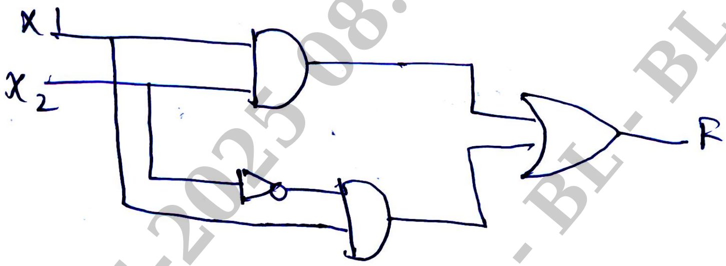

Fig. Q7(c)

OR

8 a. Describe the following term of D algorithm with example.

i) Singular cover ii) Propagation and D – cubes

iii) Primitive D – cubes and fault. **(10 Marks)**

b. What is fault diagnosis? Explain one dimensional path sensitization technique for combinational circuits with an example. **(10 Marks)**

Module-5

9 a. Define following with example :

i) Controllability ii) Observability. **(08 Marks)**

b. Describe any two Adhoc design rules for improving testability. **(06 Marks)**

c. For state table – 1 , find i) Homing sequence ii) Distinguish sequence and iii) Response of machine in homing sequence. **(06 Marks)**

	I/P	
P - state	X = 0	X = 1
A	B . 0	D . 0
B	A . 0	B . 0
C	D . 1	A . 0
D	D . 1	C . 0

OR

10 a. List LSSD design rules. **(10 Marks)**

b. Explain list generation based on functional fault models. **(10 Marks)**

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21EC643

Sixth Semester B.E./B.Tech. Degree Examination, June/July 2025
Python Programming

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Explain different types of 'If' statements supported by Python. Explain each type with appropriate example program and flow chart. **(08 Marks)**

b. Demonstrate the use of 'break' and 'continue' with while loop with suitable example in python. **(06 Marks)**

c. Write the syntax, description of any 3 built in functions that are used in python. Give example for each. **(06 Marks)**

OR

2 a. Write a python program to create a function called 'collatz( )' which reads a parameter named 'number'. If the number is even, the function should return number //2 and if the number is odd then it should return 3 $*$ number + 1. Display the returned value. This function should be called continuously until the function returns a value 1. **(08 Marks)**

b. Define scope of the variables. Illustrate with suitable example, the local and global scope variables used in python. **(08 Marks)**

c. List the naming rules to be followed in python for identifiers. **(04 Marks)**

Module-2

3 a. What is list? Explain the concept of slicing and indexing related with lists with proper examples. **(06 Marks)**

b. Write a python program to create and fill the list with 10 integers collected from user at run time. Also count the even numbers and odd numbers of this list and display the counts. **(06 Marks)**

c. Explain the pyperclip.copy( ) and paste( ) functions with example program. **(08 Marks)**

OR

4 a. Explain any 4 string methods in python with example code snippets. **(08 Marks)**

b. Compare dictionary with list. Write a python program to accept a sentence and find the total number of words and display. Create a dictionary named 'd' that collects the number of upper case letters, lower case letter and digits used in the given sentence. **(08 Marks)**

c. Differentiate get( ) and setdefault( ) methods with appropriate code snippets. Mention their outputs. **(04 Marks)**

Module-3

5 a. What is regular expressions? Explain the process of finding patterns of text with regular expression and associated methods in python with an example. **(07 Marks)**

b. Describe the following with suitable python code snippet:
(i) Greedy and non-greedy pattern matching
(ii) findall( ) method of regex object **(07 Marks)**

c. Explain saving of variables using shelve module. **(06 Marks)**

OR

6 a. Explain the file reading, writing process with suitable python program. **(07 Marks)**

b. Explain the following OS related methods with suitable code snippet:
(i) getcwd( ) (ii) chdir( ) (iii) listdir( ) **(06 Marks)**

c. List and explain shorthand code for common character classes. Illustrate how do you define your own character class. **(07 Marks)**

Module-4

7 a. Write a python program to define a class named 'rectangle' with the following attributes height, width and a member function named 'grow_rectangle'. The grow_rectangle takes a rectangle object and two numbers dheight and dwidth as arguments and returns the modified height and width. Display the height and width of rectangle before and after. **(06 Marks)**

b. What is class? How do you define a class in python? How to instantiate the class and access its members? **(07 Marks)**

c. Explain the operator overloading with example code. **(07 Marks)**

OR

8 a. Explain __init__ and __str__ methods. **(06 Marks)**

b. With example program, explain the type based dispatch concept. **(07 Marks)**

c. What is pure function? Illustrate with an example python program. **(07 Marks)**

Module-5

9 a. Write a python program to retrieve the image over HTTP and save the image to a file named 'stuff.jpg'. **(08 Marks)**

b. What is JSON? Explain the json module of python. Demonstrate with a python program. **(06 Marks)**

c. List and explain the three different kinds of keys used in data base model. **(06 Marks)**

OR

10 a. Explain in detail how to parse HTML with the BeautifulSoup. **(07 Marks)**

b. Write a simple python application that parses some XML and extracts some data elements from XML. **(06 Marks)**

c. What is a database? Write a code to create a table named 'Tracks' with two columns in the database named 'title' and 'plays'. **(07 Marks)**

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21EC653

Sixth Semester B.E./B.Tech. Degree Examination, June/July 2025
Basic VLSI Design

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Derive an expression for drain current in linear and saturation region for nMOS transistor. **(10 Marks)**

b. With neat sketches, explain the CMOS n-well fabrication process steps to fabricate CMOS inverter. **(10 Marks)**

OR

2 a. With a neat diagram, explain the cut-off, linear and saturation regions formation in MOSFET with different values of V_{gs} and V_{ds}. **(10 Marks)**

b. Explain Noise Margin with respect to CMOS inverter. **(05 Marks)**

c. Explain enhancement mode and depletion mode transistor in brief. **(05 Marks)**

Module-2

3 a. Draw the stick diagram for the following using CMOS logic :

i) $y = \overline{C \cdot (A + B)}$

ii) 2 – Input NAND gate. **(06 Marks)**

b. Discuss the different contact cuts with an example to each. **(06 Marks)**

c. Calculate the area capacitance of the layer below [Refer Fig.Q4(c)].

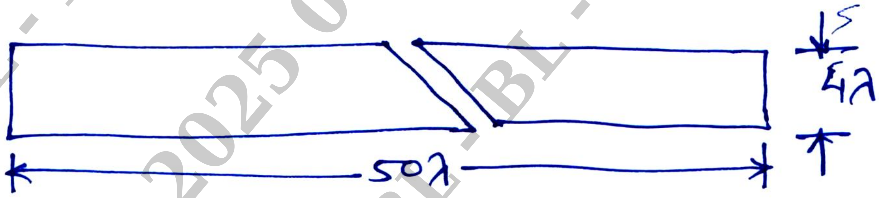

Fig.Q4(c)

i) If the layer is metal-1 and relative capacitance value is 0.075□C_g

ii) If the layer is polysilicon and relative capacitance value is 0.1□C_g. **(08 Marks)**

OR

4 a. Write the lambda based design rules for separation of layers and transistors. **(08 Marks)**

b. Derive the expression of delay interms of 'T' for CMOS inverter pair. **(08 Marks)**

c. Define sheet resistance with an equation. **(04 Marks)**

Module-3

5 a. Design a 4-bit 4 × 4 barrel shifter. Write the nMOS implementation and strategy for the same. **(10 Marks)**

b. Draw the 4 × 4 cross bar switch using MOS switches and explain it. **(05 Marks)**

c. Discuss the different bus architectures. **(05 Marks)**

OR

6 a. Describe Manchester carry chain element. **(10 Marks)**

b. Implement the ALU functions like EX–OR, EXNOR, AND and OR operations with an adder. Write the block diagram of 4-bit ALU using adder element. **(10 Marks)**

Module-4

7 a. Explain parity generator, with the nMOS implementation of parity generator with stick diagram. **(10 Marks)**

b. Draw the block diagram of generic structure of FPGA and explain it. **(10 Marks)**

OR

8 a. Construct a stick diagram for multiplexer shown in Fig.Q8(a) using CMOS.

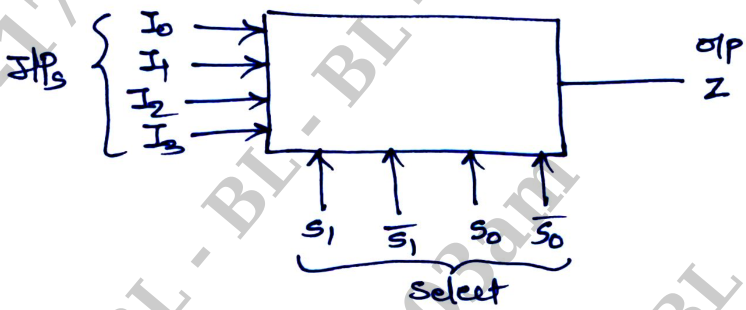

Fig.Q8(a) **(10 Marks)**

b. Explain the goals and techniques of FPGA based system design. **(10 Marks)**

Module-5

9 a. Write the system time considerations. **(05 Marks)**

b. Write a note on stuck-at-fault. **(05 Marks)**

c. With the help of block diagram, explain the process of logic verification. **(10 Marks)**

OR

10 a. Explain 3T dynamic RAM with neat circuit and stick diagram. **(06 Marks)**

b. Write a note on automatic test pattern generation. **(06 Marks)**

c. Explain nMOS pseudo static RAM cell with schematic diagram. **(08 Marks)**

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21EC71

Seventh Semester B.E./B.Tech. Degree Examination, June/July 2025
Advanced VLSI

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. With a neat flow diagram, explain the steps involved in ASIC design. **(10 Marks)**

b. With neat diagram, explain the following :
   i) Programmable logic devices
   ii) Structured gate arrays. **(10 Marks)**

OR

2 a. With relevant diagram and equations, explain the conventional ripple carry adder. Mention its limitations. **(10 Marks)**

b. Explain the following:
   i) I/O cells
   ii) Cell compilers. **(10 Marks)**

Module-2

3 a. Explain the measurement of delay in floor planning. **(10 Marks)**

b. Briefly explain the following:
   i) Goals and objectives of placement
   ii) Timing driven placement method. **(10 Marks)**

OR

4 a. Explain physical design flow with respect to placement. **(10 Marks)**

b. Explain global routing between blocks. **(10 Marks)**

Module-3

5 a. Explain the verification process with an example. **(10 Marks)**

b. Discuss direct testing method and its limitations in system verilog. **(10 Marks)**

OR

6 a. Describe fixed size arrays with an example. **(08 Marks)**

b. Explain dynamic arrays with sample code. **(06 Marks)**

c. Explain array reduction methods and array locator methods. **(06 Marks)**

Module-4

7 a. Explain tasks, functions and void functions in system verilog. **(10 Marks)**

b. Explain time values in system verilog. **(10 Marks)**

OR

8 a. List the interface tradeoffs in system verilog. **(08 Marks)**

b. Explain system verilog assertions. **(12 Marks)**

Module-5

9	a.	What is Randomization? Explain all design inputs in detail for randomization.	(10 Marks)
	b.	Explain in detail about iterative and array constraints.	(10 Marks)

OR

10	a.	Describe various functional coverage strategies in detail.	(10 Marks)
	b.	Discuss various carriage options with an example.	(10 Marks)

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21EC72

Seventh Semester B.E./B.Tech. Degree Examination, June/July 2025
Optical and Wireless Communication

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Explain the basic three configurations of optical fibers. **(10 Marks)**

b. Illustrate the relationship between acceptance angle and refractive indices according to Ray theory. **(10 Marks)**

OR

2 a. A continuous 12 km long optical fiber has a loss of 1.5 dB/km.

i) What is the minimum optical power level that must be launched into the fiber to maintain as optical power level of 0.3 μw at the receiving end.

ii) What is the required input power if the fiber has a loss of 2.5 dB/km? **(10 Marks)**

b. Explain bending losses. **(10 Marks)**

Module-2

3 a. What are avalanche photodiodes and briefly explain RAPD (Reach – through avalanche photo diode)? **(10 Marks)**

b. Derive the equations for frequency spacing and wavelength spacing for the laser diode. **(10 Marks)**

OR

4 a. Explain Etalon theory. **(10 Marks)**

b. Explain diffraction grating. **(10 Marks)**

Module-3

5 a. Compare diffraction and scattering. **(10 Marks)**

b. Consider a base-station transmitter operating at 900 MHz carrier frequency. For a mobile moving at a speed of 72 km/h, calculate the received carrier frequency if the mobile is moving.

i) Directly away from the base-station transmitter.

ii) Directly towards the base-station transmitter.

iii) In a direction which is 60° to the direction of arrival of the transmitted signal.

iv) In a direction perpendicular to the direction of arrival of the transmitted signal. **(10 Marks)**

OR

6 a. i) Assume a cellular system of 32 cells with a cell radius of 1.6 km, a total spectrum allocation that supports 336 traffic channels and a sense pattern of 7. Calculate the total service area covered with this configuration, the number of channels per all and a total system capacity. Assume regular hexagonal cellular topology.
ii) Let the size of cell be reduced to the extent that the same area as covered in (i) with 128 cells. Find the radius of the new cell and new system capacity. **(10 Marks)**

b. Illustrate and prove that for a regular hexagonal geometry, the frequency reuse ratio is given by the relationship $q = \sqrt{3K}$ where $k = i^2 + j^2 + 1 \times j$; i and j being the shift parameters. **(10 Marks)**

Module-4

7 a. List out any ten salient features of TDMA technique. **(10 Marks)**

b. What is SDMA? Give some examples of smart antennas and some advantages of smart antennas. **(10 Marks)**

OR

8 a. Illustrate the concept of hybrid TDMA/FDMA technique commonly used in 2G digital cellular systems such as IS 136 and GSM cellular systems. **(10 Marks)**

b. What are the steps involved for landline (PSTN) to mobile (cellular) call in a cellular telephone system? **(10 Marks)**

Module-5

9 a. i) Show that the 3-dB bandwidth for a Gaussian LPF used to produce $B \times T_b = 0.3$ GMSK modulation in GSM standard is 81.3 kHz. The channel data rate is 270.833 kbps.
ii) The channel data rate is 270.833 kbps in GSM standard that is 40% (say) of the theoretical maximum data rate that can be supported in a 200 kHz channel bandwidth. Calculate the corresponding theoretical S/N required. **(10 Marks)**

b. What are GSM traffic channels? Describe the two types of TCH channels. **(10 Marks)**

OR

10 a. Describe GSM hand-OFF procedures briefly. **(10 Marks)**

b. i) What is frequency hopping in GSM?
ii) In Europe, GSM uses the frequency band of 890 to 915 MHz for uplink transmission and the frequency band of 925 to 960 MHz for downlink transmission. Determine the maximum frequency hop from one frame to the next for uplink transmission and downlink transmission. Express it as a percentage of the mean carrier frequency. **(10 Marks)**

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21EC741

Seventh Semester B.E./B.Tech. Degree Examination, June/July 2025
IoT and Wireless Sensor Networks

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1	a.	Explain various IoT protocols with neat diagram.	(10 Marks)
	b.	List and explain enabling Technologies of IoT.	(10 Marks)
		OR	
2	a.	Explain level – 5 IoT system for forest fire detection.	(10 Marks)
	b.	Describe an example of IoT service that uses web socket communication.	(10 Marks)

Module-2

3	a.	Explain home automation application using IoT.	(10 Marks)
	b.	Explain the applications of IoT for smart cities.	(10 Marks)
		OR	
4	a.	Discuss the applications of IoT for energy systems.	(10 Marks)
	b.	Discuss the applications of IoT for logistics.	(10 Marks)

Module-3

5	a.	Explain the functional blocks of typical sensing node.	(10 Marks)
	b.	Briefly explain Category 1 wireless sensor network applications.	(10 Marks)
		OR	
6	a.	Discuss the challenges and hurdles of WSN (Wireless Sensor Networks).	(10 Marks)
	b.	With neat diagram, explain home control application in detail.	(10 Marks)

Module-4

7	a.	Explain different hardware and software components of wireless network.	(10 Marks)
	b.	Explain campus applications of WN-wireless networks.	(10 Marks)
		OR	
8	a.	List and explain resource constraints of WN environment.	(10 Marks)
	b.	Explain MAN/WAN applications of WN.	(10 Marks)

Module-5

9	a.	Explain middle wave architecture of WSN in detail.	(10 Marks)
	b.	Discuss data related functions in WSN in detail.	(10 Marks)
		OR	
10	a.	Discuss and summarize wireless sensor networks design issues.	(10 Marks)
	b.	List and explain performance metrics of wireless sensor networks.	(10 Marks)

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21EC752

Seventh Semester B.E./B.Tech. Degree Examination, June/July 2025
ARM Embedded Systems

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. What are the four major design rules for the implementation of RISC philosophy. Explain the physical features of ARM Processor Design. **(08 Marks)**

b. Explain the different ways that makes the ARM instruction set suitable for embedded applications. **(06 Marks)**

c. Explain the ARM – Based Embedded Device with a neat diagram. **(06 Marks)**

OR

2 a. Explain ARM core Data flow model with a neat diagram. **(08 Marks)**

b. Explain the following in brief :
1. Current Program Status Register (CPSR)
2. Processer Modes
3. Pipeline **(12 Marks)**

Module-2

3 a. Explain Barrel Shifter with a neat diagram. **(06 Marks)**

b. Explain the three load – store instruction with the indexing methods. **(08 Marks)**

c. Explain the stack operations with an example. **(06Marks)**

OR

4 a. Explain thumb register usage and ARM Thumb Networking. **(06 Marks)**

b. Explain the four branching instructions of ARM processor. **(08 Marks)**

c. Explain the thumb software interrupt (SWI) instruction with an example. **(06 Marks)**

Module-3

5 a. Define Embedded System. Explain the 6 purposes of an embedded system with an example for each. **(10 Marks)**

b. Briefly explain the classification of an embedded system. **(10 Marks)**

OR

6 a. List the embedded system application with an example. **(06 Marks)**

b. Explain the working of SRAM cell and differentiated between SRAM cell and DRAM cell. **(06 Marks)**

c. Explain the following :
i) 7 – Segment LED display
ii)Serial Peripheral Interface (SPI) Bus. **(08 Marks)**

Module-4

7 a. Explain the characteristics of an embedded system. **(06 Marks)**

b. Explain operational quality attributes. **(06 Marks)**

c. With a block diagram, explain the working of washing machine. **(08 Marks)**

OR

8 a. Explain the fundamental issues in Hardware and Software co-design. **(06 Marks)**

b. Explain state machine model with an example. **(08 Marks)**

c. Briefly explain advantages and disadvantages of assembly language based development. **(06 Marks)**

Module-5

9 a. Define an operating system. Mention the types of operating system and also basic functions of Real –Time kernel. **(06 Marks)**

b. Define Process. Explain in detail the structure of a process and state transition diagram. **(08 Marks)**

c. Three process with process ID's P1,P2,P3 with Estimated completion time 10,5,7 ms respectively enters ready queue together. A new process P_4 with estimated completion time 2 ms enters the ready queue after 2 ms. Calculate waiting time, turn around time and average turnaround time with the help of SRT Scheduling. **(06 Marks)**

OR

10 a. Explain the concept of 'deadlock' with a neat diagram. Mention the different condition which favours a deadlock situation. **(08 Marks)**

b. Write a short note for the following :

1. Message passing
2. Binary and counting semaphore
3. In system programming (ISP)

(12 Marks)

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