CBCS SCHEME

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18MAT41

Fourth Semester B.E. Degree Examination, June/July 2024
Complex Analysis, Probability and Statistical Methods

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Derive Cauchy - Riemann equations in Cartesian form. **(06 Marks)**

b. Show that the function v = (sin x cosh y + 2 los x sinh y) + ($x^2 - y^2 + 4xy$) is harmonic and hence find Analytic function. **(07 Marks)**

c. Verify that $v = \frac{1}{r^2}(\cos 2\theta)$, $r \neq 0$ is harmonic. Find an analytic function f(z) whose real part is u. **(07 Marks)**

OR

2 a. Derive Cauchy-Riemann equations in polar form. **(06 Marks)**

b. Given f(z) = u + iv an analytic function and prove the following property:

$$\left(\frac{\partial}{\partial x}|f(z)|\right)^2 + \left(\frac{\partial}{\partial y}|f(z)|\right)^2 = |f'(z)|^2$$ **(07 Marks)**

c. Find an analytic function f(z) = u + iv, given
$u - v = e^x(\cos y - \sin y)$ **(07 Marks)**

Module-2

3 a. Discuss the transformation $w = e^z$. Show the transform in z-plane and w-plane. **(06 Marks)**

b. Evaluate $\int_c \frac{e^z}{(z-2)(z-5)^3} dz$, where c is the circle $|z| = 8$. **(07 Marks)**

c. Evaluate $\int_{z=0}^{z=1+i} (x^2 - iy)dz$ along the following curves:

i) The straight line y = x ii) The parabola $y = x^2$. **(07 Marks)**

OR

4 a. Find the bilinear transformation that maps the points z = -1, i, 1 onto the points w = 1, i, -1 respectively. **(06 Marks)**

b. Discuss the transformation $w = z + \frac{1}{z}$. Show the transform in z and w planes. **(07 Marks)**

c. State and prove Cauchy's integral formula. **(07 Marks)**

Module-3

5 a. Find the value of k such that the following table represents a finite probability distribution:

x :	-3	-2	-1	0	1	2	3
$P(x_i)$:	k	2k	3k	4k	3k	2k	k

Find the mean and the standard deviation of the distribution Also find P(x >1) and P(-1 < x ≤ 2). **(06 Marks)**

b. In a certain factory turning out razor blades, there is a small chance of 0.002, for a blade to be defective. The blades are supplied in packets of 10. Using Poisson distribution, calculate the approximate number of packets containing i) no defective ii) one defective iii) two defective blades in a consignment of 10,000 packets. **(07 Marks)**

c. For the normal distribution with mean 2 and standard deviation 4, calculate the following probabilities:
i) $P(x \geq 5)$ ii) $P\{|x| < 4\}$ iii) $P\{|x| > 3\}$ **(07 Marks)**

OR

6 a. A fair coin is tossed three times. Let x denotes the number of heads showing up. Find the distribution of x. Also find its mean variance and standard deviation. **(06 Marks)**

b. An underground mine has 5 pumps installed for pumping out storm water, the probability of any of the pumps failing during the storm is 1/8. What is the probability that
i) At least 2 pumps will be working ii) All pumps will be working during a particular storm? **(07 Marks)**

c. At a certain city bus stop, three buses arrive per hour on an average. Assuming that the time between successive arrivals is exponentially distributed, find the probability that the time between the arrivals of successive buses is
i) less than 10 minutes ii) at least 30 minutes. **(07 Marks)**

Module-4

7 a. If F is the force required to lift a load W, by mass of a pulley, fit a linear expression $F = a + bW$ against the following data:

W	50	70	100	120
F	12	15	21	25

(07 Marks)

b. Employ the formula $r = \dfrac{\sigma_x^2 + \sigma_y^2 - \sigma_{x-y}^2}{2\sigma_x\sigma_y}$ to determine the coefficient of correlation r, for the following data:

x :	92	89	87	86	83	77	71	63	53	50
y :	86	83	91	77	68	85	52	82	37	57

(07 Marks)

c. The tangent of the angle θ between the lines of regression of y on x and x on y is 0.6 and the standard deviation of y is twice the standard deviation of x, find the coefficient of correlation between x and y. **(06 Marks)**

OR

8 a. Fit a second-degree parabola in the form $y = a + bx + cx^2$ for the following data:

x :	1.0	1.5	2.0	2.5	3.0	3.5	4.0
y :	1.1	1.3	1.6	2.0	2.7	3.4	4.1

(06 Marks)

b. Obtain the lines of regression and hence find the coefficient of correlation for the following data:

x :	1	3	4	2	5	8	9	10	13	15
y :	8	6	10	8	12	16	16	10	32	32

(07 Marks)

c. Fit a curve of best fit of the form $y = ax^b$ to the following data:

x :	1	2	3	4	5
y :	0.5	2	4.5	8	12.5

(07 Marks)

Module-5

9 a. The joint probability function for two discrete random variables X and Y is given by $f(x, y) = c(2x + y)$ where x and y can assume all integral values such that $0 \le x \le 2$ and $0 \le y \le 3$ and $f(x, y) = 0$ otherwise.
Find i) The value of constant c ii) $P(X = 2, Y = 1)$ iii) $P(X \ge 1, Y \le 2)$ iv) $P[(x + y) \le 1]$ **(10 Marks)**

b. Define Type-I and Type-II errors. A coin was tossed 400 times and returned heads 216 times. Test the hypothesis that the coin is unbiased. **(10 Marks)**

OR

10 a. The life time of electric bulbs for a random sampling of 10from a large shipment gave the following data:

Item	1	2	3	4	5	6	7	8	9	10
Life in '1000s of hrs	4.2	4.6	3.9	4.1	5.2	3.8	3.9	4.3	4.4	5.6

Can we accept the hypothesis that the average life time of bulbs is 4000 hrs. **(10 Marks)**

b. A joint distribution is given by the following table:

X \ Y	-3	2	4
1	0.1	0.2	0.2
3	0.3	0.1	0.1

Find the marginal distribution of X and Y evaluate μ_X , μ_Y , σ_X, σ_Y. **(10 Marks)**

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18EC42

Fourth Semester B.E. Degree Examination, June/July 2024
Analog Circuits

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 design concept of common emitter collector to Base feedback resistor biasing circuit and explain how collector to base feedback resistor provides a negative feedback in the circuit. **(07 Marks)**

b. Considering the conceptual circuit of common source MOSFET amplifier, derive the expression for transconductance g_m and voltage gain A_V. **(08 Marks)**

c. For common emitter voltage divider circuit having $\beta = 100$, $R_1 = 10\ K\Omega$, $R_2 = 5\ K\Omega$, $R_C = 1\ K\Omega$ and $R_E = 500\ \Omega$ is provided with DC biasing voltage $V_{CC} = 10$ V, Calculate V_{CE} and I_C. **(05 Marks)**

OR

2 a. Derive an expression for small signal collector current, transconductance g_m and voltage gain A_V in BJT, when small signal V_{bc} is applied between base and emitter. **(10 Marks)**

b. Design voltage divider bias circuit using MOSFET to establish $I_D = 0.5$ mA and MOSFET parameter are $V_t = 1$ V and $K_n'\left(\frac{\omega}{L}\right) = 0.5\ mA/V^2$. Assume $V_{DD} = 15$ V. **(10 Marks)**

Module-2

3 a. Explain Three basic configurations of MOSFET amplifier and derive expression for characteristic parameter of amplifiers. **(08 Marks)**

b. Briefly explain the Barkhausen criteria for oscillation. **(04 Marks)**

c. For an n-channel MOSFET with $t_{ox} = 10$ nm, $L = 1\ \mu m$, $W = 10\ \mu m$, $L_{ov} = 0.05\ \mu m$, $C_{Sbo} = C_{dbo} = 10$ fF, $V_O = 0.6$ V, $V_{SB} = 1$ V, $V_{DS} = 2$ V. Calculate the following capacitance when the transistor is operating in saturation,
(i) C_{OX} (ii) C_{OV} (iii) C_{gs} (iv) C_{gd} (v) C_{sb} and C_{db}.
Consider $\epsilon_{ox} = 3.45 \times 10^{-11}$ **(08 Marks)**

OR

4 a. Explain the working of RC phase shift oscillator and show how RC network provides 180° of phase shift. **(08 Marks)**

b. In a transistor Calpitts oscillator $C_1 = 1$ nF and $C_2 = 1000$ nF. Find the value of L for a frequency of 100 kHz. **(04 Marks)**

c. Explain the High frequency response of common source MOSFET amplifier with its equivalent circuit. **(08 Marks)**

Module-3

5 a. Explain the effect of negative feedback on input and output resistance of voltage series feedback amplifier. **(10 Marks)**

b. Explain transformer coupled Class A power amplifier and show that the maximum efficiency of transformer coupled Class A power amplifier is 50%. **(10 Marks)**

OR

6 a. Draw the block diagram of four types of feedback topologies and compare them with respect to input and output resistance. **(10 Marks)**

b. Compare Class B pushpull and complementary symmetry power amplifiers. **(04 Marks)**

c. In a Class B push pull amplifier operating with $V_{CC} = 25V$ provides a 22 V peak signal to an 8 Ω load. Find

(i) Peak load current (ii) dc current drawn from the supply (iii) input power
(iv) Output current efficiency (v) power dissipation **(06 Marks)**

Module-4

7 a. State the ideal op-amp characteristics. **(06 Marks)**

b. Design a linear combination circuit using op-amp to obtain output $V_0 = -2V_1-8V_2-V_3$ with $R_{fn} \geq 20\,k\Omega$ at all the inputs and all the resistances $\leq 200\,k\Omega$ **(04 Marks)**

c. Draw the circuit of 3 op-amp instrumentation amplifier and derive the expression for its output voltage. **(10 Marks)**

OR

8 a. Explain the working of voltage follower using op-amp and show that its gain is unity. State its advantages. **(06 Marks)**

b. Explain the working of zero crossing detectors. **(06 Marks)**

c. Design an inverting Schmitt trigger to have trigger voltages of $\pm 4V$ using op-amp 741 with supply of $\pm 15V$. Consider $I_{B(max)} = 500\,nA$. **(08 Marks)**

Module-5

9 a. With neat circuit diagram, explain the operation of R-2R D/A converter. **(10 Marks)**

b. Explain the working of pulse width modulation circuit using 555 IC. **(06 Marks)**

c. Design a low pass filter using op-amp at a cut off frequency of 1 kHz with pass gain of 2 and choose C = 0.01 μF **(04 Marks)**

OR

10 a. Explain with neat circuit diagram the working of positive precision Half Wave Rectifier. **(06 Marks)**

b. Design a monostable 555 timer circuit to produce an output pulse of 10 sec wide and draw the circuit diagram. Choose C = 100 μF. **(04 Marks)**

c. Draw the circuit of second order low pass filter and explain its operation. **(10 Marks)**

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18EC43

Fourth Semester B.E. Degree Examination, June/July 2024
Control Systems

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define closed loop control system. Compare open loop and closed loop control system. **(06 Marks)**

b. Write the differential equations of performance for the mechanical system in Fig.Q1(b). Draw its F – V analogous circuit.

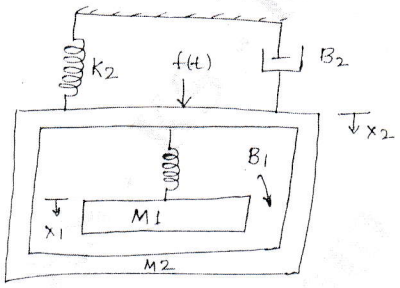

Fig.Q1(b) **(14 Marks)**

OR

2 a. What are the advantages of using negative feedback in control system? **(06 Marks)**

b. Draw the F – V and F – I analogues circuits for the mechanical system shown in Fig.Q2(b) with necessary equations.

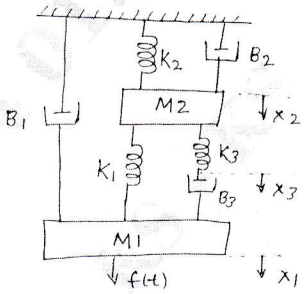

Fig.Q2(b) **(14 Marks)**

Module-2

3 a. State advantages and disadvantages of the block diagram reduction technique. **(06 Marks)**

b. For the block diagram shown in Fig.Q3(b), determine the transfer function : $\frac{Q_2(s)}{Q(s)}$ using block diagram reduction algebra.

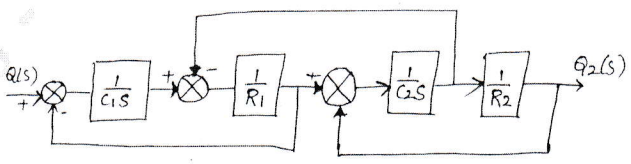

Fig.Q3(b) **(10 Marks)**

c. Derive the transfer function of simple closed loop system. **(04 Marks)**

OR

4 a. Find $\frac{C}{R}$ using Mason's gain formula for the signal flow graph shown in Fig.Q4(a).

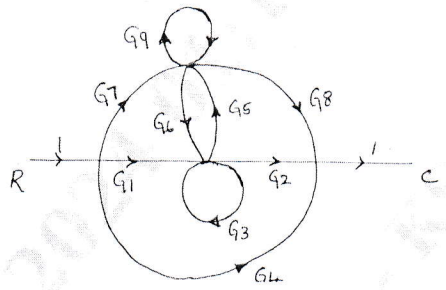

Fig.Q4(a) **(10 Marks)**

b. For the block diagram given in Fig.Q4(b) obtain overall transfer function using Mason's gain formula.

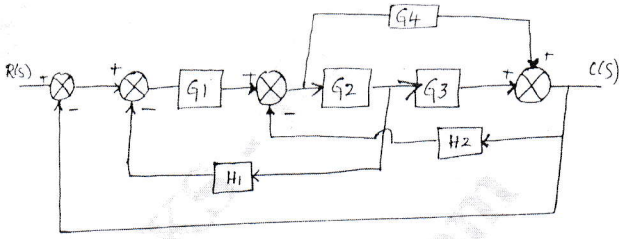

Fig.Q4(b) **(10 Marks)**

Module-3

5 a. With the help of graphical representation and mathematical expressions, explain the following signals :

i) Step signal
ii) Ramp signal
iii) Impulse signal
iv) Parabolic signal. **(10 Marks)**

b. Derive an expression for the under-damped response of a second order feedback control system for step input. **(10 Marks)**

OR

6 a. For the system shown in the Fig.Q6(a)

i) Identify the type of $\frac{C(s)}{E(s)}$

ii) Find the values of kp, kv, ka

iii) If r(t) = 10u(t), find the steady state value of the output.

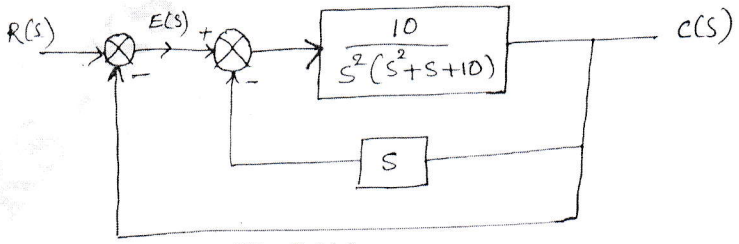

Fig.Q6(a) **(10 Marks)**

b. Discuss the various types of controllers used in the control systems. **(10 Marks)**

Module-4

7 a. $S^6 + 4s^5 + 3s^4 - 16s^2 - 64s - 48 = 0$. Find the number of roots of this equation with positive real part, zero real part and negative real part using Routh's criterion. **(10 Marks)**

b. Find the gain margin and phase margin analytically for the negative feedback control system having open loop T.F. $G(s)H(s) = \dfrac{6}{(s^2+2s+2)(s+2)}$. **(10 Marks)**

OR

8 a. The open loop transfer function of a control system is given by

$$G(s) = \frac{K}{s(s+2)(s^2+6s+25)}$$

Sketch the complete root – locos as K is varied from 0 to infinity. **(15Marks)**

b. Explain experimental determination of frequency response. **(05 Marks)**

Module-5

9 a. For a feedback control system :

$$G(s)H(s) = \frac{40}{(s+4)(s^2+2s+2)}$$

Find gain margin and stability from Nyquist plot. **(10 Marks)**

b. Draw polar plot of $G(s)H(s) = \dfrac{100}{(s+2)(s+4)(s+8)}$ **(10 Marks)**

OR

10 a. Obtain the state equation and output equation of the electric networks as shown in Fig.Q10(a).

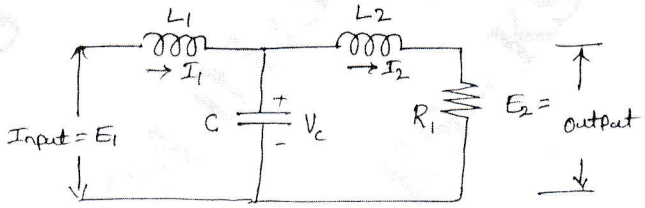

Fig.Q10(a) **(10 Marks)**

b. State the effect of lead, lag and lead – lag compensating networks. **(10 Marks)**

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18EC44

Fourth Semester B.E. Degree Examination, June/July 2024
Engineering Statistics and Linear Algebra

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Derive mean, variance and characteristic function for uniformly distributed random variable. **(10 Marks)**

b. The cdf for random variable z is $F_z(z) = \begin{cases} 1-\exp(-2z^{3/2}) & z \geq 0 \\ 0 & \text{otherwise} \end{cases}$.

Evaluate $P(0.5 < z \leq 0.9)$ **(04 Marks)**

c. It is given that $E[X] = 2$ and $E[X^2] = 6$.
(i) Find standard deviation of X.
(ii) If $Y = 6X^2 + 2X - 13$. Find mean of Y. **(06 Marks)**

OR

2 a. Given the data in the following table:

K	1	2	3	4	5
x_K	2.1	3.2	4.8	5.4	6.9
$p(x_K)$	0.21	0.18	0.20	0.22	0.19

(i) Plot pdf and cdf of discrete random variable X.
(ii) Write expression for $f_x(x)$ and $F_x(x)$ using unit delta functions and unit step functions. **(08 Marks)**

b. The random variable X is uniformly distributed between 0 and 2. $Y = 3x^3$. What is the pdf of X? **(06 Marks)**

c. The ransom variable X is uniformly distributed between 0 and 5. The event B is $B = \{X > 3.7\}$. What are $f_{X/B(x)}$, $\mu_{X/B}$ and $\sigma^2_{X/B}$? **(06 Marks)**

Module-2

3 a. A bivariate Pdf is given as
$f_{XY}(x, y) = 0.2\delta(x)\,\delta(y) + 0.3\delta(x-1)\,\delta(y) + 0.3\delta(x)\,\delta(y-1) + C\delta(x-1)\,\delta(y-1)$
i) What is the value of the constant C?
ii) What are the Pdfs for X and Y?
iii) What is $F_{XY}(x, y)$ when $(0 < x < 1)$ and $(0 < y < 1)$?
iv) What are $F_{XY}(x, \alpha)$ and $F_{XY}(\alpha, y)$
v) Are X and Y independent? **(08 Marks)**

b. The mean and variance of random variable X are -1 and 2. The mean and variance of random variable Y are 3 and 4. The correlation coefficient $\rho_{XY} = 0.5$. What are the covariance COV[XY] and the correlation E[XY]. **(05 Marks)**

c. Write a short note on Chi-square random variable and students random variable. **(07 Marks)**

OR

4 a. X is a random variable, $\mu_X = 4$ and $\sigma_X = 5$, Y is a random variable, $\mu_Y = 6$ and $\sigma_Y = 7$. The correlation coefficient is 0.2. If U = 3X + 2Y. What are var[u], cov[uX] and cov[uY]? **(08 Marks)**

Let 'X' and 'Y' be exponentially distributed random variable with $f_X(x) = \begin{cases} \lambda e^{-\lambda x} & x \geq 0 \\ 0 & x < 0 \end{cases}$

b. Obtain the characteristic function and Pdf of W = X + Y. **(06 Marks)**

c. The Random variables X_i have same mean of $m_x = 4$ and variance of $\sigma_X^2 = 1.5$. For $w = \sum_{i=1}^{150} X_i$, determine m_w and σ_w^2. Also for $w = \frac{1}{150} \sum_{i=1}^{150} X_i$, determine m_y and $\sigma^2 y$. Comment on the result. **(06 Marks)**

Module-3

5 a. Define the following:
(i) Random processes
(ii) Stationary processes. **(04 Marks)**

b. Write the properties of Autocorrelation function. **(06 Marks)**

c. Show that the random process $X(t) = A\cos(\omega_C t + \theta)$ is wide sense stationary. 'θ' is uniformly distributed in the range $-\pi$ to π. **(10 Marks)**

OR

6 a. For the random process $X(t) = A\cos(\omega_C t + \theta)$, A and ω_C are constants. θ is a random variable, uniformly distributed between $\pm\pi$. Show that this process is ergodic. **(08 Marks)**

b. Determine the power spectral density of the random process $X(t) = A\cos(\omega_C t + \theta)$ and plot the same. Here θ is random variable uniformly distributed over 0 to 2π. Hence obtain average power of X(t). If the frequency becomes zero, X(t) = A i.e. a d.c. signal, then obtain power spectral density and autocorrelation function. **(08 Marks)**

c. A wide sense stationary random process X(t) is applied to a LTI system with impulse response $h(t) = ae^{-at}u(t)$. Find the mean value of the output Y(t) of the system if $E[X(t)] = 6$ and 'a' = 2. **(04 Marks)**

Module-4

7 a. Write the complete solution as x_p + multiplies of s in the null space.

$x + 3y + 3z = 1$

$2x + 6y + 9z = 5$

$-x - 3y + 3z = 5$ **(06 Marks)**

b. Find bases for the four subspaces associated with $A = \begin{bmatrix} 1 & 2 & 4 \\ 2 & 4 & 8 \end{bmatrix}$. **(04 Marks)**

c. Find orthogonal vector A, B and orthonormal vector q_1 q_2 from a, b using Gram Schmidt process. Factorize into A = QR. $a = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$, $b = \begin{bmatrix} 4 \\ 0 \end{bmatrix}$. **(10 Marks)**

OR

8 a. Reduce A to echlon form. Which combination of rows of A produce zero row? What is the left Null space?

$$A = \begin{bmatrix} 1 & 2 & b_1 \\ 3 & 4 & b_2 \\ 4 & 6 & b_3 \end{bmatrix}$$ **(04 Marks)**

b. Project the vector b onto the line through a. Check that e is perpendicular to a.

$$b = \begin{bmatrix} 1 \\ 2 \\ 2 \end{bmatrix}, \quad a = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$$ **(08 Marks)**

c. In order to fit best straight line through four points passing through b = 0, 8, 8, 20 at t = 0, 1, 3, 4. Set up and solve normal equations $A^TA\hat{x} = A^Tb$. **(08 Marks)**

Module-5

9 a. Mention the properties of determinants. **(08 Marks)**

b. If $A = \begin{bmatrix} 3 & -1 & 1 \\ -1 & 5 & -1 \\ 1 & -1 & 3 \end{bmatrix}$, show that matrix A is positive definite matrix. **(06 Marks)**

c. Find the eigen values of $A = \begin{bmatrix} 2 & 3 \\ 3 & -6 \end{bmatrix}$. **(06 Marks)**

OR

10 a. Diagonalize the following matrix, if possible $A = \begin{bmatrix} 1 & 3 & 3 \\ -3 & -5 & -3 \\ 3 & 3 & 1 \end{bmatrix}$. **(10 Marks)**

b. Find a singular value of decomposition of, $A = \begin{bmatrix} 1 & -1 \\ -2 & 2 \\ 2 & -2 \end{bmatrix}$. **(10 Marks)**

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18EC45

Fourth Semester B.E. Degree Examination, June/July 2024
Signals and Systems

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Sketch the even and odd parts of the signal shown in Fig Q1(a)-i), ii).

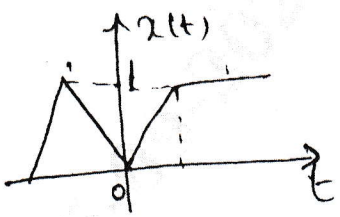

Fig Q1(a)-i)

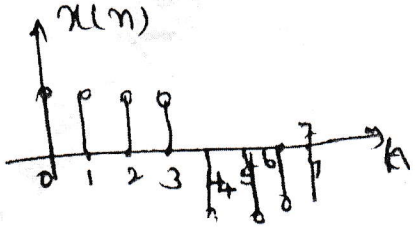

Fig Q1(a)- ii) **(08 Marks)**

b. Find the even components and odd components of the following equation
i) $x(t) = 1 + \cos t + t^2 \sin t + t^3 \sin t \cos t$ ii) $x(n) = \{-3, \underset{\uparrow}{1}, 2, -4, 2\}$ **(06 Marks)**

c. Determine whether the following signal is periodic or not if periodic find the fundamental period. i) $x(n) = \cos\frac{n\pi}{5}\sin\frac{n\pi}{3}$ ii) $x(t) = (\cos(2\pi t))^2$. **(06 Marks)**

OR

2 a. Explain with an example i) even and odd signal ii) energy and power signal iii) Time shifting iv) Time scaling v) Precedence rule. **(10 Marks)**

b. A continuous time signal x(t) is shown in Fig Q2(b) plot the following signal
i) $x\left(\frac{t}{2}+1\right)$ ii) $x[-2(t+1)]$ iii) $x(-2t-1)$.

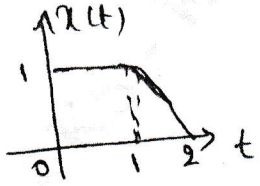

Fig Q2(b) **(06 Marks)**

c. If x(n) is as shown is Fig Q2(c) find the energy of the signal x(2n – 1)

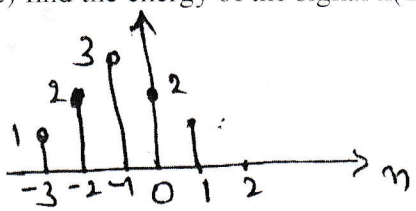

Fig Q2(c) **(04 Marks)**

Module-2

3 a. For the signal x(t) and y(t) shown in Fig Q3(a). Sketch the following signals
i) $x(t+1)\,y(t-2)$ ii) $x(t)\cdot y(t-1)$

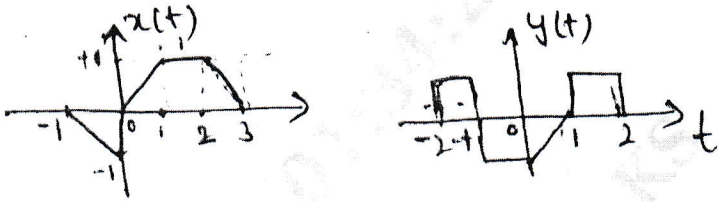

Fig Q3(a) **(10 Marks)**

b. Determine whether the following systems are memory less, causal, time invariant, stable
i) $y(n) = nx(n)$ ii) $y(t) = x(t/2)$ **(10 Marks)**

OR

4 a. Prove the following :

i) $x(n)*[h_1(n)*h_2(n)] = [x(n)*h_1(n)*x(n)*h_2(n)]$ ii) $x(n)*u(n) = \sum_{k=-\infty}^{\infty} x(k)$ **(08 Marks)**

b. The impulse response of the discrete LTI system is given by, $h(n) = u(n+1) - u(n-4)$. The system is excited by the input signal $x(n) = u(n) - 2u(n-2) + u(n-4)$. Obtain the response of the system $y(n) = x(n) * h(n)$ and plot the same. **(08 Marks)**

c. A system consists of several subsystems connected as shown in Fig Q4(c). Find the operator H relating x(t) to y(t) for the following sub systems operators.

$H_1 = y_1(t) = x_1(t)\,x_1(t-1)$
$H_2 : y_2(t) = |x_2(t)|$
$H_3 : y_3(t) = 1 + 2x_3(t)$
$H_4 : y_4(t) = \cos(x_4(t))$

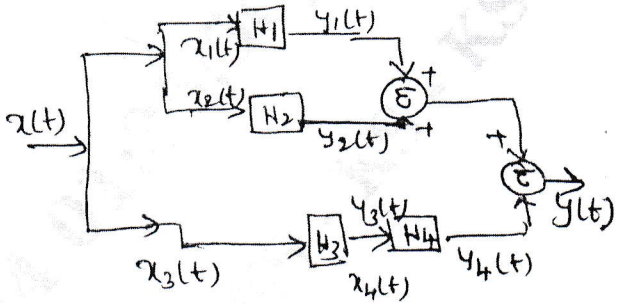

Fig Q4(c)

(04 Marks)

Module-3

5 a. Check whether the following systems are stable and causal
i) $h(t) = e^{-2t}u(t-1)$ ii) $h(t) = e^{-4t}u(t-10)$ iii) $h(t) = te^{-t}u(t)$ **(09 Marks)**

b. Find the step response of a LTI system if impulse response $h(t) = t^2\,u(t)$. **(04 Marks)**

c. Find the complex Fourier coefficient for $x(t) = \cos\left(\frac{2\pi}{3}t\right) + 2\cos\left(\frac{5\pi}{3}t\right)$. **(07 Marks)**

OR

6 a. Determine the output y(t) of a LTI system with impulse response
$h(t) = u(t+1) - 2u(t) + u(t-1)$ and input $x(t) = \begin{cases} 1 \text{ for } & |t| \le 2 \\ 0 \text{ for } & |t| > 2 \end{cases}$

Sketch the signals h(t), x(t) and y(t). **(12 Marks)**

b. Determine the FS representation for the signal x(t) of fundamental period T given by $x(t) = 3\cos\left[\frac{\pi}{2}t + \frac{\pi}{4}\right]$. Sketch the magnitude and phase of x(k). **(08 Marks)**

Module-4

7 a. State and prove the following properties

i) $y(t) = h(t)*x(t) \xleftrightarrow{FT} y(j\omega) = x(j\omega)H(j\omega)$

ii) $\frac{d}{dt}x(t) \xleftrightarrow{FT} j\omega X(\omega)$

iii) $y(t) = x(t - t_0) \xleftrightarrow{FT} y(\omega) = e^{-j\omega t_0} X(\omega)$ **(10 Marks)**

b. Find DTFT of the following signals

i) $x(n) = \{1, 2, \underset{\uparrow}{3}, 2, 1$ ii) $x(n) = (3/4)^n u(n)$ **(10 Marks)**

OR

8 a. Determine the Fourier transform of unit step sequence x(n) = u(n). **(04 Marks)**

b. A discrete signal is defined by $x(n) = \sin\left(\frac{\pi n}{8}\right)$ sketch the magnitude and phase of DTFT of x(n – 2). **(08 Marks)**

c. Define Nyquist rate (aliasing), and specific the Nyuist rate and Nyquist intervals for the following signals :

i) $g_1(t) = \text{sinc}(200t)$ ii) $g_2(t) = \text{sinc}^2(200t)$ iii) $g_3(t) = \text{sinc } 200t + \text{sinc}^2(200t)$ **(08 Marks)**

Module-5

9 a. List the properties of ROC. **(04 Marks)**

b. Using the properties of a transform, find the z-transform of these signals.

i) $x_1(n) = n(5/8)^n u(n)$ ii) $x_2(n) = (0.9)^n u(n) * (0.6)^n u(n)$ iii) $x_3(n) = (2/3)^n u(n + 2)$. **(06 Marks)**

c. Determine the Z-transform of the following signals

i) $x(n) = \left(\frac{1}{4}\right)^n u(n) - (1/2)^n(-n-1)$

ii) $x(n) = n(1/2)^n u(n)$ **(10 Marks)**

OR

10 a. What is Z-transform? Determine Z-transform and its ROC of the following signals

i) x(n) = u(n) ii) x(n) = cos (w n) u(n) **(08 Marks)**

b. Determine inverse Z-transform of the following signal

$x(z) = \frac{1}{1 - \frac{3}{2}z^{-1} - 1 + \frac{1}{2}z^{-2}}$ for i) $|z| > 1$ ii) $|z| < \frac{1}{2}$ iii) $\frac{1}{2} < |z| < 1$ **(08 Marks)**

c. Step response of a LTI system is found to be $y(n) = 2(1/3)^n u(n)$. Find out impulse of the system. **(04 Marks)**

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CBCS SCHEME

USN | | | | | | | | | | |

18EC46

Fourth Semester B.E. Degree Examination, June/July 2024
Microcontroller

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Differentiate between Microprocessor and Microcontroller. **(04 Marks)**

b. With a neat diagram, discuss the architectural features of 8051 Microcontroller. **(08 Marks)**

c. Discuss the internal RAM structure of 8051 Microcontroller. **(08 Marks)**

OR

2 a. Explain the pin description of 8051 Microcontroller. **(08 Marks)**

b. Interface 4K bytes ROM and 8K bytes RAM to 8051 Microcontroller in such a way that starting address of ROM is 1000 H and RAM is C000 H. **(08 Marks)**

c. Define embedded system systems. Mention its applications. **(04 Marks)**

Module-2

3 a. Explain any five different addressing modes with an example. **(10 Marks)**

b. Show the status of CY, AC and P flags after execution of following instructions:
MOV A, #9C H
ADD A, #64 H **(06 Marks)**

c. Write an ALP to convert a packed BCD to unpacked BCD number. **(04 Marks)**

OR

4 a. Discuss PUSH and POP instructions with an example. **(06 Marks)**

b. Explain the following instructions mentioning their addressing mode and byte size.
(i) MOVC A, @A + PC (ii) DA A **(06 Marks)**

c. Write an ALP to find whether the given number is even or odd, and store the result at 50 H and 51 H internal RAM location. **(08 Marks)**

Module-3

5 a. Discuss two instructions used to call subroutines with their ranges and write the significance of stack with respect to all instructions. **(06 Marks)**

b. Write an assembly language program to sort an array of n = 5 byte of data in descending order stored from location 30 h (Use bubble sort algorithm). **(08 Marks)**

c. Write an assembly language program to count the number of 1's and 0's in an 8-bit data received from port P1. Store the count of 1's and 0's in 30H and 31H. **(06 Marks)**

OR

6 a. Write an ALP to find factorial of an 8-bit number N. Assume value of N does not exceed 8-bit. **(06 Marks)**

b. Write an ALP to read switch given in Fig.Q6(b), if switch is closed turn ON the LED else turn OFF the LED.

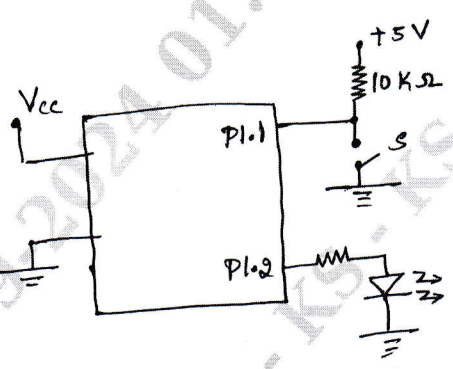

Fig.Q6(b) **(08 Marks)**

c. Define subroutine. Differentiate between CALL and JUMP. **(06 Marks)**

Module-4

7 a. Explain the bit contents of TCON and TMOD registers. **(08 Marks)**

b. Explain the importance of RI and TI flag of 8051 Microcontroller. **(04 Marks)**

c. Write an ALP to create a pulse width of 50 ms on P2.3 using Timer 0 operating in Mode 1. Assume crystal frequency = 11.0592 MHz. **(08 Marks)**

OR

8 a. Write an ALP to generate a square wave of frequency 2 kHz on P1.3 using Timer 0 in mode 2. Assume crystal frequency = 12 MHz. **(10 Marks)**

b. Write an 8051 assembly language program to interface stepper motor to rotate in clockwise direction in Port 1. **(10 Marks)**

Module-5

9 a. With a bit pattern, explain IE register. Explain how interrupt priority can be charged using IP register. **(10 Marks)**

b. With a diagram, explain 8051 interface with ADC. Write an assembly level code to interface ADC 0804 to 8051 Microcontroller. **(10 Marks)**

OR

10 a. Explain stepper motor interface with a microcontroller. Write assembly level code to run stepper motor continuously in clockwise direction. **(10 Marks)**

b. Explain DAC interfaces with 8051 Microcontroller. Write a program to generate any waveform. **(10 Marks)**

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