CBCS SCHEME

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17MAT41

Fourth Semester B.E. Degree Examination, Feb./Mar. 2022
Engineering Mathematics – IV

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Find the Taylor series method, the value of y at x = 0.1 to five decimal places from $\frac{dy}{dx} = x^2y - 1$, $y(0) = 1$. Consider upto 4^{th} degree terms. **(06 Marks)**

b. Solve $\frac{dy}{dx} = \frac{y-x}{y+x}$ with y(0) = 1 and hence find y(0.1) by taking one step using Runge-Kutta method of fourth order. **(07 Marks)**

c. Given $\frac{dy}{dx} = \frac{x+y}{2}$, given that y(0) = 2, y(0.5) = 2.636, y(1) = 3.595, y(1.5) = 4.968 then find the value of y at x = 2 using Milne's method. **(07 Marks)**

OR

2 a. Using modified Euler's method, solve $\frac{dy}{dx} = x + |\sqrt{y}|$ with y(0) = 1 and hence find y(0.2) with h = 0.2. Modify the solution twice. **(06 Marks)**

b. Use fourth order Runge-Kutta method to find y(0.2), given $\frac{dy}{dx} = 3x + y$, y(0) = 1. **(07 Marks)**

c. Find y at x = 0.4 given $\frac{dy}{dx} + y + xy^2 = 0$ at $y_0 = 1$, $y_1 = 0.9008$, $y_2 = 0.8066$, $y_3 = 0.722$ taking h = 0.1 using Adams-Bashforth method. **(07 Marks)**

Module-2

3 a. Given $\frac{d^2y}{dx^2} = x\left(\frac{dy}{dx}\right)^2 - y^2$. Find y at x = 0.2. Correct to four decimal places, given y = 1 and y′ = 0 when x = 0 using Runge-Kutta method. **(06 Marks)**

b. If α and β are two distinct roots of $J_n(x) = 0$ then prove that $\int_0^1 xJ_n(\alpha x)J_n(\beta x) = 0$ if $\alpha \neq \beta$. **(07 Marks)**

c. Show that $J_{-\frac{1}{2}}(x) = \sqrt{\frac{2}{\pi x}}\cos x$. **(07 Marks)**

OR

4 a. Given $\frac{d^2y}{dx^2} = 1 + \frac{dy}{dx}$, y(0) = 1, y′(0) = 1, compute y(0.4) for the following data, using Milne's predictor-corrector method.
y(0.1) = 1.1103, y(0.2) = 1.2427, y(0.3) = 1.399
y′(0.1) = 1.2103, y′(0.2) = 1.4427, y′(0.3) = 1.699 **(06 Marks)**

b. Express $x^3 + 2x^2 - x - 3$ in terms of Legendre polynomial. **(07 Marks)**

c. Derive Rodrigue's formula $P_n(x) = \dfrac{1}{2^n n!}\dfrac{d^n}{dx^n}[(x^2-1)^n]$ **(07 Marks)**

Module-3

5 a. State and prove Cauchy-Rieman equation in Cartesian form. **(06 Marks)**

b. Evaluate $\int_C \dfrac{e^{2z}}{(z+2)(z+4)(z+7)}.dz$ where C is the circle $|z| = 3$ using Cauchy's residue theorem. **(07 Marks)**

c. Discuss the transformation $W = e^z$. **(07 Marks)**

OR

6 a. Prove that $\left(\dfrac{\partial^2}{\partial x^2} + \dfrac{\partial^2}{\partial y^2}\right)|f(z)|^2 = 4|f'(z)|^2$ **(06 Marks)**

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

c. Find bilinear transformation which maps $Z = i, 1, -1$ onto $W = 1, 0, \infty$ **(07 Marks)**

Module-4

7 a. A random variable X has the following probability function for various values of x:

X (= xi)	0	1	2	3	4	5	6	7
P(x)	0	K	2K	2K	3K	K^2	$2K^2$	$7K^2+K$

Find: (i) The value of K (ii) $P(x < 6)$ (iii) $P(x \geq 6)$ **(06 Marks)**

b. Derive mean and variance of the binomial distribution. **(07 Marks)**

c. The joint probability distribution of two random variables X and Y as follows:

X \ Y	−4	2	7
1	$1/8$	$1/4$	$1/8$
5	$1/4$	$1/8$	$1/8$

Determine: (i) Marginal distribution of X and Y (ii) Covariance of X and Y (iii) Correlation of X and Y **(07 Marks)**

OR

8 a. In a certain factory turing 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. Use Poisson distribution to calculate the approximate number of packets containing: (i) no defective (ii) one defective (iii) two defective blades, in a consignment of 10,000 packets. **(06 Marks)**

b. In an examination 7% of students score less than 35% marks and 89% of students score less than 60% marks. Find the mean and standard deviation if the marks are normally distributed. Given $p(0 < z < 1.2263) = 0.39$ and $p(0 < z < 1.4757) = 0.43$. **(07 Marks)**

c. Given:

X \ Y	0	1	2	3
0	0	$1/8$	$1/4$	$1/8$
1	$1/8$	$1/4$	$1/8$	0

Find : (i) Marginal distribution of X and Y (ii) E[X], E[Y], E[XY] **(07 Marks)**

Module-5

9 a. Define the terms:
(i) Null hypothesis
(ii) Confidence interval
(iii) Type-I and Type-II errors (06 Marks)

b. A certain stimulus administered to each of the 12 patients resulted in the following change in the blood pressure 5, 3, 8, −1, 3, 0, 6, −2, 1, 5, 0, 4. Can it be concluded that the stimulus will increase the blood pressure ($t_{0.05}$ for 11 d.f is 2.201) (07 Marks)

c. Given the matrix $A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ \frac{1}{2} & \frac{1}{2} & 0 \end{bmatrix}$. Find the fixed probability vector. (07 Marks)

OR

10 a. A die thrown 9000 times and a thrown of 3 or 4 was observed 3240 times. Is it reasonable to think that the die is an unbiased one? (06 Marks)

b. Four coins are tossed 100 times and the following results were obtained:

Number of Heads	0	1	2	3	4
Frequency	5	29	36	25	5

Fit a binomial distribution for the data and test the goodness of fit [$\chi^2_{0.05} = 9.49$ for 4 d.f]. (07 Marks)

c. Every year, a man trades for his car for a new car. If he has Maruti, he trade it for a Tata. If he has a Tata, he trade it for a Honda. However, if he has a Honda, he is just as likely to trade it for a new Honda as to trade it for a Maruti or a Tata. In 2016, he bought his first car which was a Honda. Find the probability that he has (i) 2018 Tata (ii) 2018 Honda (iii) 2018 Maruti. (07 Marks)

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CBCS SCHEME

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17MATDIP41

Fourth Semester B.E. Degree Examination, Feb./Mar. 2022
Additional Mathematics – II

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Find the rank of the matrix by elementary row transformation:
$$\begin{bmatrix} 1 & 2 & 3 & 2 \\ 2 & 3 & 5 & 1 \\ 1 & 3 & 4 & 5 \end{bmatrix}$$
(06 Marks)

b. Solve the following system of linear equations by Gauss elimination method:
$x+y+z=9$; $x-2y+3z=8$; $2x+y-z=3$ (07 Marks)

c. Find the eigen values and eigen vectors of the matrix $\begin{bmatrix} 1 & -2 \\ -5 & 4 \end{bmatrix}$. (07 Marks)

OR

2 a. Find the rank of the matrix by elementary row transformation
$$\begin{bmatrix} 1 & 2 & 3 \\ 1 & 4 & 2 \\ 2 & 6 & 5 \end{bmatrix}$$
(06 Marks)

b. Use Cayley-Hamilton theorem to find the inverse of $A = \begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$. (07 Marks)

c. Test for consistency and solve $x+y+z=6$, $x-y+2z=5$, $3x+y+z=8$. (07 Marks)

Module-2

3 a. Solve $(D^3-2D^2+4D-8)y=0$ where $D=\frac{d}{dx}$. (06 Marks)

b. Solve $(6D^2+17D+12)y=e^{-x}$, where $D=\frac{d}{dx}$ (07 Marks)

c. Solve $(D^2+a^2)y=\sec ax$ by the method of variation of parameters. (07 Marks)

OR

4 a. Solve $(D^3-3D+2)y=0$ where $D=\frac{d}{dx}$. (06 Marks)

b. Solve $(D^2-4D+13)y=\cos 2x$ where $D=\frac{d}{dx}$. (07 Marks)

c. Solve $(D^2+2D+1)y=2x+x^2$ where $D=\frac{d}{dx}$. (07 Marks)

Module-3

5 a. Find the Laplace transform of the function $L\{e^{-2t}(2\cos 5t - \sin 5t)\}$. **(06 Marks)**

b. Find the Laplace transform of the function $L\{t \cdot \cos at\}$. **(07 Marks)**

c. If $f(t) = t^2, 0 < t < 2$, and $f(t+2) = f(t)$, for $t > 2$, find $L\{f(t)\}$ **(07 Marks)**

OR

6 a. Find the Laplace transform of the function $L\{e^{3t}\sin 5t \sin 3t\}$. **(06 Marks)**

b. Find the Laplace transform of $\frac{e^{-at} - e^{-bt}}{t}$. **(07 Marks)**

c. Find the Laplace transform of the function $L\{3t^2 + 4t + 5\}.u(t-3)$. **(07 Marks)**

Module-4

7 a. Find the inverse Laplace transform of the function $\left\{\frac{1}{s+2} + \frac{3}{2s+5} - \frac{4}{3s-2}\right\}$. **(06 Marks)**

b. Find the inverse Laplace transform of the function $\frac{3s+2}{(s-2)(s+1)}$. **(07 Marks)**

c. Solve by using Laplace transforms $\frac{d^2y}{dt^2 + K^2y = 0}$ given that $y(0) = 2, y'(0) = 0$. **(07 Marks)**

OR

8 a. Find the inverse Laplace transform of the function $\left\{\frac{s+2}{s^2+36} + \frac{4s-1}{s^2+25}\right\}$. **(06 Marks)**

b. Find the inverse Laplace transform of the function $\frac{s+2}{s^2(s+3)}$. **(07 Marks)**

c. Solve $\frac{d^2y}{dt^2} + 4\frac{dy}{dt} + 4y = e^{-t}$, $y(0) = 0, y'(0) = 0$ by using Laplace transform method. **(07 Marks)**

Module-5

9 a. A bag contains 7 white, 6 red and 5 black balls, two balls are drawn at random. Find the probability that they will both be white. **(06 Marks)**

b. If A and B are any two events, then prove that $P(A \cup B) = P(A) + P(B) - P(A \cap B)$. **(07 Marks)**

c. State and prove Bayee's theorem. **(07 Marks)**

OR

10 a. A has 2 shares in a lottery in which there are 3 prizes and 5 blanks; B has 3 shares in a lottery in which there are 4 prizes and 6 blanks. Show that A's chance of success is to B's as 27:35. **(06 Marks)**

b. A card is drawn from a well-shuffled pack of playing cards. What is the probability that it is either a spade or an ace? **(07 Marks)**

c. A bag X contains 2 white and 3 red balls and a bag Y contains 4 white and 5 red balls. One ball is drawn at random from one of the bags and is found to the red. Find the probability that it was drawn from bag Y. **(07 Marks)**

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CBCS SCHEME

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17EC42

Fourth Semester B.E. Degree Examination, Feb./Mar. 2022
Signals and System

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define signals. Explain briefly the classification of signals with expressions and waveforms. (06 Marks)

b. Determine whether the following signals are energy or power signal and also find the energy or power of the signal.

i) $x(n) = \begin{cases} n & 0 \le n \le 5 \\ 10-n & 5 \le n \le 10 \\ 0 & \text{otherwise} \end{cases}$

ii) $x(t) = 5\cos(\pi t) \quad -\infty < t < \infty$. (08 Marks)

c. A signal x(t) is defined by

$$x(t) = \begin{cases} 5-t & 4 \le t \le 5 \\ 1 & -4 \le t \le 4 \\ t+5 & -5 \le t \le -4 \\ 0 & \text{otherwise} \end{cases}$$

Determine signal $y(t) = \frac{dx(t)}{dt}$. Also find the energy of signal $y(t) = \frac{dx(t)}{dt}$. (06 Marks)

OR

2 a. Explain the important elementary signals with suitable expressions and waveforms. (05 Marks)

b. The systems given below have input x(t) or x(n) and output y(t) or y(n) respectively. Determine whether each of them is stable, causal, linear.

i) $y(n) = \log_{10}(|x(n)|)$

ii) $y(t) = \cos(x(t))$

iii) $y(t) = x\left(\frac{t}{2}\right)$. (09 Marks)

c. Determine whether the following signals are periodic. If so find their fundamental period.

i) $x(t) = \cos(2t) + \sin(3t)$

ii) $x(n) = \cos\left(\frac{7}{15}\pi n\right)$. (06 Marks)

Module-2

3 a. For an LTI system characterized by impulse response $h[n] = \beta^n u[n]$, $0 < \beta < 1$, find the output of the system for input x[n] given by $x[n] = a^n[u[n] - u[n-10]]$. (08 Marks)

b. State and prove the associative property and distributive properties of convolution integral. (08 Marks)

c. Let the impulse response of a LTI system be $h(t) = \sigma(t-a)$. Determine the output of this system in response to any input x(t). (04 Marks)

OR

4 a. Convolute $x(t) = u(t) - u(t-2)$ with signal $h(t) = u(t-1) - u(t-3)$. **(10 Marks)**

b. Convolve $x(n) = \{1, 2, -\underset{\uparrow}{1}, 1\}$ and $h(n) = \{1, \underset{\uparrow}{0}, 1\}$ using graphical method. **(05 Marks)**

c. Derive the equation of convolution sum. **(05 Marks)**

Module-3

5 a. Determine whether the systems described by the following impulse responses are stable, causal and memoryless i) $h(n) = (\frac{1}{2})^n u(n)$ ii) $h(t) = e^t u(-1-t)$. **(08 Marks)**

b. State linearity, time shift and convolution properties of Discrete Time Fourier Series. **(03 Marks)**

c. Evaluate the Fourier series representation of the signal $x(t) = \sin(2\pi t) + \cos(3\pi t)$. Also sketch the magnitude and phase spectra. **(09 Marks)**

OR

6 a. Consider the interconnection of LTI system depicted in Fig.Q6(a). The impulse response of each system is given by **(08 Marks)**

$h_1(n) = u[n], h_2[n] = u[n+2] - u[n], h_3[n] = \delta[n-2], h_4[n] = \alpha^n u[n]$.

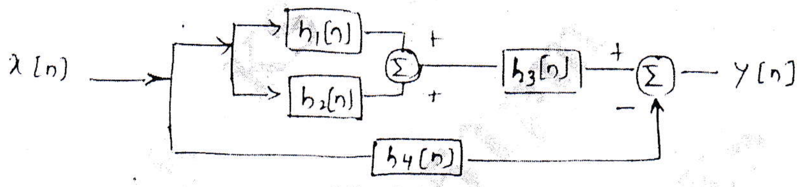

Fig.Q6(a)

Find the impulse response of the overall system, h[n]. **(04 Marks)**

b. Find the unit step response for the LTI system represented by the following responses
i) $h(n) = (\frac{1}{2})^n u(n-2)$ ii) $h(t) = e^{-|t|}$.

c. Find the DTFS representation for $x(n) = \left(\frac{\pi n}{8} + \phi\right)$. Draw magnitude and phase. **(08 Marks)**

Module-4

7 a. State and prove the following properties of Discrete Time Fourier transform.
i) Time shift property
ii) Parseval's theorem. **(08 Marks)**

b. Determine the time domain signal x(t) corresponding to $X(j\omega) = \frac{j\omega+1}{(j\omega+2)^2}$. **(06 Marks)**

c. Evaluate the DTFT of the signal $x(n) = (\frac{1}{2})^n u(n-4)$. Sketch its magnitude and phase response. **(06 Marks)**

OR

8 a. Using the appropriate properties, find the DTFT of the signal $x(n) = \sin\left(\frac{\pi}{4}n\right)\left(\frac{1}{4}\right)^n u(n-1)$. **(08 Marks)**

b. State sampling theorem. Determine the Nyquist sampling rate and Nyquist sampling interval for i) $x(t) = 1 + \cos(2000\pi t) + \sin(4000\pi t)$ ii) $x(t) = 25e^{j500\pi t}$. **(06 Marks)**

c. Evaluate the Fourier transform of the following signals
i) $x(t) = e^{-at}.u(t)$; $a > 0$ ii) $x(t) = \delta(t)$. Draw the spectrum. **(06 Marks)**

Module-5

9 a. List the properties of Region Of Convergence (ROC). (04 Marks)

b. Determine the Z-transform, the ROC, and the locations of poles and zeros of x(z) for the following signals :

i) $x(n) = -\left(\frac{3}{4}\right)^n u(-n-1) + \left(\frac{-1}{3}\right)^n u(n)$

ii) $x(n) = n.\sin\left(\frac{\pi}{2}n\right)u(-n)$. (08 Marks)

c. Find the inverse Z transformation of $X(z) = \frac{1-z^{-1}+z^{-2}}{\left(1-\frac{1}{2}z^{-1}\right)(1-2z^{-1})(1-z^{-1})}$ with the following ROCs i) $1 < |z| < 2$ ii) $\frac{1}{2} < |z| < 1$. (08 Marks)

OR

10 a. State and prove the 'differentiation in z-domain' property of z-transform. (04 Marks)

b. Find the transfer function and impulse response of a causal LTI system if the input to the system is $x(n) = (\frac{1}{3})^n u(n)$ $x(n) = \left(\frac{-1}{3}\right)^n$ and the output is $y(n) = 3(-1)^n u(n) + (\frac{1}{3})^n u(n)$. (08 Marks)

c. Using power series expansion method, determine inverse z-transform of

i) $X(z) = \cos(z^{-2})$ ROC $|z| > 0$

ii) $X(z) = \frac{1}{1-\frac{1}{4}z^{-2}}$ $|z| > \frac{1}{4}$. (08 Marks)

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CBCS SCHEME

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Fourth Semester B.E. Degree Examination, Feb./Mar. 2022
Control Systems

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. Define open loop and closed loop system and list the difference between these two. (05 Marks)

b. For the mechanical system shown in Fig Q1(b).
 i) Draw the equivalent mechanical system
 ii) Write the differential equations of performance
 iii) Draw the electrical network based on torque current analogy.

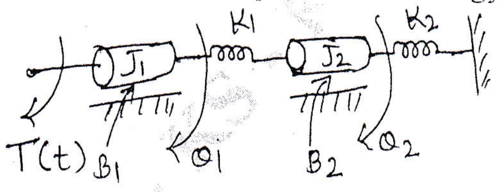

Fig Q1(b) (08 Marks)

c. Show that the two systems shown in Fig Q1(c) are analogous systems by comparing their transfer function.

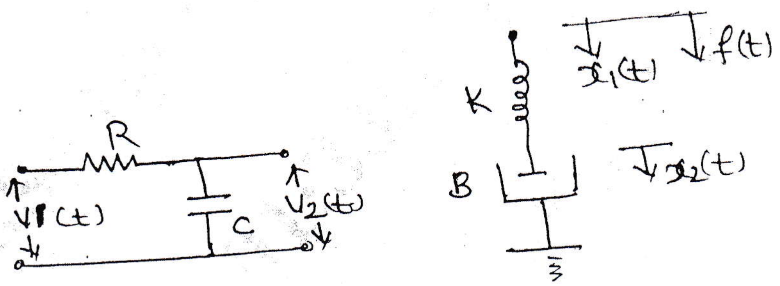

Fig Q1(c) (07 Marks)

OR

2 a. Define the following terms with respect signal flow graph.
 i) Node ii) Forward path gain iii) Self loop iv) Non-touching loops. (04 Marks)

b. For the block diagram shown in Fig Q2(b), determine the transfer function $\frac{C(s)}{R(s)}$ using block diagram reduction technique.

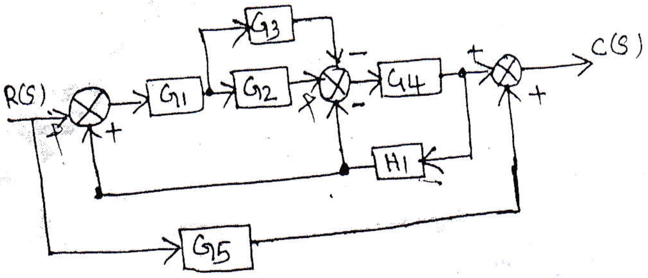

Fig Q2(b) (08 Marks)

c. Using Mason's gain formula, find the transfer function $\frac{C(s)}{R(s)}$ for the signal flow graph shown in Fig Q2(c).

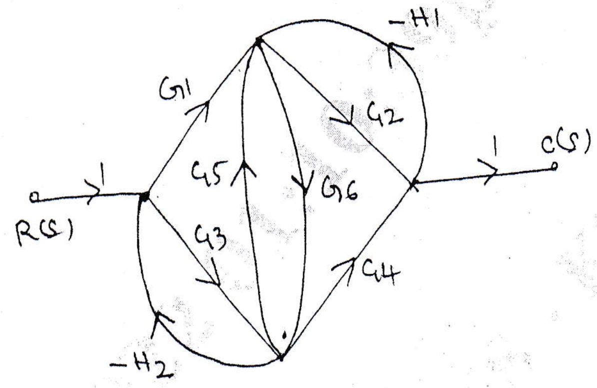

Fig Q2(c) **(08 Marks)**

Module-2

3 a. Derive an expression for unit step response of first order system. **(04 Marks)**

b. Derive an expression for i) Rise time t_r ii) Peak time t_p iii) Peak over shoot m_p **(09 Marks)**

c. A second order system is given by $\frac{C(s)}{R(s)} = \frac{25}{s^2 + 6s + 25}$. Find i) rise time ii) settling time iii) Peak overshoot iv) Peak time. Also calculate expression for its output response. **(07 Marks)**

OR

4 a. Measurements conducted on a servomechanism shown the system response to be $c(t) = 1 + 0.2\,e^{-60t} - 1.2\,e^{-10t}$. When subjected to a step of 1V.

i) Obtain an expression for the closed loop transfer function.

ii) Determine the undamped natural frequency and damping ratio of the system. **(07 Marks)**

b. A unity feedback control system has $G(s) = \frac{40(s+2)}{s(s+1)(s+4)}$. Determine :

i) Type of the system

ii) All error coefficients

iii) Error for the ramp input with magnitude 4. **(07 Marks)**

c. With a neat block diagram explain the Proportional Integral and Derivative (PID) controller. **(06 Marks)**

Module-3

5 a. State and explain Routh's stability criterion for determining the stability of the system and mention its limitations. **(06 Marks)**

b. The open loop transfer function of a unity feedback system is given by $G(s) = \frac{K}{s(1+0.4s)(1+0.25s)}$. Using RH criterion find the range of values of K for stability, marginal value of K and the frequency of sustained oscillation. **(08 Marks)**

c. Determine the range of K such that the characteristics equation $s^3 + 3(K+1)s^2 + (7K+5)s + (4K+7) = 0$ has roots more negative than s = -1. **(06 Marks)**

OR

6 a. Determine the values of 'K' and 'P' for the open loop transfer function of a unity feedback system is given by $G(s) = \frac{K(s+1)}{s^3 + Ps^2 + 2s + 1}$ so that the system oscillates at a frequency of 2 rad/sec. **(06 Marks)**

b. The open loop transfer function of a control system is given by $G(s)\,H(s) = \frac{K}{s(s+2)(s+4)}$. Find whether s = – 0.75 and s = –1 + j4 is on the root locus or not using angle condition. (04 Marks)

c. Sketch the root locus plot for the unity feedback system whose open loop transfer function is given by $G(s)\ \frac{K}{s(s+2)(s+6)}$

i) Find the range of 'K' for stability of the system

ii) Find the value of 'K' for marginal stability. (10 Marks)

Module-4

7 a. Define the following terms with respect to Bode plots.

i) Gain cross over frequency ii) Phase cross over frequency

iii) Gain margin iv) Phase margin (04 Marks)

b. With a neat circuit and relevant expressions, explain the lead compensator. (06 Marks)

c. A unity feedback control system has $G(s) = \frac{100(0.1s+1)}{s(s+1)^2(0.01s+1)}$. Draw the Bode plot. Determine Gain margin and phase margin. Comment on the stability. (10 Marks)

OR

8 a. Using Nyquist stability criterion, determine the stability of a negative feedback control system whose open loop transfer function is given by

$G(s)\,H(s) = \frac{100}{(s+1)(s+2)(s+3)}$. (10 Marks)

b. A unity feedback control system has $G(s) = \frac{4}{(0.1s+1)^2(0.01s+1)}$. Draw the Bodeplot. comment of the stability. (10 Marks)

Module-5

9 a. With a neat schematic and relevant waveforms explain signal reconstruction with respect to digital control system. (06 Marks)

b. State the advantages of state variable analysis. (04 Marks)

c. Obtain the state model of the electrical network shown in Fig Q9(c)

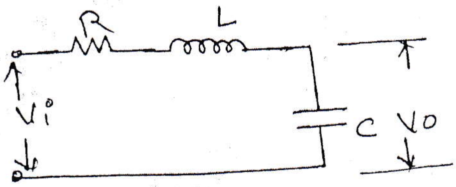

Fig Q9(c) (10 Marks)

OR

10 a. Obtain the state model for a system characterized by differential equation

$$\frac{d^3y}{dt^3} + 6\frac{d^2y}{dt^2} + 11\frac{dy}{dt} + 6y = u$$ (06 Marks)

b. The transfer function of a control system is given by

$\frac{Y(s)}{U(s)} = \frac{6s^3+4s^2+3s+10}{s^3+8s^2+4s+20}$. Obtain the state model. (06 Marks)

c. Obtain the transfer function of the system whose state output equations are given by

$\dot{x}_1 = -9x_1 - x_2 + 5u$

$\dot{x}_2 = 15x_1 - x_2 + 2u$

$y = 2x_1 + x_2$ (08 Marks)

CBCS SCHEME

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

17EC44

Fourth Semester B.E. Degree Examination, Feb./Mar. 2022
Principles of Communication Systems

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 generation of AM wave using square – law modulator with relevant equations and wave form. **(08 Marks)**

b. With a neat block diagram, explain the balanced modulate method of generating DSB – SC wave. **(07 Marks)**

c. With the functional block diagram, describe the salient features of QAM receiver. **(05 Marks)**

OR

2 a. An audio frequency signal 10 sin $2\pi \times 500t$ is used to amplitude modulate a carrier of 50 sin $2\pi \times 10^5$. Assume modulation index = 0.2. Determine side band frequency, amplitude of each sideband frequency, Bandwidth required, total power delivered to the load of 600Ω. **(07 Marks)**

b. Discuss the concept of Costas loop with block diagram. **(07 Marks)**

c. Explain the scheme of frequency division multiplexing system in detail. **(06 Marks)**

Module-2

3 a. Define Modulation index, deviation ratio and transmission bandwidth of a FM signal. **(06 Marks)**

b. Explain narrow band FM generation using Indirect method. **(06 Marks)**

c. An angle Modulated signal is defined by $s(t) = 10\cos[2\pi 10^6 t + 0.2\sin[2000\pi t]]$ volts. Find the following :

i) Power in the modulated signal
ii) Frequency deviation Δf
iii) Phase deviation
iv) Transmission bandwidth. **(08 Marks)**

OR

4 a. With schematic and frequency response explain the operation of balanced slope detector. **(07 Marks)**

b. Explain linear module PLL. **(06 Marks)**

c. With the help of block diagram, explain the working of FM 'stereo' multiplex. **(07 Marks)**

Module-3

5 a. A computer becomes inoperative, if 2 components A and B both fail. The probability that A fails is 0.01 and probability that B fails is 0.005. However the probability that B fails increases by a factor of 4, if A has failed. Calculate the probability that the compute become inoperable. Also find the probability that 'A' will fail if B has failed. **(06 Marks)**

b. Define mean, covariance and auto correlation function. **(06 Marks)**

c. Determine Noise equivalent bandwidth for RC LPF. **(08 Marks)**

OR

6 a. Explain the properties of auto correlation function. **(06 Marks)**
b. Distinguish between random variable and random process. **(06 Marks)**
c. Define noise along with sources of noise. Explain the types of noise which occur in an electronic devices. **(08 Marks)**

Module-4

7 a. Show that the figure of merit of DSBSC receivers is unity. **(10 Marks)**
b. Find the figure of merit of AM when the depth of modulation is :
i) 100% ii) 50% iii) 30% **(06 Marks)**
c. Write a note on capture effect in FM. **(04 Marks)**

OR

8 a. Show that the figure of merit of FM receiver, using single tone modulation is $1.5\beta^2$. **(08 Marks)**
b. An FM signal with a deviation of 75 KHz is applied to an FM demodulator when the input SNR is 15dB , the modulating frequency is 10KHz, estimate the SNR at the demodulator output. **(06 Marks)**
c. Explain function of De-emphasis and de-emphasis in FM systems. **(06 Marks)**

Module-5

9 a. Find the Nyquist rate and Nyquist internal for the following signals.

i) $m(t) = \frac{1}{2\pi}\cos(4000\pi t)\cos(1000\pi t)$

ii) $m(t) = \frac{\sin(5000\pi t)}{\pi t}$. **(08 Marks)**

b. Explain the generation of PAM signal. **(06 Marks)**
c. With block diagram, explain the concept of VOCODERS. **(06 Marks)**

OR

10 a. With the help of neat sketches, describe the generation, reconstruction and regenerative repeaters of PCM system. **(10 Marks)**
b. Distinguish between PAM and PPM techniques. **(10 Marks)**

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