CBCS SCHEME

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15MAT41

Fourth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Engineering Mathematics – IV

Time: 3 hrs. Max. Marks: 80

Note: 1. *Answer FIVE full questions, choosing ONE full question from each module.*
2. *Use of statistical table can be provided.*

Module-1

1 a. Using Taylor's series method find, y(0.1) given that $\frac{dy}{dx} = x - y^2$, y(0) = 1 by considering upto third degree terms. **(05 Marks)**

b. Apply Runge Kutta method of fourth order to find an approximate value of y when x = 0.5 given that $\frac{dy}{dx} = \frac{1}{x+y}$ with $y(0.4) = 1$. Take $h = 0.1$. **(05 Marks)**

c. Evaluate y(0.4) by Milne's Predictor-Corrector method given that $\frac{dy}{dx} = \frac{y^2(1+x^2)}{2}$ and y(0) = 1, y(0.1) = 1.06, y(0.2) = 1.12, y(0.3) = 1.21. Apply the corrector formula twice. **(06 Marks)**

OR

2 a. Solve by Euler's modified method $\frac{dy}{dx} = \log_e(x+y)$; y(0) = 2 to find y(0.2) with h = 0.2. Carryout two modifications. **(05 Marks)**

b. Using Runge-Kutta method of fourth order find y(0.2) to four decimal places given that $\frac{dy}{dx} = 3x + \frac{y}{2}$; $y(0) = 1$. Take $h = 0.2$. **(05 Marks)**

c. Given $\frac{dy}{dx} = x^2(1+y)$; y(1) = 1, y(1.1) = 1.233, y(1.2) = 1.548, y(1.3) = 1.979. Evaluate y(1.4) to four decimal places using Adam's-Bashforth predictor corrector method. Apply the corrector formula twice. **(06 Marks)**

Module-2

3 a. Given $\frac{d^2y}{dx^2} = y + x\frac{dy}{dx}$ with y(0) = 1, $y'(0) = 0$. Evaluate y(0.2) using Runge Kutta method of fourth order. Take h = 0.2. **(05 Marks)**

b. With usual notation prove that $J_{\frac{1}{2}}(x) = \sqrt{\frac{2}{\pi x}}\sin x$. **(05 Marks)**

c. Express $f(x) = 2x^3 - x^2 - 3x + 2$ in terms of Legendre polynomial. **(06 Marks)**

OR

4 a. Apply Milnes predictor corrector method to compute y(0.4) given that $\frac{d^2y}{dx^2} = 6y - 3x\frac{dy}{dx}$ and the following values: **(05 Marks)**

x	0	0.1	0.2	0.3
y	1	1.03995	1.138036	1.29865
y′	0.1	0.6955	1.258	1.873

b. State Rodrigue's formula for Legendre polynomials and obtain the expression for $P_4(x)$ from it. **(05 Marks)**

c. If α and β are the two roots of the equation $J_n(x) = 0$ then prove that $\int_0^1 xJ_n(\alpha x)J_n(\beta x)dx = 0$ if $\alpha \neq \beta$. **(06 Marks)**

Module-3

5 a. Derive Cauchy-Riemann equation in Cartesian form. **(05 Marks)**

b. Evaluate using Cauchy's residue theorem, $\int_C \frac{3z^2+z+1}{(z^2-1)(z+3)}dz$ where C is the circle $|z| = 2$. **(05 Marks)**

c. Find the bilinear transformation which maps the points $-1, i, 1$ onto the points 1, i, -1 respectively. **(06 Marks)**

OR

6 a. Find the analytic function, $f(z) = u + iv$ if $v = r^2\cos 2\theta - r\cos\theta + 2$. **(05 Marks)**

b. Evaluate $\int_C \frac{e^{2z}}{(z-1)(z-2)}dz$ where C is the circle $|z| = 3$ using Cauchy integral formula. **(05 Marks)**

c. Discuss the transformation $\omega = e^z$. **(06 Marks)**

Module-4

7 a. Find the constant C such that the function,

$$f(x) = \begin{cases} Cx^2 & \text{for } 0 < x < 3 \\ 0 & \text{Otherwise} \end{cases}$$ is a probability density function.

Also compute P(1<X<2), P(X≤1), P(X>1). **(05 Marks)**

b. Out of 800 families with five childrens each, how many families would you expect to have (i) 3 boys (ii) 5 girls (iii) either 2 or 3 boys (iv) at most 2 girls, assume equal probabilities for boys and girls. **(05 Marks)**

c. Given the following joint distribution of the random variables X and Y.

X \ Y	1	3	9
2	$\frac{1}{8}$	$\frac{1}{24}$	$\frac{1}{12}$
4	$\frac{1}{4}$	$\frac{1}{4}$	0
6	$\frac{1}{8}$	$\frac{1}{24}$	$\frac{1}{12}$

Find (i) E(X) (ii) E(Y) (iii) E(XY) (iv) COV(X, Y) (v) ρ(X, Y) **(06 Marks)**

OR

8 a. Obtain the mean and standard deviation of Poisson distribution. **(05 Marks)**

b. In a test on electric bulbs it was found that the life time of bulbs of a particular brand was distributed normally with an average life of 2000 hours and standard deviation of 60 hours. If a firm purchases 2500 bulbs find the number of bulbs that are likely to last for,
(i) More than 2100 hours (ii) Less than 1950 hours (iii) Between 1900 and 2100 hours.
Given that $\phi(1.67) = 0.4525$, $\phi(0.83) = 0.2967$ **(05 Marks)**

c. A fair coin is tossed thrice. The random variables X and Y are defined as follows:
X = 0 or 1 according as head or tail occurs on the first toss.
Y = number of heads
Determine (i) The distribution of X and Y (ii) Joint distribution of X and Y. **(06 Marks)**

Module-5

9 a. In a city A 20% of a random sample of 900 school boys had a certain slight physical defect. In another city B, 18.5% of a random sample of 1600 school boys had the same defect. Is the difference between the proportions significant. **(05 Marks)**

b. The nine items of a sample have the following values : 45, 47, 50, 52, 48, 47, 49, 53, 51. Does the mean of these differ from the assumed mean 47.5. Apply student's t – distribution at 5% level of significance ($t_{0.05} = 2.31$ for 8 d.f) **(05 Marks)**

c. Find the unique fixed probability vector of the regular stochastic matrix $\begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ \frac{1}{2} & \frac{1}{2} & 0 \end{bmatrix}$. **(06 Marks)**

OR

10 a. A sample of 100 tyres is taken from a lot. The mean life of tyres is found to be 40,650 kms with a standard deviation of 3260. Can it be considered as a true random sample from a population with mean life of 40,000 kms (use 0.05 level of significance) Establish 99% confidence limits within which the mean life of tyres is expected to lie, (given $Z_{0.05} = 1.96$, $Z_{0.01} = 2.58$) **(05 Marks)**

b. In the experiments of pea breeding the following frequencies of seeds were obtained.

Round and Yellow	Wrinkled and Yellow	Round and Green	Wrinkled and Green	Total
315	101	108	32	556

Theory predicts that the frequencies should be in proportions 9 : 3 : 3 : 1. Examine the correspondence between theory and experiment.
$(\chi^2_{0.05} = 7.815 \text{ for } 3 \text{ d.f})$ **(05 Marks)**

c. Three boys A, B, C are throwing ball to each other. A always throws the ball to B and B always throws the ball to C. C is just as likely to throw the ball to B is to A. If C was the first person to throw the ball find the probabilities that after the three throws.
(i) A has the ball (ii) B has the ball (iii) C has the ball. **(06 Marks)**

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15MATDIP41

Fourth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Additional Mathematics – II

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Find the rank of the matrix by $A = \begin{bmatrix} 1 & 2 & 3 & 2 \\ 2 & 3 & 5 & 1 \\ 1 & 3 & 4 & 5 \end{bmatrix}$ by applying elementary row transformations. **(06 Marks)**

b. Find the inverse of the matrix $\begin{bmatrix} 1 & 4 \\ 2 & 3 \end{bmatrix}$ using Caylery-Hamilton theorem. **(05 Marks)**

c. Solve the following system of equations by Gauss elimination method.
$2x + y + 4z = 12, \quad 4x + 11 - z = 33, \quad 8x - 3y + 2z = 20$ **(05 Marks)**

OR

2 a. Find the rank of the matrix $\begin{bmatrix} 2 & -1 & -3 & -1 \\ 1 & 2 & 3 & -1 \\ 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & -1 \end{bmatrix}$ by reducing it to echelon form. **(06 Marks)**

b. Find the eigen values of $A = \begin{bmatrix} 7 & -2 & 0 \\ -2 & 6 & -2 \\ 0 & -2 & 5 \end{bmatrix}$ **(05 Marks)**

c. Solve by Gauss elimination method: $x + y + z = 9, \quad x - 2y + 3z = 8, \quad 2x + y - z = 3$ **(05 Marks)**

Module-2

3 a. Solve $\frac{d^3y}{dx^3} + 6\frac{d^2y}{dx^2} + 11\frac{dy}{dx} + 6y = 0$ **(05 Marks)**

b. Solve $y'' - 4y' + 13y = \cos 2x$ **(05 Marks)**

c. Solve by the method of undetermined coefficients $y'' + 3y' + 2y = 12x^2$ **(06 Marks)**

OR

4 a. Solve $\frac{d^2y}{dx^2} + 5\frac{dy}{dx} + 6y = e^x$ **(05 Marks)**

b. Solve $y'' + 4y' - 12y = e^{2x} - 3\sin 2x$ **(05 Marks)**

c Solve by the method of variation of parameter $\frac{d^2y}{dx^2} + y = \tan x$ **(06 Marks)**

Module-3

5 a. Find the Laplace transform of
i) $e^{-2t}\sin h\,4t$ ii) $e^{-2t}(2\cos 5t - \sin 5t)$ **(06 Marks)**

b. Find the Laplace transform of $f(t) = t^2 \;\; 0 < t < 2$ and $f(t+2) = f(t)$ for $t > 2$. **(05 Marks)**

c. Express $f(t)=\begin{cases} t & 0<t<4 \\ 5 & t>4 \end{cases}$ interms of unit step function and hence find L[f(t)]. **(05 Marks)**

OR

6 a. Find the Laplace transform of i) t cosat ii) $\frac{\cos at - \cos bt}{t}$ **(06 Marks)**

b. Given $f(t)=\begin{cases} E & 0<t<a/2 \\ -E & a/2<t<a \end{cases}$ where f(t + a) = f(t). Show that $L[f(t)]=\frac{E}{S}\tan h\left(\frac{as}{4}\right)$. **(05 Marks)**

c. Express $f(t)=\begin{cases} 1 & 0<t<1 \\ t & 1<t\le 2 \\ t^2 & t>2 \end{cases}$ interms of unit step function and hence find L[f(t)]. **(05 Marks)**

Module-4

7 a. Find the inverse Laplace transform of i) $\frac{2s-1}{s^2+4s+29}$ ii) $\frac{s+2}{s^2+36}+\frac{4s-1}{s^2+25}$ **(06 Marks)**

b. Find the inverse Laplace transform of $\log\sqrt{\frac{s^2+1}{s^2+4}}$ **(05 Marks)**

c. Solve by using Laplace transforms $y''+4y'+4y=e^{-t}$, given that y(0) = 0, y′(0) = 0. **(05 Marks)**

OR

8 a. Find the inverse Laplace transform of $\frac{1}{(s+1)(s+2)(s+3)}$. **(06 Marks)**

b. Find the inverse Laplace transform of $\cot^{-1}\left(\frac{s+a}{b}\right)$. **(05 Marks)**

c. Using Laplace transforms solve the differential equation $y'''+2y''-y'-2y=0$ given y(0) = y′(0) = 0 and y″(0) = 6. **(05 Marks)**

Module-5

9 a. State and prove Baye's theorem. **(06 Marks)**

b. The machines A, B and C produce respectively 60%, 30%, 10% of the total number of items of a factory. The percentage of defective output of these machines are respectively 2%, 3% and 4%. An item is selected at random and is found defective. Find the probability that the item was produced by machine "C". **(05 Marks)**

c. The probability that a team wins a match is 3/5. If this team play 3 matches in a tournament, what is the probability that i) win all the matches ii) lose all the matches. **(05 Marks)**

OR

10 a. If A and B are any two events of S, which are not mutually exclusive then $P(A\cup B) = P(A) + P(B) - P(A\cap B)$. **(06 Marks)**

b. If A and B are events with $P(A\cup B) = 7/8$, $P(A\cap B) = 1/4$, $P(\overline{A}) = 5/8$. Find P(A), P(B) and $P(A\cap\overline{B})$. **(05 Marks)**

c. The probability that a person A solves the problem is 1/3, that of B is 1/2 and that of C is 3/5. If the problem is simultaneously assigned to all of them what is the probability that the problem is solved? **(05 Marks)**

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15EC42

Fourth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Microprocessors

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Explain the architecture of 8086 micro processor with a neat block diagram. **(10 Marks)**

b. Explain any three advantage of segmented memory. **(03 Marks)**

c. Explain the significance of following pins of 8086:
i) READY ii) NMI iii) $\overline{DEN}$ **(03 Marks)**

OR

2 a. Explain the following addressing modes of 8086; with example.
i) Immediate ii) Direct iii) Register iv) Register Indirect v) Register Relative vi) Relative Based Indexed. **(09 Marks)**

b. Explain the physical address formatting in 8086 with an example. Also, if CS = 0000H, DS = 1000H, SS = 2000H, ES = 3000H, AX = 1000H, BX = 2000H, find the physical address of the following instruction MOV AX, [BX]. **(04 Marks)**

c. The opcode for MOV instruction is "100010". Determine machine language code for the following instructions: i) MOV BL, CL ii) MOV [SI], DL. **(03 Marks)**

Module-2

3 a. Explain the following instructions with example: i) LOOP ii) XALT iii) DAA iv) AAM v) IMUL. **(10 Marks)**

b. Write an ALP to find out the largest number from a given twenty unordered array of 8-bit numbers, stored in the locations starting from a known address. **(06 Marks)**

OR

4 a. Explain the following assembles directives with example:
i) EVEN ii) EXTRN and PUBLIC iii) PROC. **(06 Marks)**

b. Explain any three string manipulation instructions in 8086. **(06 Marks)**

c. Write an ALP to move a string of data words from offset 2000H to offset 3000H the length of the string is OFH. **(04 Marks)**

Module-3

5 a. Explain the stack structure of 8086 and the operations of PUSH and POP instructions. **(06 Marks)**

b. Explain interrupt response sequence of 8086. Also draw the structure of interrupt vector table. **(06 Marks)**

c. Write any four differences between non maskable interrupt and maskable interrupt. **(04 Marks)**

OR

6 a. List the techniques used to pass parameters to a procedure. Explain the passing of parameters using CPU resister with an example program. **(06 Marks)**

b. Distinguish between a procedures and a macro (Any four). **(04 Marks)**

c. Write a program to generate a delay of 100ms using an 8086 system that runs on 10MHz frequency. Indicate the calculation for the delay. **(06 Marks)**

Module-4

7 a. Explain memory read cycle of 8086 with a timing diagram. **(08 Marks)**

b. Explain the different modes of operation of 8255, and the control word format. **(08 Marks)**

OR

8 a. Explain the minimum mode configuration of 8086 with a neat diagram. **(08 Marks)**

b. Interface 4 × 4 keyboard with 8086 using 8255 and write the flowchart for the same. **(08 Marks)**

Module-5

9 a. Explain the working of ADC 0808/0809 with a neat block diagram. Also draw the timing diagram. **(08 Marks)**

b. Design a stepper motor controller and write an ALP to rotate shaft of a 4-phase stepper motor. i) In clockwise 5 rotations ii) In anticlockwise 5 rotations. Assume procedure DELAY is available for this 1.8° stepper motor. **(08 Marks)**

OR

10 a. Explain control word register of Timer 8253/8254 with bit definitions. **(05 Marks)**

b. Explain the architecture of NDP 8087. **(08 Marks)**

c. Differentiate between: RISC and CISC architecture. **(03 Marks)**

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Fourth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Control Systems

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Compare open loop and closed loop control system. **(05 Marks)**

b. Find the transfer function $\frac{C(S)}{R(S)}$ for the signal flow graph shown in Fig.Q.1(b). **(05 Marks)**

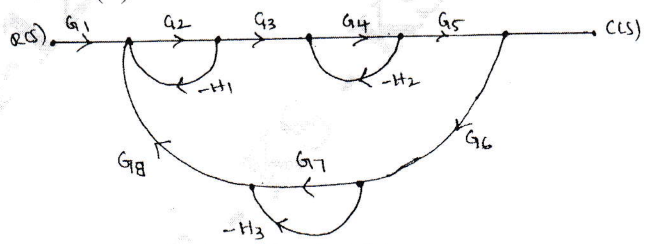

Fig.Q.1(b)

c. For the Mechanical system shown in Fig.Q.1(c):
i) Draw the mechanical network
ii) Write the differential equation
iii) Draw the force-voltage analogous electrical network. **(06 Marks)**

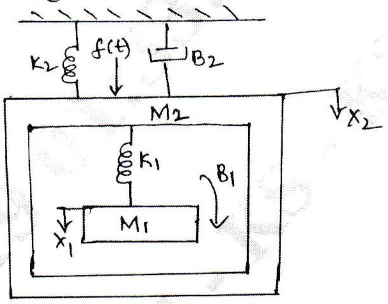

Fig.Q.1(c)

OR

2 a. Obtain the transfer function $\frac{\theta_2(s)}{T(s)}$ for the system shown in Fig.Q.2(a). **(05 Marks)**

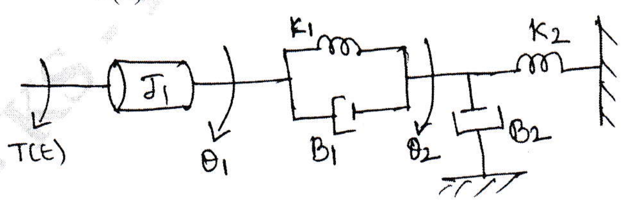

Fig.Q.2(a)

b. Obtain the transfer function $\frac{C(s)}{R(s)}$ of the system shown in Fig.Q.2(b) by using block diagram reduction technique. **(05 Marks)**

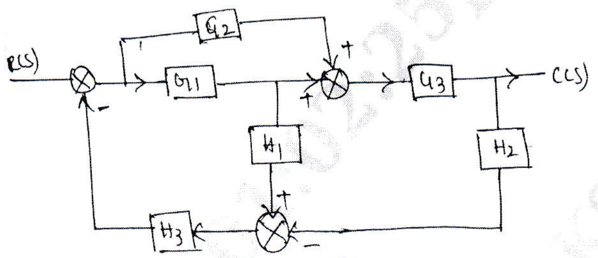

Fig.Q.2(b)

c. For the network shown in Fig.Q.2(c) construct the signal flow graph and obtain the transfer function using Mason gain formula. Given $R_1 = 100K\Omega$, $R_2 = 1M\Omega$, $C_1 = 10\mu f$, $C_2 = 1\mu f$. **(06 Marks)**

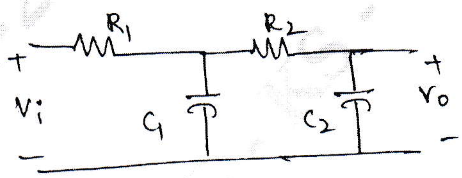

Fig.Q.2(c)

Module-2

3 a. Derive the expression for unit step response of under damped second order system. **(08 Marks)**

b. For a unity feedback control system with $G(S) = \frac{10(S+2)}{S^2(S+1)}$. Find the static error coefficients and steady state error when input transform is $R(S) = \frac{3}{S} + \frac{2}{S^2} + \frac{1}{3S^3}$. **(04 Marks)**

c. A units feedback control system has $G(S) = \frac{K}{S(S+10)}$ determine the gain K for $\xi = 0.5$. Also find rise time, peak time, peak overshoot and settling time. Assume system is subjected to a step of 1v. **(04 Marks)**

OR

4 a. Show that the steady state error $e_{ss} = \lim_{s \to o} \frac{S.R(s)}{1+G(s).H(s)}$ using simple closed loop system with negative feedback. **(04 Marks)**

b. For a spring-mass damper system shown in Fig.Q.4(b), an experiment was conducted by applying a force of 2 Newtons to the mass. The response x(t) was recorded using xy plotter and experimental result is as shown in Fig.Q.4(b) below. Find the value of M, K, B. **(07 Marks)**

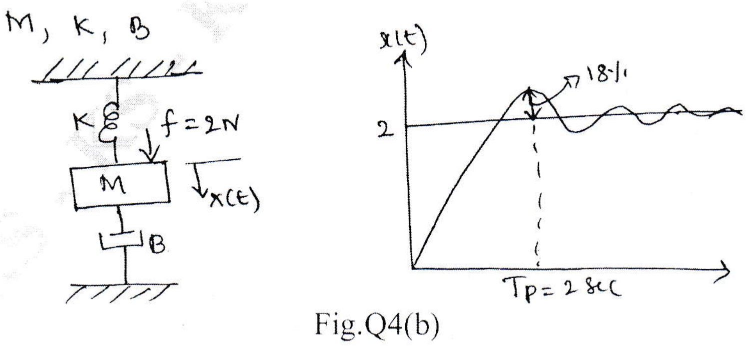

Fig.Q4(b)

c. A signal is represented by the equation $\frac{d^2\theta}{dt^2} + 10\frac{d\theta}{dt} = 150e$ where e = (r - θ) is the actuating signal, calculate the value of damping ratio, undamped and damped frequency of oscillation. Also draw the block diagram and find its closed loop transfer function. **(05 Marks)**

Module-3

5 a. Explain the concept of Routh Hurwitz creterio. What are the necessary and sufficient conditions for the system to be stable as per Routh-Hurwitz criteria? **(05 Marks)**

b. Comment on the stability of a system using Routh's stability criteria whose characteristic equation is $s^4 + 2s^3 + 4s^2 + 6s + 8 = 0$. How many poles of systems lie in right half of s plane? **(04 Marks)**

c. Construct the root locus and show that part of the root locus is circle. Comment on stability of open loop transfer function given by $G(s) = \frac{K(s+2)}{s(s+1)}$. **(07 Marks)**

OR

6 a. Determine the range of K such that the characteristic equation.
$S^3 + 3(k+1)S^2 + (7K+5)S + (4K+7) = 0$ has roots more negative than S = -1. **(07 Marks)**

b. A feedback control system has open loop Transfer function
$G(S)H(S) = \frac{K}{S(S+4)(S^2+4S+20)}$ plot the root locus for K = 0 to ∞. Indicate all the points on it. **(09 Marks)**

Module-4

7 a. Explain Nyquist stability criterion. **(04 Marks)**

b. Sketch the Nyquist plot for open loop transfer function $G(S)H(S) = \frac{K}{S(S+1)(S+2)}$. Find the range of K for closed loop stability. **(08 Marks)**

c. For the log magnitude diagram shown in Fig.Q.7(c) find the transfer function. **(04 Marks)**

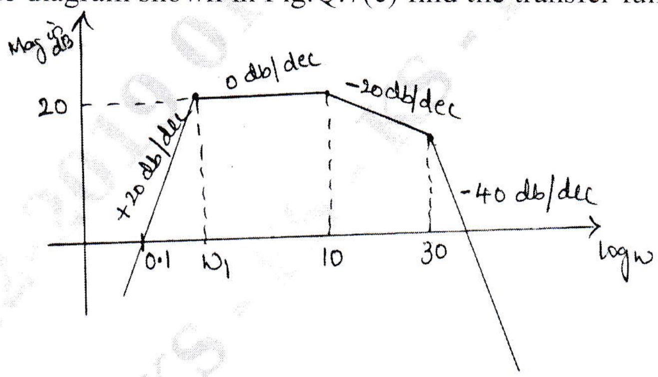

Fig.Q.7(c)

OR

8 a. Define Gain Margin and phase Margin. Explain how these can be determined using Bode plot. **(04 Marks)**

b. Construct the Bode magnitude and phase plot for $G(s)H(s) = \frac{100(0.1s+1)}{s(s+1)^2(0.01s+1)}$. Find Gain margin and phase Margin. **(06 Marks)**

c. The polar plot of open loop transfer function of unity feedback system is shown in Fig.Q.8(c). None of the G(s) H(s) functions have poles on RHS.
   i) Complete the Nyquist path
   ii) Is the system stable
   iii) What is the system TYPE number? **(06 Marks)**

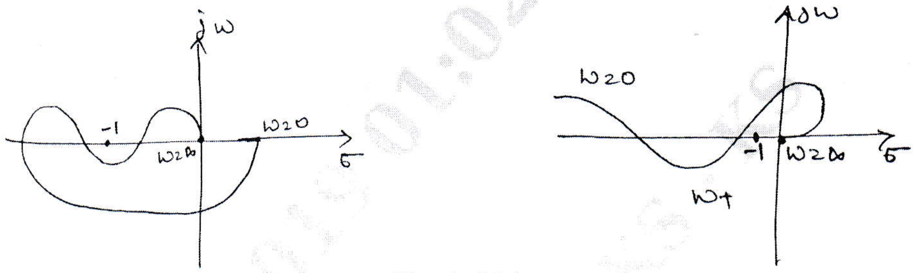

Fig.Q.8(c)

Module-5

9 a. List the properties of state transition matrix. **(04 Marks)**

b. Obtain an appropriate state model for a system represented by an electric circuit as shown in Fig.Q.9(b). **(06 Marks)**

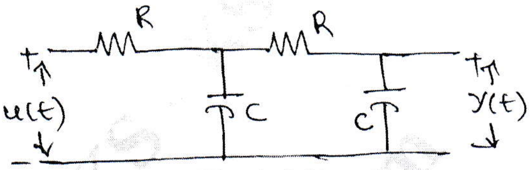

Fig.Q.9(b)

c. Find the state transition matrix for a system whose system matrix is given by

$$A = \begin{bmatrix} 0 & 1 \\ -8 & -6 \end{bmatrix}$$ **(06 Marks)**

OR

10 a. Draw and explain the block diagram of sample data control system. **(04 Marks)**

b. The transfer function of a control system is given by $\frac{y(s)}{u(s)} = \frac{s^2+3s+4}{s^3+2s^2+3s+2}$ obtain a state model using signal flow graph. **(08 Marks)**

c. Obtain the state model of the system shown in Fig.Q.10(c). **(04 Marks)**

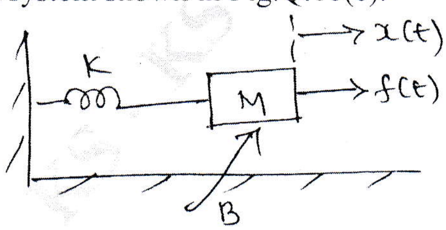

Fig.Q.10(c)

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15EC44

Fourth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Signals and Systems

Time: 3 hrs. Max. Marks: 80

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 signals shown in Fig.Q1(i) and (ii) **(08 Marks)**

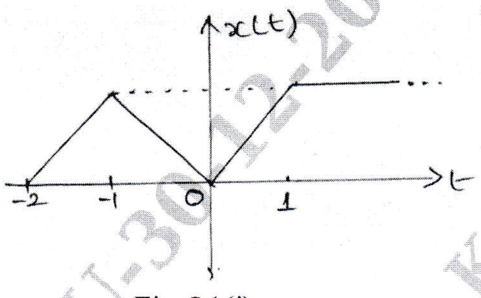


Fig.Q1(i)

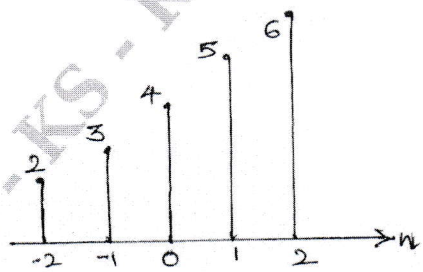


Fig.Q1(ii)

b. Determine whether the following signal is periodic or not if periodic find the fundamental period. $x(t) = \sin^2(4t)$. **(03 Marks)**

c. The trapezoidal pulse x(t) shown in Fig.Q1(c) is applied to a differentiator is $y(t) = \frac{dx(t)}{dt}$.

i) Find the resulting output y(t) of the differentiator ii) Find the energy of y(t). **(05 Marks)**

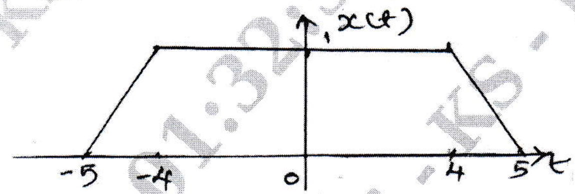


Fig.Q1(c)

OR

2 a. Determine whether the following systems are memoryless, causal, time invariant, linear and stable. i) $y(t) = x(t^2)$ ii) $y(n) = \log_{10}(|x(n)|)$. **(08 Marks)**

b. i) A continuous time signal x(t) is shown in Fig.Q2(b) sketch $y(t) = [x(t) + x(2-t)]\, u(1-t)$.

ii) Sketch the signal : $x(n) = 1; -1 \le n \le 3$

$= \frac{1}{2}$; $n = 4$

$= 0$; elsewhere

Sketch : i) $2x(2n)$ ii) $\frac{1}{2}x(n) + \frac{1}{2}(-1)^n x(n)$. **(08 Marks)**

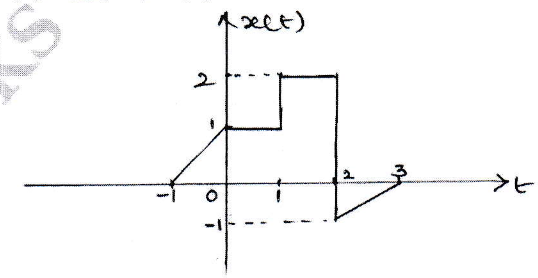


Fig.Q2(b)

Module-2

3 a. Prove the following :

i) $x(t) * u(t) = \int_{-\infty}^{t} x(\tau)\, d\tau$

ii) $x(n) * [h_1(n) * h_2(n)] = \{x(n) * h_1(n)\} * h_2(n)$. **(08 Marks)**

b. Compute the convolution sum of $y(n) = \beta^n u(n) * \alpha^n u(n)$; $|\beta| < 1$ and $|\alpha| < 1$. **(08 Marks)**

OR

4 a. Sate and prove the associative and commutative properties of convolution integral. **(08 Marks)**

b. Compute the convolution integral of $x(t) = e^{-2t}u(t)$ and $h(t) = u(t + 2)$. **(08 Marks)**

Module-3

5 a. A system consists of several subsystems connected as shown in Fig.Q5(a). Find the operator T relating x(t) to y(t) for the subsystem operators given by

$T_1 : y_1(t) = x_1(t)\, x_1(t - 1)$

$T_2 : y_2(t) = |\, x_2(t)\, |$

$T_3 : y_3(t) = 1 + 2x_3(t)$

$T_4 : y_4(t) = \cos(x_4(t))$

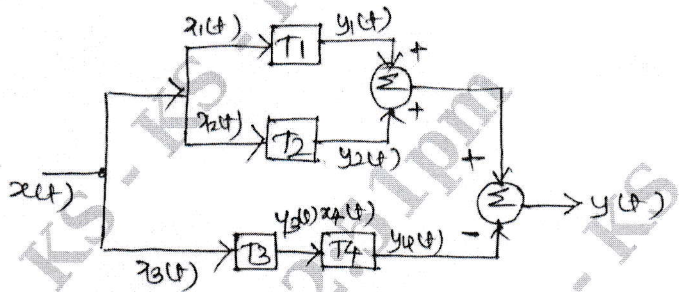


Fig.Q5(a) **(04 Marks)**

b. Determine whether the following systems defined by their impulse response are causal, meoryless and stable.

i) $h(t) = e^{-4|t|}$

ii) $h(n) = (0.99)^n u(n + 3)$. **(06 Marks)**

c. Evaluate the step response for the LTI system represented by the following impulse response

i) $h(n) = e^{-t}u(t) * \delta(t - 2)$

ii) $h(n) = (-1)^n \{u(n + 2) - u(n - 3)\}$. **(06 Marks)**

OR

6 a. State the following properties of CTFS :

i) Time shift
ii) Differentiation in time domain
iii) Linearity
iv) Convolution
v) Frequency shift scaling. **(06 Marks)**

b. Determine the DTFS coefficients of the signal

$$x(n) = \cos\left(\frac{6\pi}{13}n + \frac{\pi}{6}\right)$$

Draw : i) Magnitude spectrum
ii) Phase spectrum. **(10 Marks)**

Module-4

7 a. State and prove the following properties :

i) $y(t) = x(t - t_0) \xleftrightarrow{FT} Y(j\omega) = e^{-j\omega t_0} X(j\omega)$

ii) $-jtx(t) \xleftrightarrow{FT} \frac{d}{d\omega} X(j\omega)$. **(06 Marks)**

b. Find the DTFT of the following signals :

i) $x(n) = (-1)^n u(n)$

ii) $x(n) = (\frac{1}{2})^n \{u(n+3) - u(n-2)\}$. **(10 Marks)**

OR

8 a. Find he FT of the signal : $x(t) = te^{-2t} u(t)$. **(06 Marks)**

b. Find the FT of unit step function. **(04 Marks)**

c. Determine the signal x(n) if its spectrum is shown in Fig.Q8(c). **(06 Marks)**

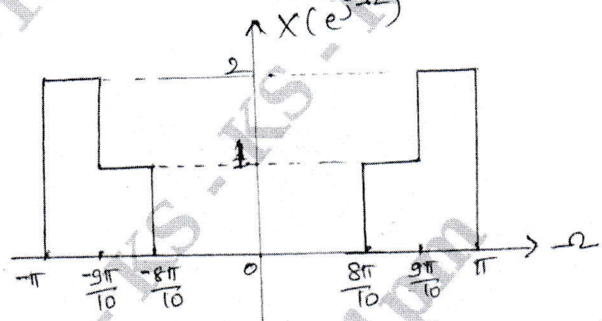


Fig.Q8(c)

Module-5

9 a. Explain properties of ROC with example. **(06 Marks)**

b. Determine the z–transform of the following signals.

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

ii) $x(n) = \left(\frac{1}{2}\right)^n \{u(n) - u(n-10)\}$. **(10 Marks)**

OR

10 a. Find the corresponding time domain signals corresponding to the following z-transform.

$x(z) = \frac{z^2 - 3z}{z^2 + \frac{3}{2} z - 1}$; ROC ; $\frac{1}{2} < |z| < 1$. **(06 Marks)**

b. The input and output of on LTI system is given by

$x(n) = u(n)$

$y(n) = (\frac{1}{2})^{n-1} u(n+1)$.

Find :

i) Transfer function

ii) Impulse response

iii) Is the system stable?

iv) Is the system causal? **(10 Marks)**

CBCS SCHEME

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

15EC45

Fourth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Principles of Communication System

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Explain the generation of AM wave using switching modulator and show the output of the switching modulator is $V_2(t) = \frac{A_c}{2}\left[1 + \frac{4}{\pi A_c} m(t)\right]\cos(2\pi f_c t)$. **(06 Marks)**

b. Calculate the percent power saving for a DSB-SC signal for the percent modulation of (i) 100% (ii) 50%. **(04 Marks)**

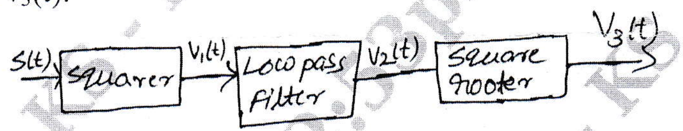
c. With a block diagram explain how downward and upward frequency translation is achieved. **(06 Marks)**

OR

2 a. Explain the operation of the ring modulator circuit which generates the DSB-SC waves. **(06 Marks)**

b. The AM signal $S(t) = A_c[1 + K_a m(t)]\cos 2\pi f_c t$ is applied to the system shown in Fig.Q.2(b). Assuming that $|k_a m(t)| < 1$ for all t and the message signal m(t) is limited to the interval $-w \le f \le w$, and the carrier frequency $f_c > 2w$, show that m(t) can be obtained from the square-rooter output $v_3(t)$. **(04 Marks)**

Fig.Q.2(b)



c. What is vestigial sideband modulation? Explain the generation of VSB modulated signal and list the advantages. **(06 Marks)**

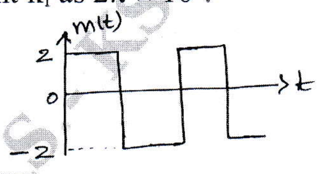
Module-2

3 a. With the help of block diagram. Explain the schemes for generating i) FM wave using PM ii) PM wave using FM. **(06 Marks)**

b. Explain non-linearity and its effect in FM system. **(06 Marks)**

c. Sketch the FM wave for the modulating signal m(t) as shown in Fig.Q.3(c). Assume frequency of 100MHz and constant k_f as $2\pi \times 10^5$. **(04 Marks)**

Fig.Q.3(c)



OR

4 a. Explain the generation of wide band FM wave using a voltage controlled oscillator. **(06 Marks)**

b. A 93.2 MHz carrier is frequency modulated by a 5kHz sine wave. The resultant FM signal has a frequency deviation of 40kHz. I) Find the carrier swing of the FM wave ii) What are the highest and lowest frequencies attained by the frequency modulated signal iii) Find the modulation index. **(04 Marks)**

c. Draw the linear model of phase locked loop and show that the resulting output signal of the PLL is approximately equal to $v(t) = \frac{K_f}{K_v} m(t)$. **(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.

Module-3

5 a. Explain mean, correlation and covariance. **(06 Marks)**

b. List the properties of autocorrelation function. **(04 Marks)**

c. A TV receiving system is as shown in the Fig.Q.5(c). A preamplifier is used to overcome the effect of the Lossy cable. Typical values of the parameters are shown.

i) Find the overall noise figure of the system.

ii) Find the overall noise figure if the preamplifier is omitted. **(06 Marks)**

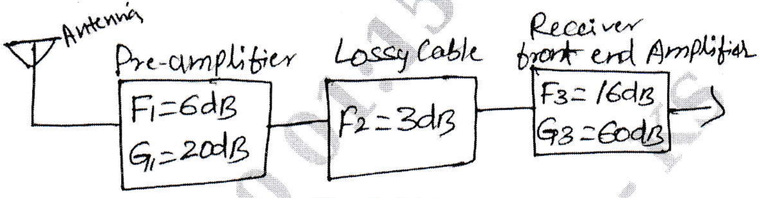


Fig.Q.5(c)

OR

6 a. What is probability density function? Show that the area under the PDF curve is equal to one. **(06 Marks)**

b. Consider the random variable X defined by probability density function

$$f_x(x) = \begin{cases} k & \text{a constant for } 2 \le x \le 4 \\ 0 & \text{elsewhere} \end{cases}$$

Determine : i) The constant K ii) $F_X(x)$. **(04 Marks)**

c. What is noise equivalent bandwidth? Show that noise equivalent band width for RC low pass filter is $\frac{1}{4RC}$. **(06 Marks)**

Module-4

7 a. Show that the figure of merit of a noisy FM receiver for single tone modulation is $\frac{3}{2}\beta^2$. **(08 Marks)**

b. Show that the figure-of-merit for DSB-SC receiver system is unity. **(08 Marks)**

OR

8 a. An AM receiver operating with a sinusoidal modulating signal has the following specifications. $\mu = 0.8$, $[SNR]_0 = 30$dB. What is the corresponding carrier-to-noise ratio? **(06 Marks)**

b. Briefly discuss FM threshold effect. **(04 Marks)**

c. Explain pre-emphasis and de-emphasis in frequency modulation system. **(06 Marks)**

Module-5

9 a. Draw the block diagram of Time Division Multiplexing system and explain the working principle of operation. **(08 Marks)**

b. Explain the generation of Pulse Position Modulation (PPM) system. **(08 Marks)**

OR

10 a. List the two operations involved in the generation of PAM [Pulse Amplitude Modulation] and explain how message signal m(t) is recovered from PAM. **(08 Marks)**

b. Discuss briefly quantization noise and show the output signal-to-noise ratio of a uniform quantizer is $[SNR]_0 = \left[\frac{3P}{m^2 \max}\right]2^{2R}$. **(08 Marks)**

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CBCS SCHEME

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15EC46

Fourth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Linear Integrated Circuits

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Define the following terms as applied to Op-Amp and mention their typical values for IC 741. i) CMRR ii) Slew rate iii) PSRR. **(06 Marks)**

b. With a neat circuit diagram explain the basic Op-Amp circuit. **(06 Marks)**

c. An operational amplifier has a specified input voltage range of ± 8V and an output voltage range of ±14V when the supply voltage is ±15V. Calculate the maximum output voltage that can be produced i) When the Op-Amp is used as a voltage follower ii) When it is used as an amplifier with a voltage gain of 2. **(04 Marks)**

OR

2 a. With a neat circuit diagram, explain direct coupled inverting amplifier with design steps, input impedance and output impedance. **(08 Marks)**

b. Derive an output voltage equation of 3 input inverting summing circuit and show how it can be converted into averaging circuit. **(08 Marks)**

Module-2

3 a. Explain capacitor coupled voltage follower with neat circuit diagram. **(08 Marks)**

b. Design a capacitor coupled non-inverting amplifier to have a voltage gain of approximately 66. The signal amplitude is to be 15mV. The load resistor is 2.2 kΩ and the lower cutoff frequency is to be 120Hz. **(08 Marks)**

OR

4 a. Explain the circuit operation of a differential input/output amplifier and derive the equation for differential voltage gain. Also show that the common mode gain is unity. **(10 Marks)**

b. Design a non-saturating precision half wave rectifier to produce a 2V peak output from a sine wave input with a peak value of 0.5V and frequency of 1MHz. Use a bipolar Op-Amp with supply voltage of ±15V. **(06 Marks)**

Module-3

5 a. With neat circuit diagram and waveforms, explain sample and hold circuit. **(08 Marks)**

b. Explain differentiating circuit operation with neat circuit diagram and design steps. **(08 Marks)**

OR

6 a. Using 741 Op-Amp with a supply of ±12V, design a phase shift oscillator to have an output frequency of 3.5KHz. **(06 Marks)**

b. Explain log amplifier and derive its output voltage equation. **(06 Marks)**

c. Using a 741 Op-Amp with supply voltage of ± 12V, design an inverting Schmitt trigger circuit to have trigger points of ± 2V. **(04 Marks)**

Module-4

7 a. Explain the operation of second order high pass filter with a neat circuit diagram, frequency response and design steps. **(08 Marks)**

b. With a neat diagram and design steps explain the operation of single stage first order bandpass filter. **(08 Marks)**

OR

8 a. With a neat sketch, explain the working of series Op-Amp regulator. **(06 Marks)**

b. List and explain the characteristics of 3 terminal IC regulators. **(04 Marks)**

c. Draw and explain functional diagram of 723 regulators. **(06 Marks)**

Module-5

9 a. Define the following in relation to PLL :
i) Lock in range ii) Capture range iii) Pull in time. **(06 Marks)**

b. With necessary circuit diagram, derive the equations and explain R – 2R DAC. What output voltage could be produced by a DAC whose output range is 0 to 10V and whose input binary number is i) 11(for 2 bit DAC) ii) 1011 (for 4 bit DAC). **(10 Marks)**

OR

10 a. Explain the operation of monostable multivibrator using 555 timer. **(08 Marks)**

b. In the satable multivibrator $R_A = 3.3k\Omega$ $R_B = 6.8k\Omega$ and $C = 0.01\ \mu F$. Calculate :
i) t_{High} ii) t_{low} iii) free running frequency iv) duty cycle D. **(08 Marks)**

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