CBCS SCHEME

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

21MAT41

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

Time: 3 hrs. Max. Marks: 100

***Note:1. Answer any FIVE full questions, choosing ONE full question from each module.***
***2. Use of Normal distribution tables can be permitted.***
***3. Use of Students distribution tables can be permitted.***



### Module-1

1 a. Derive the C-R equations in Polar form. (06 Marks)

b. Construct the analytic function whose real part is $\psi = x^2 - y^2 + \frac{x}{x^2+y^2}$. (07 Marks)

c. If f(z) is a regular function, prove that $\left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}\right)|f(z)|^2 = 4|f'(z)|^2$. (07 Marks)

**OR**

2 a. State and prove the Cauchy's integral formula. (06 Marks)

b. Show that $f(z) = e^x(\cos y + i \sin y)$ is analytic and find its derivative. (07 Marks)

c. Evaluate $\int_C \frac{e^{2z}}{(z-1)(z-2)}dz$, where $C: |z| = 3$. (07 Marks)

### Module-2

3 a. Prove that $J_{\frac{1}{2}}(x) = \sqrt{\frac{2}{\pi x}} \sin x$. (06 Marks)

b. Prove that $\int_0^1 x J_n(\alpha x) J_n(\beta x)dx = 0$, $\alpha \neq \beta$. (07 Marks)

c. Express $x^3 - 5x^2 + x + 2$ in terms of Legendre's polynomial. (07 Marks)

**OR**

4 a. Show that $J_{-n}(x) = (-1)^n . J_n(x)$. (06 Marks)

b. Prove that $P_4(x) = \frac{1}{8}(35x^4 - 30x^2 + 3)$. (07 Marks)

c. Show that $x^3 - 5x^2 + x + 2 = \frac{2}{5}P_3(x) - \frac{10}{3}P_2(x) + \frac{8}{5}P_1(x) + \frac{1}{6}P_0(x)$. (07 Marks)

### Module-3

5 a. Find the regression line y on x and calculate y when x = > 0.

| x: | 71 | 68 | 66 | 67 | 70 | 71 | 70 | 73 | 72 | 65 | 66 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| y: | 69 | 64 | 65 | 63 | 65 | 62 | 65 | 64 | 66 | 59 | 62 |

(06 Marks)

b. Ten participants in a contest are ranked by two judges as follows:

| x: | 1 | 6 | 5 | 10 | 3 | 2 | 4 | 9 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|---|
| y: | 6 | 4 | 9 | 8 | 1 | 2 | 3 | 10 | 5 | 7 |

Calculate the rank co-efficient of correlation. **(07 Marks)**

c. Fit a curve $y = ax^b$ from the following data :

| x: | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| y: | 0.5 | 2.0 | 4.5 | 8.0 | 12.5 |

**(07 Marks)**

**OR**

6 a. Given the equation of the lines $8x - 10y + 66 = 0$ and $40x - 18y = 214$. Compute the mean's of x and y, the coefficient of correlation and find $\sigma_y$ if $\sigma_x = 3$. **(06 Marks)**

b. Fit a second degree parabola $y = ax^2 + bx + c$ in the least squares for the following data :

| x : | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| y : | 10 | 12 | 13 | 16 | 19 |

**(07 Marks)**

c. Find the lines of regression of the following data :

| x : | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| y : | 9 | 8 | 10 | 12 | 11 | 13 | 14 |

**(07 Marks)**

## Module-4

7 a. A random variable X has the following probability density function :

| X : | -2 | -1 | 0 | 1 | 2 | 3 |
|---|---|---|---|---|---|---|
| P(X) : | 0.1 | K | 0.2 | 2K | 0.3 | K |

Find the value of K, mean and variance. **(06 Marks)**

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

c. The marks of 1000 students in an examination follows a normal distribution with mean 70 and standard deviation 5. Find the number of students whose marks will be, (i) less than 65 (ii) more than 75 (iii) between 65 and 75. **(07 Marks)**

**OR**

8 a. A random variable X has the pdf $f(x) = \begin{cases} Kx^2, & -3 < x < 3 \\ 0, & \text{elsewhere} \end{cases}$

Evaluate K, find (i) $P(1 \le x \le 2)$ (ii) $P(x \le 2)$ (iii) $P(x > 1)$. **(06 Marks)**

b. If the probability of a bad reaction from a certain injection is 0.001, determine the chance that out of 2000 individuals more than two will get a bad reaction. **(07 Marks)**

c. 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. **(07 Marks)**

## Module-5

9 a. The following joint probability distribution of the random variable X and Y as follows:

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

Determine the marginal distributions of X and Y. Find (i) E(X) and E(Y) (ii) COV(X, Y). **(06 Marks)**

b. A sample of 900 items has mean 3.4 and S.D 2.61. Can the sample be regarded from population with mean 3.25 at 5% LOS? **(07 Marks)**

c. The theory predicts the proportion be in the four groups $G_1$, $G_2$, $G_3$, $G_4$ should be in the ratio 9 : 3 : 3 : 1. In experiment with 1600 beans the numbers in the groups were 882, 313, 287 and 118. Do the experimental result support the theory. **(07 Marks)**

**OR**

**10** a. Define the terms : (i) Type – I and Type – II errors (ii) Null hypothesis (iii) Level of significance. **(06 Marks)**

b. A machinist is making engine parts with axle diameter of 0.7 inch. A random sample of 10 parts shows mean diameter 0.742 inch with S.D. of 0.04 inch. On the basis of this sample would you say that the work is inferior? **(07 Marks)**

c. Fit a Poisson distribution to the following data is and test for its goodness of fit at 5% LOS.

| x | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| y | 419 | 352 | 154 | 56 | 19 |

**(07 Marks)**

* * * * *

CBCS SCHEME

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

21EC42

# Fourth Semester B.E. Degree Examination, June/July 2024
## Digital 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. Prove that the sampling of Fourier transform of a sequence x(n) results in N point DFT. Using which both the sequence and the transform can be reconstructed. **(10 Marks)**

b. Compute the 8 point DFT of the sequence x(n) = {1, 1, 1, 1, 0, 0, 0, 0}. Also write a Matlab code to compute N point DFT of a sequence. **(10 Marks)**

**OR**

2 a. Compute the circular convolution of the given sequences using DFT and IDFT method $x_1(n) = \{2, \ 3, \ 1, \ 1\}$ and $x_2(n) = \{1, \ 3, \ 5, \ 3\}$. **(10 Marks)**

b. Compute the N point DFT of $x(n) = \begin{cases} \frac{1}{3}; & 0 \le n \le 2 \\ 0; & \text{otherwise} \end{cases}$ **(06 Marks)**

c. If $x(n) = \{1, \ 2, \ 0, \ 3, \ -2, \ 4, \ 7, \ 5\}$. Evaluate i) X(0) ii) X(4) iii) $\sum_{K=0}^{7} X(K)$. **(04 Marks)**

### Module-2

3 a. Determine the response of a LTI system with $h(n) = \{1, -1, 2\}$ for an input. $x(n) = \{1, 0, 1, -2, 1, 2, 3, -1, 0, 2\}$ using overlap add method. Use 6 point circular convolution in your approach. **(10 Marks)**

b. Develop the 8 point DIF_FFT algorithm. Mention the property of phase factor exploited. **(10 Marks)**

**OR**

4 a. Determine 8 point DFT of $x(n) = \{1, 0, -1, 2, 1, 1, 0, 2\}$ using of radix-2 DIT-FFT algorithm. Clearly show all intermediate results. **(10 Marks)**

b. State and prove circular time shift property. Also write the matlab code for the same. **(10 Marks)**

### Module-3

5 a. Design a filter with

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

Use Hamming window with M = 7. Obtain the system transfer function equation. **(10 Marks)**

b. Consider a FIR filter with system function: $H(z) = 1 + 2.82z^{-1} + 3.4048z^{-2} + 1.74z^{-3}$. Sketch the direct form-I and lattice realization of the filter. **(10 Marks)**

**OR**

6 a. Write a Matlab code to design a high pass FIR filter, using hanning window. The expected output with necessary calculations to be shown. **(10 Marks)**

b. Mention the two desirable characteristics of window function. Compare Rectangular, Hamming, Hanning and Bartlett window functions. **(06 Marks)**

c. Given $H(z) = (1 + 0.6z^{-1})^3$. Realize as a cascade of 1st and 2nd order section. **(04 Marks)**

## Module-4

7 a. Compare analog and digital filters. **(04 Marks)**

b. Given $H(z) = \dfrac{8z^3 - 4z^2 + 11z - 2}{\left(z - \frac{1}{4}\right)\left(z^2 - z + \frac{1}{2}\right)}$. Realize in DF-I and DF-II. **(06 Marks)**

c. Obtain the expression for order and cut-off frequency of Low Pass Butterworth filter. **(10 Marks)**

**OR**

8 a. Design a digital low pass filter using BLT method to satisfy the following characteristics:
i) Monotonic stopband and pass band
ii) -3db cut off frequency of $0.5\pi$ rad
iii) Magnitude down atleast 15dB at $0.75\pi$ rad. **(10 Marks)**

b. Mention two conditions of transforming the filter from s plane to z plane. Explain how is it achieved in bilinear transformation with mapping diagram. **(06 Marks)**

c. Write a matlab code to design an analog LP Butterworth filter. **(04 Marks)**

## Module-5

9 a. Explain :
i) General Microprocessor based on Von Neumann architecture
ii) Digital signal processors based on Harvard architecture. **(12 Marks)**

b. Convert the following:
i) Q15 signed number 0.100011110110010 to decimal number.
ii) Decimal number -0.160123 to signed Q-15 representation. **(08 Marks)**

**OR**

10 a. Explain IEEE floating point formats. **(10 Marks)**

b. Explain the basic architecture of TMS320C54X processor. **(10 Marks)**

* * * * *

CBCS SCHEME

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

21EC43

# Fourth Semester B.E. Degree Examination, June/July 2024
## 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. With help of circuits explain independent electrical sources. **(06 Marks)**

b. Using mesh current analysis, find the currents in various branches and node voltages at 'a' and 'b' points shown in Fig.Q.1(b). **(08 Marks)**

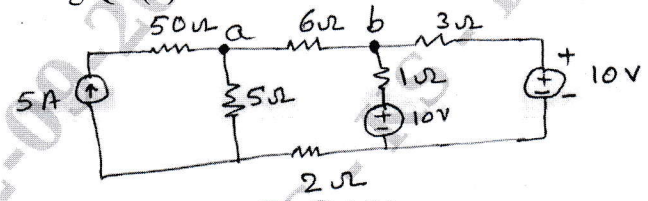


Fig.Q.1(b)

c. Using mesh current analysis, find the current in $(2 + j3)\Omega$ shown in Fig.Q.1(c).

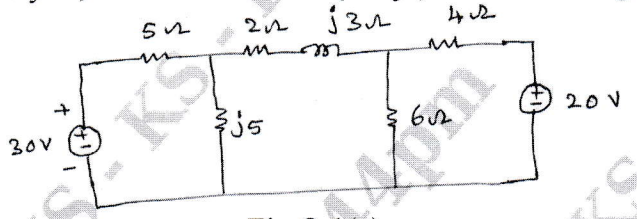


Fig.Q.1(c)

**(06 Marks)**

**OR**

2 a. State and explain Thevenin's theorem. **(08 Marks)**

b. Using nodal analysis, find the node voltages at 'a' and 'b' shown in circuit Fig.Q.2(b).

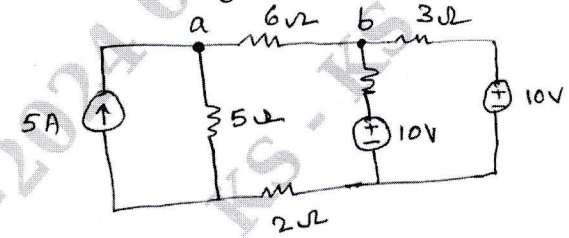


Fig.Q.2(b)

**(08 Marks)**

c. Define and explain briefly, the super position theorem. **(04 Marks)**

### Module-2

3 a. Find the Z-parameters of given circuit shown in Fig.Q.3(a). **(08 Marks)**

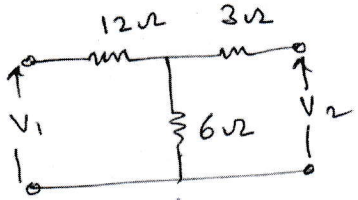


Fig.Q.3(a)

b. Find the Y-parameters of circuit shown in Fig.Q.3(b). **(08 Marks)**

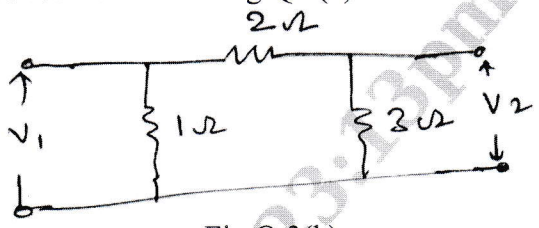


Fig.Q.3(b)

c. Explain the standard test signals unit step, unit ramp and unit impulse. **(04 Marks)**

**OR**

4 a. Define and prove that initial value theorem and final value theorem. **(08 Marks)**

b. Find the expression for current when switch 'SW' is closed at t = 0 shown in Fig.Q.4(b). (Use Laplace transform). **(08 Marks)**

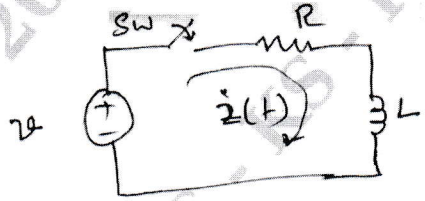


Fig.Q.4(b)

c. Obtain the Laplace transform of a gate function shown in Fig.Q.4(c). **(04 Marks)**

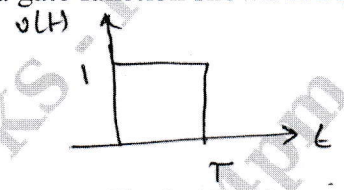


Fig.Q.4(c)

## Module-3

5 a. What is control system? List the differences between open loop control system and closed loop control system with examples. **(10 Marks)**

b. Determine the overall transfer function shown in the Fig.Q.5(b) using block diagram reduction technique. **(10 Marks)**

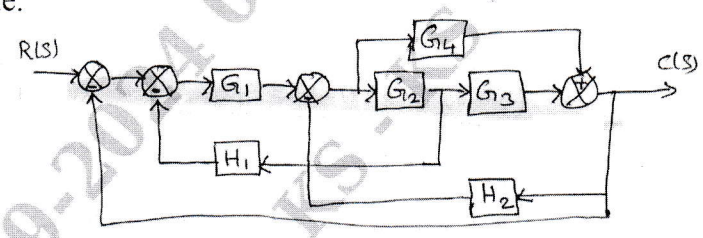


Fig.Q.5(b)

**OR**

6 a. Find the transfer function of the circuit shown in the Fig.Q.6(a). **(10 Marks)**

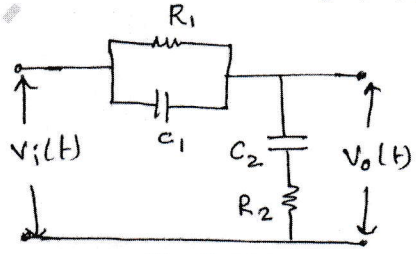


Fig.Q.6(a)

b. Find the overall gain of the SFG system shown in the Fig.Q.6(b) using Mason's gain formula. **(10 Marks)**

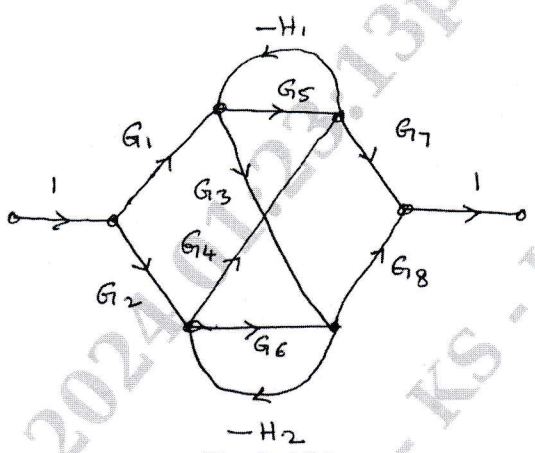


Fig.Q.6(b)

## Module-4

7 a. Derive the expression for underdamped second order system with unit step input. **(10 Marks)**

b. Discuss the stability of the closed loop system as a function of K for the open loop transfer function using RH criterion.

$$G(S)H(S)=\frac{K(S+1)}{S(S-1)(S^2+4S+16)}$$ **(10 Marks)**

**OR**

8 a. A vfb system having transfer function $\frac{C(S)}{R(S)}=\frac{2}{S(S^2+PS+4K)}$ is marginally stable and oscillates with frequency 2 rad/sec. Find $K_{mar}$ and 'P' using RH criterion. **(10 Marks)**

b. Starting from the output equation C(t) derive expressions for: i) Rise time ($t_r$) ii) Peak overshoot. **(10 Marks)**

## Module-5

9 a. Sketch the complete root locus of the system having open loop transfer function $G(S)H(S)=\frac{K}{S(S+1)(S+2)(S+3)}$ and determine values of K for which the system is stable. **(16 Marks)**

b. Construct the state model using phase variable if the system is described by the difference equation

$$\frac{d^3y(t)}{dt^3}+4\frac{d^2y(t)}{dt^2}+7\frac{dy(t)}{dt}+2y(t)=5U(t)$$ **(04 Marks)**

**OR**

10 Plot the Bode magnitude and phase diagram for a open loop transfer function

$$G(S)H(S)=\frac{10(1+0.5S)}{S(1+0.25S)(1+0.2S)}$$ **(20 Marks)**

* * * * *

CBCS SCHEME

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

21EC44

# Fourth Semester B.E. Degree Examination, June/July 2024
## Communication Theory

Time: 3 hrs. Max. Marks: 100

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



### Module-1

1 a. Derive the expression in time domain and frequency domain for an AM wave. Outline the waveform and spectrum. **(08 Marks)**

b. With neat diagram, explain costas receiver. **(06 Marks)**

c. With relevant block diagram, explain the working of FDM transmitter and receiver. **(06 Marks)**

**OR**

2 a. With relevant equations and diagrams, explain the generation of AM waves using switching modulator. **(08 Marks)**

b. Explain in detail quadrature carrier multiplexing and demultiplexing system. **(06 Marks)**

c. An audio frequency signal 5 sin $2\pi$ (1000)t is used to amplitude modulate a carrier of 100sin $2\pi$ ($10^6$)t. Assume modulation index is 0.4. Find:

i) Sideband frequencies
ii) Amplitude of each sideband
iii) Bandwidth required
iv) Total power delivered to a load of 100Ω. **(06 Marks)**

### Module-2

3 a. Define modulation index, frequency deviation and derive the time domain and frequency domain representation wideband FM with diagram. **(08 Marks)**

b. With neat diagram, explain the FM demodulation using balanced slope detector/balanced frequency discriminator. **(08 Marks)**

c. An FM signal has sinusoidal modulation with W = 15kHz and modulation index $\beta = 2$. Using Carson's rule determine the transmission bandwidth and deviation ratio. Assume $\Delta f = 75$kHz. **(04 Marks)**

**OR**

4 a. With relevant diagram, explain direct method generation of FM using Hartley oscillator and how frequency stability is achieved. **(08 Marks)**

b. With block diagram, explain the linear model of PLL. **(06 Marks)**

c. With the aid of neat diagram, explain FM stereo multiplexing. **(06 Marks)**

### Module-3

5 a. Explain shot noise and thermal noise with relevant diagrams and expressions. **(06 Marks)**

b. Derive the equation for the figure of merit of an AM receiver and show figure of merit = 1/3 when operating on a single tone AM. **(08 Marks)**

c. Explain about FM threshold effect and its reduction method. **(06 Marks)**

**OR**

6 a. With relevant diagrams and expressions explain noise equivalent bandwidth. **(04 Marks)**

b. Derive the equation for the figure-of-merit for DSB-SC receiver is one. **(08 Marks)**

c. Explain the pre-emphasis and de-emphasis with respect to FM system. **(08 Marks)**

## Module-4

7 a. List the two operations involved in the generation of PAM and explain with neat waveform and derive the equations for flat-top sampled PAM. **(10 Marks)**

b. Explain the working principle and operation of Time Division Multiplexing (TDM) with neat diagram. **(10 Marks)**

**OR**

8 a. State sampling theorem for a strictly band limited signal and explain how the effects of aliasing is overcome. **(06 Marks)**

b. With neat diagram and equations explain the generation of PPM waves. **(08 Marks)**

c. What are the advantages of transmission of digital information over analog information? **(06 Marks)**

## Module-5

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

b. What is delta modulation? With neat block diagram, explain the construction of delta modulation. **(06 Marks)**

c. Explain μ-law and A-law of compression. **(06 Marks)**

**OR**

10 a. Define quantization. Explain how the quantization process takes place. Illustrate the input output characteristics of a quantizer interms of mid-tread and mid-rise. **(08 Marks)**

b. With neat block diagram, explain the generation and reconstruction of PCM signals. **(08 Marks)**

c. Write a short note on Vocoders. **(04 Marks)**

* * * * *