CBCS SCHEME

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17MAT41

Fourth Semester B.E. Degree Examination, Jan./Feb. 2023

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. Apply modified Euler's method to solve $\frac{dy}{dx} = x + y$, $y(0) = 1$. Compute y(0.2) taking h = 0.1. **(07 Marks)**

b. Using fourth order Runge-Kutta method, find y(0.2) for the equation $\frac{dy}{dx} = \frac{y-x}{y+x}$, $y(0) = 1$ taking h = 0.2. **(06 Marks)**

c. If $\frac{dy}{dx} = 2e^x - y$, y(0) = 2, y(0.1) = 2.010, y(0.2) = 2.0679, y(0.3) = 2.090, find y(0.4) correct to four decimal places by using Milne's predictor and corrector method. **(07 Marks)**

OR

2 a. Use Taylor's series method to find y(4.1) given that $\frac{dy}{dx} = \frac{1}{x^2 + y}$ and y(4) = 4. **(06 Marks)**

b. Solve $(y^2 - x^2)dx = (y^2 + x^2)dy$ in the range $0 \le x \le 0.4$ given that y = 1 at x = 0 initially by applying R-K method of fourth order. **(07 Marks)**

c. Apply Milne's method to compute y(1.4) correct to four decimal places given $\frac{dy}{dx} = x^2 + \frac{y}{2}$ and following the data y(1) = 2, y(1.1) = 2.2156, y(1.2) = 2.4649, y(1.3) = 2.7514 **(07 Marks)**

Module-2

3 a. Given $y'' - xy' - y = 0$ with the initial condition y(0) = 1, $y'(0) = 0$. Compute y(0.2) and $y'(0.2)$ using fourth order R-K method. **(07 Marks)**

b. If α and β are two distinct roots of $J_n(x) = 0$ then prove that

$$\int_0^1 xJ_n(\alpha x)J_n(\beta x)dx = 0 \text{ if } \alpha \ne \beta.$$ **(07 Marks)**

c. Express the polynomial $4x^3 - 2x^2 - 3x + 8$ interms of Legendre polynomials. **(06 Marks)**

OR

4 a. Applying Milne's predictor and corrector formulae to compute y(0.8) given that y satisfies the equation $y'' = 2yy'$ using the following data :
y(0) = 0, y(0.2) = 0.2027, y(0.4) = 0.4228, y(0.6) = 0.6841, $y'(0) = 1$, $y'(0.2) = 1.041$, $y'(0.4) = 1.179$, $y'(0.6) = 1.468$. **(07 Marks)**

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

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
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c. Derive Rodrigue's formula, $P_n(x) = \frac{1}{2^n n!} \frac{d^n}{dx^n}\left[(x^2-1)^n\right]$. **(07 Marks)**

Module-3

5 a. Derive Cauchy-Riemann equation in the polar form. **(07 Marks)**

b. State and prove Cauchy's-Integral formula, $f(a) = \frac{1}{2\pi i}\int_C \frac{f(z)}{z-a}dz$. **(06 Marks)**

c. Find the bilinear transformation which map the points z = 1, i – 1 into w = i, 0, – i. **(07 Marks)**

OR

6 a. Find the analytic function f(z) whose real part is $\frac{\sin 2x}{\cosh 2y - \cos 2x}$. **(06 Marks)**

b. Using Cauchy's residue theorem, evaluate $\int_C \frac{z\cos z}{\left(z-\frac{\pi}{2}\right)^3}dz$ where $C : |z-1| = 1$. **(07 Marks)**

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

Module-4

7 a. If the mean and standard deviation of the number of correctly answered questions in a test given to 4096 students 2.5 and $\sqrt{1.875}$. Find an estimate of the number of candidates answering correctly,
   (i) 8 or more questions
   (ii) 2 or less
   (iii) 5 questions **(07 Marks)**

b. Derive mean and standard deviations of binomial distributions. **(06 Marks)**

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

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

Determine : (i) Marginal distribution of X and Y (ii) COV (X, Y)
(iii) Correlations of X and Y. **(07 Marks)**

OR

8 a. Derive mean and standard deviations of Exponential distribution. **(06 Marks)**

b. X and Y are independent random variables. X takes values 2, 5, 7 with probability $\frac{1}{2}, \frac{1}{4}, \frac{1}{4}$ respectively. Y take values 3, 4, 5 with the probability $\frac{1}{3}, \frac{1}{3}, \frac{1}{3}$.
   (i) Find the Joint probability distribution of X and Y.
   (ii) Show that the covariance of X and Y.
   (iii) Find the probability distribution of Z = X + Y **(07 Marks)**

c. In 800 families with 5 childrens each how many families would be expected to have, (i) 3 boys (ii) 5 girls (iii) either 2 or 3 boys (iv) atmost 2 girls by assuming probabilities for boys and girls to be equal. **(07 Marks)**

Module-5

9 a. A survey was conducted in a slum locality of 2000 families by selecting a sample size 800. It was revealed that 180 families were illiterates. Find the probable limits of the illiterate families in the population of 2000. **(07 Marks)**

b. Ten individuals are choosen at random from a population and their heights in inches are found to be 63, 63, 64, 65, 66, 69, 69, 70, 70, 71. Discuss the suggestion that the mean height of the population is 65 inches given that $t_{0.05} = 2.262$ for 9 d.f. **(07 Marks)**

c. Find the unique fixed probability vector for the regular stochastic matrix,

$$A = \begin{bmatrix} 0 & 1 & 0 \\ \frac{1}{6} & \frac{1}{2} & \frac{1}{3} \\ 0 & \frac{2}{3} & \frac{1}{3} \end{bmatrix}.$$

(06 Marks)

OR

10 a. Four coins are tossed 100 times and the following results were obtained. Fit a binomial distribution for the data and test the goodness of fit ($x^2_{0.05} = 9.49$ for 4 d.f) **(07 Marks)**

No. of heads	0	1	2	3	4
Frequency	5	29	36	25	5

b. The transition probability matrix of a Markov chain is given by,

$$P = \begin{bmatrix} \frac{1}{2} & 0 & \frac{1}{2} \\ 1 & 0 & 0 \\ \frac{1}{4} & \frac{1}{2} & \frac{1}{4} \end{bmatrix}$$

and the initial probability distribution is $P^{(0)} = \left(\frac{1}{2}, \frac{1}{2}, 0\right)$. Find $P_{13}^{(2)}$, $P_{23}^{(2)}$, $P^{(2)}$ and $P_1^{(2)}$.

(06 Marks)

c. A man's smoking habits are as follows. If he smokes filters cigarettes one week, he switches to non filter cigarettes the next week with probability 0.2. On the other hand if he smokes nonfilter cigarettes one week there is a probability of 0.7 that he will smoke non filter cigarettes the next week as well. In the long run how often does he smoke filter cigarettes? **(07 Marks)**

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17MATDIP41

Fourth Semester B.E. Degree Examination, Jan./Feb. 2023
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 $\begin{bmatrix} 2 & -1 & -3 & -1 \\ 1 & 2 & 3 & -1 \\ 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & -1 \end{bmatrix}$. **(06 Marks)**

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

c. Solve the system of equations by Gauss Elimination Method $x + y + z = 9$, $x - 2y + 3z = 8$, $2x + y - z = 3$. **(07 Marks)**

OR

2 a. Find the Eigen values and Eigen vectors of the Matrix $\begin{bmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$. **(06 Marks)**

b. Verify Cayley – Hamilton theorem for the matrix $A = \begin{bmatrix} 1 & 4 \\ 2 & 3 \end{bmatrix}$ and find its inverse. **(07 Marks)**

c. Find the Rank of the Matrix $\begin{bmatrix} 1 & 2 & 3 & 2 \\ 2 & 3 & 5 & 1 \\ 1 & 3 & 4 & 5 \end{bmatrix}$. **(07 Marks)**

Module-2

3 a. Solve $\frac{d^3y}{dx^3} + 6\frac{d^2y}{dx^2} + 11\frac{dy}{dx} + 6y = 0$. **(06 Marks)**

b. Solve $\frac{d^2y}{dx^2} - 6\frac{dy}{dx} + 9y = 5e^{-2x}$. **(07 Marks)**

c. Solve $\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 13y = \cos 2x$. **(07 Marks)**

OR

4 a. Solve $\frac{d^2y}{dx^2} + 4y = \sin^2 x$. **(06 Marks)**

b. Solve $(4D^4 - 4D^3 - 23D^2 + 12D + 36)\, y = 0$. **(07 Marks)**

c. Solve $\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 4y = x^2$. **(07 Marks)**

Module-3

5 a. Find the Laplace Transform of the function $\sin 5t \cos 2t$. **(06 Marks)**

b. Find the $L\left[\frac{\cos at - \cos bt}{t}\right]$. **(07 Marks)**

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c. Find the Laplace Transform of the Periodic function defined by $f(t) = \frac{Kt}{T}$, $0 < t < T$, $f(t + T) = f(t)$. **(07 Marks)**

OR

6 a. Find Laplace Transform of $[(3t + 4)^3 + 5^t]$. **(06 Marks)**

b. Find $L[t \cos at]$. **(07 Marks)**

c. Express the following function interms of Unit step function and hence find its Laplace Transform, where

$$f(t) = \begin{cases} t , & 0 < t < 4 \\ 5 , & t > 4 \end{cases}.$$

(07 Marks)

Module-4

7 a. i) Find $L^{-1}\left[\frac{s}{s^2 - 16}\right]$ ii) Find $L^{-1}\left[\frac{(s+2)^3}{s^6}\right]$. **(06 Marks)**

b. Find $L^{-1}\left[\frac{2s^2 + 5s - 4}{s(s-1)(s+2)}\right]$. **(07 Marks)**

c. Find $L^{-1}\left[\frac{2s - 1}{s^2 + 4s + 29}\right]$. **(07 Marks)**

OR

8 a. Find $L^{-1}\left[\frac{3}{s^2} + 2\frac{e^{-s}}{s^3} - 3\frac{e^{-2s}}{s}\right]$. **(06 Marks)**

b. Find $L^{-1}\left[\frac{3s + 2}{(s-2)(s+1)}\right]$. **(07 Marks)**

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

Module-5

9 a. State and prove Addition Theorem of probability $P(A \cup B) = P(A) + P(B) - P(A \cap B)$. **(06 Marks)**

b. The probability that an integrated circuit chip will have defective etching is 0.12. The probability that it will have a crack defect is 0.29 and the probability that it will have both defects is 0.07. What is the probability that a newly manufactured chip will have i) an etching of crack defect? ii) neither defect? **(07 Marks)**

c. If A and B are events with $P(A \cup B) = \frac{7}{8}$, $P(A \cap B) = \frac{1}{4}$, $P(A \cap \overline{B}) = \frac{1}{3}$. Find P(A) , P(B) and $P(\overline{A} \cap B)$. **(07 Marks)**

OR

10 a. State and prove Baye's Theorem. **(06 Marks)**

b. In a certain college 4% of Men students and 1% of Women students are taller than 1.8m. Further more 60% of the students are Women. If a student is selected at random and is found taller than 1.8m, what is the probability that the student is a Women? **(07 Marks)**

c. The probability that a communication system will have high fidelity is 0.81 and the probability that it will have high fidelity and high selectivity is 0.18. Find the probability that a system will have high selectivity, given it has high fidelity. **(07 Marks)**

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17EC44

Fourth Semester B.E. Degree Examination, Jan./Feb. 2023
Principles of Communication 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. Illustrate the time domain and frequency domain characteristics of standard Amplitude modulation produced by a single tone. (08 Marks)

b. A carried wave 4 sin $(2\pi \times 500 \times 10^3\ t)$ volts is amplitude modulated by an audio wave 0.2 sin 3 $[(2\pi \times 500t) + 0.1$ sin 5 $(2\pi \times 500t)]$ volts. Determine the upper and lower side band and sketch the complete spectrum of the modulated wave. Estimate the total power in the sideband. (08 Marks)

c. Discuss coherent detection of DSBSC modulated waves. (04 Marks)

OR

2 a. Discuss the concept of Frequency Translation process with the help of block diagram and spectrum. (07 Marks)

b. Explain the system of Quadrature carried multiplexing. (07 Marks)

c. Compare the parameters of DSBSC and VSB modulation system. (06 Marks)

Module-2

3 a. Explain single tone-frequency modulation. Derive necessary FM equation. (08 Marks)

b. Calculate the carrier swing, carrier frequency freq deviation and modulation index for an FM wave, which reaches max freq of 99.047 MHz and minimum frequency of 99.023 MHz. The frequency of modulating signal is 7 kHz. (08 Marks)

c. Explain Direct Method of generating FM wave. Draw block diagram of Generating WBFM wave with frequency stabilization. (04 Marks)

OR

4 a. Explain FM demodulation using PLL. Develop non-linear model of PLL. (10 Marks)

b. Explain with block diagram FM Stereo Multiplexing. (10 Marks)

Module-3

5 a. Explain the conditional probability with mathematical expressions. State and prove Baye's rule. (07 Marks)

b. Define and write the expressions for mean, correlation and covariance function. (07 Marks)

c. Explain the properties of auto correlation function with mathematical expressions. (06 Marks)

OR

6 a. Briefly explain the noises such as shot noise, thermal noise and white noise. (09 Marks)

b. Derive an expression for noise equivalent Bandwidth, with relevant circuit and equations. (07 Marks)

c. Briefly explain the Noise factor and noise figure with equations. (04 Marks)

Module-4

7 a. Derive the figure of merit of AM Receivers. (10 Marks)

b. Explain about pre – emphasis and de – emphasis in FM system. (10 Marks)

OR

8 a. Show that the figure of merit of FM is $\frac{3}{2}\beta^2$. (14 Marks)

b. An AM receiver operating with a sinusoidal modulating signal has the following specifications. $M = 0.8$ $\varepsilon[SNR]_0 = 30dB$. What is the corresponding signal to noise ratio. (06 Marks)

Module-5

9 a. A continuous time signal X(t) has a bandwidth $F_3 = 10$ kHz and it is sampled at $F_s = 22$ kHz using 8bit/sample. The signal is properly scaled. So that $|X(n)| < 128$ for all n.

(i) Determine your best estimate of the variance of the quantization error σ_e^2.

(ii) We want to increase the sampling rate by 16 times. How many bits per samples you would use in order to maintain the same level of quantization? (08 Marks)

b. State and prove sampling theorem. (08 Marks)

c. Mention advantages of digital communication. (04 Marks)

OR

10 a. Explain TDM with neat block diagram. (10 Marks)

b. Find the Nyquist rate and Nyquist interval for:

i) $m_1(t) = \frac{1}{2\pi}\cos(4000\pi t)\cos(1000\pi t)$

ii) $m_2(t) = \frac{\sin 500\pi t}{\pi t}$ (10 Marks)

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