CBCS SCHEME

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15MAT41

Fourth Semester B.E. Degree Examination, Jan./Feb. 2021
Engineering Mathematics - IV

Time: 3 hrs. Max. Marks: 80

Note: 1. ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. ***Use of Statistical table is allowed.***

Module-1

1 a. Employ Taylor's Series Method to find 'y' at x = 0.2. Given the linear differential equation $\frac{dy}{dx} = 3e^x + 2y$ and y = 0 at x = 0 initially considering the terms upto the third degree. **(05 Marks)**

b. Use fourth order Runge – Kutta method to solve $(x + y)\frac{dy}{dx} = 1$, y(0.4) = 1 at x = 0.5 correct to four decimal places (Take h = 0.1). **(05 Marks)**

c. Apply Adams – Bash fourth method to solve $\frac{dy}{dx} = x^2(1 + y)$, given that y(1) = 1, y(1.1) = 1.233, y(1.2) = 1.548 and y(1.3) = 1.979 to evaluate y(1.4). **(06 Marks)**

OR

2 a. Given $\frac{dy}{dx} = x^2 + y$, y(0) = 1. Find correct to four decimal places y(0.1) using modified Euler's method taking h = 0.05. **(06 Marks)**

b. Use Milne's Predictor and Corrector method to compute y at x = 0.4, given $\frac{dy}{dx} = 2e^x - y$ and

x	0	0.1	0.2	0.3
y	2	2.010	2.040	2.090

(05 Marks)

c. Use Fourth order Runge – Kutta method to fond y(1.1), given $\frac{dy}{dx} + y - 2x = 0$, y(1) = 3 with step size h = 0.1. **(05 Marks)**

Module-2

3 a. Given $\frac{d^2y}{dx^2} - x\frac{dy}{dx} - y = 0$ with the initial conditions y(0) = 1, y'(0) = 0. Compute y(0.2) using Runge – Kutta method. **(05 Marks)**

b. Show that $J_{1/2}(1) = \sqrt{\frac{2}{\pi x}}\sin x$. **(05 Marks)**

c. Derive Rodrigue's formula $P_n(x) = \frac{1}{2^n n!}\frac{d^n}{dx^n}(x^2 - 1)^n$. **(06 Marks)**

OR

4 a. Apply Milne's method to compute y(0.8). Given that $\frac{d^2y}{dx^2} = 2y\frac{dy}{dx}$ and the following table of initial values. (05 Marks)

x	0	0.2	0.4	0.6
y	0	0.2027	0.4228	0.6841
y'	1	1.041	1.179	1.468

b. Express $f(x) = x^3 + 2x^2 - 4x + 5$ interms of Legendre Polynomials. (05 Marks)

c. Show that $\int_0^1 x\, J_n(\alpha x)\, J_n(\beta x)\, dx = 0$, If $\alpha \neq \beta$. Where α , β are roots of $J_n(x) = 0$. (06 Marks)

Module-3

5 a. Derive Cauchy – Riemann equations in Cartesian form. (05 Marks)

b. Using Cauchy's Residue theorem, evaluate the integral $\int_C \frac{ze^z}{z^2-1}dz$, where C is the circle $|Z| = 2$. (05 Marks)

c. Find the Bilinear transformation that transforms the points $Z_1 = 0$, $Z_2 = 1$, $Z_3 = \infty$ into the points $W_1 = -5$, $W_2 = -1$, $W_3 = 3$ respectively. (06 Marks)

OR

6 a. State and prove Cauchy's theorem. (05 Marks)

b. Evaluate $\int_C \frac{\sin^2 Z}{(Z-\pi/6)^3}dz$, where 'C' is the circle $|Z| = 1$, using Cauchy's integral formula. (05 Marks)

c. Construct the analytic function whose real part is $x + e^x \cos y$. (06 Marks)

Module-4

7 a. Obtain Mean and Variance of Exponential distribution. (05 Marks)

b. Find the binomial probability distribution which has mean 2 and variance $\frac{4}{3}$. (05 Marks)

c. The Joint probabilities distribution for two Random Variations X and Y as follows :

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

Find i) Marginal distributions of X and Y ii) Co-variance of X and Y. Also verify that X and Y are independent iii) Correlation of X and Y. (06 Marks)

OR

8 a. A certain number of articles manufactured in one batch were classified into three categories according to a particular characteristic, being less than 50, between 50 and 60 and greater than 60. If this characteristic is known to be normally distributed, determine the mean and standard deviation for this batch if 60% , 35% and 5% were found in these categories. [$\phi(0.25) = 0.0987$, $\phi(1.65) = 0.4505$]. (05 Marks)

b. Obtain the mean and standard deviation of Poisson distribution. (05 Marks)

c. Define Random variable. The pdf of a variate X is given by the following table :

X	0	1	2	3	4	5	6
P(X)	K	3K	5K	7K	9K	11K	13K

i) Find K, if this represents a valid probability distribution.

ii) Find $P(x \geq 5)$ and $P(3 < x \leq 6)$. **(06 Marks)**

Module-5

9 a. Coins are tossed 100 times and the following results were obtained. Fit a binomial distribution for the data and test the goodness of fit [$\Psi^2_{0.05} = 9.49$ for 4 d.f]. **(06 Marks)**

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

b. Find a Unique fixed Probability vector for the regular stochastic matrix.

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 1/6 & 1/2 & 1/3 \\ 0 & 2/3 & 1/3 \end{bmatrix}$$ **(05 Marks)**

c. A group of boys and girls were given an intelligence test. The mean score. S.D score and numbers in each group are as follows :

	Boys	Girls
Mean	74	70
SD	8	10
n	12	10

Is the difference between the means of the two groups significant at 5% level of significance [$t_{.05} = 2.086$ for 20 d,f]. **(05 Marks)**

OR

10 a. A coin was tossed 400 times and the head turned up 216 times. Test the hypothesis that the coin is unbiased at 5% level of significance. **(05 Marks)**

b. The weight of 1500 ball bearings are normally distributed with a mean of 635 gms and S.D of 1.36 gms. If 300 random samples of size 36 are drawn from this populations. Determine the expected mean and S.D of the sampling distribution of means if sampling is done i) With replacement ii) without replacement. **(05 Marks)**

c. Every year, a man trades his car for a new car. If he has a Maruti, he trades it for an Ambassador. If he has an Ambassador, he trades it for a Santro. However, if he has a Santro, he is just as likely to trade it for a new Santro as a trade it for a Maruti or an Ambassador. In 2000 he bought his first car which was a Santro. Find the probability that he has

i) 2002 Santro ii) 2002 Maruti. **(06 Marks)**

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15EE43

Fourth Semester B.E. Degree Examination, Jan./Feb.2021
Transmission and Distribution

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 effects of high voltage transmission based on the conductor volume, transmission efficiency and percentage line drop. **(08 Marks)**

b. The towers of height 30 m and 90 m respectively. Support a transmission line conductor at water crossing. The horizontal distance between the towers is 500 m. If the tension in the conductor is 1600 kg, find the minimum clearance between the conductor and water and also clearance midway between the supports. Weight of the conductor is 1.5 kg/m. Bases of the towers can be considered to be at water level. **(08 Marks)**

OR

2 a. Derive an expression for sag of a line conductor suspended between equal level supports taking into effects of ice and wind loading. **(08 Marks)**

b. Define string efficiency. Derive an expression for the string efficiency of a 4 disc string. **(08 Marks)**

Module-2

3 a. What is transposition of transmission line? Derive an equation for inductance of a 3-phase line with unsymmetrical spacing but transposed. **(10 Marks)**

b. A two conductor, single phase line operates at 50 Hz. The diameter of each conductor is 30 mm and the spacing between the conductors is 2 m calculate :

(i) Inductance of each conductor per km.
(ii) The loop inductance of the line per km.
(iii) The inductive reactance per km. **(06 Marks)**

OR

4 a. Derive an expression for the capacitance per phase with equilateral spacing. **(10 Marks)**

b. A three phase circuit, 50 Hz line consists of a 3 conductors each of diameter 30 mm. The spacing between conductors is as follows: X to Y = 3.5 m, Y to Z = 5 m and Z to X = 4 m. Find the capacitance and the capacitance reactance / phase / km of the line. The line is transposed at regular intervals. **(06 Marks)**

Module-3

5 a. Obtain the ABCD constants of a medium transmission line using nominal T-method and prove AD – BC = 1. **(10 Marks)**

b. A 3 phase line delivers 3600 kW at a pf of 0.8 lagging to a load. If the sending end voltage is 33 kV, determine (i) The receiving end voltage. (ii) line current (iii) Transmission efficiency.
The resistance and reactance of each conductor are 5.31 Ω and 5.54 Ω respectively. **(06 Marks)**

OR

6 a. Obtain expressions for sending end voltage and current for long transmission line using rigorous solution. **(10 Marks)**

b. A 3-phase, 50 Hz, 150 km line has a resistance, inductive reactance and capacitive shunt admittance of 0.1 Ω, 0.5 Ω and 3×10^{-6} S per km per phase respectively. If the line delivers 50 MW at 110 kV and 0.8 pf lagging, determine the sending end voltage and current. Assume a nominal π circuit for the line. **(06 Marks)**

Module-4

7 a. Describe the phenomenon of corona in overhead transmission lines. Mention the disadvantages of corona. **(06 Marks)**

b. Obtain an expression for the capacitance of a single core cable. **(06 Marks)**

c. The insulation resistance of a single-core cable is 495 MΩ per km. If the core diameter is 2.5 cm and resistivity of insulation is 4.5×10^{14} Ω-cm, find the insulation thickness. **(04 Marks)**

OR

8 a. Obtain expressions for minimum and maximum dielectric stress in a single core cable. Hence prove that, $\frac{g_{max}}{g_{min}} = \frac{D}{d}$, where D = Sheath diameter , d = Core diameter. **(08 Marks)**

b. A single core cable of conductor diameter 2 cm and lead sheath of diameter 5.3 cm is to be used on a 66 kV, 3 phase system. Two intersheaths of diameter 3.1 cm and 4.2 cm are introduced between the core and lead sheath. If the maximum stress in the layers is the same, find the voltages on the intersheaths. **(08 Marks)**

Module-5

9 a. Explain radial and ring main distribution systems. What are the advantages and disadvantages of radial distribution? **(10 Marks)**

b. A 2-wire dc distributor AB, 900m long is fed at A at 400 V and loads of 50 A, 100 A, 150 A are tapped off from C, D and E which are at a distance of 200 m, 500 m and 800 m from Point A respectively. The distributor is also loaded uniformly at the rate of 0.5 A/m. If the resistance of distributor per metre is 0.00001 Ω, calculate voltage at,
(i) Point B (ii) at Point D. **(06 Marks)**

OR

10 a. Explain the probability concepts applied to reliability. **(08 Marks)**

b. A 3-phase, 4-wire distributor supplies a balanced voltage of 400/230 V to a load consisting of 50 A at 0.8 pf lagging for R phase, 50 A at 0.866 pf lagging for Y phase and 50 A at unity pf for B phase. The resistance of each line conductor is 0.2 Ω, calculate the supply end voltage for R phase. The resistance of neutral is 0.4 Ω. **(08 Marks)**

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15EE44

Fourth Semester B.E. Degree Examination, Jan./Feb. 2021
Electric Motors

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. What is back emf? Explain its significance. **(05 Marks)**

b. Derive an expression for the torque of a DC motor. **(05 Marks)**

c. A 250 V DC shunt motor runs at 1000 rpm on No Load and takes 5A. The architecture and shunt field resistance are 0.2 Ω and 250 Ω respectively. Calculate the speed when loaded and taking a current of 50 A. due to armature reaction the field weakness by 3%. **(06 Marks)**

OR

2 a. Explain the different methods of controlling speed of DC shunt motor. **(06 Marks)**

b. Enumerate the various losses in a DC machine. Explain briefly. **(05 Marks)**

c. Draw and explain the characteristics of a DC series motor. **(05 Marks)**

Module-2

3 a. With a neat sketch, explain the important and procedure of conducting swin burne test on DC shunt motor. List the advantages of this test. **(08 Marks)**

b. Describe the Hopkinson's test for two identical shunt motors indicating how the η of each machine on full load is obtained. **(08 Marks)**

OR

4 a. Derive torque equation for a 3ϕ induction motor and derive condition for maximum torque. **(08 Marks)**

b. Discuss the complete torque-slip characteristics of a 3ϕ induction motor including motoring, generating and braking regions. **(08 Marks)**

Module-3

5 a. Starting from the fundamentals develop the equivalent circuit of a polyphase induction motor and explain how the mechanical power developed is taken care of in the equivalent circuit. **(06 Marks)**

b. Draw the circle diagram from No load and SC test of a 3ϕ, 14.92 KW, 400 V, 6 pole induction motor from the following test results (line values).

No load test	400 V	11 A	pf = 0.2 lag
SC test	100 V	25 A	pf = 0.4 lag

Rotor copper loss at stand still is half of the total copper loss. From the circle diagram. Find:
(i) Line currents (ii) Slip (iii) η (iv) pf at Full load **(10 Marks)**

OR

6 a. Explain the phenomenon of cogging and crawling in a 3ϕ induction motor. **(06 Marks)**

b. Explain how the variation in rotor resistance can be achieved in 3ϕ squirrel cage induction motor by deep bar and double cage rotor construction. **(10 Marks)**

Module-4

7 a. What is induction generator? Discuss the principle of operation with the help of a phasor diagram. (10 Marks)

b. Explain the importance of induction generator in grid connected application. (06 Marks)

OR

8 a. Enumerate the methods of starting 3ϕ induction motor. Explain Y-Δ starter of 3ϕ squarrel cage induction motor with a suitable diagram. (08 Marks)

b. Mention the different speed control methods of a 3ϕ induction motor. Explain any one method from each side. (08 Marks)

Module-5

9 a. With neat sketches, explain the construction, working and applications of split phase induction motor. (08 Marks)

b. Describe any one method of starling the single phase induction motor with phasor diagram. (08 Marks)

OR

10 a. Why synchronous motors are not self starting? Explain briefly. (08 Marks)

b. State the methods of starting synchronous motor. Explain any one in detail. (08 Marks)

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15EE45

Fourth Semester B.E. Degree Examination, Jan./Feb. 2021
Electromagnetic Field Theory

Time: 3 hrs. Max. Marks: 80

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Draw neat figures wherever necessary.

Module-1

1 a. Explain spherical coordinate system. Also derive the relation between spherical and Cartesian coordinate system. **(08 Marks)**

b. Find the gradient of the following scalar fields
i) $t = x^2y + e^z$
ii) $w = 10r \sin^2\theta \cos\phi$ **(04 Marks)**

c. If $\vec{F} = (x + 2y + az)\hat{a}_x + (bx - 3y - z)\hat{a}_y + (4x + cy + 2z)\hat{a}_z$
Find the constants a, b and c so that $\vec{F}$ is irrotational. **(04 Marks)**

OR

2 a. Derive an expression for electric field intensity at a point 'P' due to surface charge. **(06 Marks)**

b. State and prove Gauss's law. **(06 Marks)**

c. Three point charges 1μc, 1μc and 0.5μc are placed in air at the corners of an equilateral triangle of 0.5m side. Find the force on 0.5μc charge. **(04 Marks)**

Module-2

3 a. Derive an expression for electric potential at a point due to a point charge. **(06 Marks)**

b. If $V = x - y + xy + 2z$ volts. Find the electric field intensity at P(1, 2, 3) and also the energy stored in a cube of side 2 mts centered at the origin. **(06 Marks)**

c. Given the potential field $V = 3x^2y + 2y^2z + 3xyz$. Find the electric field strength at M(1, 2, -1). **(04 Marks)**

OR

4 a. Describe the boundary conditions between two dielectric media having permitivities ϵ_1 and ϵ_2. **(08 Marks)**

b. A parallel plate capacitor of area 'A' m^2 is filled with a dielectric of permittivity $\epsilon = \epsilon_0\left[1 + \epsilon_r\left(\frac{y}{d}\right)\right]$ where y = 0 at one plate and y = d at the other plate. Obtain an expression for its capacitance. **(08 Marks)**

Module-3

5 a. Using Laplace and equation obtain the capacitance of a spherical shell having inner radius 'a' mts and outer radius 'b' mts. The inner conductor is at a potential V_D and the outer conductor is grounded. **(08 Marks)**

b. Verify whether the following potential factors satisfy Laplace's equation
i) $V = 2x^2 - y^2 - z^2$ volts
ii) $V = 6e\phi z$ **(04 Marks)**

c. Verify whether $v = \frac{k}{r}$ where 'k' is a constant satisfies Laplace equation. **(04 Marks)**

OR

6 a. Derive an expression for magnetic field intensity at a point on the axis of a current carrying short solenoid. **(08 Marks)**

b. Magnetic factor intensity in free space is given by $H = 10e^2\ \hat{a}_\phi$ A/m

i) Find J

ii) Find the current over the circular surface e = 1m; all ϕ; z = 0 **(08 Marks)**

Module-4

7 a. Explain in brief any three magnetic materials. **(06 Marks)**

b. Explain the boundary conditions between two magnetic media. **(06 Marks)**

c. Calculate the inductance of a solenoid of 2000 turns wound tightly on a cylindrical tube of 6cms diameter. The length of the tube is 60 cms and the solenoid is in air. **(04 Marks)**

OR

8 a. With usual notations derive $\nabla X\vec{E} = -\frac{\partial B}{\partial t}$. **(06 Marks)**

b. Derive Lorentz's force equation for the combined field. **(06 Marks)**

c. A conductor 4m long lies along the y-axis with a current of 10 A flowing through it. Find the force on the conductor if the fields on the region is $\vec{B} = 0.05\hat{a}_z wb/m^2$ **(04 Marks)**

Module-5

9 a. Derive Maxwell's equation for time varying fields. **(08 Marks)**

b. A conductor carries a steady current of 'I' amperes. The components of current density vector are $J_x = 2ax$ and $J_y = 2ay$. Find the third component J_z. Derive the relation employed. **(08 Marks)**

OR

10 a. Explain the transverse nature of electro magnetic waves. **(06 Marks)**

b. Derive the relation between $\vec{E}$ and $\vec{H}$ for a conducting medium. **(06 Marks)**

c. The depth of penetration in a certain conducting medium is 0.1m and the frequency is 1MHz. Find the conductivity of the medium. **(04 Marks)**

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15EE46

Fourth Semester B.E. Degree Examination, Jan./Feb. 2021
Operational Amplifiers and Linear IC's

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Analyze the given circuit in [Fig Q1(a)] and derive expressions for closed loop voltage gain (A_f), Inpt Resistance (R_{if}) and Output Resistance (R_{of}) of the circuit, with required diagrams.

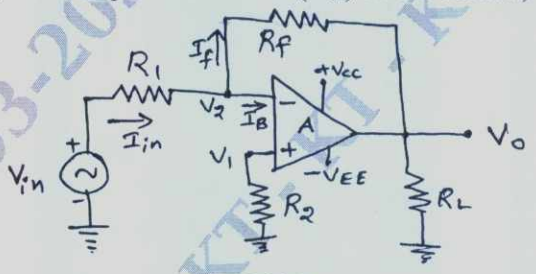

Fig Q1(a) **(10 Marks)**

b. Define the terms slew rate, common-mode rejection ratio and supply voltage rejection rate. **(06 Marks)**

OR

2 a. Explain how a transducer bridge can be connected to an instrumentation amplifier. With required diagram, derive an expression for output voltage of the circuit. What are the applications of instrumentation amplifier? **(08 Marks)**

b. Derive an expression for output voltage (V_o) in the given summing amplifier circuit (Fig Q2(b).

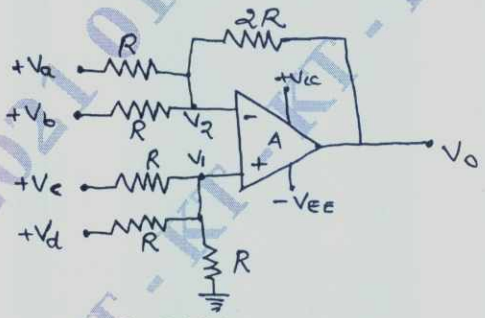

Fig Q2(b) **(08 Marks)**

Module-2

3 a. Derive equations for gain magnitude and phase angle of a First Order Low Pass Filter with required diagrams. Also show how the gain magnitude varies for different input frequencies. **(10 Marks)**

b. Design a wide Band Pass Filter with f_L = 200Hz f_H = 1KHz and a passband gain = 4. Given that capacitance for High pass section = 0.05μF and that of Low Pass section = 0.01μF. Also find quality factor (Q). **(06 Marks)**

OR

4 a. Design a precision Voltage Regulator circuit to provide a 12V output with 50mA maximum load current. Find the value of supply voltage (Vs) required and power dissipation of the circuit. [Use op-amp 741, $I_{B(max)}$ = 500nA and Zener diode 1N757, V_z = 9.1V] **(10 Marks)**

b. With a neat circuit diagram, explain the positive voltage regulator circuit using LM317 IC. Show the output voltage (V_o) equation of the circuit. **(06 Marks)**

Module-3

5 a. Explain the working of a Triangular wave generator circuit with Duty Cycle and Frequency controls. Write the required equations with a neat circuit diagram. **(10 Marks)**

b. Design a Wein bridge oscillator circuit using op-amp to produce a 1KHz and ± 9V output. [Use C_1 = 0.01μF and A_{CL} = 3]. **(06 Marks)**

OR

6 a. With required diagrams and equations, explain how an op-amp circuit output switches between $+V_{osat}$ and $-V_{osat}$ when input voltage, Vin arrives at UTP and LTP, when non-inverting configuration is used. **(08 Marks)**

b. Write short notes on Inverting Zero Crossing Detector, Non-inverting zero crossing Detector and current amplifier. **(08 Marks)**

Module-4

7 a. Sketch an op-amp precision clamping circuit, draw the input and output waveforms and explain the circuit operation. **(08 Marks)**

b. Draw the diagram of op-amp sample and Hold circuit. Sketch the waveforms and explain the circuit operation. **(08 Marks)**

OR

8 a. With a neat sketch, explain the operation of 8-bit Digital to Analog converter using IC 1408. **(08 Marks)**

b. Briefly explain Linear Ramp Analog to Digital converter with the circuit diagram and waveforms. **(08 Marks)**

Module-5

9 a. Draw the block diagrams of phase Locked loop and explain its components briefly. **(08 Marks)**

b. Discuss the working of frequency multiplier with a block diagram. **(04 Marks)**

c. Define the terms Capture Range and Tracking Range. **(04 Marks)**

OR

10 a. Draw the internal block diagram of IC 555 and explain its operation. **(08 Marks)**

b. With required diagrams, waveforms and equations, explain the Astable operation of IC 555 timer. **(08 Marks)**

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15MATDIP41

Fourth Semester B.E. Degree Examination, Jan./Feb. 2021
Additional Mathematics – II

Time: 3 hrs. Max. Marks: 80

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. Find the rank of the matrix

$$A = \begin{bmatrix} 2 & 1 & 3 & 5 \\ 4 & 2 & 1 & 3 \\ 8 & 4 & 7 & 13 \\ 8 & 4 & -3 & -1 \end{bmatrix}$$

by applying elementary row transformations. **(06 Marks)**

b. Solve the system of equations by Gauss-elimination method:

$x + y + z = 6$

$x - y + 2z = 5$

$3x + y + z = 8$ **(05 Marks)**

c. Find all eigen values and eigen vectors of the matrix

$$A = \begin{bmatrix} 5 & 4 \\ 1 & 2 \end{bmatrix}$$ **(05 Marks)**

OR

2 a. Find all eigen values and all eigen vectors of the matrix

$$A = \begin{bmatrix} 7 & -2 & 0 \\ -2 & 6 & -2 \\ 0 & -2 & 5 \end{bmatrix}$$ **(06 Marks)**

b. Solve by Gauss elimination method:

$3x + y + 2z = 3$

$2x - 3y - z = -3$

$x + 2y + z = 4$ **(05 Marks)**

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

Module-2

3 a. Solve $(D^3 - 6D^2 + 11D - 6)y = 0$ **(06 Marks)**

b. Solve $(D^2 + 6D + 9)y = 2e^{-3x}$ **(05 Marks)**

c. Solve by the method of variation of parameters $(D^2 + 1)y = \tan x$. **(05 Marks)**

OR

4 a. Solve $(D^3 - 5D^2 + 8D - 4)y = 0$ **(06 Marks)**

b. Solve $(D^2 - 4D + 3)y = \cos 2x$ **(05 Marks)**

c. Solve by the method of undetermined coefficients $y'' - y' - 2y = 1 - 2x$. **(05 Marks)**

Module-3

5 a. Find Laplace transform of $\cos^3 at$. (06 Marks)

b. A periodic function of period 2a is defined by

$$f(t) = \begin{cases} E & \text{for } 0 \le t \le a \\ -E & \text{for } a \le t \le 2a \end{cases}$$ where E is a constant. Find $L\{f(t)\}$. (05 Marks)

c. Express the function $f(t) = \begin{cases} \cos t, & t \le \pi \\ \sin t, & t > \pi \end{cases}$ in terms of unit step function and hence find its Laplace transform. (05 Marks)

OR

6 a. Find $L\left\{\dfrac{\cos at - \cos bt}{t}\right\}$ (06 Marks)

b. Find $L\{\sin t \sin 2t \sin 3t\}$ (05 Marks)

c. Express the function $f(t) = \begin{cases} t^2, & t \le 2 \\ 4t, & t > 2 \end{cases}$ in terms of unit step function and hence find its Laplace transform. (05 Marks)

Module-4

7 a. Find $L^{-1}\left\{\dfrac{2s+3}{s^3 - 6s^2 + 11s - 6}\right\}$ (06 Marks)

b. Find $L^{-1}\left\{\cot^{-1}\left(\dfrac{s}{a}\right)\right\}$ (05 Marks)

c. Using Laplace transform method, solve the initial value problem $y'' + 5y' + 6y = 5e^{2t}$, given that $y(0) = 2$ and $y'(0) = 1$. (05 Marks)

OR

8 a. Find $L^{-1}\left\{\dfrac{s+2}{s^2 - 4s + 13}\right\}$ (06 Marks)

b. Find $L^{-1}\left\{\log\left(\dfrac{s^2+1}{s(s+1)}\right)\right\}$ (05 Marks)

c. Using Laplace transforms, solve the initial value problem $y' + y = \sin t$, given that $y(0) = 0$. (05 Marks)

Module-5

9 a. For any two events A and B, prove that $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ (06 Marks)

b. If A and B are any two events with $P(A) = \frac{1}{2}$, $P(B) = \frac{1}{3}$ and $P(A \cap B) = \frac{1}{4}$, find P(A/B), P(B/A), $P(\overline{A}/\overline{B})$ and $P(\overline{B}/\overline{A})$ (05 Marks)

c. From 6 positive and 8 negative numbers, 4 numbers are selected at random and are multiplied. What is the probability that the product is positive? (05 Marks)

OR

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

b. A book shelf contains 20 books of which 12 are on electronics and 8 are on mathematics. If 3 books are selected at random, find the probability that all the 3 books are on the same subject. (05 Marks)

c. The machines A, B, C produce 50%, 30% and 20% of the items in a factory. The percentage of defective outputs of these machines are 3, 4 and 5 respectively. If an item is selected at random is found to be defective, then determine the probability that the item was manufactured by machine A. (05 Marks)