CBCS SCHEME

USN | | | | | | | | | | | **15MAT41**

Fourth Semester B.E. Degree Examination, July/August 2021
Engineering Mathematics – IV

Time: 3 hrs. Max. Marks:80

Note: ***Answer any FIVE full questions.***

1 a. Find y at x = 0.4 correct to 4 decimal places given $\frac{dy}{dx} = 2xy + 1$; y(0) = 0 applying Taylor's series method upto third degree term. **(05 Marks)**

b. Using modified Euler's method find y(0.2) correct to four decimal places solving the equation $y' = x - y^2$, y(0) = 1 taking h = 0.1. Use modified Euler's formula twice. **(05 Marks)**

c. 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. **(06 Marks)**

2 a. Using Runge-Kutta method of fourth order, find y(0.2) for the equation $\frac{dy}{dx} = \frac{y - x}{y + x}$, y(0) = 1 by taking h = 0.2. **(05 Marks)**

b. Apply Milne's method to find y at x = 1.4 correct to four decimal places given $\frac{dy}{dx} = x^2 + \frac{y}{2}$ and the following data y(1) = 2, y(1.1) = 2.2156, y(1.2) = 2.4649, y(1.3) = 2.7514. **(05 Marks)**

c. Find the value of y at x = 4.4 by applying Adams – Bashforth method given that $5x\frac{dy}{dx} + y^2 - 2 = 0$ with the initial values of y : $y_0 = 1$, $y_1 = 1.0049$, $y_2 = 1.0097$, $y_3 = 1.0142$ corresponding to the values of x : $x_0 = 4$, $x_1 = 4.1$m, $x_2 = 4.2$, $x_3 = 4.3$. **(06 Marks)**

3 a. Apply Milne's predictor – corrector method to compute y(0.4) given the differential equation $y'' + 3xy' - 6y = 0$ and the following table of initial values. **(05 Marks)**

x	0	0.1	0.2	0.3
y	1	1.03995	1.13803	1.29865
y′	0.1	0.6955	1.258	1.873

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

c. Express $f(x) = 4x^3 + 6x^2 + 7x + 2$ in terms of Legendre polynomials. **(06 Marks)**

4 a. Given $y'' - xy' - y = 0$ with the initial conditions y(0) = 1, y′(0) = 0, compute y(0.2) using fourth order Runge – Kutta method. **(05 Marks)**

b. Prove the Rodrigues formula $P_n(x) = \frac{1}{2^n n!}\frac{d^n}{dx^n}(x^2 - 1)^n$. **(05 Marks)**

c. Obtain the series solution of Bessel's differential equation $x^2y'' + xy' + (x^2 + n^2)y = 0$. **(06 Marks)**

5 a. State and prove Cauchy's – Riemann equation in polar form. **(05 Marks)**

b. Discuss the transformation $W = Z^2$. **(05 Marks)**

c. Using Cauchy's residue theorem evaluate :

$$\int_C \frac{z\cos z}{(z - \frac{\pi}{2})^3} dz \quad \text{where} \quad C : |z - 1| = 1.$$ **(06 Marks)**

6 a. Find an analytical function whose real part is $e^{-x}\left[(x^2-y^2)\cos y + 2xy\sin y\right]$. **(05 Marks)**

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

c. Find the bilinear transformation which maps the points Z = 1, i, –1 into w = 0, 1, ∞. **(06 Marks)**

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

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

Find : i) K ii) Evaluate $P(x < 6)$ $P(x \geq 6)$ and $P(0 < x < 5)$. **(05 Marks)**

b. Find the mean and standard deviation of the exponential distribution. **(05 Marks)**

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

X \ Y	–2	–1	4	5
1	0.1	0.2	0	0.3
2	0.2	0.1	0.1	0

Determine :
i) Marginal distribution of X and Y
ii) Expectation of X
iii) S.D of Y
iv) Covariance of X and Y
v) Correlation of X and Y. **(06 Marks)**

8 a. A random variable x has the following density function :

$$f(x) = \begin{cases} Kx^2, & 0 < x < 3 \\ 0, & \text{otherwise} \end{cases}$$

Evaluate : i) K ii) $P(1 < x < 2)$ iii) $P(x \leq 1)$ iv) $P(x > 1)$ v) Mean. **(05 Marks)**

b. In a quiz contest of answering 'Yes' or 'No' what is the probability of guessing atleast 6 answers correctly out of 10 questions asked? Also find the probability of the same if there are 4 options for a correct answer. **(05 Marks)**

c. In a normal distribution 31% of the items are under 45 and 8% of the items are over 64. Find the mean and S.D of the distribution. It is given that if :

$$P(Z) = \frac{1}{\sqrt{2\pi}} \int_0^z e^{-z^2/2} dz$$

then $A(-0.4958) = 0.19$ and $A(1.405) = 0.42$. **(06 Marks)**

9 a. The weights of 1500 ball bearings are normally distributed with a mean of 635gms and S.D of 1.36gms. If 300 random samples of size 36 are drawn from this population, 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)**

b. Two athletes A and B were tested according to the time (in seconds) to run a particular race with the following results.

Athlete A	28	30	32	33	33	29	34
Athlete B	29	30	30	24	27	29	

Test whether you can discriminate between the two Athletes. ($t_{0.05} = 2.2$ and $t_{0.02} = 2.72$ for 11d.f). **(05 Marks)**

c. A student's study habits are as follows. If he studies one night, he is 70% sure not to study the next night. On the other hand if he does not study one night, he is 60% sure not to study the next night. In the long run how often does he study? **(06 Marks)**

10 a. The mean and S.D of the maximum loads supported by 60 cables are 11.09 tonnes and 0.73 tonnes respectively. Find : i) 95% ii) 99% confidence limits for mean of the maximum loads of all cables produced by the company. **(05 Marks)**

b. Fit a Poisson distribution for the following data and test the goodness of fit given that $\chi^2_{0.05} = 7.815$ for 3d.f.

x	0	1	2	3	4
f	122	60	15	2	1

(05 Marks)

c. Show that $P = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ \frac{1}{2} & \frac{1}{2} & 0 \end{bmatrix}$ is a regular stochastic matrix. Also find the associated unique fixed probability vector. **(06 Marks)**

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CBCS SCHEME

USN | | | | | | | | | | 15EE43

Fourth Semester B.E. Degree Examination, July/August 2021
Transmission & Distribution

Time: 3 hrs. Max. Marks: 80

Note: ***Answer any FIVE full questions.***

1 a. Explain with the help of line diagram a typical transmission and distribution system scheme indicating the standard voltages. **(06 Marks)**

b. Derive the expression for sag in overhead transmission line conductor with supports at same levels. **(08 Marks)**

c. Mention different types of insulators. **(02 Marks)**

2 a. An overhead transmission line at river crossing is supported from two towers at heights 40 meters and 90 meters above water level, the horizontal distance between the towers being 400 meters. The maximum allowable tension is 2000 kg. Find the clearance between the conductor and water at a point midway between the towers. Weight of conductor is 1 kg/mt. **(08 Marks)**

b. A string of 4 insulators has a self capacitance equal to 10 times pin to earth capacitance. Find (i) Voltage distribution of various units as a percentage of total voltage across the string and (ii) String efficiency. **(08 Marks)**

3 a. Derive an expression for the inductance of a 3-phase lines with equilateral spacing. **(06 Marks)**

b. Determine the inductance / km of a double circuit 3-phase line as shown in Fig. Q3 (b). The transmission line is transposed within each circuit and diameter of each conductor is 15 mm. **(10 Marks)**

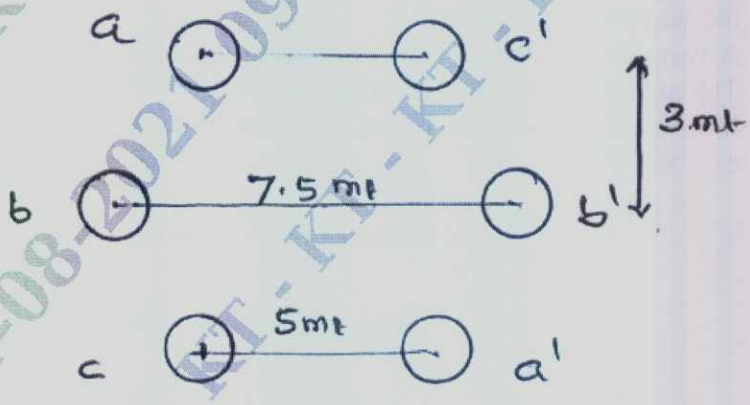

Fig. Q3 (b)

4 a. Derive an expression for the capacitance of a two wire line. **(08 Marks)**

b. Find the capacitance of a single-phase 2 wire-line 40 km long consisting of 2 parallel wires of diameter 5 mm each, 1.5 mt apart also determine the capacitance considering earth effect if the height of the conductor is above ground is 7 meters. **(08 Marks)**

5 a. Derive the expression for ABCD parameters of a medium transmission line using nominal T method. **(08 Marks)**

b. A single phase medium transmission line 80 km long has the following constants:

Resistance / km = 0.3125 Ω   Reactance / km = 1.0 Ω

Susceptance / km = 17.5×10^{-6} S   Receiving end voltage = 66 KV

Assuming that the total capacitance of line is localized at the end alone. Determine (i) Sending current (ii) Sending end voltage (iii) Regulation (iv) Line losses (v) Efficiency

The line is delivering 15 MW at 0.8 p.f. lagging. **(08 Marks)**

6 a. Derive an expression for sending end voltage and current for long transmission line using rigorous method. **(10 Marks)**

b. Explain Ferranti effect in long transmission lines, with the help of a phasor diagram. **(06 Marks)**

7 a. What is meant by grading of cable? Explain capacitance grading. **(08 Marks)**

b. A single core lead covered cable has a conductor diameter of 3 cm with insulation diameter of 8.5 cm. The cable is insulated with two dielectric with permittivities 5 and 3 respectively. The maximum stresses in the two dielectrics are 38 KV/cm and 26 KV/cm respectively. Then calculate radial thickness of insulating layers and the working voltage of the cable. **(08 Marks)**

8 a. State and explain factors affecting corona and corona loss. **(08 Marks)**

b. A 132 KV, 3 phase line with 1.956 cm diameter conductor in built so that corona takes place, if the line voltage exceeds 210 KV(rms). If the value of potential gradient at which ionization occurs can be taken as 30 KV per cm. Find the spacing between the conductors. Assume $\delta = 1$ and $M_0 = 1$. **(04 Marks)**

c. Write a note on disruptive critical voltage. **(04 Marks)**

9 a. Draw and explain the phasor diagram for an AC distributor with power factors referred to the receiving end voltage. **(08 Marks)**

b. A two wire distributor 1200 mt long is loaded as shown in Fig. Q9 (b), B is the mid point. The power factors at the two load points refer to the voltage at C. The impedance of each line is $0.15 + j0.2$ ohm. Calculate the sending end voltage, current and power factor at point C is 220 V. **(08 Marks)**

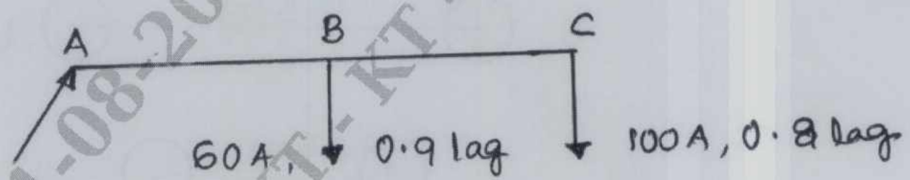

Fig. Q9 (b)

10 a. Explain radial feeders and parallel feeders for AC distribution system. **(08 Marks)**

b. A 3-phase star connected system with 230 volts between each phase and neutral has resistance of 4, 5 and 6 Ω respectively in the 3-phases. Estimate the current flowing in each phase and the neutral current. Find the total power observed. **(08 Marks)**

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CBCS SCHEME

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15EE45

Fourth Semester B.E. Degree Examination, July/August 2021
Electro Magnetic Field Theory

Time: 3 hrs. Max. Marks:80

Note: ***Answer any FIVE full questions.***

1 a. What are scalars and vectors? Explain dof product and cross product. Give the relationship between Cartesian and cylindrical coordinate system. **(08 Marks)**

b. Derive an expression for electric field intensity for an infinite line charge lying on z – axis. **(08 Marks)**

2 a. State and explain Gauss law and hence drive an expression for divergence theorem. **(08 Marks)**

b. If $\overline{D} = xy^2z^2\hat{a}_x + x^2yz^2\hat{a}_y + x^2y^2z\hat{a}_z \, c/m^2$. Find :

i) An expression for ρ_v (volume charge density)

ii) Total charge within the cube defined by $0 \le x \le 2$; $0 \le y \le 2$, $0 \le z \le 2$m. **(08 Marks)**

3 a. Derive energy expanded or work done in moving a point charge in an electric field. With usual notation prove that $\overline{E} = -\overline{\nabla}V$. **(08 Marks)**

b. Find the electric field strength at a point M(1, 2, –1)m given the potential, $V = 3x^2y + 2y^2z + 3xyz$ volts. **(08 Marks)**

4 a. Discuss the boundary conditions at the interface between two dielectric of different permutivities. **(08 Marks)**

b. Determine the capacitance of capacitor consisting of two parallel plates 30mm × 30cm surface area separates by 5mm in air. What is the total energy stored by the capacitor. If potential is charged to a potential difference of 500V? What is the energy density? **(08 Marks)**

5 a. Derive Poisson's and Laplace equations starting from point form of Gauss law. **(08 Marks)**

b. Determine whether the following potential field satisfy the laplace equation or not?

i) $V = x^2 - y^2 + z^2$ ii) $V = r\cos\phi + z$. **(08 Marks)**

6 a. State and explain Biot – Savart law and Amperes circuital law. **(08 Marks)**

b. Find the magnetic field intensity and flux density at a point 'P' for the current circuit show in Fig.Q6(b).

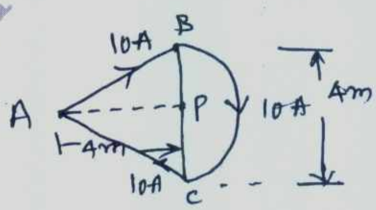

Fig.Q6(b) **(08 Marks)**

7 a. State and explain Lorentz force equation. **(08 Marks)**

b. A point charge Q = –50nc is moving in a magnetic field of density, $\overline{B} = 2\hat{a}_x - 3\hat{a}_y + 5\hat{a}_z$ mT with a velocity of 6×10^6m/sec. Calculate the force in the direction specified by the unit vector = $-0.48\hat{a}_x - 0.6\hat{a}_y + 0.64\hat{a}_z$. **(08 Marks)**

8 a. Obtain the relationship between α_1 and α_2 interns of relative permeabilities of the two media μ_{r_1} and μ_{r_2}. **(08 Marks)**

b. Calculate the inductance of a solenoid of 600 turns wound on a cylindrical tube 6cm in diameter. The length of the tube is 60cm and the medium is air. **(08 Marks)**

9 a. Write Maxwell's equation is point form and integral form for time varying fields. **(08 Marks)**

b. Derive an expression for Maxwell's 2nd equation for time varying field from Ampers Circuital Law. $\overline{\nabla} \times \overline{H} = \overline{J} + \frac{\partial \overline{D}}{\partial t}$. **(08 Marks)**

10 a. State and explain pointing theorem. **(08 Marks)**

b. The electric field of uniform plane wave is given by

$\overline{E} = 40\sin(30\pi \times 10^6 t - 2\pi z)\hat{a}_x + 40\cos(30\pi \times 10^6 t - 2\pi z)\hat{a}_y$ v/m

Find :
i) Frequency of operation
ii) Wave length
iii) Direction of propagation of wave
iv) Associated magnetic field. **(08 Marks)**

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CBCS SCHEME

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15EE46

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

Time: 3 hrs. Max. Marks:80

Note: *Answer any FIVE full questions.*

1 a. Explain with the block diagram a typical operational amplifier. **(06 Marks)**
b. Explain with a neat circuit diagram the operation of instrumentation amplifier. **(05 Marks)**
c. An inverting amplifier has R_1 = 8.2kΩ and R_2 = 270Ω, i) determine the voltage gain ii) calculate a new resistance for R_2 to give A_{CL} = 60. (Refer Fig.Q1(c)).

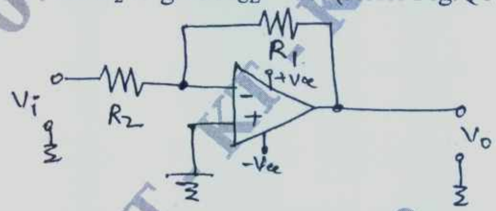

Fig.Q1(c) Inverting Amplifier **(05 Marks)**

2 a. Explain with a neat circuit diagram the operation of difference amplifier. **(06 Marks)**
b. Explain with a neat circuit diagram of a open loop op-amp configurations. **(05 Marks)**
c. Using a 741 op-amp, design a non inverting amplifier to have a voltage gain of approximately 66. The signal amplitude is to be 15mV. **(05 Marks)**

3 a. Explain the operation of first order high pass filter with its circuit diagram and its frequency response. **(06 Marks)**
b. Explain with a neat sketch the operation of LM 317, IC positive voltage regulator. **(05 Marks)**
c. An unregulated DC power supply output changes from 20V to 19.7V when the load is increased from zero to maximum. The voltage also increases to 20.2V when the AC supply increases by 10%. Calculate the load and source effects and the load and line regulation. **(05 Marks)**

4 a. Explain with a neat circuit diagram the operation of an adjustable output regulator. **(06 Marks)**
b. Explain with a block diagram and response curve how band stop filter can be obtained using low pass, high pass and a summing circuit. **(05 Marks)**
c. Design a second order low pass filter at a high cut off frequency of 1KHz. **(05 Marks)**

5 a. Explain the operation of op-amp based RC phase shift oscillator with the necessary circuit diagram. **(06 Marks)**
b. Explain with neat circuit diagram and wave forms the operation of a zero crossing detector. **(05 Marks)**
c. Design a inverting Schmitt trigger circuit to give triggering points of ±2V. **(05 Marks)**

6 a. Explain with neat circuit diagram and waveforms the operation of non-inverting Schmitt trigger. **(06 Marks)**
b. Explain with circuit diagram the signal generator output controls. **(05 Marks)**
c. Design the Wein bridge oscillator using op-amp to produce a 1KHz, ±9V output. **(05 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.

7 a. Sketch and explain the working of op-amp sample and hold circuit. **(06 Marks)**
b. Explain the operation of a full wave rectifier circuit using a precision half wave circuit and a summing circuit. **(05 Marks)**
c. Explain the operation of the Dual slope integrator ADC with neat sketch and wave forms. **(05 Marks)**

8 a. Explain with the neat circuit diagram the operation of R – 2R DAC. **(06 Marks)**
b. Explain with the help of schematic diagram and wave forms the operation of digital Ramp ADC. **(05 Marks)**
c. Explain with neat circuit diagram the operation of a voltage follower peak detector. **(05 Marks)**

9 a. What is phase locked loops? Explain the operation the working of the building blocks of PLL. **(08 Marks)**
b. Explain with the neat block diagram the internal structure of 555 Timer. **(08 Marks)**

10 a. Explain with the neat circuit diagram and waveforms the design of Astable multivibrators. **(08 Marks)**
b. Explain the functional block diagram of the integrated circuit 565 PLL system. **(08 Marks)**

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CBCS SCHEME

USN | | | | | | | | | |

15MATDIP41

Fourth Semester B.E. Degree Examination, July/August 2021
Additional Mathematics – II

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions.

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.

1 a. Determine the rank of the matrix $A = \begin{bmatrix} 0 & 1 & -3 & -1 \\ 1 & 0 & 1 & 1 \\ 3 & 1 & 0 & 2 \\ 1 & 1 & -2 & 0 \end{bmatrix}$ by applying elementary row transformations. **(05 Marks)**

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

c. Solve by Gauss elimination method

$2x + y + 4z = 12$

$4x + 11y - z = 33$

$8x - 3y + 2z = 20$ **(06 Marks)**

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

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

$x + y + z = 9$

$x - 2y + 3z = 8$

$2x + y - z = 3$ **(06 Marks)**

c. Find the rank of the matrix by reducing it to echelon form.

$$\begin{bmatrix} -2 & -1 & -3 & -1 \\ 1 & 2 & 3 & 1 \\ 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & 1 \end{bmatrix}$$ **(05 Marks)**

3 a. Solve $\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 5y = 0$ subject to $\frac{dy}{dx} = 2$, $y = 1$ at $x = 0$. **(05 Marks)**

b. Solve $(4D^4 - 4D^3 - 23D^2 + 12D + 36)y = 0$. **(05 Marks)**

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

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

b. Solve $y'' + 2y' + y = 2x + x^2$ **(05 Marks)**

c. Using the method of undetermined coefficients, solve $y'' - 5y' + 6y = e^{3x} + x$ **(06 Marks)**

5 a. Find the Laplace transform of (i) $\frac{e^{-at}-e^{-bt}}{t}$ (ii) $\sin 5t \cos 2t$ **(05 Marks)**

b. Find the Laplace transform of

$$f(t)=\begin{cases} E, & 0<t<\frac{a}{2} \\ -E, & \frac{a}{2}<t<a \end{cases} \quad \text{where } f(t+a)=f(t)$$ **(06 Marks)**

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

6 a. Express $f(t)=\begin{cases} \cos t, & 0<t<\pi \\ \cos 2t, & \pi<t<2\pi \\ \cos 3t, & t>2\pi \end{cases}$ in terms of unit step function and hence find its Laplace transform. **(06 Marks)**

b. Find the Laplace Transform of (i) $t \sin at$ (ii) $t^5 e^{4t}$ **(05 Marks)**

c. If $f(t)=t^2$, $0<t<2$ and $f(t+2)=f(t)$ for $t>2$, find $L[f(t)]$. **(05 Marks)**

7 a. Find the inverse Laplace Transform of $\frac{2s-1}{s^2+4s+29}$. **(05 Marks)**

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

c. Solve by using Laplace Transforms $\frac{d^2y}{dt^2}+4\frac{dy}{dt}+4y=e^{-t}$; $y(0)=0$, $y'(0)=0$. **(06 Marks)**

8 a. Solve the initial value problem $y''+4y'+3y=e^{-t}$ conditions with $y(0)=1$, $y'(0)=1$ using Laplace Transforms. **(06 Marks)**

b. Find the inverse Laplace Transform of $\frac{s+2}{s^2(s+3)}$ **(05 Marks)**

c. Find the inverse Laplace Transform of $\log\left[\frac{s^2+4}{s(s+4)(s-4)}\right]$ **(05 Marks)**

9 a. A box contains 3 white, 5 black and 6 red balls. If a ball is drawn at random, what is the probability that it is either red or white? **(05 Marks)**

b. 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)**

c. Three machines A, B and C produce respectively 60%, 30%, 10% of the total number of items of a factory. The percentages 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. **(06 Marks)**

10 a. State and prove Baye's theorem. **(05 Marks)**

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

c. Three students A, B, C, write an entrance examination. Their chances of passing are 1/2, 1/3 and 1/4 respectively. Find the probability that

(i) atleast one of them passes (ii) all of them pass (iii) atleast two of them passes. **(06 Marks)**

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