CBCS SCHEME

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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 :

$\int_C \frac{z\cos z}{(z - \frac{\pi}{2})^3} dz$ where $C : |z - 1| = 1$. **(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 $w = 0, 1, \infty$. (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

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15CV42

Fourth Semester B.E. Degree Examination, July/August 2021
Analysis of Determinate Structures

Time: 3 hrs. Max. Marks: 80

Note: *Answer any FIVE full questions.*

1 a. Distinguish between determinate and indeterminate structures with examples. **(06 Marks)**

b. Determine the degree of static indeterminacy for the structures shown in Fig. Q1 (b). **(10 Marks)**

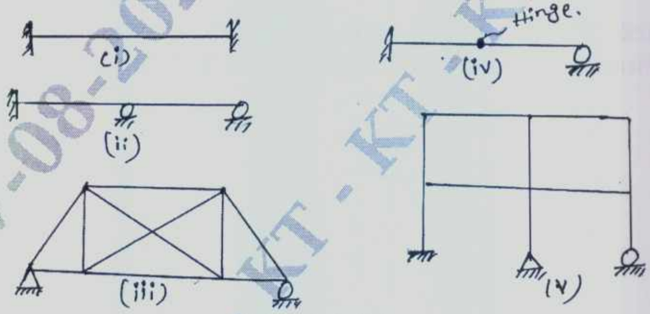

Fig. Q1 (b)

2 Determine the forces in all the members of the truss shown in the Fig. Q2, by the method of joints and verify the forces in members DB, EC and DC by the method of sections. **(16 Marks)**

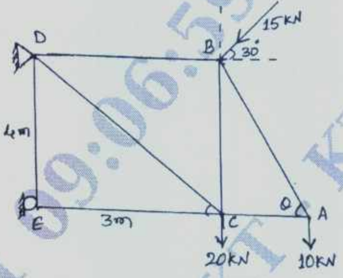

Fig. Q2

3 a. Determine the slope and deflection at the free end for the Cantilever beam shown in Fig. Q3 (a). Using moment area method. **(08 Marks)**

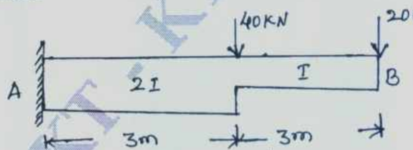

Fig. Q3 (a)

b. Find the deflection under loads and at mid span for the beam shown in Fig. Q3 (b) by conjugate beam method. Also find slope at the supports. **(08 Marks)**

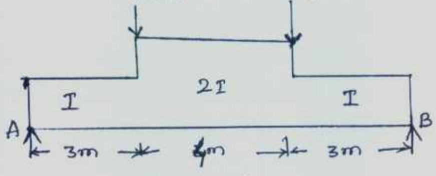

Fig. Q3 (b)

4 a. A Cantilever beam of span 6 m subjected to udl of 20 kN/m over entire span. Determine slope and deflection at free end. Using Double Integration method. **(06 Marks)**

b. A simply supported beam AB of span 7 m and carries a point load of 100 kN at a distance of 4 m from left end A as shown in Fig.Q4 (b). Find the deflection under the load and also maximum deflection in the beam. Using Double Integration Method. **(10 Marks)**

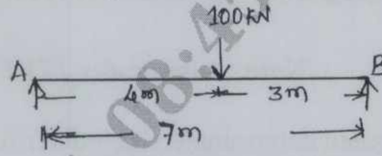

Fig. Q4 (b)

5 A steel truss of span 6 m is loaded as shown in Fig. Q5. The cross sectional area of each member is 500 mm^2. Calculate the vertical deflection at joint B. Take E = 200 GPa. **(16 Marks)**

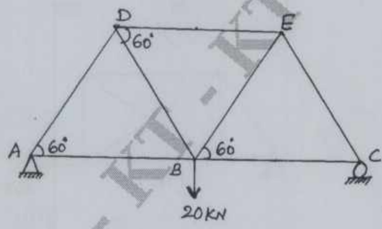

Fig. Q5

6 a. Obtain an expression for strain energy stored in a member when it is subjected to bending. **(06 Marks)**

b. Find the value of vertical and horizontal deflection at 'D' for the structure shown in Fig. Q6 (b) by Castiglione's theorem. **(10 Marks)**

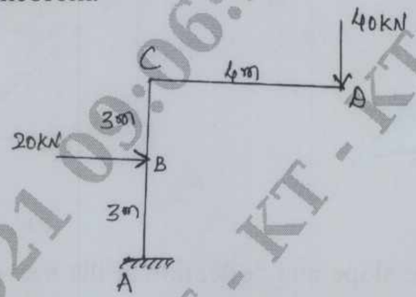

Fig. Q6 (b)

7 A three hinged parabolic arch has a span of 20 m and a rise of 5 m. It carries a udl of 2 kN/m over the left half of the span and a point load of 12 kN at 5 m from the right end. Find the B.M, normal thrust and radial shear at a section 4 m from left end. Draw BMD. **(16 Marks)**

8 A cable is suspended between two points A and B, 100 m apart and a central Dip of 8 m. It carries udl of 20 kN/m.

Determine

(i) Length of the cable.

(ii) Maximum and minimum tension in the cable.

(iii) Size of the cable, if the permissible stress of the cable material is 200 N/mm^2.

(iv) Calculate forces in the tower for both conditions. Take $\theta_A = 25^\circ$. **(16 Marks)**

9 a. What is an Influence line? Explain its importance in structural analysis. **(06 Marks)**

b. An N-type girder of span 12 m has to be designed for the member force CI as shown in Fig. Q9 (b). Draw ILD for member CI. **(10 Marks)**

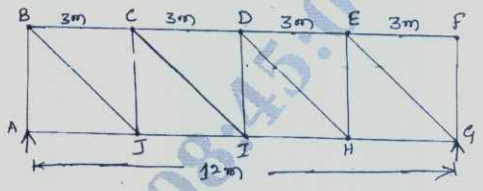

Fig. Q9 (b)

10 a. Using I.L , determine the B.M and S.F at 'X'. Due to the given system of loads as shown in Fig. Q10 (a). **(06 Marks)**

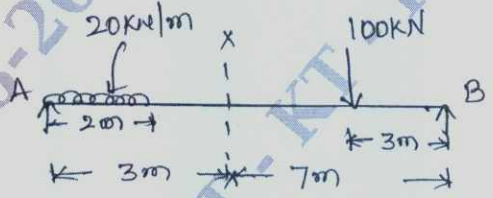

Fig. Q10 (a)

b. For a simply supported beam of span 28 m with the multiple points loads system as shown in Fig. Q10 (b). Compute the following by ILD principles.

(i) Maximum +ve and −ve SF at a section 12 m from left.

(ii) Maximum bending moment at a section 12 m from left. **(10 Marks)**

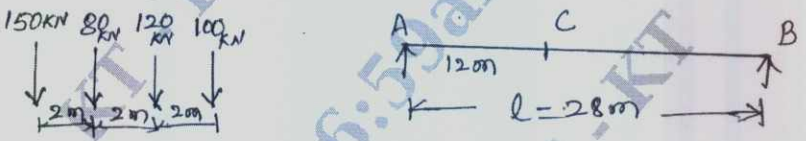

Fig. Q10 (b)

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15CV43

Fourth Semester B.E. Degree Examination, July/August 2021
Applied Hydraulics

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions.

1 a. State the advantages of dimensional analysis. **(03 Marks)**

b. Define the terms: (i) A model (ii) Prototype and state the difference between distorted models and undistorted models. **(06 Marks)**

c. Find the volume of water displaced and position of centre of Buoyancy for a Wooden block of width 2.5 m and depth 1.5 m, when it floats horizontally in water. The density of wooden block is 650 kg/m^3 and its length 6m. **(07 Marks)**

2 a. State the Buckingham, π theorem and mention the advantages. **(04 Marks)**

b. A model of spillway is made to test in the laboratory. The discharge and the velocity of flow over the model is measured as 2.5 m^3/s and 1.5 m/s respectively. Find the discharge and the velocity over the prototype, which is 50 time larger than its model. **(06 Marks)**

c. Define:
(i) Geometric similarity
(ii) Kinematic similarity
(iii) Buoyancy
(iv) Metacentre **(06 Marks)**

3 a. What do you mean by conveyance of a channel section? **(02 Marks)**

b. A flow of water of 100 ℓps flows down in a rectangular flume of width 600 mm and having adjustable bottom slope. If Chezy's C = 56, find the bottom slope necessary for uniform flow with a depth of flow of 300 mm. **(06 Marks)**

c. Define specific energy. Draw specific energy curve and obtain an expression for critical depth and critical velocity. **(08 Marks)**

4 a. What do you mean by most efficient channel section? **(02 Marks)**

b. A Trapezoidal channel with side slopes 1:1 has to be designed to convey 10 m^3/s at a velocity of 2 m/s. So that the amount of concrete lining for the bed and sides is the minimum. Calculate:
(i) Area of lining required for 1m length of the channel
(ii) Bed slope of the channel if, N = 0.015. **(06 Marks)**

c. Derive Chezy's equation for discharge through uniform flow in an open channel. **(08 Marks)**

5 a. Derive the dynamic equation governing Gradually Varied Flow (GVF). **(08 Marks)**

b. In Hydraulic Jump occurring in a rectangular horizontal channel, the discharge per unit width is 2.5 m^3/s/m and the depth before the jump is 0.25 m. Compute : (i) Sequent depth (ii) Energy loss **(08 Marks)**

6 a. Explain the classification of surface profiles in an open channel with neat sketches. **(10 Marks)**

b. A rectangular channel with a bottom width of 4.0 m and a bottom slope of 0.0008 has discharge of 1.5 m^3/s. In a GVF, in this channel, the depth at a certain location is found to be 0.30 m. Assuming n = 0.016, determine the type of GVF profile. **(06 Marks)**

7 a. State Impulse Momentum Principle and give the Impulse Momentum Equation. **(02 Marks)**

b. Prove that the workdone per second by a jet striking on a series of moving curved radial vane is ρ_{av_1} [$Vw_1u_1 \pm Vw_2u_2$] **(08 Marks)**

c. Two jets strike the buckets of a pelton wheel, which is having shaft power as 15450 KW. The diameter of each jet is 200 mm. If the net head of the turbine is 400 m. find the overall efficiency. Assume $C_V = 1$. **(06 Marks)**

8 a. Define (i) Absolute velocity (ii) Relative velocity, in the concept of velocity triangle. **(02 Marks)**

b. Draw a neat sketch of a layout of hydroelectric power plant and name the each component and different heads. **(06 Marks)**

c. A 15 cm diameter jet moving at 30 m/s impinges on a series of vanes moving at 15 m/s in the direction of the jet. The jet leaves the vanes at 60° with the direction of motion of the vanes, calculate:

(i) The force excerted by the jet in the direction of motion of the vanes.

(ii) Workdone by the jet/sec **(08 Marks)**

9 a. Define draft tube and mention its function. Draw the neat sketches of different types of draft tubes. **(06 Marks)**

b. What do you mean by minimum starting speed of a centrifugal pump? Give an expression for the same. **(04 Marks)**

c. A centrifugal pump delivers water against a net head of 10 m at 1000 rpm. The vanes are curved backwards and make an angle of 30° with the tangent at outer pheriphery. The impeller diameter is 30 cm and width is 5 cm at outlet. Determine the discharge if the manometric efficiency is 95%. **(06 Marks)**

10 a. What do you mean by multistage centrifugal pump? Distinguish between pumps in series and pumps in parallel. **(07 Marks)**

b. Define: (i) Unit head (ii) Unit discharge (iii) Unit power **(03 Marks)**

c. A Kaplan turbine develops 15000 KW power at a head of 30 m. The diameter of the boss is 0.35 times the diameter of the runner. Assuming a speed ratio of 2.0, a flow ratio of 0.65 and an overall efficiency of 90%. Calculate:

(i) Diameter of the runner

(ii) Rotational speed

(iii) Specific speed **(06 Marks)**

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15CV45

Fourth Semester B.E. Degree Examination, July/August 2021
Basic Geotechnical Engineering

Time: 3 hrs. Max. Marks: 80

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

1 a. With the help of 3-phase diagram, define Void ratio, Porosity, Water content and degree of saturation. **(08 Marks)**

b. A partially saturated soil sample obtained from an earthfill has a natural moisture content of 22% and a unit weight of 19.62 KN/m^3. Assuming G = 2.7, compute degree of saturation and void ratio. If subsequently the soil gets saturated, determine its unit weight. **(08 Marks)**

2 a. With a neat sketch, explain the importance of plasticity chart. **(08 Marks)**

b. Liquid limit test on a clayey sample gave the following results. The plastic limit of the soil is 20%.

No. of blows	12	18	22	34
Water content, %	56	52	50	45

Plot flow curve and obtain liquid limit, flow index, plasticity index and toughness index. **(08 Marks)**

3 a. Define diffuse double layer and exchangeable ions with neat sketch. **(08 Marks)**

b. Explain the following clay minerals with neat sketches of their basic structural units:
(i) Kaolinite
(ii) Montmorillonite. **(08 Marks)**

4 a. Discuss the effect of compaction on different soil properties. **(06 Marks)**

b. Differentiate between standard and modified proctor tests. **(04 Marks)**

c. The observations of a standard Proctor's test are given below:

Dry density, KN/m^3	16.16	17.06	18.61	18.95	18.78	17.13
Water Content, %	5.02	8.81	11.25	13.05	14.40	19.25

(i) Plot compaction curve and determine OMC.
(ii) Also compute void ratio and degree of saturation at OMC. Take G = 2.77 **(06 Marks)**

5 a. What are the assumptions and limitations of Darcy's law? **(08 Marks)**

b. Explain with a neat sketch the method of locating the phreatic line in a homogeneous earth dam with horizontal filter. **(08 Marks)**

6 a. What is a flownet? Briefly explain the characteristics and user of flownets. **(08 Marks)**

b. A clay structure of thickness 8 m is located at a depth of 6 m below the ground surface, it is overlayed by fine sand. The water table is located at a depth of 2 m below ground surface. For find sand submerged unit weight is 10.2 KN/m^3. The moist unit weight of sand located above the water table is 16 KN/m^3. For clay layer G = 2.76 and W = 25%. Compute the effective stress at the middle of clay layer. **(08 Marks)**

7 a. Explain mass-spring analogy of consolidation of soils. (06 Marks)
b. How preconsolidation pressure is determined by casagrande's method? (06 Marks)
c. A soil sample 2 cms thickness takes 20 minutes to reach 20% consolidation. Find the time for a clay layer 6 cms thick to reach 40% consolidation. Assume double drainage in both the cases. (04 Marks)

8 a. What are curve fitting methods used in consolidation test? Explain any one with a neat sketch. (08 Marks)
b. There is a bed of compressible clay of 4 m thickness with pervious sand on top and impervious rock at the bottom. In a consolidation test on an undisturbed specimen of clay from this deposit, 90% settlement was reached in 4 hours. The specimen was 20 mm thick. Estimate the time in years for the building founded over this deposit to reach 90% of its final settlement. (08 Marks)

9 a. What are the advantages and disadvantages of direct shear test over triaxial shear test? (08 Marks)
b. Explain sensitivity and thixotropy of clay. (08 Marks)

10 a. Explain Mohr-Coulomb failure theory of soil. (06 Marks)
b. What are the factors affecting shear strength of soil? (04 Marks)
c. In a shear test conducted on river sand, the following results were obtained:

Normal stress, KN/m^2	22.2	44.4	66.7	88.9
Shear stress, KN/m^2	13.9	28.06	41.4	55.8

Determine C and ϕ. (06 Marks)

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CBCS SCHEME

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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.

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^5e^{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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