



- Notes :
1. All question carry marks as indicated.
 2. Due credit will be given to neatness and adequate dimensions.
 3. Assume suitable data wherever necessary.
 4. Illustrate your answer necessary with the help of neat sketches.
 5. Use of slide rule logarithmic tables, Steam tables, Moller's Chart, Drawing instrument, Thermodynamic table for moist air, Psychrometric Charts and Refrigeration charts is permitted.
 6. Use of pen Blue/Black ink/refill only for writing the answer book.

1. a) A tightly stretched string with fixed end points $x = 0$ & $x = l$ is initially in a position given by $y = y_0 \sin^3 \frac{\pi x}{l}$. If it is released from rest from this position, find the displacement $y(x, t)$. 7

- b) The temperature distribution in a bar of length π , which is perfectly insulated at the ends of $x = 0$ & $x = \pi$ is governed by the PDE $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$. Assuming the initial temperature distribution as $u(x, 0) = f(x) = \cos 2x$. Find the temperature distribution at any instant of time. 7

OR

2. a) Find the solution of the equation $\frac{\partial^2 y}{\partial t^2} = C^2 \frac{\partial^2 u}{\partial x^2}$ with the condition that at $t = 0$, $y = xe^x$, 7

$$\frac{\partial y}{\partial t} = C(x-1)e^{-x}.$$

- b) Solve the equation $\frac{\partial u}{\partial t} = k \frac{\partial^2 u}{\partial x^2}$ with $u(0, t) = 0$, $\frac{\partial}{\partial x}[u(x, t)] = 0$ for $x = l$ and 7

$$u(x, 0) = \frac{u_0 x}{l} \text{ for } 0 \leq x \leq l.$$

3. a) If $w = \phi + i\psi$ represents the complex potential for an electric field and $\psi = x^2 - y^2 + \frac{x}{x^2 + y^2}$, determine the function ϕ . 5

- b) Prove that $\tanh^{-1} x = \sinh^{-1} \left(\frac{x}{\sqrt{1-x^2}} \right)$. 4

- c) If $i^{\alpha+i\beta} = \alpha + i\beta$, prove that $\alpha^2 + \beta^2 = e^{-(4n+1)\pi\beta}$. 4

OR

4. a) Determine the analytic function whose real part is $e^{2x}(x \cos 2y - y \sin 2y)$. 5
- b) Solve the equation $x^9 - x^5 + x^4 - 1 = 0$. 4
- c) If $u = \log \tan \left(\frac{\pi}{4} + \frac{\theta}{2} \right)$ prove that $\tanh \frac{u}{2} = \tan \frac{\theta}{2}$ 4

5. a) Find by Newton's method, a root of the equation $x^3 - 2x - 5 = 0$ correct to 3 decimal places. 6
- b) A certain curve is given by the following points of rectangular ordinates. 7

x	1	2	3	4	5	6	7	8	9
y	0.2	0.7	1	1.3	1.5	1.7	1.9	2.1	2.3

Use Simpson's one third rule to approximate the volume generated by the revolving the area between the curve, x-axis and the ordinates $x = 1$ & $x' = 9$.

OR

6. a) Find the real root of the equation $x^2 - 3x + 1 = 0$ by the method of iteration. 6
- b) Evaluate $\int_0^1 \frac{dx}{1+x^2}$ using Trapezoidal rule taking $h = \frac{1}{4}$. 7

7. a) Using Simplex method, solve the following LPP. 7
- Minimize: $Z = 3x_1 + 5x_2 + 4x_3$
 subject to $2x_1 + 3x_2 \leq 8$
 $2x_2 + 5x_3 \leq 10$
 $3x_1 + 2x_2 + 4x_3 \leq 15$
 $x_1, x_2, x_3 \geq 0$
- b) Solve the following LPP by graphical method. 7
- Maximize: $Z = x + 2y$
 subject to $x + 2y \geq 100$
 $2x - y \leq 0$
 $2x + y \leq 200$
 $x, y \geq 0$

OR

8. a) Solve graphically the following LPP. 7
- Maximize: $Z = 4x_1 + 3x_2$
 subject to $x_1 - x_2 \leq -1$
 $-x_1 + x_2 \leq 0$
 $x_1, x_2 \geq 0$

- b) Using Simplex method. Solve the following L.P.P.

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Minimize: $Z = x_1 - 3x_2 + 2x_3$

subject to $3x_1 - x_2 + 2x_3 \leq 7$

$-2x_1 + 4x_2 \leq 12$

$-4x_1 + 3x_2 + 8x_3 \leq 10$

$x_1, x_2, x_3 \geq 0$

9. a) The probability that a pen manufactured by a company will be defective is $\frac{1}{10}$. If 12 such pens are manufactured, find the probability that -
i) exactly two will be defective
ii) none will be defective.

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- b) A skilled typist on routine work kept a record of mistakes made per day during 300 working days.

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Mistake / day	0	1	2	3	4	5	6
No. of days	143	90	42	12	9	3	1

Fit a P.D. to the above data & hence calculate the theoretical frequencies.

OR

10. a) A certain screw making machine produces on average of 2 defective screws out of 100, and packs them in boxes of 500. Find the probability that a box contains 15 defective screws.

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- b) A husband and wife appear in an interview for two vacancies in the same post. The probability of husband, selection is $\frac{1}{7}$ & that of wife's selection is $\frac{1}{5}$, what is the probability that - <http://www.sgbaonline.com>

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- i) Both of them will be selected.
ii) Only one of them will be selected
iii) None of them will be selected.

11. a) The regression equations of two variables x and y are $x = 0.7y + 5.2$, $y = 0.3x + 2.8$ Find the means of x and y and γ_{xy} .

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- b) In a sample of 600 men from a certain city, 450 are found smokers. In another sample of 900 men from another city 450 are smokers. Do the data indicate that the cities are significantly different with respect to the habit of smoking among men.

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OR

12. a) Fit a straight line to the data.

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x	0	5	10	15	20	25
y	12	15	17	22	24	30

- b) A sample of 6 person in an office revealed an average daily smoking of 10, 12, 8, 9, 16, 5 cigarrates. The average level of smoking in the whole office has to be estimated at 90% level of confidence $t = \pm 2.015$ for 5 degree of freedom.

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