

<b>CSM – 53 / 16</b>
<b>Mathematics</b>
<b>Paper – II</b>

*Time : 3 hours*

*Full Marks : 300*

*The figures in the right-hand margin indicate marks.*

*Candidates should attempt Q. No. 1 from  
Section – A and Q. No. 5 from Section – B  
which are compulsory and any three of  
the remaining questions, selecting  
at least one from each Section.*

**SECTION – A**

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1. Answer any four of the following :  $15 \times 4 = 60$
- (a) Construct Lagrange's interpolation given the following data :

$$f(0) = 1, f(-1) = 2, f(1) = 3$$

(b) Find the approximate value of the integral

$\int_1^2 \frac{dx}{x}$  by the compound Simpson's  $\frac{1}{3}$ rd rule with 4 sub intervals.

(c) How many edges must a planar graph have if it has 7 regions and 5 vertices. Draw one such graph.

(d) Determine the number of edges in a graph with 6 vertices, 2 of degree 4 and 4 of degree 2. Draw two such graphs.

(e) Find the differential equation of the family of curves  $y = Ae^{3x} + Be^{5x}$  for the different values of A and B.

2. (a) Obtain  $\sqrt{12}$  to four places of decimal by Newton-Raphson method. 20

(b) Evaluate the integral  $I = \int_0^1 \frac{dx}{1+x}$  by subdividing the interval [0, 1] into two equal parts and then applying the Gauss-Legendre three point formula. 20

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- (c) Applying the Euler method, find the numerical solution of the initial value

problem  $\frac{dy}{dx} = x + y$ ;  $y(0) = 1$ , with spacing  $h = 0.2$  on the interval  $[0, 1]$ . 20

3. (a) Let  $G$  be a simple regular graph with  $n$  vertices and 24 edges. Find all possible values of  $n$  and give example of  $G$  in each case. 20

- (b) Prove that a tree  $T$  with  $n$  vertices has precisely  $n - 1$  edges. 20

- (c) Let  $G$  be a  $K$ -critical graph. Prove that  $G$  is connected and the degree of every vertex of  $G$  is at least  $K - 1$ . 20

4. (a) Solve : 20

$$y = 2px - xp^2, \text{ where } p = \frac{dy}{dx}$$

- (b) Solve : 20

$$(3 - x) \frac{d^2y}{dx^2} - (9 - 4x) \frac{dy}{dx} + (6 - 3x)y = 0.$$

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(c) Find the complete integral of the equation

$$(p^2 + q^2)y = qz, \text{ where } p = \frac{\partial z}{\partial x} \text{ and } q = \frac{\partial z}{\partial y}.$$

20

## SECTION – B

5. Answer any four of the following :  $15 \times 4 = 60$

(a) At the completion of the following program loops, what will be the values of K, L and M ?

M = 0

DO 150 I = 1, 10

K = I

DO 140 J = 1, 5

L = J

M = M + 1

140 CONTINUE

150 CONTINUE

(b) Find errors, if any, in each computed GO TO Statement :

(i) GO TO (5, 8, 4) MARK

(ii) GO TO (5, 22, 22, 57), KKK

(iii) GO TO (2, 84, 578), ERIK

(iv) GO TO (5, 76, 0, 24), J

- (c) If a force  $P$  be resolved into two forces making angles  $45^\circ$  and  $15^\circ$  with its direction, show that the latter force

is  $\frac{\sqrt{6}}{3}P$ .

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- (d) Find the moment of inertia of a uniform circular disk of mass  $m$  and radius  $a$  about a line through its centre perpendicular to its plane.

- (e) Solve the following linear programming problem by graphical method :

$$\text{Maximize } 3x_1 + 2x_2$$

Subject to the constraints

$$-2x_1 + x_2 \leq 1$$

$$x_1 \leq 2$$

$$x_1 + x_2 \leq 3$$

and  $x_1, x_2 \geq 0$

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6. (a) Draw a flow chart and write a Fortran program which calculates  $1 + 2 + 3 + \dots + 50$ . 20
- (b) What is the purpose of a DO Statement ?  
Write a program to print the first 100 positive integers using DO loop. 20
- (c) Write a function subprogram to find the positive, real root (if it exists) of a quadratic equation  $ax^2 + bx + c = 0$ . The a term is always positive for this problem. If there are no real, positive roots, make the answer equal to 0. 20
7. (a) A light ladder is supported on a rough floor and leans against a smooth wall. How far up the ladder can a man climb without slipping taking place ? 20
- (b) A boy standing at the edge of a cliff, throws a ball upward at a  $30^\circ$  angle with an initial speed of 64 ft/sec. Suppose that when the ball leaves the boy's hand, it is 48 ft above the ground at the base of the cliff. What are

the time of flight of the ball and its range ?

What are the velocity of the ball and its speed at impact ? ( $g = 32 \text{ ft/sec}^2$ ). 20

(c) Derive the equation of continuity for incompressible fluid motion. 20

8. (a) Write the dual of the problem : 10

$$\text{Minimize } Z = 2x_1 + 5x_2$$

$$\text{Subject to } x_1 + x_2 \geq 2$$

$$2x_1 + x_2 + 6x_3 \leq 6$$

$$x_1 - x_2 + 3x_3 = 4$$

$$\text{and } x_1, x_2, x_3 \geq 0$$

(b) Using simplex algorithm solve the problem :

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$$\text{Maximize } Z = 2x_1 + 5x_2 + 7x_3$$

$$\text{Subject to } 3x_1 + 2x_2 + 4x_3 \leq 100$$

$$x_1 + 4x_2 + 2x_3 \leq 100$$

$$x_1 + x_2 + 3x_3 \leq 100$$

$$\text{and } x_1, x_2, x_3 \geq 0$$

(c) Solve the following transportation problem : 25

	$S_1$	$S_2$	$S_3$	$S_4$	Capacities of sources
$O_1$	1	2	1	4	30
$O_2$	3	3	2	1	50
$O_3$	4	2	5	9	20
Requirements	20	40	30	10	100

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