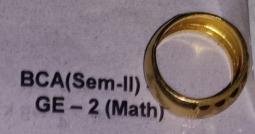
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2021

Time: 3 hours

Full Marks: 70

Candidates are required to give their answers in their own words as far as practicable.

The figures in the margin indicate full marks.

Answer from all the Parts as directed.

Part - A

1. Choose the correct answer in each of the following:

$$1 \times 5 = 5$$

(a)
$$\int \frac{xdx}{x^4 - x^2 - 2}$$
 is equal to :

(i)
$$\frac{1}{6} \log k \frac{x^2 - 1}{x^2 + 1}$$

(ii)
$$\frac{1}{4} \log k \frac{x^2 - 2}{x^2 + 2}$$

(iii)
$$\frac{1}{2} \log k \frac{x^2 - 4}{x^2 + 4}$$

- (iv) None of these
- (b) Area of loop of the curve $y^2 = x(x-1)^2$ is:
 - (i) $\frac{2}{3}$
 - (ii) $\frac{4}{11}$ electors algreen ent a semon ent

- (iv) None of these
- (c) The differential equation $(x^2 4xy y^2)dx + (y^2 4xy x^2)dy = 0$ is of:
 - (i) First order and first degree
 - (ii) First order and second degree
 - (iii) Second order and first degree
 - (iv) None of these

(d) Solution of the differential equation

$$\frac{dy}{dx} + \frac{y}{x} = x^3 \text{ is :}$$

$$yx = \frac{x^4}{4} + c$$

(ii)
$$yx = \frac{x^5}{5} + c$$

(iii)
$$yx = \frac{x^6}{6} + c$$

- (iv) None of these
- (e) Which of the following is a mode of operation for Block Ciphers in cryptography?

- (ii) Cipher Block Chaining (CBC)
 - (iii) Counter Mode
 - (iv) All of these
- 2. Fill in the blanks:

 $1 \times 5 = 5$

(a) Data Encryption Standard (DES) is a

- (b) An equation of the form $\frac{dy}{dx} + py = Q$, where P and Q are functions of x or constants is known as ______
- (c) The limit of

$$n\left[\frac{1}{n^2} + \frac{1}{n^2 + 1^2} + \frac{1}{n^2 + 2^2} + \dots + \frac{1}{n^2 + (n-1)^2}\right]$$
 is

- (d) The area bounded by the curve $r = f(\theta)$ and the radii vectors $\theta = \alpha$ and $\theta = \beta$ is given by the definite integral _____
- (e) If the convex set of feasible solutions of Ax=b, x≥0 is a convex polyhedron, then at least one of the extreme points gives

Part - B

Answer any four questions of the following:

 $5 \times 4 = 20$

3. (a) Examine whether the set

$$S = \{(x_1, x_2) : x_1^2 + x_2^2\} \le 9$$
 is a convex set.

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

$$Max Z = x_1 + 3x_2$$

Subject to the constraints

$$5x_1 + 2x_2 \le 10$$

$$x_1, x_2 \ge 0$$

4. Evaluate $\int_0^{\pi/2} \cos^n x \cos nx \, dx$, where n is a positive integer.

Solve:
$$x \frac{dy}{dx} + y = y^2 \log x$$
.

- 6 Explain RC⁴ Encryption Algorithm.
 - 7. How can you combine hash function with public key encryption for message authentication?

8. Find the perimeter of the curve
$$x^{2/3} + y^{2/3} = a^{2/3}$$
.

Answer any four questions of the following:

10×4 = 40

9. Solve the following linear programming problem by simplex method :

Max Z =
$$3x_1 + 5x_2 + 4x_3$$

Subject to $2x_1 + 3x_2 \le 8$
 $2x_2 + 5x_3 \le 10$
 $3x_1 + 2x_2 + 4x_3 \le 15$
 $x_1, x_2, x_3 \ge 0$

- Find the valume and surface are of the solid generated by revolving the cycloid $x = a(\theta + \sin\theta)$, $y = a(1 + \cos\theta)$ about its base.
- What is RSA encryption and how does is work?
 Is RSA encryption secure?
- 12. Find the moment of inertia of a thin hollow spherical shell of radius a and mass M about a diameter.

13. (a) Find the orthogonal trajectories of $r = a (1 - \cos \theta)$, where a is the parameter.

(b) Solve:
$$(x-a) p^2 + (x-y)p - y = 0$$

14. Solve:

(a)
$$\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 4y = x^2$$

(b)
$$\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = e^x + xe^{2x} - 2\sin x$$

