

General Instructions:

- i) The question paper contains five sections A, B, C, D and E. Each section is compulsory. However, there are internal choices in some questions.
- ii) Section A has 18 MCQ's question and 2 Assertion – Reason based questions of 1 mark each.
- iii) Section B has 5 Very Short Answer (VSA) type questions of 2 marks each.
- iv) Section C has 6 Short Answer (SA) type questions of 3 marks each.
- v) Section D has 4 Long Answer (LA) type questions of 5 marks each.
- vi) Section E has 3 source based /case based/passage based/ integrated units assessment of 4 marks each with sub parts.

SECTION – A

1. Let $A = \{1, 2\}$, then number of reflexive relations on A is
a) 2 b) 4 c) 0 d) 8
2. If set A contains 5 elements and set B contains 6 elements, then number of one – one and onto mappings from A to B is
a) 720 b) 120 c) 0 d) none
3. The principal value of $\cos^{-1}(\cos \frac{2\pi}{3}) + \sin^{-1}(\sin \frac{2\pi}{3})$ is
a) π b) $4\pi/3$ c) $\pi/2$ d) none
4. $\sin\left[\frac{\pi}{6} - \sin^{-1}(-1/2)\right]$ is equal to
a) 1/2 b) 1/3 c) 1/4 d) $\sqrt{3}/2$
5. The value of $\tan(2 \tan^{-1} \frac{1}{3})$ is
a) 12/5 b) 3/4 c) 4/3 d) 5/12
6. Given a skew symmetric matrix $A = \begin{bmatrix} 0 & a & 1 \\ -1 & b & 1 \\ -1 & c & 0 \end{bmatrix}$, the value of $(a + b + c)^2$ is
a) 0 b) 1 c) 2 d) 3
7. Given the matrix A and B are of order $3 \times n$ and $m \times 5$ respectively, then the order of the matrix $C = 5A + 3B$ is
a) 3×5 and $m = n$ b) 3×5
c) 3×3 d) 5×5
8. The order of the product of matrices $\begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix} [2 \ 3 \ 4]$ is
a) 1×1 b) 1×3 c) 3×1 d) 3×3
9. Value of k, for which $A = \begin{bmatrix} k & 8 \\ 4 & 2k \end{bmatrix}$ is singular matrix is
a) 4 b) -4 c) ± 4 d) 0

10. The value of $|3I_3|$, where I_3 is identity matrix of order 3 is
 a) 3 b) 9 c) 27 d) none
11. If A is any square matrix of order 3 x 3 such that $|\text{adj } A| = 169$ and $|A|$ is non-negative, then the value of $|A|$ is
 a) 13 b) -13 c) ± 13 d) none
12. If $y = f(x^2)$ and $f'(x) = e^{\sqrt{x}}$, then value of $\frac{dy}{dx}$ is
 a) $2xe^x$ b) xe^x c) x^2e^x d) $2x^2e^x$
13. If $y = \sec^{-1}\left[\frac{\sqrt{x+1}}{\sqrt{x-1}}\right] + \sin^{-1}\left[\frac{\sqrt{x-1}}{\sqrt{x+1}}\right]$, then $\frac{dy}{dx}$ is
 a) 0 b) 1 c) -1 d) none
14. The value of 'k' for which the function $f(x) = \begin{cases} \frac{(x+3)^2 - 36}{x-3}, & x \neq 3 \\ k, & x = 3 \end{cases}$ is continuous at $x = 3$ is
 a) 12 b) 3 c) 14 d) 9
15. Which of the following function is decreasing in $(0, \pi/2)$?
 a) $\sin 2x$ b) $\tan x$ c) $\cos x$ d) $\cos 3x$
16. The value of x for which function $f(x) = x - x^2$ is maximum, is
 a) $3/4$ b) $1/2$ c) $1/3$ d) $1/4$
17. The value of $\int_0^{\pi/2} \log\left(\frac{3+5\cos x}{3+5\sin x}\right) dx$ is
 a) 0 b) 1 c) 2 d) none
18. The value of $\int_{-\pi/2}^{\pi/2} \sin^3 x \cos^5 x dx$ is
 a) 1 b) $\pi/2$ c) 0 d) none

Assertion – Reasoning Based Questions

In the following questions, a statement of Assertion (A) is followed by a statement of Reason (R), choose the correct answer out of the following choices :

- a) Both (A) and (R) are true and (R) is the correct explanation of (A).
 b) Both (A) and (R) are true and (R) is not the correct explanation of (A).
 c) (A) is true but (R) is false.
 d) (A) is false but (R) is true.
19. Assertion (A) : $\int \frac{dx}{x^2 + 2x + 2} = \tan^{-1}(x+1) + C$
 Reason (R) : $\int \frac{dx}{x^2 + a^2} = \frac{1}{a} \tan^{-1}(x/a) + C$
20. Assertion (A) : If the radius of a circle is increasing at the uniform rate of 3 cm/sec. At the instant when the radius of the circle is 2cm, it's area increases at the rate of 12π cm²/sec.
 Reason (R) : Rate of change of radius = $\frac{dr}{dt}$, Rate of change of area = $\frac{dA}{dt}$.

SECTION – B

21. Find the value of $\sin(2\cos^{-1}(-3/5))$.
22. If $A = \begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix}$ and $f(x) = x^2 - 2x - 3$, then show that $f(A) = 0$.
23. Evaluate $\int \frac{e^{2x} - 1}{e^{2x} + 1} dx$ (OR) Evaluate $\int \frac{dx}{x \log x \log(\log x)}$
24. Differentiate $ax^2 + 2hxy + by^2 + 2gx + 2fy + c = 0$ w.r.t x .
25. An edge of a variable cube is increasing at the rate of 10 cm/sec. How fast the volume of the cube is increasing when the edge is 5cm long?

SECTION – C

26. Show that the relation R on the set $A = \{x \in \mathbb{Z} : 0 \leq x \leq 12\}$ given by $R = \{(a, b) : |a - b| \text{ is multiple of } 4\}$ is an equivalence relation.
27. If $A = \begin{bmatrix} 3 & 2 \\ 1 & 1 \end{bmatrix}$ then find the value of a and b such that $A^2 + aA + bI = 0$. Hence find A^{-1} .
28. Discuss the differentiability of the function $f(x) = \begin{cases} 2x - 1, & x < 1/2 \\ 3 - 6x, & x \geq 1/2 \end{cases}$ at $x = 1/2$.
29. If $y = x^{\sin x} + \sin(x^x)$ then find $\frac{dy}{dx}$.
(OR)
If $x = \cos t + \log \tan(t/2)$ and $y = \sin t$ then find the value of $\frac{d^2y}{dt^2}$ and $\frac{d^2y}{dx^2}$ at $t = \pi/4$.
30. Evaluate $\int \frac{\sin 2x}{\sin 5x \sin 3x} dx$ (OR) Evaluate $\int \frac{3x+2}{x^2 + x + 1} dx$.
31. Find the intervals in which function $f(x) = 5 + 36x + 3x^2 - 2x^3$ is strictly increasing and strictly decreasing.

SECTION – D

32. If $A = \begin{bmatrix} 1 & -1 & 1 \\ 2 & 1 & -3 \\ 1 & 1 & 1 \end{bmatrix}$, find A^{-1} . Hence solve following system of equation:
 $x + 2y + z = 4$; $-x + y + z = 0$; $x - 3y + z = 2$.
(OR)

If $A = \begin{bmatrix} -4 & 4 & 4 \\ -7 & 1 & 3 \\ 5 & -3 & -1 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & -1 & 1 \\ 1 & -2 & -2 \\ 2 & 1 & 3 \end{bmatrix}$ find AB and hence solve
 $x - y + z = 4$; $x - 2y - 2z = 9$; $2x + y + 3z = 1$.

33. Evaluate $\int_0^\pi \frac{x dx}{a^2 \cos^2 x + b^2 \sin^2 x}$ (OR) Evaluate $\int_0^1 \frac{\log(1+x)}{1+x^2} dx$.
34. Show that of all the rectangles inscribed in a given fixed circle the square has the maximum area.
35. If $x = \sin t$, $y = \sin pt$, prove that $(1 - x^2)y_2 - xy_1 + p^2y = 0$.

SECTION – E

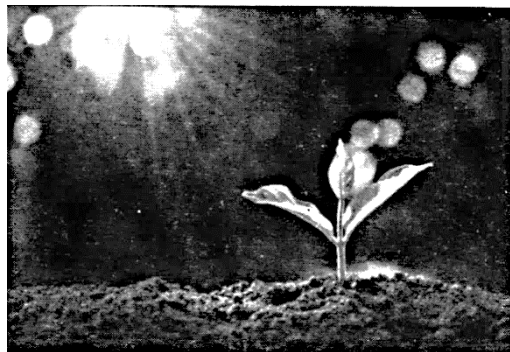
36. Three schools DPS, CJM and KPS decided to organise a fair for collecting money for helping the flood victims. They sold handmade fans, mats, and plates from recycled material at a cost of Rs 25/-, Rs 100/- and Rs 50/- each respectively. The number of article sold are given below:

School/ Article	DPS	CJM	KPS
Handmade Fans	40	25	35
Mats	50	40	50
Plates	20	30	40

Using matrices answer the following :

- a) What is the total money (in Rs) collected by all three schools DPS, CJM and KPS?
- b) If the number of handmade fans and plates are interchanged for all the schools, find the total money collected by all the school.

37. The relation between the height of the plant (y in cm) w.r.t exposure to sunlight is governed by the following equation $y = 4x - \frac{x^2}{2}$, where x is the number of days exposed to sunlight.



- a) Find the rate of growth of the plant w.r.t exposure of sunlight.
- b) What is the number of days it will take for the plant to grow to the maximum light?
- c) What is the maximum height of the plant?

(OR)

If the height of the plant is $7/2$ cm, find the number of days it has been exposed to the sunlight.

38. Let f be a continuous function defined on the closed interval $[a, b]$ and F be an antiderivative

of f, then $\int_a^b f(x) dx = [F(x)]_a^b = F(b) - F(a)$.

This result is very useful as it gives us method of calculating the definite integral easily. Here, we have no need to write integration constant c.

Based on the above information answer the following questions:

a) Evaluate $\int_0^1 x e^x dx$

b) Evaluate $\int_0^{\pi/4} 2 \tan^3 x dx$

-X-X-X-X-X-X-X-X-X-