PART–B
MATHEMATICS

51. If matrix $A=\begin{pmatrix}\cos x & \sin x\\ -\sin x & \cos x\end{pmatrix}$ then A^3 is given by

(A) $\begin{pmatrix}\cos 3x & \sin 3x\\ -\sin 3x & \cos 3x\end{pmatrix}$

(B) $\begin{pmatrix}\cos 2x & \sin 3x\\ -\sin 2x & \cos 3x\end{pmatrix}$

(C) $\begin{pmatrix}\cos 2x & \sin 3x\\ -\sin 3x & \cos 2x\end{pmatrix}$

(D) $\begin{pmatrix}\cos 3x & -\sin 3x\\ \sin 3x & -\cos 3x\end{pmatrix}$

52. For what values of α, the rank of matrix

$$A = \begin{bmatrix}1 & 1 & -1 & 0\\ 4 & 4 & -3 & 1\\ \alpha & 2 & 2 & 2\\ 9 & 9 & \alpha & 3\end{bmatrix} \text{ is } 3.$$

(A) $\alpha = 6, -2$

(B) $\alpha = -6, 2$

(C) $\alpha = -3, 2$

(D) None of these

53. The approx. positive root of the equation : $x^3 - 12.2\,x^2 + 7.45\,x + 42 = 0$ lying between $x = 11$ and $x = 12$ by Regula Falsi method is given by

(A) 11.4994

(B) 11.1194

(C) 11.1994

(D) 11.9994

54. The matrix obtained by :

$$\begin{pmatrix}1 & -\tan x\\ \tan x & 1\end{pmatrix}\begin{pmatrix}1 & \tan x\\ -\tan x & 1\end{pmatrix}^{-1}$$

is given by

(A) $\begin{pmatrix}\cos 3x & \sin 3x\\ -\sin 3x & \cos 3x\end{pmatrix}$

(B) $\begin{pmatrix}\cos 2x & \sin 2x\\ -\sin 2x & \cos 2x\end{pmatrix}$

(C) $\begin{pmatrix}\cos 2x & -\sin 2x\\ \sin 2x & \cos 2x\end{pmatrix}$

(D) $\begin{pmatrix}\cos 3x & -\sin 3x\\ \sin 3x & -\cos 3x\end{pmatrix}$

55. Using Runge Kutta (fourth order) method, where $\frac{dy}{dx} = x + y$ and $y(0) = 1$, approximation to $y(0.1)$ correct to five decimal places in steps of $h = 0.1$ is given by option :

(A) 2.11133

(B) 1.11034

(C) 1.21135

(D) 1.23230

56. Determine λ and μ such that the equations
$x + y + z = 6$,

$x + 2y + 3z = 10$,

$x + 2y + \lambda z = \mu$

have infinite number of solutions.

(A) $\lambda = 3,\ \mu \neq 10$

(B) $\lambda = -3,\ \mu = -10$

(C) $\lambda = 3,\ \mu = 10$

(D) $\lambda \neq 3$ and μ can have any value

57. If $\phi(x, y, z) = 3x^2y - y^3z^2$, value of grad. ϕ at the point (1, –2, –1) is given by

(A) $-12i + 9j - 16k$

(B) $12i - 9j - 6k$

(C) $-12i - 9j - 16k$

(D) None of these

58. The rank of matrix

$$A = \begin{bmatrix} 5 & 6 & 7 & 8 \\ 6 & 7 & 8 & 9 \\ 11 & 12 & 13 & 14 \\ 16 & 17 & 18 & 19 \end{bmatrix}$$

is given by

(A) 2

(B) 3

(C) 4

(D) None of these

59. The n^{th} derivative of the function $y = x^4/\{(x-1)(x-2)\}$ is

(A) $(-1)^n\, n!\left[\frac{16}{(x-2)^{n+1}} - \frac{1}{(x-1)^{n+1}}\right](n > 2)$

(B) $n!\left[\frac{16}{(x-2)^{n+1}} - \frac{1}{(x-1)^{n+1}}\right]\ (n > 0)$

(C) $(-1)^n\left[\frac{16}{(x-2)^{n+1}} - \frac{1}{(x-1)^{n+1}}\right]$

(D) $(-1)^{n+1} n!\left[\frac{16}{(x-2)^{n+1}} - \frac{1}{(x-1)^{n+1}}\right](n > 2)$

60. For the matrix $A = \begin{pmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{pmatrix}$, find the matrix represented by $A^8 - 5A^7 + 7A^6 - 3A^5 - 5A^3 + 8A^2 - 2A + I$.

(A) $\begin{bmatrix} 8 & 4 & 5 \\ 0 & 3 & 0 \\ 5 & 5 & 9 \end{bmatrix}$

(B) $\begin{bmatrix} 8 & 5 & 1 \\ 6 & 3 & 0 \\ 5 & 5 & 8 \end{bmatrix}$

(C) $\begin{bmatrix} 8 & 5 & 5 \\ 0 & 3 & 0 \\ 5 & 5 & 8 \end{bmatrix}$

(D) None of these

61. If $V = \pi r^2 h$ is the volume of a right circular cylinder of radius r and height h, r is measured with an error of no more that 2% and h with an error of no more than 0.5%, the resulting maximum possible error in the computation of V is

(A) 45%

(B) 4.0%

(C) 4.5%

(D) 0.5%

62. The nature of an infinite series $\sum \log \frac{n}{n+1}$ is said to be

(A) convergent

(B) absolute convergent

(C) divergent

(D) conditional convergent

63. A unit vector normal to the surface $x^3 + y^3 + 3xyz = 3$ at the point (1, 2, –1) is given by

(A) $\frac{1}{\sqrt{11}} (-i + 3j - k)$

(B) $i - j + k$

(C) $\frac{1}{\sqrt{3}} (i + k)$

(D) None of these

64. The eigen values of the following matrix $\begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$ are given by solving the cubic equation

(A) $\lambda^3 + 2\lambda^2 + 2\lambda - 13 = 0$

(B) $\lambda^3 - 6\lambda^2 + 9\lambda - 4 = 0$

(C) $\lambda^3 + 7\lambda^2 + 2\lambda - 7 = 0$

(D) $\lambda^3 - 6\lambda^2 + 12\lambda + 12 = 0$

65. If $A = \begin{pmatrix} 1 & 2 \\ 5 & 7 \end{pmatrix}$, then A^{-1} is given by

(A) $\frac{1}{3}\begin{pmatrix} -7 & 2 \\ 5 & -1 \end{pmatrix}$

(B) $\frac{1}{3}\begin{pmatrix} 7 & 2 \\ 5 & 1 \end{pmatrix}$

(C) $\begin{pmatrix} -7 & 2 \\ 5 & -1 \end{pmatrix}$

(D) None of these

66. The quadratic form corresponding to the matrix $A = \begin{bmatrix} 1 & 2 & 5 \\ 2 & 0 & 3 \\ 5 & 3 & 4 \end{bmatrix}$ is given by

(A) $x_1^2 + 4x_3^2 + 4x_1x_2 + 10x_1x_3 + 3x_2x_3$

(B) $x_1^2 + 4x_3^2 + 4x_1x_2 + 10x_2x_3 + 6x_2x_3$

(C) $x_1^2 - 4x_3^2 + 4x_1x_2 + 10x_1x_3 + 6x_2x_3$

(D) $x_1^2 + 4x_3^2 + 4x_1x_2 + 10x_1x_3 + 6x_2x_3$

67. The infinite series

$$1 + \frac{3}{7}x + \frac{3.6}{7.10}x^2 + \frac{3.6.9}{7.10.13}x^3 + \frac{3.6.9.12}{7.10.13.16}x^4 + \ldots\infty$$

is said to be convergent for

(A) $|x| > 1$

(B) $x < 1$

(C) $|x| > -1$

(D) $x < 2$

68. If $y = \cos(m \sin^{-1} x)$, which is correct

(A) $(1-x^2)y_{n+2} - (2n+1)xy_{n-1} - (n^2 - m^2)y_n = 0$

(B) $(1-x^2)y_{n+2} - (2n+1)x_{n+1} - (n^2 - m^2)y_n = 0$

(C) $(1-x^2)y_{n+2} - (2n+1)xy_{n+1} - (n^2 + m^2)y_n = 0$

(D) $(1-x^2)y_{n+2} - (2n+1)xy_{n+1} - (n^2 - m^2)y_n = 0$

69. Given that $f(u, v, w)$ is a differentiable function with $u = x-y$, $v = y-z$, $w = z-x$, the value of $\frac{\partial f}{\partial x} + \frac{\partial f}{\partial y} + \frac{\partial f}{\partial z}$ is given by

(A) 0

(B) 1

(C) –1

(D) None of these

70. For what value of a and b, the following function is everywhere differentiable for the function given by

$$f(x) = \begin{cases} x^2 + 3x + a, & \text{for } x \le 1 \\ bx + 2, & \text{for } x > 1 \end{cases}$$

(A) $a = 3,\ b = 4$

(B) $a = 3,\ b = 5$

(C) $a = 2,\ b = 5$

(D) $a = -3,\ b = -5$

71. For the functions $f(x) = x^3 + 2$ and $g(x) = x^2 - 1$ in the interval [0, 1], the value of c for Cauchy's Mean Value theorem is given by

(A) $c = 12/9$

(B) $c = 14/6$

(C) $c = 1/9$

(D) $c = 14/9$

72. Using the expansion of tan $(x + h)$, the value of tan 46° correct to 4 significant figures is (where $\pi = 3.14159$)

(A) 0.5151

(B) 1.5051

(C) 1.1131

(D) 1.0355

73. The system

$$x + 2y - 3z = -1$$
$$3x - y + 2z = 7$$
$$5x + 3y - 4z = 2$$

is

(A) Inconsistent

(B) Consistent with trivial solution

(C) Consistent with unique solution

(D) Consistent with more than one solution

74. The expansion of $f(x, y) = e^x \cos y$ about the point (0, 0) is given by

(A) $1 - x + \frac{1}{2}[x^2 + y^2] + \frac{1}{6}[x^3 - 3y^2x] + ...$

(B) $1 + x + \frac{1}{2}[x^2 - y^2] + \frac{1}{6}[x^3 - 3y^2x] + ...$

(C) $1 + x - \frac{1}{2}[x^2 - y^2] + \frac{1}{9}[x^3 - 3y^2x] + ...$

(D) None of these

75. The main difference between Jacobi's and Gauss-Seidal Method is

(A) Deviation from the correct answer is more in Gauss-Seidal

(B) Convergence in Jacobi's method is faster

(C) Computations in Jacobi's can be done in parallel but not in Gauss-Seidal

(D) Gauss-Seidal can solve the system of linear equations in three variables whereas Jacobi cannot

76. Given that $u = \tan^{-1}\left(\frac{x^3 + y^3}{x + y}\right)$, the value of $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}$ is given by

(A) $\sin u$

(B) $\sin 2u$

(C) $\sin 3u$

(D) $\tan u$

77. Value of $\int_0^{2\pi} \frac{1}{2+\cos\theta} d\theta$ is given by the option :

(A) $\frac{2\pi}{3}$

(B) $\frac{\pi}{2}$

(C) $\frac{2\pi}{\sqrt{3}}$

(D) $\frac{3\pi}{\sqrt{2}}$

78. If $\frac{dy}{dx} = -\frac{F_x}{F_y}$ and $\frac{d^2y}{dx^2} = -(F_{xx}F_y^2 - pF_x F_y F_{xy} + F_{yy}F_x^2)/F_y^3$, given that the equation $F(x, y) = 0$ defines y implicitly as a differentiable function of the independent variable x and $F_y \neq 0$, then value of p is given by

(A) 3

(B) 2

(C) –2

(D) 1

79. The solution of

$$(y^4 + 2y)dx + (xy^3 + 2y^4 - 4x)dy = 0$$

is given by

(A) $x\left(y + \frac{2}{y^2}\right) + y^3 = c$

(B) $x\left(y + \frac{2}{y^2}\right) + y^2 = c$

(C) $x\left(y + \frac{1}{y^2}\right) + y^2 = c$

(D) $y\left(y + \frac{2}{y^2}\right) + y^2 = c$

80. The residue at each pole of the function : $f(z) = \cot z$ is given by

(A) 4

(B) 2

(C) 0

(D) 1

81. The Particular Integral of the equation :

$$(D^3 - 7D^2 + 10D)y = e^{2x} \sin x$$

is given by

(A) $\frac{e^x}{50}(7 \cos x - \sin x)$

(B) $\frac{e^{2x}}{50}(7 \cos x - \sin x)$

(C) $\frac{e^{2x}}{50}(7 \cos x + \sin x)$

(D) $\frac{e^{2x}}{5}(7 \cos x + \sin x)$

82. The value of $\int_C \frac{1}{z^2-1} dz$, where C is the circle $|z| = 2$ is

(A) 0

(B) 2

(C) 3/4

(D) 2

83. If $\phi(x, y) = \dfrac{x}{x^2 + y^2}$, the magnitude of the directional derivative along a line making an angle 30° with the positive direction of x-axis at point (0, 2) is given by

(A) $\dfrac{\sqrt{5}}{8}$

(B) $\dfrac{1}{\sqrt{2}}\ (i + k)$

(C) $\dfrac{\sqrt{3}}{8}$

(D) $\dfrac{\sqrt{3}}{8}\,i$

84. In which option, algebraic structure is not semi group

(A) (N, +)

(B) (Z, –)

(C) (N, +), (Z, –)

(D) None of these

85. The mobius transformation which maps the points z = $-i$, 0, i into the points $w = -1$, i, 1 respectively is given by

(A) $w = \dfrac{-iz + i}{z + 2}$

(B) $w = \dfrac{iz + i}{z + 1}$

(C) $w = \dfrac{-iz + i}{z + 1}$

(D) $w = \dfrac{-iz + i}{z - 1}$

86. The n^{th} derivative of $y = x^{n-1} \log x$ is given by

(A) $\dfrac{n!}{x}$

(B) $\dfrac{(n+1)!}{x}$

(C) $\dfrac{(n-1)!}{x}$

(D) $\dfrac{(n-1)!}{2x}$

87. By method of variation of parameters, the solution of equation $y'' + y = \text{cosec } x$ is given by

(A) $A \cos x + B \sin x - (x \sec x + \log \tan x)$

(B) $A \cos x + B \sin x + x \cos x + \sin x . \log \sin x$

(C) $A \cos x - B \sin x - \cos x \log (\sec x . \tan x)$

(D) $A \cos x + B \sin x - x \cos x + \sin x . \log \sin x$

88. Using Green's theorem, value of

$$\int_c (x^2 + xy)dx + (x^2 + y^2)dy$$

where c is the square formed by the lines $y = \pm 1$, $x = \pm 1$.

(A) $\dfrac{3}{8}$

(B) $\dfrac{5}{12}$

(C) 1

(D) 0

89. The solution of equation by method of separation of variables, where $\frac{\partial u}{\partial x} = 2\frac{\partial u}{\partial t} + u$ and given that $u(x, 0) = 6e^{-3x}$ is given by

(A) $u = 6e^{-3x-3y}$

(B) $u = 6e^{3x} + 2y$

(C) $u = 6e^{-3x-2t}$

(D) $u = 6e^{-3x+2t}$

90. The Particular integral of the differential equation :

$$(D^2 + DD' - 6D'^2)z = x^2 \sin(x + y)$$

is given by

(A) $\frac{1}{4}\left(x^2 + \frac{13}{8}\right)\sin(x+y) + \frac{3x}{8}\cos(x+y)$

(B) $\frac{1}{4}\left(x^2 - \frac{13}{6}\right)\sin(x+y) - \frac{13x}{8}\cos(x+y)$

(C) $\frac{1}{4}\left(x^2 - \frac{13}{8}\right)\sin(x+y) - \frac{3x}{8}\cos(x+y)$

(D) $\frac{1}{4}\left(x^2 - \frac{13}{8}\right)\cos(x+y) - \frac{13x}{8}\sin(x+y)$

91. The Particular integral of the differential equation :

$$(D^3 + 2D^2 + D)y = e^{2x} + x^2 + x$$

is given by

(A) $\frac{1}{18}e^{2x} + \frac{1}{3}x^3 - \frac{3}{2}x^2 + 4x$

(B) $\frac{1}{18}e^{2x} + \frac{5}{3}x^3 - \frac{3}{2}x^2 + 4x$

(C) $\frac{1}{18}e^{2x} + \frac{1}{3}x^3 - \frac{3}{2}x^2 + 3x$

(D) $\frac{1}{18}e^{2x} + \frac{1}{3}x^3 - \frac{3}{5}x^2 + 4x$

92. A vector field F is given by $F = (\sin y)i + x(1 + \cos y)j$, then value of integral $\int_c F.d\bar{r}$

Where C is the circular path given by $x^2 + y^2 = a^2$

(A) $3\,\pi a^2$

(B) $2\,\pi a^2$

(C) πa^2

(D) $\frac{1}{2}\,\pi a^2$

93. The two regression equations of the variables x and y are $x = 19.13 - 0.87\,y$ and $y = 11.64 - 0.50\,x$, the correlation coefficient between x and y is given by

(A) −0.26

(B) −0.36

(C) −0.66

(D) 0.66

94. The Particular integral of $(D^2 - D'^2)z = \cos(x + y)$ is given by

(A) $\frac{x}{2}\cos(x + y)$

(B) $x\sin(x + y)$

(C) $2x\sin(x + y)$

(D) $\frac{x}{2}\sin(x + y)$

95. If $z = xf(y/x) + g(y/x)$, then value of $x^2 \frac{\partial^2 z}{\partial x^2} + 2xy \frac{\partial^2 z}{\partial x \partial y} + y^2 \frac{\partial^2 z}{\partial y^2}$ is given by

(A) $\frac{-x}{y} \frac{\partial u}{\partial y}$

(B) –1

(C) 0

(D) None of these

96. The analytic function whose imaginary part is $e^{-x}(x \sin y - y \cos y)$, is given by

(A) $f(z) = e^{-z}(-z) + c$

(B) $f(z) = e^{-z}(z) + c$

(C) $f(z) = e^{z}(-z) + c$

(D) $f(z) = e^{-2z}(-z) + c$

97. If the variance of the poisson distribution is 2 and given : $e^{-2} = 0.1353$, the value of $P(r \geq 4)$ using recurrence relation of the poission distribution is

(A) 0.1321

(B) 0.3613

(C) 0.1431

(D) None of these

98. A can hit a target 3 times in 5 shots, B 2 times in 5 shots and C 3 times in 4 shots. All of them fire one shot each simultaneously at a target. What is the probability that at least two shots hit the target?

(A) 69/100

(B) 9/20

(C) 63/100

(D) 18/100

99. The algebraic structure (Q, +, ·), (R, +, ·) represent

(A) Ring

(B) Field

(C) Group

(D) Commutative ring with unity

100. The solution of partial differential equations:

$x(y^2 - z^2)p + y(z^2 - x^2)q = z(x^2 - y^2)$

is given by

(A) $F(xyz, x^2 + y^2 + z^2) = 0$

(B) $F(xyz, x^2 - y^2 - z^2) = 0$

(C) $F(1/(xyz), x^2 + y^2 + z^2) = 0$

(D) None of these.

ROUGH WORK

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Answer Key: Maths

Q No	Answer
51	A
52	B
53	C
54	A
55	B
56	C
57	C
58	A
59	A
60	C
61	C
62	C
63	A
64	B
65	A
66	D
67	B
68	D
69	A
70	B
71	D
72	D
73	A
74	B
75	C

Q No	Answer
76	B
77	A
78	B
79	B
80	D
81	C
82	A
83	C
84	B
85	C
86	A
87	D
88	D
89	C
90	C
91	A
92	C
93	C
94	D
95	C
96	A
97	C
98	C
99	D
100	A