11N501

Roll No. _____ Total No of Pages: 3

11N501

B. Tech. I - Sem. (New Scheme) Main Exam., July – 2022

1FY1 – 01 Engineering Mathematics – I

Common to all Branches

Time: 2 Hours **Maximum Marks: 70**

Min. Passing Marks:

Instructions to Candidates:

Part – A: Short answer questions (up to 25 words) 5×3 marks = 15 marks. Candidates have to answer 5 questions out of 10.

Part – B: Analytical/Problem Solving questions 3×5 marks = 15 marks. Candidates have to answer 3 questions out of 7.

Part – C: Descriptive/Analytical/Problem Solving questions 2×20 marks = 40 marks. Candidates have to answer 2 questions out of 5.

Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.

Use of following supporting material is permitted during examination. (Mentioned in form No. 205)

1. NIL 2. NIL

PART– A

Q.1 What is the largest interval of x for which $f(x) = xe^{x^2}$ is concave upward?

Q.2 Find the points of inflexion of the curve $y = (x - 2)^2 (x - 3)^5$.

Q.3 Find the radius of curvature at $\left(\frac{3a}{2}, \frac{3a}{2}\right)$ on the Folium of Descartes

$x^3 + y^3 = 3axy$, $a > 0$.

Q.4 If $u = \sec^{-1}\left(\frac{x^3+y^3}{x+y}\right)$, Show that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = 2\cot u$.

Q.5 Solve the partial differential equation $p(1 + q) = 3q$.

Q.6 Solve the differential equation $ydx - xdy + x^2 \cos x\, dx = 0$

Q.7 If e^x is one of the linearly independent solution for the differential equation

$$x\frac{d^2y}{dx^2} - (2x - 1)\frac{dy}{dx} + (x - 1)\,y = 0,$$

Find the second linearly independent solution.

Q.8 Write a short note on double points.

Q.9 Find the values of p and q in the PDE $z^2(p^2 + q^2) = x^2 + y^2$ in term of x, y, z and arbitrary constant.

Q.10 Find the asymptotes of $y^2 (x - b) = x^3 + a^3$, $a, b > 0$.

PART– B

Q.1 Discuss the maxima and minima of the function $f(x,y) = x^4 + y^4 - 2x^2 + 4xy - 2y^2$.

Q.2 Trace the Cartesian curve $y^2 (a + x) = x^2 (a - x)$, $a > 0$.

Q.3 Show that the asymptotes of the following curve cut the curve again in eight points which lie on a circle of radius unity:

$$(x^2 - 4y^2)(x^2 - 9y^2) + 5x^2y - 5xy^2 - 30y^2 + xy + 7y^2 - 1 = 0$$

Q.4 Solve the differential equation -

$$\frac{d^2y}{dx^2} - \frac{1}{x}\frac{dy}{dx} + 4x^2y = x^4$$

Q.5 The diameter and altitude of a right circular cylinder are measured as 4 cm and 6 cm respectively. If the possible error in each measurement is 0.1 cm, find approximately the maximum possible error in the value computed for the volume and lateral surface.

Q.6 Solve the ODE $y'' + 5y' + 4y = 0$ subject to the conditions $y(0) = 0$ and $y'(0) = 3$.

Q.7 Solve the PDE $yp = 2yx + \log q$.

PART–C

Q.1 Find the dimension of the rectangular box, open at the top, of maximum capacity whose surface is 432sq. cm.

Q.2 Solve by the method of variation of parameter -

$$(x + 2)\frac{d^2y}{dx^2} - (2x + 5)\frac{dy}{dx} + 2y = (x + 1)e^x$$

Q.3 Find the equation of circle of curvature of the curve $\sqrt{x} + \sqrt{y} = \sqrt{a}$ at $\left(\frac{a}{4}, \frac{a}{4}\right)$.

Q.4 Find a general solution of the PDE $p^2u^2 + q^2 = 1$ using Charpit's method.

Q.5 If z be a function of x and y and $u = lx + my$, $v = ly - mx$ be two other variables. Show that $\frac{\partial^2 z}{\partial x^2} + \frac{\partial^2 z}{\partial y^2} = (l^2 + m^2)\frac{\partial^2 z}{\partial y^2} + \frac{\partial^2 z}{\partial v^2}$
