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Reg. No. :

Question Paper Code : 54016

B.E./B.Tech. DEGREE EXAMINATION, JANUARY 2018

First Semester

Civil Engineering

MA 8151 – ENGINEERING MATHEMATICS – I

Common to All Branches (Except Marine Engineering)

(Regulations 2017)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions.

PART – A **(10×2=20 Marks)**

1. Sketch the graph of the function $f(x) = \begin{cases} 1+x\,; x < -1 \\ x^2\,; -1 \le x \le 1 \\ 2-x\,; x \ge 1 \end{cases}$ and use it to determine the value of "a" for which $\lim\limits_{x \to a} f(x)$ exists ?

2. Does the curve $y = x^4 - 2x^2 + 2$ have any horizontal tangents ? If so where ?

3. If $x = r\cos\theta$ and $y = r\sin\theta$ then find $\frac{\partial r}{\partial x}$.

4. If $x = uv$ and $y = \frac{u}{v}$ then find $\frac{\partial(x, y)}{\partial(u, v)}$.

5. What is wrong with the equation $\int_{-1}^{2} \frac{4}{x^3}\, dx = \left[\frac{-2}{x^2}\right]_{-1}^{2} = \frac{3}{2}$?

6. Evaluate $\int_{4}^{\infty} \frac{1}{\sqrt{x}}\, dx$ and determine whether it is convergent or divergent.

7. Find the value of $\int_0^{\infty}\int_0^{y}\left(\frac{e^{-y}}{y}\right)dx\,dy$.

8. Find the limits of integration in the double integral $\iint_R f(x,y)\,dx\,dy$ where R is in the first quadrant and bounded $x = 1$, $y = 0$, $y^2 = 4x$.

9. Convert $x^2y'' - 2xy' + 2y = 0$ into a linear differential equation with constant coefficients.

10. Find the particular integral of $(D-1)^2 y = e^x \sin x$.

PART – B **(5×16=80 Marks)**

11. a) i) For what value of the constant "c" is the function "f" continuous on $(-\infty,\infty)$, $f(x) = \begin{cases} cx^2 + 2x \,;\, x < 2 \\ x^3 - cx \,;\, x \geq 2 \end{cases}$. (8)

ii) Find the local maximum and minimum values of $f(x) = \sqrt{x} - \sqrt[4]{x}$ using both the first and second derivative tests. (8)

(OR)

b) i) Find y" if $x^4 + y^4 = 16$. (6)

ii) Find the tangent line to the equation $x^3 + y^3 = 6xy$ at the point (3, 3) and at what point the tangent line horizontal in the first quadrant. (10)

12. a) i) If $u = \left(x^2 + y^2 + z^2\right)^{-1/2}$ then find the value of $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2}$. (8)

ii) Find the dimensions of the rectangular box without a top of maximum capacity, whose surface area is 108 sq.cm. (8)

(OR)

b) i) Obtain the Taylor's series expansion of $x^3 + y^3 + xy^2$ in terms of powers of $(x-1)$ and $(y-2)$ up to third degree terms. (8)

ii) Find the maximum or minimum values of $f(x, y) = 3x^2 - y^2 + x^3$. (8)

13. a) i) Evaluate $\int \frac{\tan x}{\sec x + \cos x}\,dx$. (8)

ii) Evaluate $\int e^{ax}\cos bx\,dx$ using integration by parts. (8)

(OR)

b) i) Evaluate $\int \frac{x}{\sqrt{x^2 + x + 1}}\,dx$. (8)

ii) Evaluate $\int_0^{\pi/2} \cos^5 x\,dx$. (8)

14. a) i) Change the order of integration for the given integral $\int_0^{a}\int_0^{2\sqrt{ax}} (x^2)\,dy\,dx$ and evaluate it. (8)

ii) Evaluate by changing to polar coordinates $\int_0^{a}\int_y^{a} \frac{x}{x^2 + y^2}\,dx\,dy$. (8)

(OR)

b) i) Evaluate $\iiint (x\,y\,z)\,dx\,dy\,dz$ over the first octant of $x^2 + y^2 + z^2 = a^2$. (8)

ii) Using double integral, find the area bounded by $y = x$ and $y = x^2$. (8)

15. a) i) Solve $\frac{d^2y}{dx^2} + y = \cot x$ by using method of variation of parameters. (8)

ii) Solve $(D^2 - 2D)\,y = 5e^x \cos x$ by using method of undetermined coefficients. (8)

(OR)

b) i) Solve $[(x+1)^2 D^2 + (x+1) D + 1]\, y = 4 \cos \log (x+1)$. (8)

ii) Solve $Dx + y = \sin 2t$ and $-x + D\,y = \cos 2t$. (8)