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**BTECH**  
**(SEM II) THEORY EXAMINATION 2021-22**  
**ENGINEERING MATHEMATICS-II**

Time:3 Hours

Total Marks:100

Notes-

- Attempt all sections and assume any missing data.
- Appropriate marks are allotted to each question, answer accordingly.

SECTION -A	Attempt all of following question in brief	Marks (10×2=20)	CO
Q.1(a)	Find the differential equation which represents the family of straight lines passing through the origins?		1
Q.1(b)	State the criterion for linearly independent solutions of the homogeneous linear nth order differential equation.		1
Q.1(c)	Evaluate: $\int_0^1 \frac{dx}{\sqrt{-\log x}}$ .		2
Q.1(d)	Find the volume of the solid obtained by rotating the ellipse $x^2 + 9y^2 = 9$ about the $x$ -axis.		2
Q.1(e)	Test the series $\sum_{n=1}^{\infty} \frac{1}{n} \sin \frac{1}{n}$ .		3
Q.1(f)	Find the constant term when $f(x) = 1 +  x $ is expanded in Fourier series in the interval $(-3, 3)$ .		3
Q.1(g)	Show that $f(z) = z + 2\bar{z}$ is not analytic anywhere in the complex plane.		4
Q.1(h)	Find the image of $ z - 2i  = 2$ under the mapping $w = \frac{1}{z}$ .		4
Q.1(i)	Expand $f(z) = e^{z/(z-2)}$ in a Laurent series about the point $z = 2$ .		5
Q.1(j)	Discuss the nature of singularity of $\frac{\cot \pi z}{(z-a)^2}$ at $z = a$ and $z = \infty$		5

SECTION -B	Attempt any three of the following questions	Marks (3×10=30)	CO
Q.2(a)	Solve: $\frac{d^2x}{dt^2} + \frac{dy}{dt} + 3x = e^{-t}$ , $\frac{d^2y}{dt^2} - 4\frac{dx}{dt} + 3y = \sin 2t$ .		1
Q.2(b)	Assuming $\Gamma(n)\Gamma(1-n) = \pi \operatorname{cosec} n\pi$ , $0 < n < 1$ , show that $\int_0^{\infty} \frac{x^{p-1}}{1+x} dx = \frac{\pi}{\sin n\pi}$ ; $0 < p < 1$ .		2
Q.2(c)	Test the series $\frac{x}{1.2} + \frac{x^2}{3.4} + \frac{x^3}{5.6} + \frac{x^4}{7.8} + \dots$		3
Q.2(d)	If $f(z) = u + iv$ is an analytic function, find $f(z)$ in term of $z$ if $u - v = \frac{e^y - \cos x + \sin x}{\cosh y - \cos x}$ when $f\left(\frac{\pi}{2}\right) = \frac{3-i}{2}$ .		4
Q.2(e)	Evaluate by contour integration: $\int_0^{2\pi} e^{-\cos \theta} \cos(n\theta + \sin \theta) d\theta$ ; $n \in \mathbb{I}$ .		5



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SECTION -C	Attempt any one of the following questions	Marks (1×10=10)	CO
Q.3(a)	Use the variation of parameter method to solve the differential equation $(D^2 - 1)y = 2(1 - e^{-2x})^{-1/2}$		1
Q.3(b)	Solve: $(1+x)^2 \frac{d^2y}{dx^2} + (1+x) \frac{dy}{dx} + y = 4 \cos \log(1+x)$ .		1

SECTION -C	Attempt any one of the following questions	Marks (1×10=10)	CO
Q.4(a)	The arc of the cardioid $r = a(1 + \cos \theta)$ included between $-\frac{\pi}{2} \leq \theta \leq \frac{\pi}{2}$ is rotated about the line $\theta = \frac{\pi}{2}$ . Find the area of surface generated.		2
Q.4(b)	Evaluate $\iiint xyz \sin(x+y+z) dx dy dz$ , the integral being extended to all positive values of the variables subject to the condition $x+y+z \leq \frac{\pi}{2}$ .		2

SECTION -C	Attempt any one of the following questions	Marks (1×10=10)	CO
Q.5(a)	Test for convergence of the series $\frac{a+x}{1!} + \frac{(a+2x)^2}{2!} + \frac{(a+3x)^3}{3!} + \dots$		3
Q.5(b)	Obtain Fourier series for the function $f(x) = \begin{cases} 1 + \frac{2x}{\pi}, & -\pi < x < 0 \\ 1 - \frac{2x}{\pi}, & 0 < x < \pi \end{cases}$ Hence deduce that $\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \dots = \frac{\pi^2}{8}$ .		3

SECTION -C	Attempt any one of the following questions	Marks (1×10=10)	CO
Q.6(a)	Prove that $w = \frac{z}{1-z}$ maps the upper half of the z-plane onto upper half of the w-plane. What is the image of the circle $ z  = 1$ under this transformation?		4
Q.6(b)	Find a bilinear transformation which maps the points $i, -i, 1$ of the z-plane into $0, 1, \infty$ of the w-plane respectively.		4

SECTION -C	Attempt any one of the following questions	Marks (1×10=10)	CO
Q.7(a)	Evaluate $\oint_c \frac{e^z}{z(1-z)^3} dz$ , where c is (i) $ z  = \frac{1}{2}$ (ii) $ z-1  = \frac{1}{2}$ (iii) $ z  = 2$ .		5
Q.7(b)	Find the Taylor's and Laurent's series which represent the function $\frac{z^2-1}{(z+2)(z+3)}$ when (i) $ z  < 2$ (ii) $2 <  z  < 3$ (iii) $ z  > 3$ .		5