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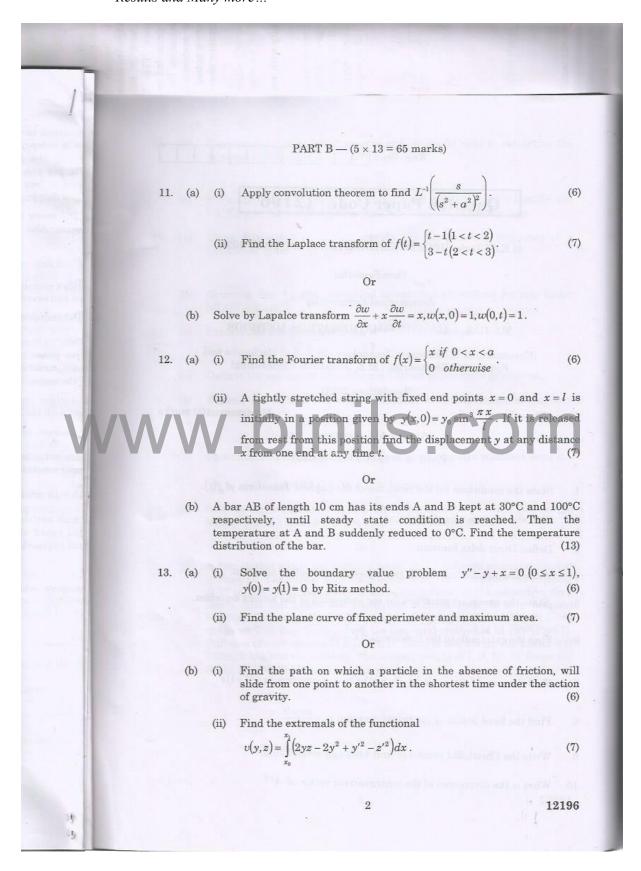
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Reg. No. :	
Question Paper Code: 12196	
M.E./M.Tech. DEGREE EXAMINATIONS, JANUARY	2022.
First Semester	Labor and the
Aeronautical Engineering	in Charles are
MA 4153 — ADVANCED MATHEMATICAL METHO	ODS .
(Common to M.E. Aerospace Technology / M.E. Soil Mech. Foundation Engineering / M.E. Structural Engineer	anics and ing)
(Regulations 2021)	Audit
Time: Timee noute	imum : 100 marks
Answer ALL questions.	nì n
PART A — $(10 \times 2 = 20 \text{ marks})$	
 State the conditions for the existence of the Laplace Transfor Find the Laplace transform t sin t 	S.COM
3. Define Dirac delta function.	udist-its
4. Write the possible solution of two dimensional Laplace equat	tion. (A) (A) BA
5. State the necessary condition for the extremum of the Euler	's equation.
6. Find the extremals of the functional $\int_{x_0}^{x_1} \frac{y'^2}{x^3} dx$.	The second secon
7. Find the map of the circle $ z = k$ by the transformation $w = 0$	(1+i)z.
8. Find the fixed points of the transformation $w = \frac{6z-9}{z}$.	A dia Name
9. Write the Christoffel symbol of first kind and second kind.	- Care
10. What is the divergence of the contravariant vector of A^{i} ?	and the same of
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14.	(a)	(i)	Find the bilinear transformation that maps the points $z_1 = 1$, $z_2 = i, z_3 = -1$ into the points $w_1 = 2, w_2 = i$ and $w_3 = -2$. (6)	
		(ii)	Find the transformation, which will map the interior of the infinite strip bounded by the lines $v=0$, $v=\pi$ onto the upper half of the z-plane. (7)	
	(b)	(i)	Find the temperature field around a long thin wire of radius $r_1=1$ mm that is electrically heated to $T_1=500^{\circ}\mathrm{F}$ and is surrounded by a circular cylinder of radius $r_2=100$ mm, which is kept at temperature $T_2=60^{\circ}\mathrm{F}$ by cooling it with air. (The wire is at the origin of the coordinate system).	
		(ii)	Show that $F(Z) = iZ^2$ also models a flow around a corner. Sketch streamlines and equipotential lines. Find V . (7)	
15.	(a)	(i)	Show that any inner product of the tensors A_r^p and B_t^{qS} is a tensor of rank 3. (6)	
		(ii)	If $(ds)^2 = (dr)^2 + r^2(d\theta)^2 + r^2\sin^2\theta(d\phi)^2$, find the values of	
			(1) [22, 1] and [13, 3]	
			(2)	
	(b)	(i) (ii)	Prove that $\frac{\partial g_{ij}}{\partial x^j} = [ik, j] + [jk, i]$. (6) Prove that the covariant derivative of g^{ij} is zero. (7) PART C — $(1 \times 15 = 15 \text{ marks})$	
16.	(a)	(i)	Show that $L[tJ_0(at)] = \frac{s}{(s^2 + a^2)^{\frac{3}{2}}}$ (8)	
		(ii)	Evaluate $\int_{0}^{\infty} \frac{x^{2}}{(a^{2} + x^{2})(b^{2} + x^{2})} dx \text{ and hence find } \int_{0}^{\infty} \left(\frac{x}{x^{2} + 1}\right)^{2} dz. $ (7)	
			Or	
	(b)	(i)	Prove that the shortest distance between two points in a plane is a straight line. (8)	
		(ii)	Prove that $w = \frac{z}{1-z}$ maps the upper half of the z-plane onto the	
			upper half of the w -plane. What is the image of the circle $ z =1$ under this transformation? (7)	
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