

Reg. No. :

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Question Paper Code : 11635

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2026.

Third Semester

Civil Engineering

MA3351 – TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

(Common to Aeronautical Engineering/Aerospace Engineering/Automobile Engineering/Biomedical Engineering/Civil Engineering (Environmental Engineering)/Manufacturing Engineering/Marine Engineering/Materials Science and Engineering/Mechanical Engineering/Mechanical Engineering (Sandwich)/Mechanical Engineering (Specialized in Automobile /Mechanical Engineering (Specialised in Smart Manufacturing)/Mechanical and Automation Engineering/Mechatronics Engineering/Medical Electronics /Petrochemical Engineering/ Production Engineering/Robotics and Automation /Safety and Fire Engineering/Bio Technology/Biotechnology and Biochemical Engineering/Food Technology /Petrochemical Technology/Petroleum Engineering/Pharmaceutical Technology)

(Regulations 2021)

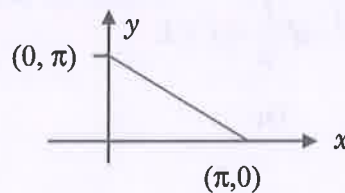
Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Form the PDE by eliminating the arbitrary constants ' a ' and ' b ' from the relation $z = ax + by + ab$.
2. Solve the PDE $pq + p + q = 0$.
3. Is it possible for a function $f(x) = \tan x$, $-\pi < x < \pi$ to be expanded as Fourier series? Justify.
4. Sketch one odd and one even periodic extensions of $f(x)$ given in the figure below.



5. State the physical assumptions behind the modelling of one dimensional wave equation of a vibrating string.
6. The ends A and B of a rod 100 cm long, have their temperatures kept at 10°C and 100°C respectively. Then find the steady state temperature distribution function.
7. Find the Fourier sine transform of $f(x) = e^{-|x|}$.
8. Interpret the Fourier transform from a physical perspective.
9. Find the Z transform of the sequence $\{1, 0, -1, 0, 1, \dots\}$
10. State initial value theorem in Z transforms.

PART B — ($5 \times 16 = 80$ marks)

11. (a) (i) Solve $(y^2 + z^2)p - xyq + zx = 0$. (8)

(ii) Solve $(D^3 + D^2D' - 4DD'^2 - 4D'^3)z = \cos(2x + y)$. (8)

Or

(b) (i) Solve $\frac{\partial^2 z}{\partial x^2} + z = 0$, given that when $x = 0$, $z = e^y$ and $\frac{\partial z}{\partial x} = 1$. (8)

(ii) Obtain the general solution of $(D^2 + (D')^2)z = \sin 2x \sin 3y$. (8)

12. (a) Sketch the function $f(x) = \begin{cases} x^2, & -\pi < x < 0 \\ 0, & 0 < x < \pi \end{cases}$ which is assumed to be periodic with period 2π and find the Fourier coefficients.

Or

(b) The following are 12 values of y corresponding to equidistant values of the angles x^0 in the range 0° to 360° . Find the first three harmonics in the Fourier series expansion of y in $(0, 2\pi)$.

x^0 :	0	30	60	90	120	150	180	210	240	270	300	330
y :	10.5	20.2	26.4	29.3	27.0	21.5	12.8	1.6	-11.2	-18.0	-15.8	-3.5

13. (a) Find the solution of the wave equation $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$ satisfying $u(0, t) = 0$, $u(L, t) = 0$ for all $t \geq 0$ and corresponding to the triangular initial

deflection $f(x) = \begin{cases} \frac{2k}{L}x & \text{if } 0 < x < \frac{L}{2} \\ \frac{2k(L-x)}{L} & \text{if } \frac{L}{2} < x < L \end{cases}$ and initial velocity zero.

Or

- (b) Find the temperature $u(x,t)$ in a bar of silver of length 10 cm and constant cross section of area 1 cm^2 (density 10.6 g/cm^3 , thermal conductivity $1.04 \text{ cal/(cmsec}^\circ\text{C)}$, specific heat $0.056 \text{ cal / (g}^\circ\text{C)}$) that is perfectly insulated laterally, with ends kept at temperature 0°C and initial temperature $f(x)^\circ\text{C}$, where $f(x) = k$.

14. (a) (i) Find the Fourier transform of the function $f(x) = \begin{cases} a^2 - x^2, & |x| \leq a \\ 0, & |x| > a \end{cases}$. (8)
- (ii) Find the Fourier cosine transform of $f(x) = \frac{1}{1+x^2}$. (8)

Or

- (b) Find the Fourier transform of $f(x) = e^{-a^2 x^2}$, $a > 0$. Hence deduce that $e^{-x^2/2}$ is self reciprocal in respect of Fourier transform.
15. (a) Using Z transform, solve the difference equation $u_{n+2} - 5u_{n+1} + 6u_n = 0$; given $u_0 = 0$ and $u_1 = 1$.

Or

- (b) State and prove the convolution theorem in Z transforms and apply it to find inverse Z transform of $\frac{z^2}{(z-a)(z-b)}$.

Find the temperature $u(x, y, z)$ in a bar of length a in the x -direction, cross-section in the yz -plane, and insulated on the x -faces. The temperature is 0 on the y -faces, 0 on the z -faces, and 0 on the $x = a$ face. The temperature is 1 on the $x = 0$ face.

14. Find the temperature $u(x, y, z)$ in a bar of length a in the x -direction, cross-section in the yz -plane, and insulated on the x -faces. The temperature is 0 on the y -faces, 0 on the z -faces, and 0 on the $x = a$ face. The temperature is 1 on the $x = 0$ face.

15. Find the temperature $u(x, y, z)$ in a bar of length a in the x -direction, cross-section in the yz -plane, and insulated on the x -faces. The temperature is 0 on the y -faces, 0 on the z -faces, and 0 on the $x = a$ face. The temperature is 1 on the $x = 0$ face.

16. Find the temperature $u(x, y, z)$ in a bar of length a in the x -direction, cross-section in the yz -plane, and insulated on the x -faces. The temperature is 0 on the y -faces, 0 on the z -faces, and 0 on the $x = a$ face. The temperature is 1 on the $x = 0$ face.

17. Find the temperature $u(x, y, z)$ in a bar of length a in the x -direction, cross-section in the yz -plane, and insulated on the x -faces. The temperature is 0 on the y -faces, 0 on the z -faces, and 0 on the $x = a$ face. The temperature is 1 on the $x = 0$ face.

18. Find the temperature $u(x, y, z)$ in a bar of length a in the x -direction, cross-section in the yz -plane, and insulated on the x -faces. The temperature is 0 on the y -faces, 0 on the z -faces, and 0 on the $x = a$ face. The temperature is 1 on the $x = 0$ face.

$$u(x, y, z) = \frac{1}{2} \left(1 - \frac{x}{a} \right) \left(1 - \frac{y}{b} \right) \left(1 - \frac{z}{c} \right)$$