

SECTION-A

- 1- a) Derive Stoke's Theorem. 10
b) Verify Stoke's theorem for $A = (2x - y)\underline{i} - yz^2\underline{j} - y^2z\underline{k}$ where 's' is the upper half surface of the sphere $x^2 + y^2 + z^2 = 1$ and c is the boundary. 10
- 2- a) Define and establish the spherical Bessel function, with Helmholtz equation $\nabla^2\psi + k^2\psi = 0$ 10
b) Prove that $J_{-n}(x) = (-1)^n J_n(x)$ 10
- 3- a) Discuss the Legendre equation as a Sturm Liouville's Problem. 10
b) Put the Hermite equation $y'' - 2xy' + 2\alpha y = 0$ into Sturm Liouville form. 10
- 4- a) Solve the Green's function for One Dimensional Problem. 10
b) Solve $t^2 y'' + 7ty' + 5y = t$ with boundary condition $y(1) = 0, y'(1) = 0$ if $V(x, y) = e^{-y} \sin x$. 10
- 5- a) Show that the Kronecker Delta is a mixed tensor of rank 2. 10
b) State and prove Quotient Law of Tensor. 10

SECTION-B

- 6- a) Find the Fourier Co-efficients of the periodic function $f(x) = \begin{cases} -K & \text{if } -\pi < x < 0 \\ K & \text{if } 0 < x < \pi \end{cases}$ 10
b) Find the Fourier Transform of $f(t)$, where $f(t) = e^{-t}$. 10
- 7- a) Find the Laplace transform of i) $\sin Kt$ ii) $\cos Kt$ 10
b) Find Laplace inverse transform; $\mathcal{L}^{-1} \left\{ \frac{1}{(s+a)(s+b)} \right\}$ 10
- 8- a) Prove that $p_{2n}(0) = 0$
 $P_n(-x) = (-1)^n p_n(x)$ 10
b) Establish the generating function of the Bessel function. 10
- 9- a) Prove the Cauchy Riemann Equations. 10
b) Define an analytic function of $w(x) = u(x, y) + i v(x, y)$ if $u(x, y) = x^3 - 3xy^2$. 10