3. (a) Apply the method of variation of parameters to solve
\[ \frac{d^2y}{dx^2} + 4y = \tan 2x \]  \hspace{1cm} (10)

(b) Solve \[ x^2 \frac{d^2y}{dx^2} - 3x \frac{dy}{dx} + 5y = x^2 \sin (\log x) \]  \hspace{1cm} (10)

Section – B

4. (a) Find the Laplace transform of the function
\[ f(t) = \frac{\cos at - \cos bt}{t} \]  \hspace{1cm} (6)

(b) Apply convolution theorem to evaluate:
\[ L^{-1}\left[ \frac{s}{(s^2 + 1)(s^2 + 4)} \right] \]  \hspace{1cm} (7)

(c) Solve the following equation by the Laplace transform method:
\[ \frac{d^2x}{dt^2} + 9x = \cos 2t , x(0) = 1, x\left(\frac{\pi}{2}\right) = -1 \]  \hspace{1cm} (7)

5. (a) Prove that
\[ \int_{0}^{1} \frac{dx}{\sqrt{1-x^4}} = \frac{\sqrt{\pi}}{4} \Gamma\left(\frac{1}{4}\right) \]  \hspace{1cm} (6)

(b) Evaluate \[ \iint r \sin \theta \, dr \, d\theta \] over the area of the cardioid
\[ r = a(1 + \cos \theta) \] above the initial line. \hspace{1cm} (6)

(c) Change into polar co-ordinate and evaluate
\[ \int_{0}^{\infty} \int_{0}^{\infty} e^{-x^2 + y^2} \, dy \, dx \] \hspace{1cm} (8)

6. (a) Find the area enclosed by the ellipse \[ \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1 \] \hspace{1cm} (10)

(b) Find, by double integration, the volume of the solid generated by revolving the cardioid \[ r = a(1 + \cos \theta) \] about the initial line. \hspace{1cm} (10)