1) Derive the 2D Laplacian operator in polar coordinates using the following relationships: $x = R\cos\theta$ and $y = R\sin\theta$.

2) Solve Laplace's equation in polar coordinates for the equilibrium temperature $T(r,\theta)$ in a circular disk of radius r = 1 with $T(1,\theta) = f(\theta)$, which denotes a prescribed temperature on the boundary. (Use separation of variables).

3) Complete Trim pg 174 #2

4) Complete Trim pg 40, #2-4.

On the Region what form (a) Dirichlet; (b) Neumann and (c) Robin boundary conditions Take for The PDE?

2. $\dfrac{\partial^2 V}{\partial x^2} + \dfrac{\partial^2 V}{\partial y^2} + \dfrac{\partial^2 V}{\partial z^2} + V = F(x,y,z)$ $\quad 0 < x < L \; ; \; y > 0 \; ; \; z > 0$

3. $\dfrac{\partial^2 V}{\partial r^2} + \dfrac{1}{r}\dfrac{\partial V}{\partial r} + \dfrac{1}{r^2}\dfrac{\partial^2 V}{\partial \theta^2} = F(r,\theta)$ $\quad 0 < r < r_0 \; ; \; -\pi < \theta < \pi$

4. $\dfrac{\partial^2 V}{\partial r^2} + \dfrac{1}{r}\dfrac{\partial V}{\partial r} + \dfrac{1}{r^2}\dfrac{\partial^2 V}{\partial \theta^2} = F(r,\theta)$ $\quad 0 < r < r_0 \; ; \; 0 < \theta < \pi$

A cylindrical, homogeneous isotropic rod with insulated sides has Temperature $f(x)$, $0 \le x \le L$; at time $t=0$. For time $t>0$; its ends (at $x=0$ and $x=L$) are held at Temperature $0°C$. Find a Formula for the Temperature $U(x,t)$ in the rod for $0 < x < L$ and $t > 0$.