Linear partial differential equations: End Set exam (Full marks 10)
Time 1.5 hours [Answer sheet should be submitted before 5 pm]

1. If $H(S,p)$ is the enthalpy of a thermodynamic (p,V,T,S) system, the the values of $(\frac{\partial H}{\partial S})_p, (\frac{\partial H}{\partial P})_S$ are respectively (a) (T,V) (b) (V,T) (c) (U,V) (d) (T, U). [Marks 1]
2. Helmoltz free energy $F = U - TS$ and Gibbs free energy $G = F + pV$. Which of the followings is true ? (a) $(\frac{\partial G}{\partial T})_p = V$ (b) $(\frac{\partial G}{\partial p})_T = -S$ (c) $G = (\frac{\partial (F/V)}{\partial (1/V)})_T$ (d) $F = (\frac{\partial (G/V)}{\partial (1/V)})_T$ [Marks 2]
3. Solve $(x+2z)z_x + (4zx - y)z_y = 2x^2 + y$. (a) $F(x^2+y^2+z^2, x-y-z) = 0$ (b) $F(xy - z, z^2x + y) = 0$ (c) $F(x - yz, x + y + z) = 0$ (d) $F(xy - z^2, x^2 - y - z) = 0$ [Marks 2]
4. Solve $(y+z)z_x + (z+x)z_y = x + y$ (a) $F(\frac{x-y}{y-z}, \frac{y-z}{\sqrt{x+y+z}}) = 0$ (b) $F(\frac{x-z}{y-z}, \frac{z-x}{\sqrt{x+y+z}}) = 0$ (c) $F(\frac{y-z}{z-x}, \frac{x-y}{\sqrt{x+y+z}}) = 0$ $(d) F(x-y, x-y+z) = 0$ [Marks 2]
5. A pendulum consists of a mass m and a massless stick of length l. The pendulum support oscillates horizontally with a position given by $x(t) = Acos\omega t$ [Figure attached].What is the general solution for the angle of the pendulum as a function of time?
   (a). $l\ddot{\theta} - A\omega^2 cos\omega t cos\theta + gsin\theta = 0$ (b) $l\ddot{\theta} - Acos\omega t sin\theta + gcos\theta = 0$
   (c) $l\ddot{\theta} + A\omega^2 sin\omega t sin\theta + gcos\theta = 0$ (d). $l\ddot{\theta} + A\omega^2 cos\omega t cos\theta + gcos\theta = 0$
   [Marks 3]