Second Mid Term Exam., Summer, 1434
M 107 Full Marks: 25 Time: **90 Min.**

Question 1. [Marks: 2+2+2=6]
(a) A particle moves along the curve

$$r(t) = (t^3 + 1)i + 2tj + t^2k,$$

where t is time. Find velocity $\mathbf{v}$ and acceleration $\mathbf{a}$ at $t = 1$. Also, find the component of velocity $Com_{\mathbf{b}}\mathbf{v}$, and component of acceleration $Com_{\mathbf{b}}\mathbf{a}$ in the direction of the vector $b = i + j + 2k$. $t = (1)$
(b) Find all values of c such that $\mathbf{a}$ and $\mathbf{b}$ are orthogonal, where $\mathbf{a} = \langle 4, 2, c\rangle$ and $\mathbf{b} = \langle 1, -22, 3c\rangle$.

Question 2. [Marks: 2+2+4=8]
(a) Determine whether the two lines l_1 and l_2 intersect, and if so, find the point of intersection, and also, find the angle between l_1 and l_2:
$l_1 :\ x = 1 + 2t, y = 1 - 4t, z = 5 - t$
$l_2 :\ x = 4 - v, y = -1 + 6v, z = 4 + v.$
(b) Find the volume of the box having adjacent sides AB, AC and AD where $A(2, 1, -1)$, $B(3, 0, 2)$, $C(4, -2, 1)$ and $D(5, -3, 0)$.

Question 3. [Marks: 2+1=3]
Sketch the graph of the equation $16x^2 - 4y^2 - z^2 + 1 = 0$ in an xyz-coordinate system, and identify the surface.

Question 4. [Marks: 4]
Find the position vector $r(t)$ if the acceleration and initial conditions are given by
$a(t) = i + 2tj + t^2k, \quad r(0) = 2k, \quad v(0) = i + j.$

Question 5.[Marks: 2+2=4]
Find the normal component of acceleration and curvature of the curve $r(t) = \cos t\, i + \sin t\, j + k$, at $t = \frac{\pi}{2}$.