

# KIBABII UNIVERSITY

## MAT 223:DYNAMICS I CAT II

DATE: 17/11/2015

1. Given the vectors  $\vec{p} = 2\hat{i} - \hat{j} + \hat{k}$ ,  $\vec{q} = \hat{i} + 3\hat{j} - 2\hat{k}$ ,  $\vec{r} = -2\hat{i} + \hat{j} - 3\hat{k}$  and  $\vec{s} = 3\hat{i} + 2\hat{j} + 5\hat{k}$ , find scalars  $k, l$  and  $m$  such that  $\vec{s} = k\vec{p} + l\vec{q} + m\vec{r}$ . (4 marks)
2. The angular acceleration of a body rotating about an axis is directly proportional to the time  $t$  sec. The initial angular velocity of the body is  $-12m/s$ . Given that the angular velocity  $\omega = 0 rad/s$  and angular displacement  $\theta = 10 rad$  when  $t = 2s$ , determine the equation of motion of the body. (5 marks)
3.
  - a. A body rotates about an axis with a constant angular acceleration  $\alpha$ . Derive an expression for its angular displacement  $\theta$  and hence show that  $\omega^2 = \omega_0^2 + 2\alpha(\theta - \theta_0)$  where  $\omega, \omega_0, \theta$  and  $\theta_0$  are the angular velocity, initial angular velocity, angular displacement and initial angular displacement respectively. (5marks)
  - b. A flour mill shaft motor is switched on and reaches the rated speed of  $1800rpm$  with an acceleration of  $4rad/s^2$ . When it is switched off it decelerates at the rate of  $-2rad/s^2$ . Determine the number of revolutions it turns to
    - i. Attain the rated speed (3 marks)
    - ii. Come to rest (3 marks)
4. The position of a particle  $P$  at time  $t$  is given by  $\vec{r} = (2t^3 - 3)\hat{i} + (5t + 2)\hat{j} + (t^3 + 2t^2)\hat{k}$ . Find
  - i. The distance  $OP$  when  $t = 0$  sec (2 marks)
  - ii. The velocity of  $P$  when  $t = 2$  sec (2 marks)
  - iii. The acceleration of  $P$  when  $t = 3$  sec (2 marks)
5. Show that for a body executing uniform circular motion the centripetal acceleration is given by  $a = \frac{v^2}{r}$  (4 marks)