... 5.2×10^{-5}, the system will be oscillatory.

(ii) $M = 3$

Ans. to the Ques 2:

a, Given,

$u = \langle 4,-1,0\rangle$, $w = \langle 2,0,1\rangle$

Vector component of $\vec{u}$ along $\vec{w}$,

$$\text{Proj}_{\vec{w}}\vec{u} = \frac{\vec{u}\cdot\vec{w}}{|\vec{w}|^2}\,\vec{w}$$

$$= \frac{\langle 4,-1,0\rangle\cdot\langle 2,0,1\rangle}{2^2+0^2+1^2}\cdot\langle 2,0,1\rangle$$

$$= \frac{-8+0+0}{5}\cdot\langle 2,0,1\rangle$$

$$= \left\langle -\frac{16}{5}, 0, -\frac{8}{5}\right\rangle$$

Vector component of $\vec{u}$ along ~~orthogonal~~ to $\vec{u}$:

$$\text{Proj}_{\bar{u}}\,\bar{u} = \frac{\bar{u}\cdot\bar{u}}{|\bar{u}|^2}\cdot\bar{u}$$

$$= \frac{\langle -4,-1,0\rangle\langle -4,-1,0\rangle}{16+1+0}\cdot\langle -4,-1,0\rangle$$

$$= \frac{\langle 16,+1,0\rangle}{17}\langle -4,-1,0\rangle$$

$$= \frac{16+1+0}{17}\langle -4,-1,0\rangle$$

$$= \langle -4,-1,0\rangle$$

$\therefore$ Vector component of $\vec{u}$ orthogonal to $\vec{u}$

$$\vec{u} - \text{Proj}_{\bar{u}}\,\bar{u} = \langle -4,-1,0\rangle - \langle -4,-1,0\rangle$$

$$= 0$$

b) It is given,

$$P_1(1,-2,3), \ P_2(3,1,-2), P_3(-2,3,1)$$

$\overrightarrow{P_1P_2}$ = since they lie in the same plane, the vectors $\overrightarrow{P_1P_2} = \langle 2, 3, -5 \rangle$ and $\overrightarrow{P_1P_3} = \langle -3, 5, -2 \rangle$

$$\overrightarrow{P_1P_2} \times \overrightarrow{P_1P_3} = \begin{vmatrix} i & j & k \\ 2 & 3 & -5 \\ -3 & 5 & -2 \end{vmatrix} = \hat{i}(-6+25) - \hat{j}(-4-15) + k(10+9)$$

$$= 19\hat{i} + 19\hat{j} + 19\hat{k} = \vec{V}$$

Here, $\vec{V}$ is ~~ortho~~ normal to the plane, since ~~it~~ is orthogonal to both $\overrightarrow{P_1P_2}$ and $\overrightarrow{P_1P_3}$. By using $\vec{V}$ and the point P_1, we get:

$$19(x-1) + 19(y+2) + 19(z-3) = 0$$

$$\Rightarrow 19x - 19 + 19y + 38 + 19z - 57 = 0$$

$$\Rightarrow 19x + 19y + 19z - 38 = 0 \quad \text{(Ans)}$$

c) We know that, the vectors p, q, r will lie on the same plane if the scalar triple product of the vectors are equal to zero.

Here,

$\vec{p} = <1,5,0>$, $\vec{q} = <-2,0,6>$, $\vec{r} = <0,-7,1>$

Now,

$$\vec{p}\cdot(\vec{q}\times\vec{r}) = \begin{vmatrix} 1 & 5 & 0 \\ -2 & 0 & 6 \\ 0 & -7 & 1 \end{vmatrix}$$

$$= 1(0+42) - 5(-2-0) + 0(14-0)$$

$$= 42 + 10$$

$$= 52 \neq 0$$

$\therefore$ $\vec{p}, \vec{q}, \vec{r}$ does not lie ~~no on~~ in the same plane.